Structural Priming in German

Priming of Dative and Voice Alternation

Magister thesis

(English translation)

original version submitted to the
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Leipzig, January 11th, 2007

Please note that this is a translation of the original thesis, which was written and submitted in German.

I would like to express my thanks to my supervisors Dr Sandra Pappert and Prof. Dr Thomas Pechmann, for their extensive support.

I would also like to thank my parents Cornelia Ruth-Hanke and Dr Reinhard Hanke, my brother Daniel Hanke, as well as José Alvarado, Andreas Opitz and all the others who supported me in any form during the preparations and in the writing process. Special credit deserve those friends, acquaintances and stangers who served as volunteers for the experiments.

Contents

1. Introduction

Linguistics looks at many different levels of speech utterances, starting with single segments in phonetics and phonology, going on to analysing morphemes and sentences. Finally, the linguistic subdisciplines of pragmatics, sociolinguistics, text and discourse linguistics look at even bigger linguistic units. The focus of this thesis is on the production of sentences. Bußmann (2002) defines a *sentence* as 'a unit of speech that is constructed from smaller units according to language-specific rules and that is relatively complete and independent in terms of content, grammatical structure and intonation' (p. 578)[1]. It should become clear that sentences are very complex linguistic units which can be subject to scrutiny on different levels at the same time. The method theoretical linguists commonly use for the analysis of syntactic structures is to derive rules from language material and set up generalised rule systems. Section 2.1 will give a short survey over a small selection of syntactic theories and will point to some differences in their respective predictions about the mechanisms of language production.

The research of psycholinguists into language production is aimed at unveiling the psychological processes involved in production. Collecting behavioural data allows to draw (however indirectly) inferences about functional dissociations between psychological processes. Section 2.2 will present a widely known model for the production of sentences which is based on an information-processing metaphor. The chapter will show which processing stages the model assumes for language production.

Since the 1980s, *syntactic priming* has proven quite helpful in experimental research targeting the production of sentences. Syntactic priming is a tendency to reuse the structure of a previous utterance in the production of a sentence. One of the earliest experimental applications of this effect were reported (1986) by Kathryn Bock. She showed that the syntactic structure subjects used to describe pictures can be influenced by presenting sentences in a specific structure. Section 2.2.2 contains details on syntactic priming and how it has been applied experimentally so far. The following section 2.2.3 describes how experimental results from syntactic priming studies have been used in the

[1] '[n]ach sprachspezifischen Regeln aus kleineren Einheiten konstruierte Redeeinheit, die hinsichtlich Inhalt, gramm. Struktur und Intonation relativ vollständig und unabhängig ist.'

modelling of language production in psycholinguistics.

Until now, rather few experimental studies on sentence-level language production in German have made use of syntactic priming. A survey of previous research on syntactic priming in German is given in section 2.3. From there I will move on to motivate the experiments described in this thesis. They are intended to supply further data on priming of active and passive voice in German. According to my current state of knowledge, no attempt to show syntactic priming effects for the voice alternation in German has been successful so far. Studies carried out in English, however, have been able to demonstrate priming of active and passive voice. Chapter 3 is going to describe a pre-test for material which was intended to be used in a replication of Kathryn Bock's picture description paradigm (Bock, 1986). Since the pre-test was not successful and did not yield a sufficient amount of critical items for an experiment, a different method was chosen for further testing. The alternative paradigm, 'sentence recall', used written sentences as primes and targets. The method was successfully used by Potter and Lombardi (1998) and Chang, Bock, and Goldberg (2003) to show syntactic priming effects. To my knowledge, it has not been used for syntactic priming studies in German so far. In chapter 4 I am going to report an experiment on the priming of the so called 'dative alternation'. This alternation has proven to be primeable in German before, a very recent demonstration was given by Melinger and Dobel (2005). The results reported in this thesis point to the same direction as Melinger and Dobel's and they also show that 'sentence recall' can be used to demonstrate syntactic priming in German as well. The second experiment (reported in chapter 5) applies the 'sentence recall' paradigm to the active/passive voice alternation. According to my current state of knowledge, priming of the voice alternation using this method has not been reported before, not even in English. The results of both experiments reported here have to be seen with some methodological restrictions. Still, they indicate that active and passive voice can be primed using the 'sentence recall' method. What is more, they suggest that priming effects for voice can be shown in German as well.

The general discussion in chapter 6 will relate the experimental results to models of grammar from the area of theoretical linguistics and to psycholinguistic models of language production. The discussion will focus on the question to which extent syntactic priming experiments allow for the testing of different assumptions about the language production system. The experiments reported in this thesis lack such power, yet still they enlarge our knowledge about syntactic priming effects in German.

2. Argument realisation and syntactic priming

The verb plays a central role in the generation of sentences. In current linguistic theory it is assumed that the entry of a verb in the mental lexicon contains information about which arguments the verb can be combined with in order to yield a well-formed expression of a language. The *argument structure* of a verb specifies which role a single argument plays in the event described by the verb. A verb like 'to deodorise', for example, needs to be combined with two arguments to form a complete, interpretable expression: in order for a deodorising event to actually happen, there has to be an originator of the action. Additionally it has to be specified on which entity the action is applied. Otherwise there would remain a gap in the mental model a listener creates after hearing something like: 'Herbert deodorises.' The function an entity has in a situation is often referred to by so-called *thematic roles*. The originator of an action, 'Herbert' in our example, is usually called AGENT or CAUSE. The entity (person, object, etc.) on which an action applies, for instance 'the ferret', is often called PATIENT. The names for thematic roles include, among others, terms such as GOAL, LOCATION or RECIPIENT. The question of thematic roles is a constant matter of theoretical discussion (cf. Bußmann, 2002: 697). Neither is there any unanimity about the thematic role inventory, nor is it clear, whether the roles form atomic categories or can be decomposed into more basic semantic properties (cf. Dowty, 1991). Dealing with the problem of thematic roles more extensively is beyond the scope of this thesis. For the present work, it shall suffice to stick with the simple assumption of few atomic roles as the ones described above.

Syntactic surface relations reflect semantic relations between arguments. In the sentence 'Herbert deodorises the ferret.', the AGENT 'Herbert' takes the *grammatical function* of the sentence subject and the PATIENT 'the ferret' takes the function of the direct (accusative) object. As with thematic roles, the definition of grammatical or syntactic functions is rather problematic. Grammatical functions could be defined with respect to the content of a sentence, based on thematic roles (cf. Bußmann, 2002: 675). However, by adopting such a definition, we would encounter problems in languages like English

or German, since for instance in passive sentences the assignment of subject function to the thematic role AGENT is broken: 'The ferret is being deodorised by Herbert.' Syntactic functions in German are thus commonly defined on the basis of case. (Bußmann, 2002: 675). What is more, different linguistic theories of grammar use terminology for grammatical functions in different ways. This topic will be discussed in more detail in section 2.1.

If we look at the passive sentence example from the paragraph above we can see that speakers possess some flexibility in realising a state of affairs as a syntactic structure. The very same event (an event of deodorising, with Herbert as AGENT and the ferret as PATIENT) can be expressed with different syntactic realisations. At a first glance, the verb stays the same if we abstract away from the different inflection. Yet the mapping between thematic roles and syntactic functions in the passive sentence is different from the mapping in a sentence in active voice. In German linguistics, the different 'variants' or 'states' of a verb are traditionally referred to as 'Diathesis' (see Bußmann, 2002: 166, and Wunderlich, 1993). The alternation between active and passive voice is possible with most verbs. Other forms of a change of state are possible as well, for example with ditransitive verbs. Some of these can undergo the so called 'dative alternation' and change between a state in which the RECIPIENT or GOAL of an event is realised as the indirect (dative) object (see example 1), and a state in which these roles are realised as oblique, or prepositional object, as in example (2):

(1) Walther schickt [dem Vermieter]$_{\text{DP}_{\text{dat}}}$ [den Brief]$_{\text{DP}_{\text{acc}}}$.
Walther is sending the landlord the letter.

(2) Walther schickt [den Brief]$_{\text{DP}_{\text{acc}}}$ [an den Vermieter]$_{\text{PP}}$.
Walther is sending the letter to the landlord.

The systematic alternation in the mapping between thematic roles and grammatical functions makes these regular changes an interesting field of study, if one is interested in the properties of argument realisation. Several times the alternation between active and passive voice as well as the dative alternation served as a topic for research in theoretical linguistics (cf. Wunderlich, 1993) as well as in psycholinguistics (see for instance Bock, 1986).

Next in this chapter we will take a look at some accounts of argument realisation from linguistic grammar theory. I will limit myself to pointing out only a few major issues and differences between theories, since the focus of this thesis is on the psycholinguistic modelling of sentence production. The section on syntactic theory is followed by a description of a psycholinguistic model of language production, where we will take a

closer look at the interface between the conceptual level and the level of structural assembly. I will present some factors that can influence the mapping between arguments and grammatical functions. I will show which role priming is assumed to play in the mapping process, which experimental paradigms are used to study argument realisation, and what data can be obtained from that.

2.1. Argument realisation in grammar theory

Linguistic grammar theory forms an important grounding for psycholinguistic modelling of language processing. This section will provide an overview over three grammar theories and the assumptions they make about the mapping between arguments of a conceptual representation and grammatical functions in a sentence. The selection of these three particular theories is not supposed to imply any preferences of the author. Rather, they represent those theories which, in my humble opinion, have featured most prominently in past work on structural priming.

Lexical-functional grammar

Lexical functional grammar (LFG; Kaplan & Bresnan, 1982) assumes different parallel representations of linguistic structures (cf. Bresnan, 2001). The constituent structure, or *c-structure*, represents terminal, phrasal and sentential constituents as well as their hierarchical and linear order. The *f-structure* representation contains information about the grammatical function of constituents, such as subject or object. Functions such as subject or direct object are considered primitives in LFG theory (cf. Carnie, 2002; Bußmann, 2002: pp. 400). They are mapped onto thematic roles in the argument structure of a specific verb's lexicon entry. In LFG, syntactic structures are derived in one step, in which a mapping function relates elements from the functional representation directly to nodes in the constituent structure.

Changes in the subcategorisation frame, as they occur for instance in passivisation, are seen as purely lexical processes:

> Lexical rules relate the respective verb classes and establish correspondence between the complement positions (...). (Bußmann, 2002: 401)[1]

The lexical rule for passivisation maps the argument position which is realised as object in active voice onto the subject function in the passive voice verb entry. For the dative

[1] 'Lexikalische Regeln setzen die entsprechenden Verbklassen in Beziehung und stellen die Korrespondenzen zwischen den Komplementstellen (...) her.'

alternation a corresponding lexical rule is assumed. It establishes a relation between the two alternative variants of a verb and maps the RECIPIENT of an action either onto the indirect object or onto a prepositional object respectively (cf. Kaplan & Bresnan, 1982).

Generative transformational grammar

Generative transformational grammar in the Chomskyan tradition (cf. for instance Carnie, 2002; Radford, 1997) assumes a universal and to some extent innate rule system for all languages, a 'universal grammar' (UG), which guides the creation of syntactic structures. Variance between different languages is explained by the parametrised nature of the UG principles and constraints. Parameters can take different values for different languages. On the theory level of the so called Government and Binding theory (GB; Chomsky, 1988) two distinct levels of syntactic representation are proposed. The deep structure directly captures the thematic relations within the argument structure of a verb. A verb is said to 'project' its thematic structure into a syntactic one. The deep structure is transformed into a surface structure by movement operations. Accoding to Wunderlich (1993), the derivation of a surface structure from a deep structure is an 'effect' of operations necessary to fulfill 'general principles about the mapping to syntactic positions and the well-formedness of theta-structures respectively' (Wunderlich, 1993: 745).[2]

Examples for such principles are the case filter (all phonologically non-empty nominal elements must be assigned case; cf. Chomsky, 1988: 49) and the theta criterion (every argument must bear only one theta role, and every theta role is realised by only one argument: cf. Chomsky, 1988: 36). In the derivation of the passive it is assumed that a verb with passive morphology cannot assign the AGENT theta role.[3] The base generated structure would thus look like this (after Wunderlich, 1993):

(3) [e [[$_{\mathrm{VP}}$ *is* V*en* NP$^{\mathrm{y}}$] (*by* NP$^{\mathrm{x}}$)]

In this example the subject position is empty (e), while at the same time the passivised verb cannot assign case to its internal argument any more. To saturate the case filter,

[2] 'Effekte (...) [von Operationen, die zur Erfüllung] allgemeiner Prinzipen über die Abbildung auf syntaktische Positionen bzw. die Wohlgeformtheit von Theta-Strukturen (...) [erforderlich sind.]'

[3] On what level the change in the argument structure of a verb happens, is subject to debate. Two hypotheses exist within the transformational grammar framework. According to the transformational hypothesis morphological processes take place on the syntactic level, whereas the lexicalist hypothesis locates the relation between alternative variants of a verb in the lexicon. To this effect, the latter assumes lexical rules, following assumptions from LFG (Bußmann, 2002: 405).

the internal argument NP^y has to be moved to position e, where it can be assigned nominative case.

A verb's argument structure only contains information about thematic relations. Grammatical relations such as subject or object are defined configurationally in transformational grammar and are read from the schematic representation (tree diagram) of a derivation (cf. Carnie, 2002). In GB theory, for instance, the subject occupies the specifier position of a verb. In a passive sentence, however, the subject of the surface structure is equivalent to the object of the underlying deep structure.[4] Therefore, grammatical roles can be defined only with respect to a certain level of syntactic representation.

A well-known analysis of the dative alternation in English is based on the work of Larson (1988). In the underlying configuration the indirect object is located within a prepositional phrase in the verb's complement position, and the direct object occupies the specifier position. In order to obtain a free position for the subject Larson assumes a new phrase, called νP shell. Its head is a so called 'light verb' ν (cf. Radford, 1997), which is phonetically empty in English and bears an abstract meaning such as 'causation'. To derive the correct word order in the surface representation, the sentence's main verb is merged with the light verb in the course of the derivation. Larson derives the double object construction from the underlying configuration with a prepositional object. He assumes that a preposition is equivalent to case marking, in this case comparable to the dative. Along the lines of the theory of passivisation Larson assumes a change in the subcategorisation properties of the verb undergoing the so called 'dative shift'. The shifted verb cannot assign structural case to the indirect object in its complement position anymore; therefore the preposition is omitted. The indirect object is then raised to an argument position further up in the structure to obtain case. This results in the indirect object appearing before the direct object in surface structure.

The assumption of νP shells is quite common by now, yet there is still discussion going on about Larson's analysis of the dative alternation. See for instance Grewendorf (2002) on the question of the order of arguments in German.

Construction grammar

Construction grammar (**CxG**) posits atomic constructions as the focus of the analysis of language structure. Constructions are pairs of form and meaning or form and discourse

[4] Newer versions of transformational grammar based on the minimalist program (cf. for instance Radford, 1997) have abandoned the distinction between deep and surface structure. However, the derivation of a passive sentence is still assumed to include movement of the later subject out of the complement position.

function. Goldberg (2003) views all linguistic units that carry meaning as constructions, beginning at the morpheme level; syntactic constructions bear a meaning of their own, independent of the meaning of individual words.

> Any linguistic pattern is recognized as a construction as long as some aspect of its form or function is not strictly predictable from its component parts or from other constructions recognized to exist. (Goldberg, 2003: 219)

According to grammarians working with a construction grammar framework there is no sharp division between the lexicon and a (rule based) syntax, as for instance generative grammars in the Chomskyan tradition would assume (cf. Goldberg, 2003). Rather it is assumed that syntactic constructions form part of a continuum of morphemes, words and larger units in the lexicon ('construct-i-con', Goldberg, 2003: 219).

An example for a syntactic construction is CAUSED-MOTION, as given in (4), realised in (5).

(4) [Subj [V Obj Obl]]

(5) He sneezed the napkin off the table. (Goldberg, 1995: 9)

Sentence (5) serves Goldberg (1995) as an example for how speakers of a language use construction-based analogies in a productive way. The example might also pose a problem to other grammar theories. To explain this particular use of the verb 'to sneeze' in an LFG framework or with transformational grammar, Goldberg argues that one would have to assume implausible meanings in the lexicon entry of the (intransitive) verb 'to sneeze': 'X CAUSES Y TO MOVE Z *by sneezing*' (Goldberg, 1995: 9). Construction grammar on the other hand can explain this use straight away. The framework allows for a direct combination of the syntactic construction's meaning with the verb meaning. A verb used in a CAUSED-MOTION construction specifies the manner of motion.

For the English passive a construction as in (6) is assumed (cf. Goldberg, 2003: 220). Based on that I assume the construction (7) for the German passive.

(6) [Subj aux $VP_{\text{past part.}}$ (PP_{by})]

(7) [Subj aux ($PP_{\text{von/durch}}$) $VP_{\text{part. perf.}}$]

Since constructions are defined as pairs of form and meaning, we might ask the question what the passive construction actually 'means'. Accoding to Goldberg (1995, 2003) the answer lies in the passive's discourse function. The construction allows to topicalise the THEME or PATIENT argument, while at the same time allowing to realise the AGENT or CAUSE in a non-topicalised way, if it is not omitted entirely.

The dative alternation is not viewed as an alternation in construction grammar. The theory does not assume any syntactic transformations or lexical rules to change subcategorisation properties. An analysis within a transformational grammar framework establishes a relation between the double object (DO) structure and the prepositional object (PO) construction by deriving one from the other. According to Goldberg (1995), such a derivation is equivalent to semantic synonymity of constructions. Synoymity relations in construction grammar result from the properties of constructions, without having to assume one construction as more 'basic' than the other. Goldberg (1995) analyses the PO construction as a metaphoric extension of the CAUSED-MOTION construction: 'Transfer of Ownership as Physical Transfer' (Goldberg, 1995: 89). The PO construction is synonymous to the DO construction on a semantic level. A difference in meaning exists, however, as far as the pragmatics are concerned. The double object construction is ususally used to focus the Patient, while the PO construction emphasises the Recipient of an event (cf. Goldberg, 1995: 92).

The mapping of semantic roles to grammatic functions is a property of a construction. Functional mapping can thus be considered direct, as in lexical functional grammar. More precisely, there is no formal mapping operation necessary in CxG.

2.2. Argument realisation in psycholinguistics

Most psycholinguistic theories model the language production process with three levels (cf. Pechmann, 1994). The process begins at the conceptual level (conceptualiser). At this stage the 'message' is formed that is to be verbalised. At the following formulation stage the lexicon is accessed and the message is mapped onto a syntactic structure, which will then be phonologically specified. The final processing stage (articulator) realises the actual speaking process by translating the phonological representation into code which controls the articulatory muscles.

Perhaps the most detailed model of language production has been proposed by Willem Levelt in his 1989 book 'Speaking: From Intention to Articulation' (cf. Pechmann, 1994). The three levels of production mentioned above shall be elaborated further along the lines of Levelt's model. Figure 2.1 on page 14 shows a schematic depiction of the model.

The generation of a conceptual message by the *conceptualiser* involves two steps. The first step is **macroplanning**,

> [t]he elaboration of a communicative intention by selecting the information whose expression may realize the communicative goals (...) (Levelt, 1989: 5)

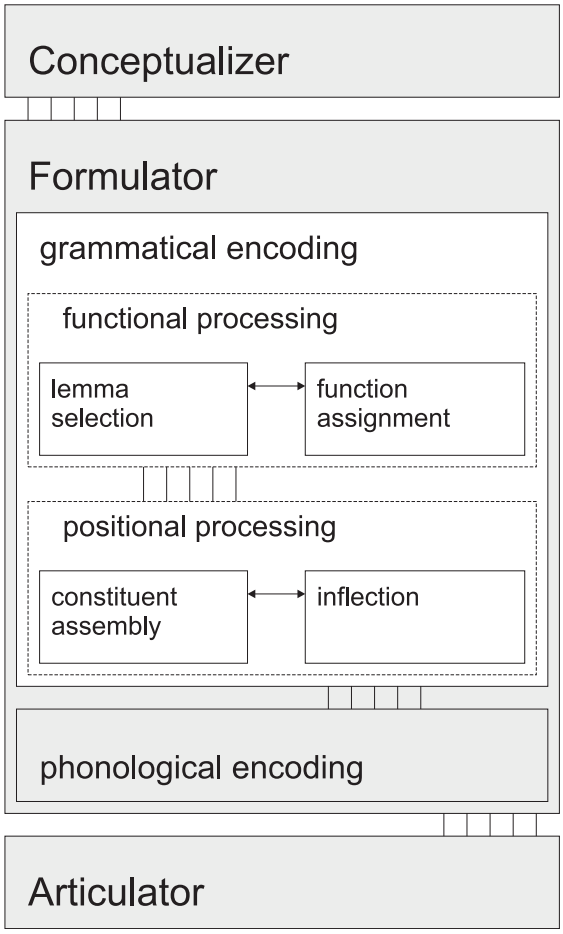


Figure 2.1.: Model of the language production process, adapted from Bock & Levelt (1994) and Pechmann (1994)

First, information has to be compiled that is appropriate in the ongoing discourse and a suitable speech act has to be chosen (cf. Levelt, 1989). Further conceptual planning deals with information structure, for instance marking single elements of a message as given or new, or focussing pieces of information. Levelt calls this preparation on an information structure level **microplanning** (Levelt, 1989: 5).

The conceptualisation stage results in a 'preverbal message' (cf. Levelt, 1989: 9), which serves as input for the next processing stage, the *formulator*. Formulation involves two steps, grammatical and phonological encoding. During **grammatical encoding**, so called *lemmas* are activated and syntactic structures are built. A lemma contains syntactic information about a word, but no information about a word's phonology (cf. Pechmann, 1994; Levelt, 1989). Depending on the type of lemma certain 'diacritic' pa-

rameters (cf. Levelt, Roelofs, & Meyer, 1999) are specified, for instance person, number or tense for a verb lemma. More details on lemma selection and the creation of syntactic structure will follow in section 2.2.3. The result of grammatical encoding is the 'surface structure': '(...) an ordered string of lemmas grouped in phrases and subphrases of various kinds (...)' (Levelt, 1989: 11). At this stage the surface structure is not yet phonologically specified. Phonological information is added to the representation during the second sub-process of the formulation stage, **phonological encoding**. At this point the word form entries or *lexemes* of the respective lemmas are accessed and the hierarchically organised syntactic structure is translated into a linear chain of phonemes. This 'phonetic or articulatory plan' (Levelt, 1989: 12) is carried out by the *articulator*, which activates the necessary muscles according to the plan.

The architecture of Levelt's model is serial and modular. This allows for strong and falsifiable hypotheses (cf. Levelt, 1989: 16). Levelt argues for the assumption of autonomous and specialised processing components, which operate without interaction with other components. He explicitly argues against direct feedback between conceptualiser, formulator and articulator. The only possible feedback link he sees is between phonological encoding and the conceptualiser. Such feedback is based on internal or external speech processed by the language comprehension components. Levelt supports his claim that no direct feedback exists between formulator and conceptualiser with experimental data. In the study by Levelt and Maassen (1981) the authors were testing whether lexical accessibility of words can influence conceptualisation. The results of the are interpreted as evidence against feedback; however, Pechmann (1994) entertains some doubt about this interpretation on methodological grounds.

Levelt also assumes that the input for a processing components should be specific, that is, maximally restricted to the properties of the process.

According to Levelt, the assumption of autonomously operating components and the requirement of specific input are largely equivalent to *informational encapsulation* of psychological processing components as defined by Fodor (1983). Levelt refers to the discussion about the modularity hypothesis (cf. Fodor, 1983; Bußmann, 2002: 443) but refrains from taking a stand (also cf. Pechmann, 1994).

> Whether the automatic components proposed (...) share the additional features that would make them modules will, however, not be a major issue in this book; hence, we will not call them modules. (Levelt, 1989: 22)

Another important feature of the model architecture is *incrementality* of processing (Levelt, 1989: 24). If processing is incremental, parts of the output of a processing stage

can be passed on to the next stage and be worked on. On the level of conceptualising, for instance, it is not necessary to compile a message completely, before passing it on in its entirety to the formulator. Non-incremental processing would, according to Levelt (1989), lead to 'serious dysfluencies in discourse' (p. 24). Kempen and Hoenkamp (1987) proposed a theory of an *incremental procedural grammar*, which they designed to be psychologically plausible, and in which incremental processing plays a central role (cf. Pechmann, 1994). Pechman writes about the work of Kempen and Hoenkamp:

> The incremental character of a procedural grammar is justified on the one hand by the necessity to cope with the fluency and speed of spoken language, on the other hand by the limited capacity of working memory, which might be overburdenend soon if it had to process very extensive and complex structures in their entirety. (Pechmann, 1994: 106)[5]

Kempen and Hoenkamp's incremental procedural grammar served Levelt (1989) as the theoretical framework for his modelling of grammatical encoding. Section 2.2.3 will go into more detail on this.

2.2.1. Factors influencing argument realisation

Mapping of message arguments to syntactic functions like subject or direct object is influenced by several factors. Properties of the message play an important role in this process. Generally, more 'prominent' or salient parts of a message tend to be realised earlier in a sentence, or in grammatical functions ranked higher in a 'preference hierarchy' (as proposed by Levelt (1989), p. 192), for instance as the subject.

> All that is at issue is the claim that foregrounded, nuclear, emphasized entities in the message typically find their grammatical encoding in higher grammatical functions or earlier in the sentence than backgrounded or non-nuclear entities. (Levelt, 1989: 267)

Among the argument properties that play a role in the syntactic realisation is *conceptual accessibility* of arguments (cf. Bock & Warren, 1985). This notion captures how easily mental representations can be retrieved from memory. In the Bock and Warren

[5] 'Der inkrementelle Charakter einer prozeduralen Grammatik wird zum einen mit der Notwendigkeit begründet, der Flüssigkeit und Geschwindigkeit gesprochener Sprache gerecht zu werden, zum anderen aber auch mit der Begrenztheit der Kapazität des Arbeitsgedächtnisses, das möglicherweise schnell überfordert wäre, wenn es sehr umfangreiche und komplexe Strukturen in ihrer Gesamtheit verarbeiten müsste.'

(1985) article the authors equate the respective ease of accessibility with 'imageability' for the purpose of their experiment. However, in general

> (...) conceptual accessibility is closely tied to characteristics of perceptual and conceptual representation, with accessible concepts being those that are in some sense most 'thinkable' - those whose mental representations are learned earliest and are most richly detailed in adult representations of knowledge. (Bock & Warren, 1985: 50)

Concerning conceptual accessibility of entities Prat-Sala and Branigan (2000) make a distinction between inherent and derived accessibility. Inherent accessibility on the one hand is based on semantic properties of arguments, for instance animacy. The derived accessibility, on the other hand, can be influenced by relative saliency in a discourse, moderated for instance by the narrator's perspective or higher number of occurrences. The experimental results of Prat-Sala and Branigan suggest that inherent and derived accessibility interact and that the latter can override the effects of the former in some cases.

Another factor is the *animacy* of referents. According to Itagaki and Prideaux (1985) participants in an experiment tend to realise nouns with animate referents in the subject position. In the authors' experiment they asked their subjects to write sentences and short texts about single noun stimuli. Subsequently Itagaki and Prideaux counted the frequency of stimuli occurring in subject position of sentence responses. They found significant main effects for animacy and concreteness, as well as for frequency. Ferreira (1994) showed that the probability of subjects producing passive structures in a sentence generation task could be increased by controlling the animacy of given arguments. A similar influence could be shown in experiments by Bock, Loebell, and Morey (1992).

Furthermore, it appears that the *thematic roles* of message arguments correlate with certain syntactic functions. According to Levelt (1989) arguments bearing an AGENT role are preferably realised as subjects. He writes:

> The simplest explanation for this fact is that the subject who perceives such an event normally encodes it from the perspective of the agent (...) (Levelt, 1989: 261)

Assuming *incremental* processing, higher conceptual accessibility of an argument entails that it is available to the formulator earlier than other elements of the message. This way it can be realised at an earlier position in the sentence (or in a grammatical function ranked higher). Further processing is constrained by this initial mapping of

an argument to a grammatical function and the remaining syntactic structure of the sentence has to be generated accordingly.

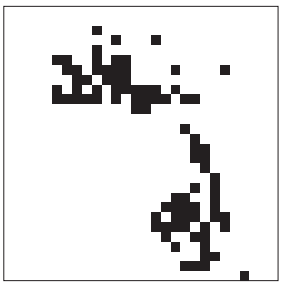
The correlation between high accessibility of an entity and its realisation as a sentence subject is different in other languages than English. In German, Levelt (1989) assumes it to be lower, because of the variability in word order.

(8) Den Ball wirft der Mann.
The ball-*Acc* throw-*3sgPresProg* the man-*Nom*
It is the ball that the man is throwing.

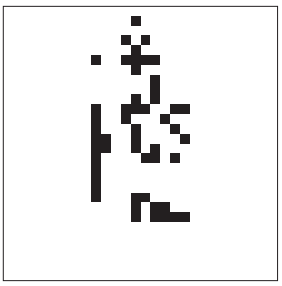
In sentence (8) 'den Ball' is topicalised without taking the subject position, which is occupied by the animate AGENT 'der Mann'. Perhaps the two salient entities compete with each other for 'prominent' realisation in the sentence. In German, such a competition might then be resolved by choosing a non-canonical word order (cf. Levelt, 1989: 265).

2.2.2. Syntactic priming

The generation of syntactic structure can be influenced by other factors besides message properties. Several experimental studies show that the structure of sentences produced or read can influence the subsequent production of sentences independently of conceptual factors. This effect is called syntactic or structural priming, or syntactic persistence (cf. for instance Bock, 1986; Bock & Loebell, 1990; Bock et al., 1992; Pickering, Branigan, Cleland, & Stewart, 2000). In her 1986 experiment Kathryn Bock used pictures that



The church is being struck by lightning.
Lightning is striking the church.



The man is reading the boy a story.
The man is reading a story to the boy.

Figure 2.2.: Examples of items and possible descriptions, material provided by Kathryn Bock (personal communication)

could be described using sentences in both active and passive voice, as well as images that could be described using double object structures and prepositional object structures.

An example is given in figure 2.2. Under the pretext of a recognition task participants of the experiments were alternately shown sentences and pictures. The experimenters asked the subjects to repeat each sentence and to describe each picture briefly as an aid to memory. Critical trials consisted of a prime sentence in either active or passive voice (and in double object or prepositional object structure respectively) and a target picture. The results show that the probability of an image to be described in a passive sentence was significantly higher after the participants had read and repeated a passive sentence prime than after reading an active prime. The experiments on the dative constructions yielded comparable results.

Subsequent research has dealt with the question on which level of the language processing system such a priming effect operates and which factors might influence it. Bock and Loebell (1990) wanted to see whether sentences with identical surface structure but different thematic roles differ in strength of a possible priming effect.

(9) The 747 was alerted by the tower.

(10) The 747 was landing by the tower.

If structural priming was a tendency to realise arguments with identical thematic roles in identical positions or syntactic functions, sentence (9) should prime a passive picture description, with an Agent in the PP_{by}. Sentence (10) on the other hand contains a locative GOAL instead of an AGENT in its PP and should constitute a worse prime than sentence (9). The results of the study, however, did not show a significant difference in priming strength between the two different sentence types.

In another experiment, Bock and Loebell (1990) contrasted primes with almost identical linear order, but different constituent structure with each other:

(11) Susan brought a book to study.

(12) Susan brought a book to Stella.

According to the experimental results a sentence like (11) does not produce a priming effect comparable to the effect of a sentence with prepositional object (12). The important factor, the authors say, is the difference in hierarchical structure between the two sentences. They conclude that structural priming effects can appear on the *constituent structure* level, independently of thematic or metrical structure variation:

> (...) constituent structures are processing entities in their own right, divorcible from operations associated with conceptual information or phonological and metrical information. (Bock & Loebell, 1990: 30).

Similar syntactic priming effects were found with different methods as well: in written sentence completion tasks (Pickering & Branigan, 1998), in controlled dialogue situations ('confederate scripting', Branigan, Pickering, Stewart, & McLean, 2000), in corpus studies (Gries, 2005), and in a sentence recall task (Potter & Lombardi, 1998). Loebell and Bock (2003) and Hartsuiker, Pickering, and Veltkamp (2004) tried to elicit priming effects between languages in bilinguals, and their results indicate that comparable constituent structures can have such an effect.

The experiments by Pickering and Branigan (1998) showed effects of structural priming using linguistic stimuli only. The effect was significant even if prime and target contained different verb forms, for instance, different in tense. Even when the verbs differed between prime and target an effect was detectable. The strength of the effect, however, was smaller under the latter condition than under the condition in which the verb had been repeated.

Bock et al. (1992) used syntactic priming to try to test the differing assumptions that LFG and transformational grammar make about the mapping between arguments and syntactic functions. As pointed out earlier, the mapping between slots in the argument structure of a verb and syntactic functions is carried out in a direct fashion in LFG; Bock et al. speak of *direct mapping*. In contrast to this they assume so-called *mediated mapping* in transformational grammar, since the assignment between arguments and syntactic functions is mediated by the deep structure. This assumption has ramifications on the analysis of, for instance, passive structures. In a transformational analysis of the English passive, the surface subject has to be base generated as object in the verb's complement position, from which it is moved subsequently.

In their experiment Bock et al. pitted the influence of animacy against the influence of structural priming. Their method was the classic picture description paradigm by Bock (1986). Target images depicted events with an inanimate CAUSE and an animate PATIENT. For the prime sentences the authors combined the two levels active and passive of the factor surface structure with a factor animacy. This factor had two levels as well; the authors used sentences with animate AGENT and inanimate PATIENT as well as sentences with inanimate AGENT (or CAUSE) and animate PATIENT. For both factors there is independent evidence from prior experimental studies that they can influence the structure of the produced target image descriptions. After an active prime the test subjects are more likely to describe the target image using an active sentence. A prime sentence with an inanimate subject creates a bias towards realising inanimate entities in the subject position of target sentences. Since the target pictures in the experiment by Bock et al. (1992) only showed inanimate CAUSES and animate PATIENTS,

prime sentences with inanimate subjects should result in a higher number of picture descriptions in the active voice.

(13) The boat carried five people.

(14) Five people carried the boat.

(15) The boat was carried by five people.

(16) Five people were carried by the boat.

Assuming either direct or mediated mapping, in both cases the surface structure of the prime sentence should exert the same influence on the production of target sentences. The mapping hypotheses differ, however, in the predictions they make about the influence of the factor animacy. Bock et al. (1992) assume that with mediated mapping priming exerts its influence on the mapping between arguments and syntactic positions on the deep structure level. Prime sentence (13) should elicit frequent picture descriptions in active voice, since both surface structure and animacy work in the same direction. A mapping of the inanimate entity to the subject position is easily realised with an active sentence. Generally, the authors say, active and passive primes with animate entities in the deep structure object position (i. e. sentences 13 and 16) should elicit more active voice target descriptions than prime sentences with an inanimate entity as the deep structure complement (sentences 14 and 15). Under the assumption of mediated mapping Bock et al. expect an interaction between prime sentence structure and the factor animacy, visible in the relative production frequency of target sentence structures. With direct mapping on the other hand only two simple main effects for syntactic structure and animacy are expected.

The results of the experiments coincide with the latter assumption, as only two main effects for syntactic structure and animacy were found, but no interaction. The authors interpret this result as evidence against 'mediated mapping'. In this respect the outcome of the study might pose a problem for grammar theories assuming transformations, since no evidence was found for movement operations that change grammatical functions between deep and surface structure. Monostratal theories like LFG or construction grammar, however, do not conflict with the results of the experiments.

2.2.3. Models of grammatical encoding

According to Levelt, psycholinguistic models for syntactic structure generation need to draw on a background from theoretical linguistics (Levelt, 1989: 161). His own 1989 model is based on the Incremental-Procedural Grammar by Kempen and Hoenkamp

(1987). This grammar theory in turn follows assumptions from Lexical-Functional Grammar (Kaplan & Bresnan, 1982). In Levelt's model the generation of surface structure is determined by the order in which elements of the message become available for formulation. Syntactic structure building procedures are called by lemmas (cf. Levelt, 1989: 236). The actual surface structure that is generated might from this point of view be seen as an epiphenomenon of the order in which entities of a message are being shifted from the conceptualisation to the formulation level. Levelt explains this by means of an example: The generation of the sentence 'The child gave the mother the cat.' begins with the assembly of a message. The argument 'CHILD' selects its lemma and sets certain diacritic parameters, for instance number and definiteness. The lemma calls a syntactic procedure which generates a partial structure, in this case a noun phrase. The partial structure then calls a 'categorial procedure' (Levelt, 1989: 238), which generates a superordinate category `S` (sentence). Since the sentence mode is declarative, the already existing NP is by default assigned the subject function and associated with the overarching structure under the node `S` as far left as possible. The categorial procedure for the entire sentence then has to make sure a verb lemma is selected which is compatible to the mapping between the AGENT argument 'CHILD' and the subject function. Levelt assumes in his 1989 model that lemmas contain subcategorisation frames which determine the mapping between thematic roles of a message and syntactic functions like subject, direct or indirect object.

In order to explain the existence of syntactic priming effects, Levelt assumes that syntactic procedures can be biased by reading and repeating of a sentence (cf. Levelt, 1989: 275). This way the influence of conceptual factors on sentence structure generation can be overwritten by a bias of the grammatical encoding mechanisms.

Bock and Levelt (1994), following Levelt (1989), describe grammatical encoding as verb-centred. The generation of a functional representation is determined by syntactic information in the verb lemma. The authors, however, do not present any further details about syntactic procedures involved in the generation of sentence structure.

In their modelling of language production, Bock and Levelt (1994) distinguish between the *functional* and the *positional* level of processing by following assumptions by Garrett (1980), which are based on speech errors. The distinction between the two levels of processing during grammatical encoding has been accounted for in figure 2.1 on page 14. Initially, at the level of functional processing, the mapping between message arguments and syntactic functions takes place. The mapping process uses argument structure information from the (verb) lemmas involved. The functional level does not, however, contain information about the hierarchical or linear order of the individual sentence elements (cf.

Bock & Levelt, 1994: 968). It is only at the positional processing level that hierarchical order information is encoded in a constituent structure. Experimental evidence for the distinction between functional and positional processing might be found in the study by Bock et al. (1992) on the interaction between animacy and syntactic priming in sentence production. The authors interpret the missing interaction between both factors in their data as support for the assumption that functional mapping processes and constituent structure building processes can be distinguished.

> The former appear to be keyed to the meanings of expressions that occupy basic syntactic relations, whereas the latter appear to be keyed to the syntactic privileges of those relations with little regard for the semantic features of the occupants. (Bock et al., 1992: 168)

As an interpretation of their research on word order priming in Dutch Hartsuiker and Westenberg (2000) divide positional processing even further. The authors assume distinct and independent representations for the hierarchy and for the linear order of constituents in a sentence. This assumption is refuted, however, by Pickering, Branigan, and McLean (2002). In their experiments they do not find any support for a representation of hierarchical relations that might be independently primeable.

The WEAVER++ model by Levelt et al. (1999) is an extension of Levelt's 1989 model in the area of lexical selection. The authors maintain the assumption that verb lemmas contain syntactic information or are linked to nodes bearing such information in a lexical network model. Among the syntactic information represented on the lemma level are diacritic parameters and syntactic category information. The model by Levelt et al. (1999) further assumes that the category nodes of verbs contain a subcategorisation frame. The authors, however, do not present any further details on syntactic structure generation, especially regarding the question which syntactic procedures are involved and how they are called in the first place (cf. Levelt et al., 1999: 6).

An extension of the model by Levelt et al. (1999) that caters on this question is proposed by Pickering and Branigan (1998). They assume the existence of *combinatorial nodes* which contain information about the combinatorial potential of a verb lemma. The verb 'to give', for instance, can be combined with two noun phrases in a double object construction, and with a noun phrase and a prepositional phrase in a prepositional object construction. In this case the authors assume the lemma node for 'give' to be linked to two combinatorial nodes $< NP, NP >$ and $< NP, PP >$. Depending on the syntactic construction in which the verb is to be used, the respective combinatorial node receives activation. Like syntactic category nodes, combinatorial nodes are shared

between verbs, i. e. different lemmas can be linked to the same combinatorial node. Likewise it is possible that an individual verb lemma is linked to different combinatorial nodes, depending on the realisation variants (diatheses) the verb allows. Pickering and Branigan (1998) present experimental evidence from a written sentence completion task, in which priming effects were found even when prime and target verb differed.

Syntactic priming in the eyes of the authors is a based on residual activation of nodes, which increases the likelihood of this node to be activated and selected again. If a particular combinatorial node is selected during the production of a prime sentence, the probability of it being selected again for the production of a sentence with a compatible verb is increased during the *decay* of the node activation. In the experiments of Pickering and Branigan (1998) stronger priming effects were found when prime and target verb were identical. This leads the authors to assume that the link between a verb lemma and a combinatorial node also can retain residual activation and thus influences the selection probability of a node.

The authors do not go into much detail about the level of functional processing. But they leave open the possibility that the difference between functional and positional processing can be implemented in the model by assuming yet another type of node:

> Note that the connection between the lemma node and the combinatorial node might be mediated by nodes specifying grammatical functions like subject and direct object (...) (Pickering & Branigan, 1998: 635)

Pickering et al. (2002) further supplement the combinatorial node information by information about the linear order of constituents. The extension of the WEAVER++ model by Pickering and Branigan (1998) is, just like the original model, underspecified in terms of the processing details of sentence structure generation and regarding how different lemmas interact in the context of an entire sentence.

Based on the results of an experiment testing syntactic priming between languages, Hartsuiker et al. (2004) propose a type of feature nodes encoding voice. They assume priming of active and passive to work through residual activation of nodes in the lexical network, along the lines of Pickering and Branigan's proposal. Hartsuiker et al. (2004) do not specify any details about the voice feature node's content.

The representation-based account of syntactic priming described so far is not the only possible explanation. Another theory views structural priming as a form of *implicit learning*. Under this view it is assumed that the language production system is subject to long-term alteration by 'tuning'. The learning process is implicit, because the procedural knowledge involved in language production is not accessible to conscious processing

(cf. Chang, Dell, Bock, & Griffin, 2000: 220). The article by Chang et al. (2000) models the assumption of implicit learning in a *connectionist network*. Such models attempt to emulate psychological processing in computer-simulated networks consisting of highly inter-connected small units, which carry out a host of parallel and primitive calculations, instead of symbolic operations (Schade, 1992: pp. 11). One of the features of connectionist models is their lack of discrete processing levels (which is more or less complete, depending on the size and architecture of the model). Processing happens continuously, with parallel processing in both horizontal and vertical direction (Schade, 1992: 43).[6]

A connectionist model of language production possesses a learning mechanism that can alter connections and change connection weights during the production of a syntactic structure. In subsequent processing of compatible messages the probability that the same structure is used again is increased. The model by Chang et al. (2000) could successfully emulate structural priming effects.

2.3. Current state of research in German

The preceding sections presented the general state of syntactic priming research using evidence mainly from experiments in English. There is also a number of studies that deal with structural priming in German. Especially since German allows for more variation in word order as compared to English, German poses an interesting case for investigation. With studies carried out in German it might be possible to experimentally distinguish between processing on the functional and on the positional level.

Scheepers and Corley (2000) pursued this aim in their study on the priming of word order in German. They employed the written sentence completion paradigm by Pickering and Branigan (1998), but carried out the experiment using an internet questionnaire. The study's subject was the order of constituents in the double object construction. Accoding to the authors this order is almost free in German:

> (...) the order of these arguments is (almost) arbitrary, so that *Ich gab dem Mann das Buch* and *Ich gab das Buch dem Mann* are both translated as 'I gave the man the book'. (Scheepers & Corley, 2000: 2)

Prime sentences in which an accusative object preceded a dative object yielded no priming effect. Irrespective of the prime structure, experimental subjects almost always completed target fragments like (17) to form monotransitive structures.

[6] A more extensive description of other features of connectionist systems, especially of the subsymbolic processing hypothesis, would be beyond the scope of this thesis.

(17) Der Mann hat den Freund ... wollen.
The man-*Nom* has-*3sgPast* the friend-*Acc* ... wanted-*Infinit.*
The man wanted to ... the friend[7]

When the authors used target fragments with a dative object preceding the gap, however, a priming effect of sentences with the order dative object before accusative object could be found. In this case, the dat-acc order primes elicited significantly more ditransitive fragment completions than primes with acc-dat object order. Scheepers and Corley (2000) interpret these results as evidence for priming on the level of positional processing. Furthermore, they argue that the effect they observed supports the idea of feedback from the positional to the functional level of processing.

Hadelich, Crocker, and Scheepers (2003) tried to measure the effects of visual and syntactic priming on the production of passive sentences in German. They employed the picture description paradigm described by Bock (1986). Target pictures always showed an action involving two animate entities. Prime items consisted of sentences, as well as pictures showing one of the entities to appear on the following target picture. Priming sentences were presented in one of three structures; active, passive or active with fronted object ('Den Brief befleckt die Tinte' - 'It is the letter the ink is staining.'). The latter structure was intended to allow a separation of functional level priming effects from effects operating on the positional level. Manipulation of the visual primes had a significant effect on the structure of the target picture descriptions. The participants tended to realise the visually primed entity as the subject of their target sentence. Under the conditions where sentence primes were presented, however, no significant effect of the different prime structures on the structure of target descriptions could be found.

Loebell and Bock (2003) tested whether syntactic priming effects can be shown to operate between German and English in bilinguals. Their subjects were bilingual speakers with German as a first language, and they used the picture description paradigm. Participants read the prime sentence in one language and were asked to describe the target picture in the other. The authors used pictures of events which could be described as either double object (DO) or prepositional object (PO) structure, as well as pictures that could be described in either an active or a passive sentence. A significant priming effect was found when dative alternation items were tested, no matter which of both possible structures was used in the prime. This indicates that DO or PO structures can be primed in German as well. What is more, the authors see their results as evidence for sharing of syntactic structure between languages.

[7] A possible completion with two objects might have been: 'Der Mann hat den Freund seiner Frau vorstellen wollen.' - 'The man wanted to introduce the friend to his wife.'

The trials in which Loebell and Bock tested priming of the voice alternation, however, did not show a significant priming effect in their results. The authors see a possible explanation for this failure to show an effect in the different constituent structures of passive sentences in German and in English. Still, they argue, structural priming effects within German should be possible to show. A different experiment by Loebell and Bock with non-bilingual German native speakers tested this assumption. The results of this study point to the same direction as earlier studies on syntactic priming of voice in English, yet the effect does not reach significance.

Melinger and Dobel (2005) report an experiment on the priming of the dative alternation in German. They elicit syntactic priming effects, using a picture description paradigm and single-word primes. The authors used prime verbs that are only compatible with either the double object or the prepositional object structure and do not undergo the dative alternation. The results indicate a clear preference of the subjects for the double object structure. The also show a significantly higher number of target picture descriptions in prepositional object structure following PO primes, than after DO primes.

The studies presented in this section show that syntactic priming can be demonstrated in German as well and that it might even exert its effect between languages. German might present an interesting case for investigating whether functional and positional processing can be distinguished experimentally. It is striking, however, that to my current state of knowledge experiments in German so far have not yielded significant results when priming active and passive — which contrasts with the results found for English (see for instance Bock, 1986; Bock & Loebell, 1990). In the general discussion I will present some tentative explanations that exist for this disparate picture.

The fact that so far syntactic priming of active and passive voice could not be demonstrated in German served as the starting point for the experiments carried out for this thesis. They are a new attempt to gain empirical data on syntactic priming in German, in particular on the priming of voice. Originally we had planned a replication of the picture description paradigm described by Bock (1986). The next chapter reports an item pre-test.

3. Picture description pre-test

For experiments aimed at syntactic priming Kathryn Bock developed a method that allows systematic manipulation of the conceptual message without linguistic material. She reports experiments in English in her 1986 article. For the experiments she used pictures of events, which can be described with alternating verbs. The verbs used were ditransitives that licence the so-called 'dative alternation', and monotransitive verbs that could alternate between active and passive voice (see also section 2.2.2).

During an experimental session, subjects were read sentences and presented pictures in turns. A critical trial began with a sentence that served as the prime. Subjects then were asked to repeat the sentence. A prime sentence always appeared in one of the two possible structures of the alternation in question. After they had repeated the sentence, the participants were presented with a picture, which was not related in content to the prime sentence. The participants then had to give a short description of the picture.

Here are some example prime sentences from the experiment on the dative alternation:

(18) a. *A rock star sold some cocaine to an undercover agent.* prep. object
b. *A rock star sold an undercover agent some cocaine.*[1] double object

The subsequently shown image depicted for instance a man who is reading a story to a boy (see figure 2.2 on page 18). The experimenter was interested in the syntactic structure the participants used to describe the picture. Just as the prime sentence was alternated between double object and prepositional object structure, the picture could in principle be described using either structure:

(19) a. *The man is reading a story to the boy.* prepositional object
b. *The man is reading the boy a story.* double object structure

The dependent variable of the experiment was the structure of the picture descriptions the participants produced. According to the hypothesis subjects should be more likely to produce picture descriptions with a prepositional object after primes in prepositional object structure. In turn, more double object structure descriptions were expected

[1] examples from Bock (1986)

following prime sentences in double object structure. The hypothesis for the voice alternation experiment ran along the same lines: after passive primes more passive picture descriptions were expected than after active primes and vice versa.

Bock (1986) found experimental evidence for her hypotheses in both the experiment on the dative alternation as well as in the experiment on the active/passive alternation. The paradigm was used to show syntactic priming effects in English in later studies as well (e. g. Bock & Loebell, 1990). However, already in her 1986 article Bock notes that features of the conceptual message influence the choice of the syntactic structure to be generated. In the experiment on the voice alternation she found an effect of the animacy of the pictured entities. Ferreira (1994) showed (employing a different experimental task) that the animacy of entities which are to be described can influence the syntactic form of the description.

3.1. Objectives

The attempt by Hadelich et al. (2003) to show syntactic priming effects for the voice alternation in German with the paradigm of Bock (1986) was not fruitful. Neither could Loebell and Bock (2003) find a significant priming effect for the voice alternation in their experiment with non-bilingual Germans. Therefore we deemed necessary a pre-test for the material we intended to use in our picture description experiment. According to Christoph Scheepers (personal communication) the preference for the active voice might be so high with German verbs, that a priming effect for passive voice presumably cannot be demonstrated because of a floor effect. Since pictures showing an animate AGENT and an inanimate PATIENT are very likely to create a bias towards active sentences, we decided to exclude this combination from the final experiment and only test images with animate AGENT and animate PATIENT, inanimate AGENT and inanimate PATIENT, as well as images showing an inanimate AGENT and an animate PATIENT. The latter combination of inanimate Agent and animate Patient should be particularly interesting, since the tendency to realise animate entities in the subject position might result in a higher number of passive picture descriptions under this condition. This in turn might help to see a possible syntactic priming effect better.

Based on these considerations we designed a pre-test for target pictures. The pre-test was supposed to show which of those images used by Loebell and Bock (2003) and Hartsuiker et al. (2004) spontaneously elicit active or passive sentences from German native speakers and in what proportion both structures occur. The results should serve as a guideline to chose suitable target pictures for a priming experiment.

3.2. Method

3.2.1. Participants

19 native speakers of German, between 18 and 56 years of age ($\bar{x}$ 26,94; *sd* 12,04), participated in the pre-test. The sample group consisted of twelve women and seven men who were recruited from an introductory lecture to psycholinguistics and from the author's personal background. All participants were naïve with regards to the objective of the study and did not receive payment.

3.2.2. Materials

For the pre-test 94 black and white line drawings were used. The original material was kindly provided by Kathryn Bock and Robert Hartsuiker (both personal communication).

The drawings were made available to us as GIF and JPEG files. If necessary, individual drawings were printed out, retraced and rescanned to increase the resolution of the pictures. One picture was replaced by a new drawing of the same event, done by the author. Appendix B contains an overview over the material used. The drawings depicted different events involving two entities, for example a ship being destroyed by a torpedo; a boy pushing a girl on a swing; a woman being hit by a wave. The drawings differ in the respective animacy of AGENT and PATIENT. The material set contained 53 critical items, in detail

- 7 drawings with animate AGENT and inanimate PATIENT;
- 17 drawings with inanimate CAUSE and animate PATIENT;
- 16 drawings with inanimate CAUSE and inanimate PATIENT, as well as
- 13 drawings with animate AGENT and animate PATIENT.

The remaining drawings showed events and actions that could be described with intransitive verbs and served as fillers (for example the depiction of a man sleeping).

3.2.3. Design

Every participant was presented with all pictures. In order to test for any influence of the horizontal alignment of pictures, we created a mirror image of every drawing and distributed the two versions of each picture over two lists. Every subject saw 50% of the

images in the order AGENT-PATIENT and 50% in the order PATIENT-AGENT. For each of the two lists we created four different randomisations.

3.2.4. Procedure

The participants were given questionnaires with the test images. The questionnaires contained 16 pages with six images per page (four on the last page). On the cover page the subjects were instructed how to fill in the following pages (see Appendix A). We asked participants to write down a brief description of the action depicted by each image. They were requested to use complete sentences, to not think too long about their answer, to not use proper names, and to work through the questionnaire sequentially and without help from others. Participants were allowed to fill in the questionnaires at home.

For the analysis all answers were transferred into a spreadsheet and evaluated under certain aspects. The criteria included transitivity and whether a sentence could be changed into the passive voice. The answers were also annotated for voice and animacy of AGENT and PATIENT. For a sentence to be considered transitive, we applied a strict definition of transitivity and only included sentences with exactly one accusative object into the category. With answers given in active voice we checked whether the passive voice counterpart of the same sentence was meaningful and grammatical. Intransitive and incomplete sentences, as well as answers that did not describe the event depicted by the respective image were counted as invalid.

3.3. Results

Of 94 items in total, 70 pictures elicited intransitive or invalid answers. For the remaining 24 items, at least 50% of all participants produced transitive picture descriptions that could be passivised. Out of these

- 5 items showed an event with an animate AGENT and an animate PATIENT,
- 3 items showed an event with an inanimate AGENT and an animate PATIENT,
- 8 items showed an event with an inanimate AGENT and an inanimate PATIENT.

A t-test yielded no significant difference between the number of valid transitive picture descriptions elicited by the two horizontal alignments possible for each item.

3.4. Discussion

For the planned implementation of the three animacy distributions (animate AGENT/animate PATIENT, inanimate AGENT/animate PATIENT, inanimate AGENT/inanimate PATIENT) as a factor in the experiment we would have needed an equal amount of critical items for each factor level. However, according to the results of the pre-test only 16 of all items tested would be suitable for an experiment. Furthermore, these few items were distributed very unevenly over the planned factor levels.

It is very likely that some deficiencies of the instructions we used is to blame for the very low number of suitable items. The instruction did not contain an example and participants were not explicitly asked to answer in one single sentence without subordinate clauses. A considerable amount of answers had to be counted as invalid because they described the picture in more than one sentence or made use of constructions with subordinate clauses. A replication of the pre-test using an improved instruction sheet might lead to different results than those reported here. Since the time limitations imposed on the work for this thesis did not allow for a replication, a different paradigm was chosen to examine structural priming effects in German.

4. Experiment 1: dative alternation

4.1. Objectives

Because of the problems with the material for a picture description paradigm described in section 3.4 we opted for an experimental method that uses sentences as primes and targets. Compared to the picture description paradigm the presentation of complete sentences has the advantage that the message participants are supposed to use can be effectively controlled. Experiments by Potter and Lombardi (1998) and by Chang et al. (2003) were able to demonstrate syntactic priming effects in English using the *sentence recall* paradigm. Details of the experimental method will be given in section 4.2. Since this paradigm has, to our current state of knowledge, not been employed before to investigate syntactic priming in German, we first wanted to test the general validity of the method for experiments in German. For this purpose experiment 1 comprised material to test syntactic priming of the dative alternation, for which exists independent experimental evidence from a study by Melinger and Dobel (2005). Experiment 2, reported in chapter 5, employed the sentence recall paradigm to investigate syntactic priming effects for active and passive voice.

4.2. Method

The capacity of short term memory (STM) is canonically assumed to span six or seven items (Baddeley, 1990; Miller, 1956). These items can be individual characters, numbers, symbols or for example unrelated words in a list. However, the memory capacity seems to be considerably higher when people are required to memorise and immediately repeat an entire sentence. The ability to memorise and recall structured linguistic material of a greater extent is commonly attributed to so called 'chunking' (see for instance Baddeley, 1990). Glanzer, Fischer, and Dorfman (1984) assume that while reading we always keep the last one or two sentences in STM from which they can be reproduced verbatim. According to the authors the short term 'verbatim storage' contains all words of a sentence including its surface structure (Glanzer et al., 1984: pp. 483).

Potter and Lombardi (1990), however, hypothesise that sentences are generated anew from the conceptual level even in short term recall. They do not attribute the great accuracy in recall to verbatim storage of the surface structure, but rather to the high availability of recently activated lexicon entries:

> Instead of using a 'surface' representation such as a phonemic string or any ordered perceptual representation, recall relies on a conceptual representation of the sentence and on active but unordered lexical entries. (Potter & Lombardi, 1990: 635)

In the experiments they report they used an 'intrusion paradigm' in which participants were presented sentences in RSVP[1]. According to the authors this form of presentation resembles spoken language more closely than normal reading. Each sentence was immediately followed by a distractor task that contained a 'lure': participants had to read a list of nouns, one of which was synonymous to a noun from the preceding sentence. After the distractor task the subjects were prompted to repeat the sentence presented initially as accurate as possible. In general, participants managed the repetitions quite well; in some cases, however, they were led up the garden path by the lure from the distractor task and replaced the critical noun from the sentence by the synonym from the word list.

For a follow-up study (Lombardi & Potter, 1992) the authors used lure *verbs* instead of nouns. In some cases the subcategorisation frame of a lure verb was incompatible to the structure of the sentences presented before. The verb 'to give' in a sentence like 'The rich widow is going to give a million dollars to the university.' can be replaced by the (lure) verb 'to donate' without problems, however, integrating 'donate' into a sentence like 'The rich widow is going to give the university a million dollars.' would require changing the syntactic structure of the sentence (cf. Lombardi & Potter, 1992: 266). The authors observed exactly that. In some cases experimental subjects integrated an incompatible lure verb into a prime sentence by altering the sentence structure.

However, the authors asked themselves why subjects did not alter the structure of sentences spontaneously in their repetition when a lure verb was compatible to more than one structure. The authors assumed that the reason for the low number of spontaneous changes was syntactic priming by the verb in the prime sentence (cf. Lombardi & Potter, 1992; Potter & Lombardi, 1998).

Potter and Lombardi (1998) report experiments that show syntactic priming effects between two recalled sentences. On critical trials the subjects were presented with a

[1] rapid serial visual presentation

sentence in either double object or prepositional object structure which they had to repeat after a brief distractor task. Before that they had read and repeated a prime sentence in either the same or the other of the two possible structures. The experiment also included neutral control primes. The authors found priming effects and interpreted them as further confirmation for their hypothesis that sentences are regenerated from the conceptual level even in short term verbatim recall.

As mentioned earlier in section 4.1, the 'sentence recall' paradigm was also successfully employed to show syntactic priming by Chang et al. (2003). Experiments 1 and 2 replicate the studies by Potter and Lombardi (1998) and Chang et al. (2003) to some extent.

4.2.1. Participants

In total, 33 subjects aged between 15 and 41 ($\bar{x}$ 26,27; *sd* 5,12) participated in the experiment. The sample group consisted of 20 female and 13 male participants. All subjects were either recruited from the personal background of the author or were volunteers who contacted us through the website of the Department of Linguistics website. Subjects did not receive payment for their participation and they were not informed about the study's objectives beforehand.

4.2.2. Materials

For experiment 1, German sentences with ditransitive verbs were used that could be realised in a double object structure as well as in a prepositional object structure. Items for the experiment were taken from the materials used by Loebell and Bock (2003) and Chang et al. (2003). They were translated and adapted to sound natural in both alternate structures. Table B.1 in the appendix contains a list of the sentences used. In order for critical items not stand out too much from the other sentences, two different types of dative construction were used: 'transfer' datives and 'benefactive' datives (cf. Chang et al., 2003). **Transfer datives** have in common a core meaning of transfer of ownership (see examples 20a and 20b). Prototypical transfer dative verbs include *to give, to send, to hand*. In a double object construction in a German main clause (20a) the RECIPIENT is realised as dative object, followed by the THEME, which is realised as accusative object. In a prepositional object structure the order of RECIPIENT and THEME is reversed; the THEME is followed by the RECIPIENT embedded in a prepositional phrase headed by the preposition 'an'.

(20) a. Die Fluggesellschaften übermitteln den USA viel zu viele Daten.
The airlines transmit the US-*Dat* way too much data-*Acc*.
The airlines transmit way too much data to the US.

b. Die Fluggesellschaften übermitteln viel zu viele Daten an die USA.
The airlines transmit way too much data-*Acc* to the US.
The airlines transmit way too much data to the US.

Benefactive datives describe the creation or acquisition of something, for instance an object, with the additional meaning component that this is happening for the benefit of someone else. This construction can be used with many verbs that describe actions of producing or taking into possession, for instance *to paint, to buy, to bake*. In a benefactive double object structure (21a) the RECIPIENT is realised as a dative object followed by an accusative object which functions as THEME. In the prepositional object structure the order of RECIPIENT and THEME is reversed, the RECIPIENT is realised in a PP headed by the preposition 'für' (see example 21b).

(21) a. Der Friedrich zeichnet dem Robert eine Illustration.
The Friedrich-*Nom* draws-*prg* the Robert-*Dat* an illustration-*Acc*.
Friedrich is drawing Robert an illustration.

b. Der Friedrich zeichnet eine Illustration für den Robert.
The Friedrich-*Nom* draws-*prg* an illustration-*Acc* for the Robert-*Dat*.
Friedrich is drawing an illustration for Robert.

For the distribution of items over the experimental lists we used 16 events for each of the two dative structures. Every event could be described by a sentence in double object structure just as well as by a sentence in prepositional object structure. Out of the 32 events or 'concepts' in total, 16 concept pairs were formed. The pairing was done with the provision that no or only minimal semantic overlap existed between two sentences of a pair (cf. Chang et al., 2003). Unlike in the experiment by Chang et al. (2003) 'transfer' and 'benefactive' dative items were not combined in prime-target sentence pairs. Since each of the two concepts in a pair could be realised as either DO or PO structure, four sentence structure combinations were possible, as shown in table 4.1. Each concept pair was used in two orders, so that every event appeared as prime and as target with equal frequency. This resulted in eight prime-target sentence pairs (possible realisations) for each concept pair.

From the critical sentence pairs we compiled eight lists with four blocks each. First, all eight transfer dative concept pairs were distributed over the lists by using a latin sqare. Then we counterbalanced the eight possible realisations per concept pair over each list. The eight concept pairs with benefactive dative were distributed the same way over

Table 4.1.: possible combinations of prime and target sentences

prime produced	target presented	prime and target structure are
double object prep. object	double object prep. object	identical
double object prep. object	prep. object double object	not identical

lists and blocks. Each participant saw every concept pair once. The critical items from experiment 2 were added, likewise amounting to 16 sentence pairs per list. The order of blocks in a list was counterbalanced over all lists using a latin square. For each list, four randomizations of items in a block were created. Finally, each list was complemented with 192 filler sentences, so that each block began with three filler items and after that a critical sentence pairs was separated by six filler sentences from the next pair. The fillers were translations based on the English material used by Chang et al. (2003); the sentences were kindly provided by Franklin Chang (personal communication). Among the fillers were sentences of various structures and the sentence length varied between three and eleven words.

4.2.3. Design

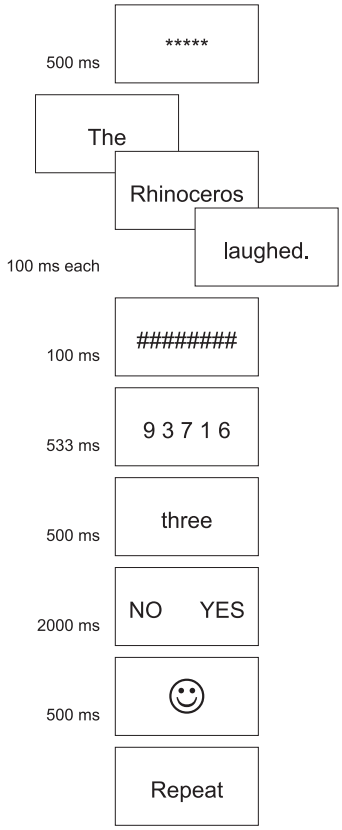
Each subject saw every possible prime-target combination four times. As table 4.1 shows, the four possible combinations of prime and target structure can be combined to form a single factor with two factor levels (identical vs. not identical) for the statistical analysis.

We assumed that the prime structure that subjects produce would exert an influence on the production of the target structure. Therefore, in those cases where the recalled prime sentence and the presented target sentence differed in structure, we expected the subjects to recall the target sentence using the structure they had previously used for the prime. This alteration of the target structure was hypothesised to occur more frequently in the 'not identical' than in the 'identical' condition.

4.2.4. Apparatus and procedure

Participants were tested individually in a sound proof booth. The experiment was programmed with the *Experimental Run Time System* (ERTS; Beringer, 1999) and ran on an IBM compatible PC (Pentium-S 166MHz) under MS-DOS 6.22. Stimuli were pre-

Figure 4.1.: trial scheme



sented with a resolution of 640x480 pixels and with a refresh rate of 60Hz on a 17 inch CRT monitor. The text was typeset in 24 point Bitstream Swiss.

Figure 4.1 shows the time course of what the participants saw during a single trial. The trial scheme is eqivalent to the one Chang et al. (2003) used for their experiments. The presentation times of individual stimuli were originally taken from the article by Potter and Lombardi (1998).

Each trial began with the presentation of a row of five stars as a fixation point. Then a sentence was presented word by word in rapid succession. The words of the sentence appeared individually for 100 ms at the centre of the screen. The last word was followed by a row of twelve hash symbols (#), presented for 100 ms as a visual mask. The mask was immediately followed by the distractor task, for which the subjects were shown a row of five single digits for 533 ms. After 100 ms of blank screen they saw for 500 ms a word denoting a number between zero and nine. The participants were then prompted

to decide whether the number spelled out as a word had been among the five digits presented earlier. They gave their answer by pressing a button on a three-key button box which was connected to the controlling PC by an 'EXKEY' keyboard logic. For a positive answer the subjects had to press the rightmost button, for a negative answer the leftmost of the three buttons. Unlike in the experiment described by Chang et al. (2003) we imposed a 2000 ms limit on the answering time for the distractor task; if subjects responded too slowly, they were prompted to make a faster response. If the answer to the distractor task had been correct, a happy Smiley face appeared on the screen for 500 ms; otherwise a sad Smiley face showed up. After another 500 ms of blank screen subjects were prompted with 'Wiederholen' which requested them to repeat the sentence that had been presented at the beginning of the trial. The spoken answers were recorded on the hard drive of a second PC with a Neumann TLM 103 capacitor microphone and a M-Audio Mobile PRE USB-amplifier. A second keyboard connected to the PC controlling the experiment was used to classify the answers. The second keyboard was located outside the sound-proof booth and could not be seen by the subjects. Each sentence repetition was immediately classified by the investigator by pressing a key. The categories were: double object or prepositional object structure for critical items of experiment 1, active or passive for the items of experiment 2, incorrect repetitions and correctly repeated fillers. The investigator's input automatically started a new trial.

Before the experiment participants were given a written instruction (see appendix A). After they had read it, the subjects could ask questions and the instructor made sure the instructions had been understood. Subjects were also informed that all of the sentences presented during the experiment would be grammatical. A practice block containing 24 sentences allowed subjects to get used to the task. After they had finished practising they were again allowed to ask questions. The experimental session was divided into four blocks containing 64 sentences each. Between the blocks subjects could pause as long as they wanted, and they started the next block by pressing the middle key on the button box. An entire session took 50 minutes on average.

Following the design of the experiments by Chang et al. (2003), critical sentence pairs from experiment 1 (dative alternation) were combined with the sentence pairs from experiment 2 (active/passive alternation) and with filler sentences to form eight lists with 256 individual sentences each (cf. section 4.2.2). This way critical sentence pairs did not stand out from the other material; sentence pairs from experiment 2 served as fillers for the first experiment and vice versa. In order to make the distractor task easier on critical sentences and to elicit fewer wrong answers, we imposed some restrictions on

the distractor task material for critical items (cf. Chang et al., 2003; and Franklin Chang, personal communication). On trials with critical sentences the answer to the number recognition task was always positive and the spelled-out number always denoted a digit at the left or right margin of the digit row. One third of the filler sentence distractor tasks also had a positive answer and two thirds had to be answered with 'no'. This way both answers occurred equally frequent in the list. In those cases where filler sentence distractor tasks had a positive answer, the spelled-out number could denote any one of the five digits in the row. This was supposed to prevent participants from developing answer strategies.

4.2.5. Scoring

As described above the subject's answers were classified immediately by the investigator during the experiment. The classifications were recorded by ERTS in the results files. The classification was additionally recorded by editing a printed script. Together with the audio material the redundant recording allowed for an easy correction of classification errors.

The first complete sentence a participant uttered in a trial was classified. In the evaluation of the structure, minor changes and omissions of function words were ignored, if the sentence remained grammatical and did not differ radically in meaning from the presented sentence.[2] Alterations of content words were also ignored to some extent, for instance if a verb's tense was changed or a noun was replaced by a synonym. However, in this case the produced structure still had to allow alternation between DO and PO structure. If all those criteria were not met, an utterance was marked as invalid. For the statistical analysis the data of all prime and target sentences were extracted from the ERTS result files and the two rows of data per sentence pair (one for the prime and one for the target) were merged into one data row. Then we excluded all invalid sentence pairs from further analysis, i. e. all cases in which subjects had produced an invalid structure on either prime or target trial. From the prime trials, only the structure that had actually been produced was considered in the analysis, since this would be the structure which should, according to the hypothesis, exert an influence on the production of the target sentence.

To be classified as either a double object or a prepositional object structure, the

[2] One subject, for instance, produced the sentence 'Der Architekt warf den Firmenchef raus' (The architect fired the CEO.) instead of 'Der Architekt entwarf dem Firmenchef ein Haus' (The architect designed a house for the CEO.). This alteration differed too much from the original sentence and was classified as invalid.

answers had to contain two objects and had to match the template DP_{nom} *verb* DP_{dat} DP_{acc} (DO) and DP_{nom} *verb* DP_{acc} *preposition* DP_{acc} (PO) respectively.

Since the data were not normally distributed, the statistical analysis was carried out with a non-parametric test instead of an analysis of variance. The *sign test* is a very robust method of analysis, for it does not rely on any assumptions about the shape of the data's distribution (cf. Siegel, 1987: 65). The test, however, is also very conservative (cf. *IFA Services: Statistics, Sign Test*, n.d.). To apply the sign test on our data, the four possible combinations of prime and target were collated in two conditions, *identical* (prime and target structure are identical) and *not identical* (prime and target structure differ). Table 4.3 contains mean values for these two conditions. The dependant variable in this case is the proportion of correctly produced answers, i. e. the proportion of target sentences that were recalled in the same structure as presented. The proportion of incorrect answers thus contains all cases in which participants changed the structure of the target sentence and produced it in the other of the two possible structures. For every experimental subject the frequency of correctly produced answers in the 'identical' condition was subtracted from the frequency of correct answers in the 'not identical' condition. If the two values did not differ between conditions, this resulted in a so called 'tie' (cf. Siegel, 1987: 68), which was excluded from further calculation. In case the frequency values differed between conditions, the subtraction could result in either a positive or a negative value. The number of positive prefixes and the number of negative prefixes was counted. An item-specific analysis was carried out accordingly, based on mean values for each prime-target sentence pair.

The subjects answered the distractor task correctly in 78.4% of all cases. 81.9% of all sentence repetitions, including sentences of experiment 2 and filler items, were counted as valid. Of all critical sentence repetitions 79.5% were considered valid. Data from two subjects had to be excluded from further analysis, because they produced more than 50% invalid repetitions.

Of all critical sentence *pairs* for both experiments 69% were valid, i. e. both sentences fulfilled the criteria mentioned earliert. These data served as the basis for statistical analysis.

4.3. Results

67.2% of the critical sentence pairs from the dative alternation experiment were valid and could be subjected to further analysis. In the data from five participants there were empty cells for at least one prime/target structure combination. Therefore the data of

these participants had to be excluded from the statistics. Three items had to be excluded from the item-specific analysis for the same reason.

Table 4.3 contains relative and absolute frequencies per condition of the two possible structures for target sentences. Table 4.3 collates the frequency of correctly repeated targets, i. e. targets repeated as presented, in the two factor levels 'identical' and 'not identical'.

Table 4.2.: Proportion of structures produced (absolute frequencies in brackets)

		target produced as	
prime produced	target presented	double obj. (DO)	prep. obj. (PO)
DO	DO	1.0 (74)	0 (0)
PO	DO	0.84 (59)	0.16 (11)
DO	PO	0.09 (7)	0.91 (74)
PO	PO	0.05 (4)	0.95 (79)

Table 4.3.: Proportion of correctly produced structures (absolute frequencies in brackets)

prime	target	correctly produced targets		prime and target are
DO	PO	0.91 (74)	0.88 (151)	not identical
PO	DO	0.84 (59)		
DO	DO	1.0 (74)	0.98 (157)	identical
PO	PO	0.95 (79)		

The positive/negative prefix count for the subject-specific sign test resulted in one negative and 12 positive differences, as well as 13 ties for the dative alternation data. The one-sided probability for one negative difference to occur in a sample of the size $N = 13$ is $p < 0.01$, according to table D from Siegel (1987). In the item-specific analysis we counted two negative and 13 positive differences, as well as 14 ties. The one-sided probability for this distribution to occur in a sample sized $N = 15$ is $p < 0.01$.

4.4. Discussion

The results show that subjects for the most part repeat the presented target sentence without changing its structure. They do, however, tend to alter the structure of a target

more often after they had processed a prime sentence with a different structure than the target. This effect can be explained with syntactic priming. In the framework of the model by Pickering and Branigan (1998) this translates into a combinatorial node for either double object or prepositional object structure being activated for the production of a prime. During subsequent sentence production that also involves a choice between the DO and PO combinatorial node, the node activated by the prime is more likely to be selected again, because it has retained some residual activation and its activation or selection threshold is reached sooner.

If identical structures were presented in both prime and target trial, no alteration of the produced target structure was expected to occur. The results showed no variance in the prime/target combination DO-DO. In the combination of two PO structures, however, a small number of spontaneous changes were made by the subjects. The lack of variance in one condition and the data's strong deviation from the normal distribution unfortunately did not allow for an analysis of variance. The sign test yields a significant difference between the two conditions 'identical' and 'not identical', but because of the small size of the analysed sample ($N = 13$) no individual comparisons between the four different prime/target combinations are possible. Without any information about possible interactions between conditions, multiple comparisons would simply be very problematic for methodological reasons. At a first glance, in the 'identical' condition there seems to be a tendency in favour of the double object structure. In the 'not identical' condition we might spot something like a preference for the prepositional object structure. Without further statistical analyses, however, these descriptive tendencies cannot be interpreted. Based on our data we therefore cannot make any statements about the direction in which a syntactic priming effect might work, neither can we draw any conclusions about a possible general preference for one of the two structure types.

In general the outcome of this experiment corroborates the results of earlier studies on the priming of the dative alternation in English (for instance Potter & Lombardi, 1998; Chang et al., 2003), as well as the results of studies in German (cf. Melinger & Dobel, 2005, who used a different paradigm, however). The sentence recall paradigm appears to be suited to demonstrate syntactic priming effects. For experiment 2 the same paradigm was employed to investigate syntactic priming of the alternation between active and passive voice.

5. Experiment 2: voice alternation

5.1. Objectives

As mentioned before in 2.3, the experiments by Hadelich et al. (2003) and Loebell and Bock (2003) could not show significant syntactic priming effects for the voice alternation. The experiment reported here forms a new attempt to replicate this effect, which has been shown for English, with German material. To our current state of knowledge the sentence recall method has not been used to investigate syntactic priming of the voice alternation before, neither in German nor in English. The experiment therefore poses a novel attempt in this regard.

In the theoretical part of this thesis we already noted that experiments using German material might form an interesting case for investigation aiming at independently manipulating functional and positional processing. Because of its pilot study character this functional separation was not implemented, since it would have made the experimental design more complicated; without much doubt it would also have reduced the statistical power of the experiment.

5.2. Method

In effect, the items from experiment 1 and 2 were presented to each subject in a single experimental session. Participants and procedure details were the same for both experiments.

5.2.1. Participants

Participants were the same as for experiment 1.

5.2.2. Materials

The critical sentences were based on 32 events which involved two entities each and could be described equally well by an active and a passive sentence. Some of these 'concepts' were taken from the material for the image pre-test described in chapter 3. As for the

pre-test our assumption held that events with animate AGENT and inanimate PATIENT would lead to a strong bias in favour of active sentences (cf. Bock et al., 1992). For this reason only events with inanimate AGENT and animate PATIENT, as well as events with inanimate AGENT/CAUSE and inanimate PATIENT were used for this experiment.

The events were combined into 16 pairs, each of which formed an item. The combination was carried out so that as little semantic overlap as possible occurred (cf. Chang et al., 2003). The two animacy options were treated separately and were not combined in pairs. Each of the two concepts of a pair could be realised as an active or a passive sentence. Table 5.1 shows the structure combinations used in the study. Table B.2 in

Table 5.1.: possible combinations of prime and target sentences

prime produced	target presented	prime and target structure are
active	active	identical
passive	passive	
active	passive	not identical
passive	active	

the appendix contains a list of all sentences used. Critical sentences were six, seven or eight words long.

To keep the linear order of entities involved constant between active and passive sentences, we changed the word order of the passive sentences from the canonical (SOV) matrix sentence word order to a word order in which the object was placed at the beginning of a sentence (see Hadelich et al., 2003). This also helped controlling the morphological form of the verb, which was realised as participle in both structures.

(22) a. Der Feuerwehrmann wurde von dem Hydranten nassgespritzt.
The fireman-*Nom* was by the hydrant-*Dat* drenched.
The fireman was drenched by the hydrant.

b. Den Feuerwehrmann hat der Hydrant nassgespritzt.
The fireman-*Acc* has the hydrant-*Nom* drenched.
It was the fireman whom the hydrant drenched.

The experimental lists were created as described above for experiment 1; each subject was presented with all concept pairs. In addition to the 192 designated filler sentences the critical items from both experiments served each other as fillers.

5.2.3. Design

As in the first experiment subjects saw each of the four possible prime/target combinations from table 5.1 four times with different content. For the experiment on voice alternation, again the four possible combinations were collated in one factor with the levels 'identical' and 'not identical'.

The hypothesis was the same as in experiment 1: If the prime sentence structure was different from the target sentence structure, a smaller number of correctly, i. e. as presented, produced targets was expected than for structurally identical prime and target.

5.2.4. Apparatus and procedure

Apparatus and procedure were identical to experiment 1.

5.2.5. Scoring

The structures produced by the subjects were classified by the experimenter during the session. For the classification, the same criteria as in experiment 1 applied with regard to the general validity of an answer (cf. section 4.2.5).

An active sentence was supposed to match the template DP_{acc} $aux_{to\ have}$ DP_{nom} $verb_{past\ participle}$, placing the PATIENT in object function at the beginning of a sentence. Passive sentences should see the PATIENT take the subject function in sentence initial position. The AGENT was supposed to be realised in a PP with the preposition 'von', according to the template DP_{nom} $aux_{to\ be}$ *preposition* DP_{dat} $verb_{past\ participle}$. The tense form of the auxiliary was ignored for this experiment.

In those cases where the produced prime sentence and the presented target sentence were identical, target sentences were never altered and always repeated as presented. The data of the 'identical' condition therefore contained no variance at all. As with experiment 1 the statistical analysis was carried out with the non-parametric sign test.

5.3. Results

70.7% of all critical sentence repetitions for experiment 2 were valid. Because of missing values for some items, data from four subjects had to be excluded from the subject-specific analysis. For the same reason the data for three items was excluded from the item-specific analysis.

Table 5.3 contains relative and absolute frequencies of the target structures produced per condition. In table 5.3 the relative frequencies of produced targets were collated in the two conditions 'identical' and 'not identical'. The subtraction of 'identical' from

Table 5.2.: Proportion of structures produced (absolute frequencies in brackets)

		target produced as	
prime produced	target presented	active	passive
active	active	1.0 (83)	0 (0)
passive	active	0.926 (75)	0.074 (6)
active	passive	0.037 (3)	0.963 (78)
passive	passive	0 (0)	1.0 (86)

Table 5.3.: Proportion of correctly produced structures (absolute frequencies in brackets)

prime	target	correctly produced targets		prime and target are
active	passive	0.96 (78)	0.94 (162)	not identical
passive	active	0.93 (75)		
active	active	1.0 (83)	1.0 (169)	identical
passive	passive	1.0 (86)		

'not identical' subject mean values for the voice alternation resulted in five positive and no negative differences. The one-sided probability of no negative differences occurring in a sample of size $N = 5$ is $p < 0,05$, according to table D from Siegel (1987). One-sided probability suffices in this case, since the hypothesis is one-sided as well: it was expected that prime/target sentence pairs with differing structures should result in fewer target sentences being recalled as presented. In the item-specific analysis, nine negative and no positive differences were counted. The probability of this distribution for a sample of the size $N = 9$ is $p < 0,01$.

5.4. Discussion

The results show that participants occasionally changed the structure of the target sentences in their repetition, if prime and target sentence structure differed. This effect

basically supports the assumption that voice of a sentence can be primed. The modelling by Hartsuiker et al. (2004) assumes the existence of feature nodes for active and passive, however without specifying these nodes any further. The voice feature nodes are activated during lemma selection (see section 2.2.3).

As in the discussion of the dative alternation experiment, some methodological reservations have to be noted. Items with identical prime and target sentence structure did not elicit any spontaneous alteration of the target structure that cannot be ascribed to priming; the data from the 'identical' condition does not contain any variance. Therefore we could not apply variance-analytical methods and had to resort to a non-parametric method. The difference between 'identical' and 'not identical' conditions proved to be significant, but the result of the sign test was based on an effective sample size of $N = 5$ for the subject-specific analysis. Consequently the results suffer from a lack in statistical power.

Again no individual comparisons between single prime/target combinations are possible, for instance to investigate differences in priming strength between active and passive primes. The difference in the amount of priming between both 'not identical' conditions cannot be interpreted without further statistical validation.

During the scoring, a tendency of some participants to replace the auxiliary 'hat' (has) by the form 'hatte' (had) in active sentences stood out. At debriefing a great number of subjects told us that they had noticed the word order of the critical active sentences. The order of entities in active sentences had been supposed to parallel the order of passice sentences, to present PATIENT or THEME role bearers equally prominent in both structures. Passivisation and movement to the prefield are two alternative possibilities to topicalise a PATIENT or THEME (cf. Levelt, 1989). The object initial word order in the active, however, is marked compared to the canonical word order, if it is not accompanied by a *contrastive focus* on the topicalised object. In the production of the participants a clear contrastive focus on the fronted object was not apparent; participants did not deem the word order ungrammatical even without contrastive focus. This statement is subject to the restriction that sentences were presented in a laboratory setting. It is possible that participants accepted the critical active sentences as grammatical, because they were presented without context and as part of an experiment. The data we collected does not allow for conclusions about whether the critical active sentence's word order had an influence on the results.

6. General discussion and outlook

The experiments carried out for this thesis project complement previous research on syntactic priming in two different aspects. Firstly, the 'sentence recall' method has to our current state of knowledge not been employed to investigate syntactic priming in German before. The results indicate that the method is suitable to demonstrate syntactic priming effects in German. Secondly, priming of the voice alternation has to our knowledge not been shown with a sentence recall paradigm before, even in English. Notwithstanding methodological reservations the results give an indication that priming of active and passive voice with this paradigm is possible.

Method

While scoring the participants' answers it was noted that some experimental subjects occasionally replaced numerals in the sentence they had to repeat by the number from the distractor task. This behaviour was not part of the research goals and had therefore not been considered in the operationalisation. The observations, however, are in line with experimental results by Potter and Lombardi (1990) and Lombardi and Potter (1992). They see an 'intrusion' of words from a secondary task as evidence for their assumption that sentences are regenerated from the conceptual level even during short term recall. The numeral intrusion observed in experiments 1 and 2 is at least a small indication for the validity of 'sentence recall' as a method to observe grammatical encoding processes.

The statistical analysis of this study's results has to be taken with a grain of salt. In both experiments statistically significant priming effects were found, but the effects are based on very small samples analysed. Variance in the results of the voice alternation experiment is based on the data of five out of 26 participants. What is more, in this experiment the data from the 'identical' condition, where prime and target sentence structure were the same, contained no variance at all. In this condition, subjects always produced target sentences as they had been presented. Such extreme values bear the danger of a ceiling effect being responsible for a significant result.

Previous studies raised the question whether syntactic priming effects have a symmetrical influence or not, that is whether a difference exists in the primeability of two alternate

structures. Based on the results of this study, no conclusions about the symmetry of syntactic priming effects can be drawn. The data from both experiments reported here could not be examined with variance-analytical methods, which prevented individual comparisons between conditions. A descriptive tendency in the voice alternation experiment points towards the less frequent structure, the passive. Without further validation this tendency cannot be interpreted, however. The descriptively apparent differences in the data from the dative alternation experiment do not yield a clear picture in favour of any of the two structures.

Scheepers (2003) primed the attachment of relative clauses in German and found weaker priming effects for the generally preferred structure compared to a baseline condition. The author cannot form any assumptions about the symmetry of priming based on his data, he merely conjectures that the preferred structure is less informative than the non-preferred. Melinger and Dobel (2005) also included a baseline condition in their experiment on syntactic priming in Dutch. What they found was a priming effect of double object structures and no significant difference between prepositional object structures and the baseline. The authors assume the reason for the asymmetric effects they observed might lie in the paradigm used. In their experiment participants were presented with single verbs as primes, which were either compatible with DO or PO structures. However, the authors say, in some instances 'DO-only' verbs are compatible to structures which resemble prepositional object structures (Melinger & Dobel, 2005: B18). This way the DO-only prime verbs might have increased the production probability of PO structures.

Given the studies by Hadelich et al. (2003) and Loebell and Bock (2003), who could not show syntactic priming effects for the voice alternation in German, and facing the relatively weak effects of experiment 2 reported here, one might ask the question why syntactic priming effects for active and passive thus far posed so different to demonstrate in German, as compared to English.

When looking for structural differences between the two languages, the differences in argument encoding are obvious. The encoding of syntactic functions in English on the one hand almost exclusively relies on configuration, i. e. word order. German on the other hand makes use of obligatory overt case marking. Therefore, German syntactic structures contain additional information on the mapping between grammatical function and arguments. In a passive sentence, for instance, the mapping between PATIENT or THEME and the subject function is encoded in the word order (slots in the constituent structure) as well as by overt nominative case marking of the DP. WEAVER++ represents case marking as activation of a specific phonological form on the word form level.

Taking into account the assumption underlying the model that no feedback exists between grammatical and phonological encoding, the word form should not influence the generation of a sentence. Different models of lexical access and phonological encoding on the other hand do assume such a feedback influence (cf. Dell, 1986). The experiments carried out for this thesis project do not allow for an answer to the question whether the representation of case marking exerts an influence on the generation of target structures.

Differences in strength of syntactic priming effects between dative and voice alternation have also been reported in studies on English before. It is, however, unclear which of the two alternation types can be primed better, the data do not show a consistent picture (Bock & Griffin, 2000: 187). The results of the experiments carried out for this thesis tend to be in line with results by Bock (1986) and Bock and Loebell (1990). All three studies found more pronounced priming effects for the dative alternation than for the voice alternation. According to Bock and Griffin (2000) several presumptions exist about the reason for this difference, but very little data. The authors name a few structural differences between the dative and voice alternation that might be accountable for the asymmetry in priming effect strength. They mention for instance the number of arguments involved (three in the dative alternation, two in the voice alternation), restrictions on the application of the dative alternation, or the general frequency of occurrence of a structure in a language. So far, an influence could not be proven for any of these factors. The relative frequency of either of the two alternate structures of an alternation might, according to Bock and Griffin, play a role. The passive is used rather rarely, compared to the active, whereas the relative frequencies of double object and prepositional structures are closer to equality (Bock & Griffin, 2000: 188). Up to now, no correlation could be established between verb-specific biases for any alternation variant and the strength of a syntactic priming effect (ibid.).

In their general discussion, Hartsuiker et al. (2004) raise the question about the influence of the syntactic structure of baseline items. In their experiment passive primes had an effect on the production of passive target sentences; active primes elicited fewer passives, however, just as many as intransitive baseline primes. This result might on the one hand indicate that syntactic priming works asymmetrically. On the other hand, the authors say, the result might be based on the active morphology of the intransitive primes, which might prime active target sentences. This argument might be made for the experiments reported in this thesis as well. Although there were no baseline items in, for instance, experiment 2, the critical sentences for the experiments were embedded in a large collection of filler sentences which mostly stood in the active voice.

Models of grammatical encoding

In Construction Grammar (CxG) approaches, syntactic structures are specified by their *construction*. According to Goldberg (1995), basic configurational properties, for instance the SVO word order in English, are framed by general constructions like 'TRANSITIVE' which pass on their properties to more specific constructions via 'inheritance links'. In general, constructions contain construction-specific information about the mapping between thematic roles and grammatical functions. The generation of a syntactic structure is always dependent on properties of the message, there is no 'free choice' between syntactic structures. This follows from Dwight Bolinger's 'Principle of No Synonymy' (Goldberg, 1995: 67) which Goldberg adopts for her Construction Grammar approach.

Applied to the psycholinguistic modelling of grammatical encoding proposed by Pickering and Branigan (1998), the assumption that the surface structure is determined by message properties would argue for a set of nodes containing functional mapping information. Pickering and Branigan (1998) suggested that such information might be represented in separate nodes (see section 2.2.3), but such functional representation has to our knowledge not been implemented in the model so far. An alternative implementation might represent both functional mapping information and information about the linear and hierarchical order of constituents in extended combinatorial nodes; this would come even closer to CxG assumptions about syntactic representation made by Goldberg (1995)[1]. Such an extended combinatorial representation would amount to a one-to-one mapping between a message with certain properties and some syntactic surface structure. For each alternative structure a separate node would be required. From a construction grammar point of view the priming effects for the dative alternation and the alternation between active and passive would have to be located on the functional processing level only.

A challenge to representation-based models such as the extension of WEAVER++ by Pickering and Branigan (1998) might form studies that show priming effects of constituent structure that are independent of functional mapping. An experiment by Bock and Loebell (1990) is particularly worth mentioning. The authors showed that active sentences with a locative prepositional phrase like (24) can elicit passive sentences as well as passive primes (also see section 2.2.2).

[1] As mentioned before in chapter 2.1, proponents of CxG approaches make some far-ranging assumptions about the lexicon ('construct-i-con'). To implement these in an activation spreading model, like the one by Levelt et al., 1999, significant architectural changes would have to be considered. However, such considerations are beyond the scope of this thesis.

(23) The 747 was alerted by the tower.

(24) The 747 was landing by the tower.

Given the assumption that the separation between functional and positional processing is represented in the model by implementing different node types, the question arises how a structural representation pre-activated by the prime can influence functional processing. The results by Bock and Loebell (1990) entail the question about interaction between the positional and the functional level of processing. Within the range of this thesis, this issue cannot be pursued further.

Also still subject to intensive debate is the time course of syntactic priming. The issue is currently argued about in the literature (see for instance Branigan, Pickering, & Cleland, 1999; Bock & Griffin, 2000) because different models of priming apparently make different predictions about how long syntactic priming effects persist. In terms of the extension of the WEAVER++ model with combinatorial nodes, as proposed by Pickering and Branigan (1998), syntactic priming is an effect of increased selection probability of a combinatorial node with residual activation. The persistence of a priming effect is determined by the properties of the decay of activation in a node.

> (...) combinatorial nodes have a baseline level of activation, temporarily raise this level following use of a particular construction, and then decay rapidly back to their baseline level. (Branigan et al., 1999: 639)

Branigan et al. (1999) tested their hypothesis using a written sentence completion paradigm in which they varied the number of intervening sentence fragments between prime and target fragment. They found a drastic decrease in the amount of syntactic priming if one or more fragments were placed between prime and target. The authors view this as evidence for *fast* and *automatic* decay of residual activation.

This standpoint contrasts with results from a study by Bock and Griffin (2000). The authors carried out a picture description experiment and found priming effects that exerted an influence on target pictures after as much as ten intervening items. Based on these results the authors propose an explanation for syntactic priming as an effect of *implicit learning*. This involves a (subliminal) 'tuning' of syntactic structure building mechanisms. The realisation of a message in a particular syntactic structure therefore permanently increases the likelihood of a compatible message being realised in the same structure. As mentioned in the theoretical part of this thesis, connectionist or PDP models ('parallel distributed processing', Dell, Chang, & Griffin, 1999) of language production exist that allow to emulate syntactic priming as implicit learning (cf. Chang et al., 2000; Chang, 2002).

The hypothesis that syntactic priming has a long term effect is not per se incompatible to representation-based processing models like WEAVER++. Pickering et al. (2000) in principle consider it possible that repeated production of a particular structure can change the weight of the link between a lemma and a combinatorial node. Hartsuiker, Kolk, and Huiskamp (1999) and Hartsuiker and Westenberg (2000) also see evidence for long-term priming effects in their data on the priming of word order in Dutch. They presume that, in addition to the short-term effects based on residual activation, the resting level of representational nodes is increased over time (cf. Hartsuiker & Westenberg, 2000: B36). Therefore it is questionable whether assumptions about the time course of syntactic priming can be used to test the different models.

Another attempt to differentiate between representation-based accounts (WEAVER++ with the extension by Pickering & Branigan, 1998) and process-based models (implicit learning, Bock & Griffin, 2000) has been made with the experiments carried out by Melinger and Dobel (2005). They used single verbs instead of sentences as primes (see section 2.3). They interpreted the priming effects they found as evidence against implicit learning accounts, which depend on the processing of entire sentences as the origin of the priming effect. According to Melinger and Dobel, in the paradigm they chose, no entire sentences are processed. However, a representation-based account is able to explain the results, since in such a model the combinatorial information linked to the lemma are available and can already cause priming after processing a single verb.

The experiments reported in this thesis are neutral with regard to the psycholinguistic modelling of grammatical encoding.

Outlook

Subsequent experiments following up the work reported here should clearly aim at refining the method in order to obtain data that can be examined with variance-analytical methods. For this purpose it should be achieved that participants spontaneously change the structure of target sentences even in the 'identical' condition. Adjustments in the sentence recall paradigm can for instance be made to the distractor task, which helps to prevent sub-vocal rehearsal of prime sentences by the participants. The number recognition task used in the experiments reported here contained five digits the participants had to remember and therefore made rather high demands on the subjects' attention. The task could be made more difficult, in order to elicit a higher variability in the recalled sentence structures[2]. But increasing the difficulty bears the risk of increasing the

[2]According to Franklin Chang (personal communication) some degree of spontaneous alternation between the two forms of the dative alternation can be obtained this way

number of invalid answers or forgotten sentences. An alternative change to the distractor task could involve fewer demands on the subjects' attention, but at the same time it should require a spoken reaction. This might help to minimise any influence of a phonological representation created during reading of the sentence. It might also help to increase variance in the data, which might then be subjected to more powerful statistical analyses.

German offers some possibilities to examine experimentally the separation between functional and positional processing assumed by psycholinguistic models of language production. This might be achieved by systematically manipulating the word order, as proposed by Hadelich et al. (2003). Another option might be to replicate the experiment by Bock and Loebell (1990) described earlier. It is possible to contrast active primes containing a locative PP with passive primes in German as well:

(25) Die reiche Witwe wird von dem Chauffeur abgeholt.
The rich widow become-*3Sg* by the driver picked up.
The rich widow is being picked up by the driver.

(26) Die reiche Witwe wird von ihrem Posten zurücktreten.
The rich widow become-*3Sg* from her post resign.
The rich widow is going to resign from her post.

A replication might pose an opportunity to critically evaluate the results and interpretations of the (1990) study by Bock and Loebell.

In order to be able to draw conclusions about the symmetry of syntactic priming effects, subsequent studies should add a baseline condition. However, for a sentence recall experiment in particular a careful choice of items is essential, lest baseline items increase priming effects in one of the critical conditions. The same holds for filler items as well.

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A. Instructions

Pre-test questionnaire

Fragebogenstudie DAPPeS
Mai 2006

Liebe Teilnehmerin, lieber Teilnehmer,

vielen Dank für deine Mithilfe bei unserer Fragebogenstudie „DAPPeS“. Bitte lies dir die folgenden Hinweise gründlich durch, bevor Du mit dem Ausfüllen beginnst.

Zunächst bitten wir dich, den vorliegenden Fragebogen nur dann auszufüllen, wenn Du **Muttersprachler** des Deutschen bist. Andernfalls gib den Fragebogen bitte an die Person zurück, von der Du ihn bekommen hast.

Das musst Du tun...
Auf den folgenden 16 Seiten findest Du kleine Strichzeichnungen. Wir bitten Dich, in die jeweils dazugehörigen Zeilen rechts vom Bild eine kurze Beschreibung der dargestellten Handlung einzutragen.

- Bitte verwende dazu ganze Sätze;
- es ist nicht notwendig, dass Du bei jedem Bild lange überlegst, oder dir besonders originelle oder abwechslungsreiche Beschreibungen ausdenkst – schreib’ einfach auf, was dir als erstes in den Sinn kommt;
- bitte vermeide es, Eigennamen (Hildegard, Erwin, Jolanda, etc.) zu benutzen;
- es kommt nicht darauf an, für die Beschreibung die beiden Zeilen voll auszunutzen;
- bitte arbeite den Fragebogen zügig, der Reihe nach und vollständig durch und besprich dich während des Ausfüllens bitte nicht mit anderen Teilnehmern;
- kannst Du auf einem der Bilder etwas nicht erkennen, schreib’ dies bitte ebenfalls auf.

Wenn Du mit der Bearbeitung fertig bist, gib den Fragebogen bitte vollständig an die/den Seminarleiter/in zurück oder, falls Du ihn außerhalb einer Lehrveranstaltung ausgefüllt hast, wirf ihn bitte umgehend in das Postfach von **Dr. Sandra Pappert** im **Institut für Linguistik** (GWZ, 5. Etage, Haus 1) ein. Falls Du Fragen zu der Studie hast, kannst Du sie gerne per Email an eldonquijote23@hotmail.com richten.

Zum Schluss möchten wir Dich noch um folgende statistische Angaben bitten:

Alter:	Geschlecht: ☐ w ☐ m

Schon im voraus vielen Dank für deine Teilnahme!

Experiments 1 & 2

Instruktion „Ahorn“ (rsvp_ap_do)

Mirko Hanke & Sandra Pappert,
August 2006

Liebe Teilnehmerin, lieber Teilnehmer,

im Verlauf des Experiments wird Dir eine Reihe verschiedener Sätze präsentiert. Die Worte eines Satzes erscheinen dabei in sehr rascher Folge einzeln in der Mitte des Bildschirms.

Ein einzelner Durchlauf beginnt immer mit einer Reihe von Sternchen in der Mitte des Bildschirms. Gleich darauf folgt ein Satz, den Du bitte leise mitliest, wie er auf dem Bildschirm erscheint. Bitte wiederhole den Satz nicht laut.

Nach jedem Satz siehst Du kurz eine einzelne Reihe aus fünf verschiedenen Ziffern. Bitte merke dir diese fünf Ziffern, jedoch ohne sie laut zu wiederholen.

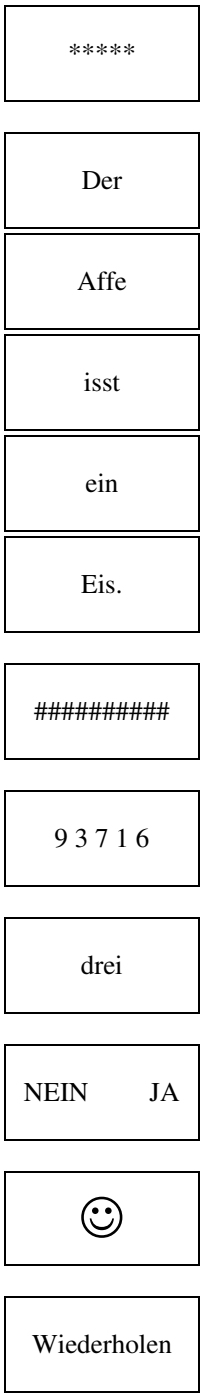
Im Anschluss an die Ziffernreihe wird ein einzelnes Zahlwort eingeblendet, z. B. „drei“. Bitte entscheide, ob die genannte Zahl in der zuvor gezeigten Ziffernfolge enthalten war oder nicht. Antworte entsprechend mit ‚NEIN’ (linke Taste) oder ‚JA’ (rechte Taste), sobald die Aufforderung dazu auf dem Bildschirm erscheint. Ein Smiley zeigt dir an, ob deine Antwort richtig oder falsch war.

Zuletzt erscheint die Aufforderung „Wiederholen“ auf dem Bildschirm. Bitte wiederhole nun den Satz, den Du zu Beginn des Durchlaufs gesehen hast. Danach beginnt ein neuer Durchlauf.

Ein Schema des Ablaufs findest Du nebenstehend. Zu Anfang wird die sehr schnelle Darbietung auf dem Bildschirm etwas ungewohnt für dich sein. Im Verlauf des Experiments gewöhnst Du dich aber daran und wirst weniger Fehler machen. Wenn Du noch Fragen zu dem beschriebenen Ablauf hast, kannst Du sie jetzt dem Versuchsleiter stellen.

Das Experiment beginnt mit einigen Übungsdurchgängen. Danach folgt eine Pause, in der Du nochmals Fragen stellen kannst.
Das eigentliche Experiment ist in vier Blöcke unterteilt, die jeweils durch eine Pause voneinander getrennt sind. Wenn Du nach einer Pause fortfahren möchtest, sag’ bitte dem Versuchsleiter Bescheid. Setz’ dich für das Experiment bequem hin, so dass Du möglichst gerade auf den Monitor schaust. Das gesamte Experiment wird etwa 50 Minuten dauern.

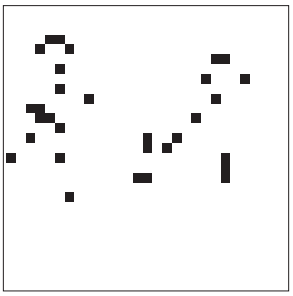
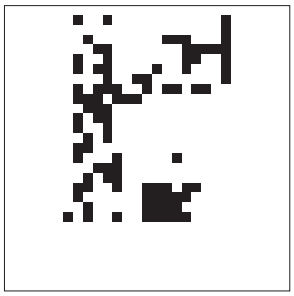
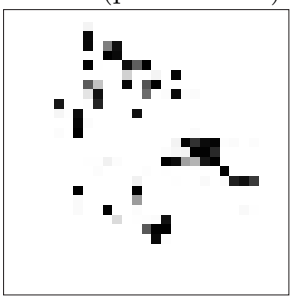
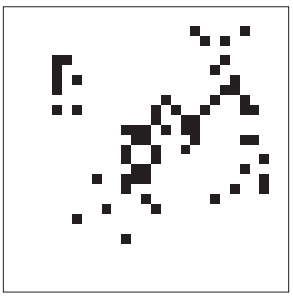
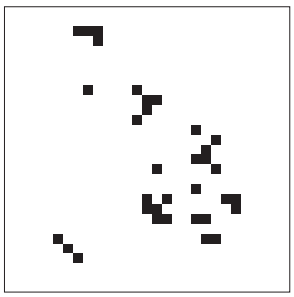
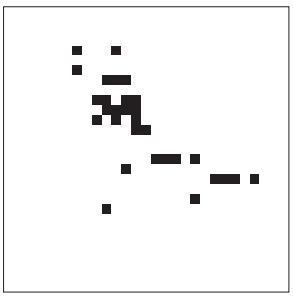
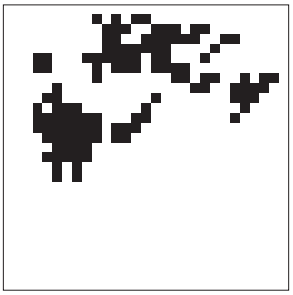
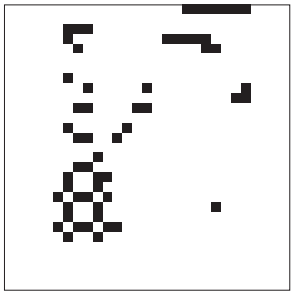
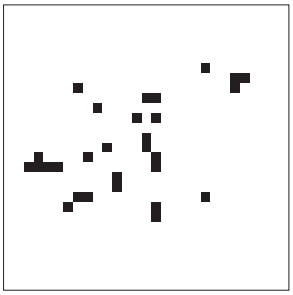
Bereits jetzt herzlichen Dank für deine Teilnahme!

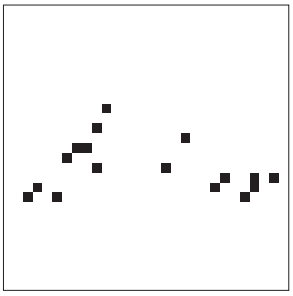
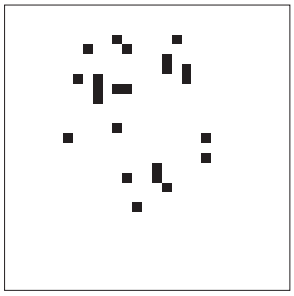
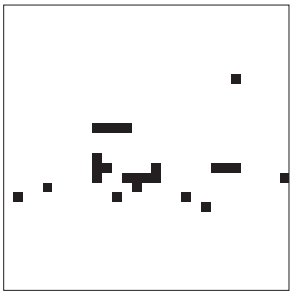
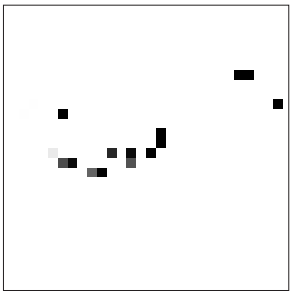
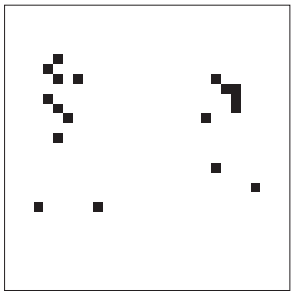
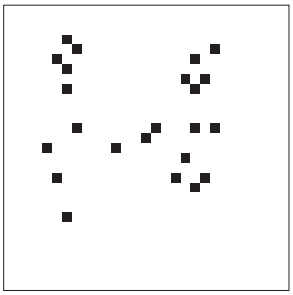
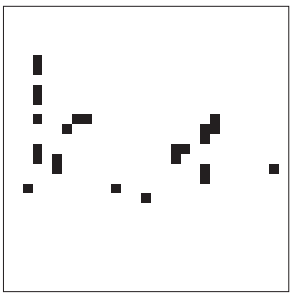
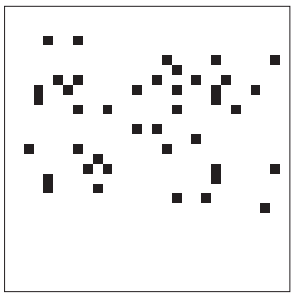
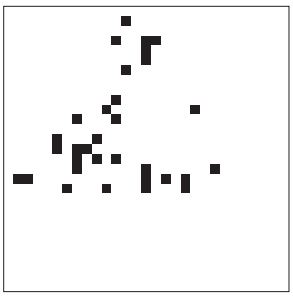
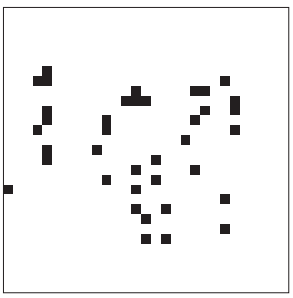
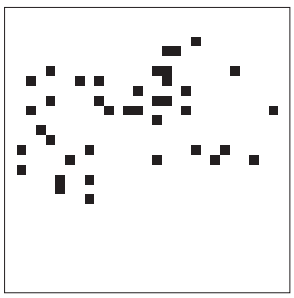
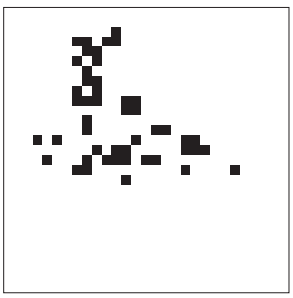


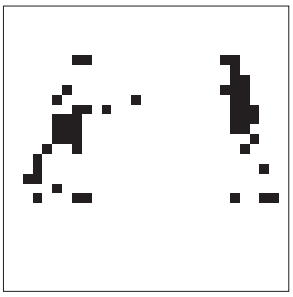
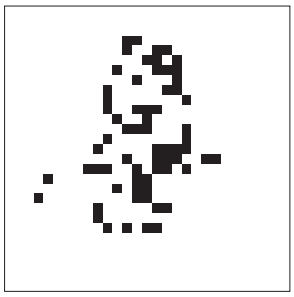
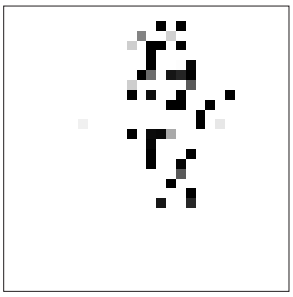
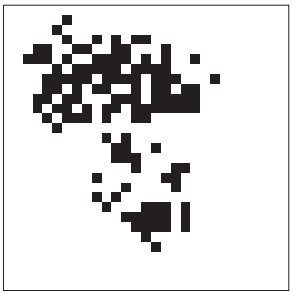
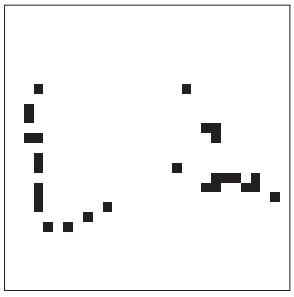
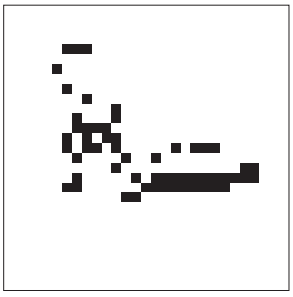
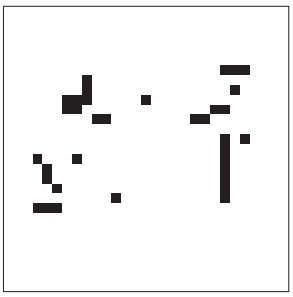
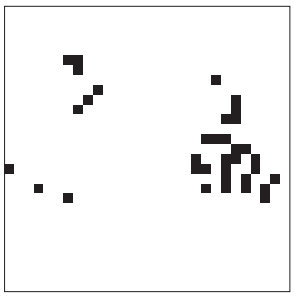
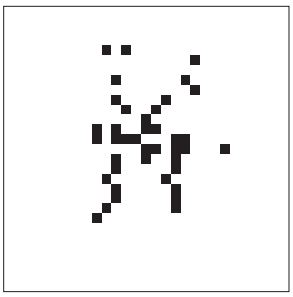
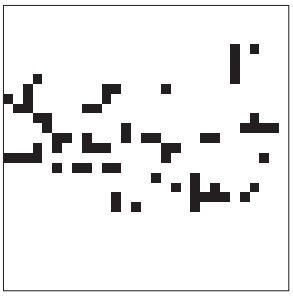
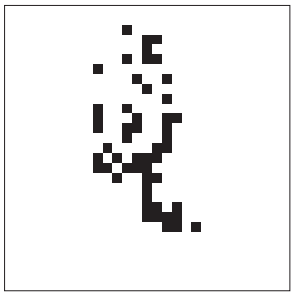
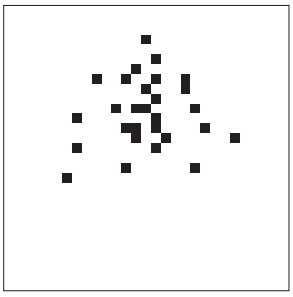
B. Material

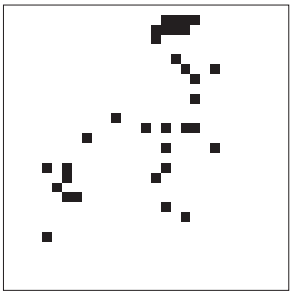
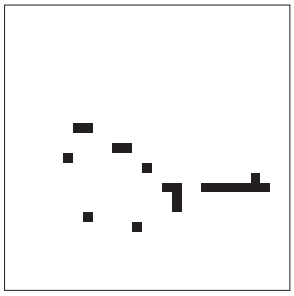
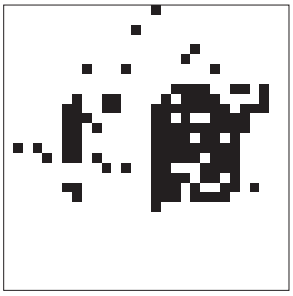
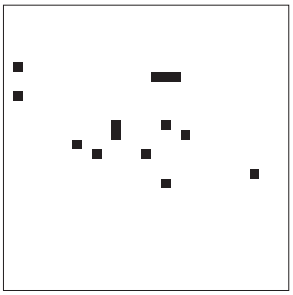
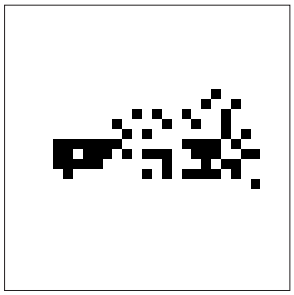
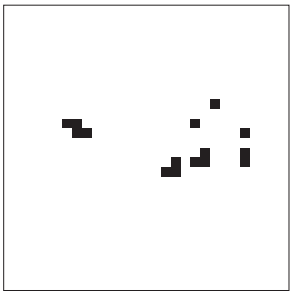
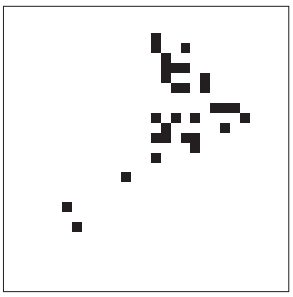
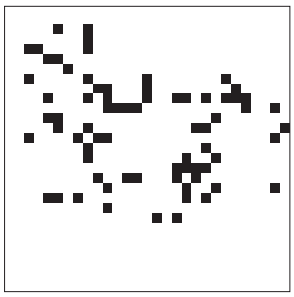
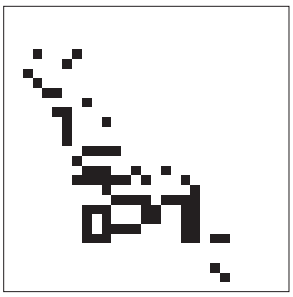
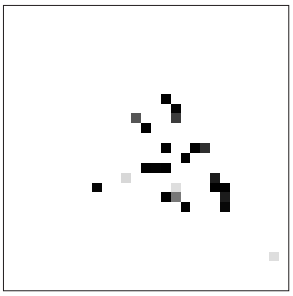
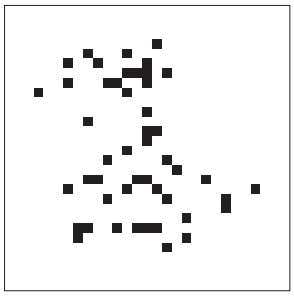
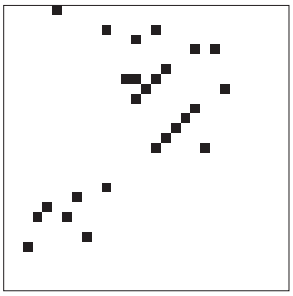
Images pre-test

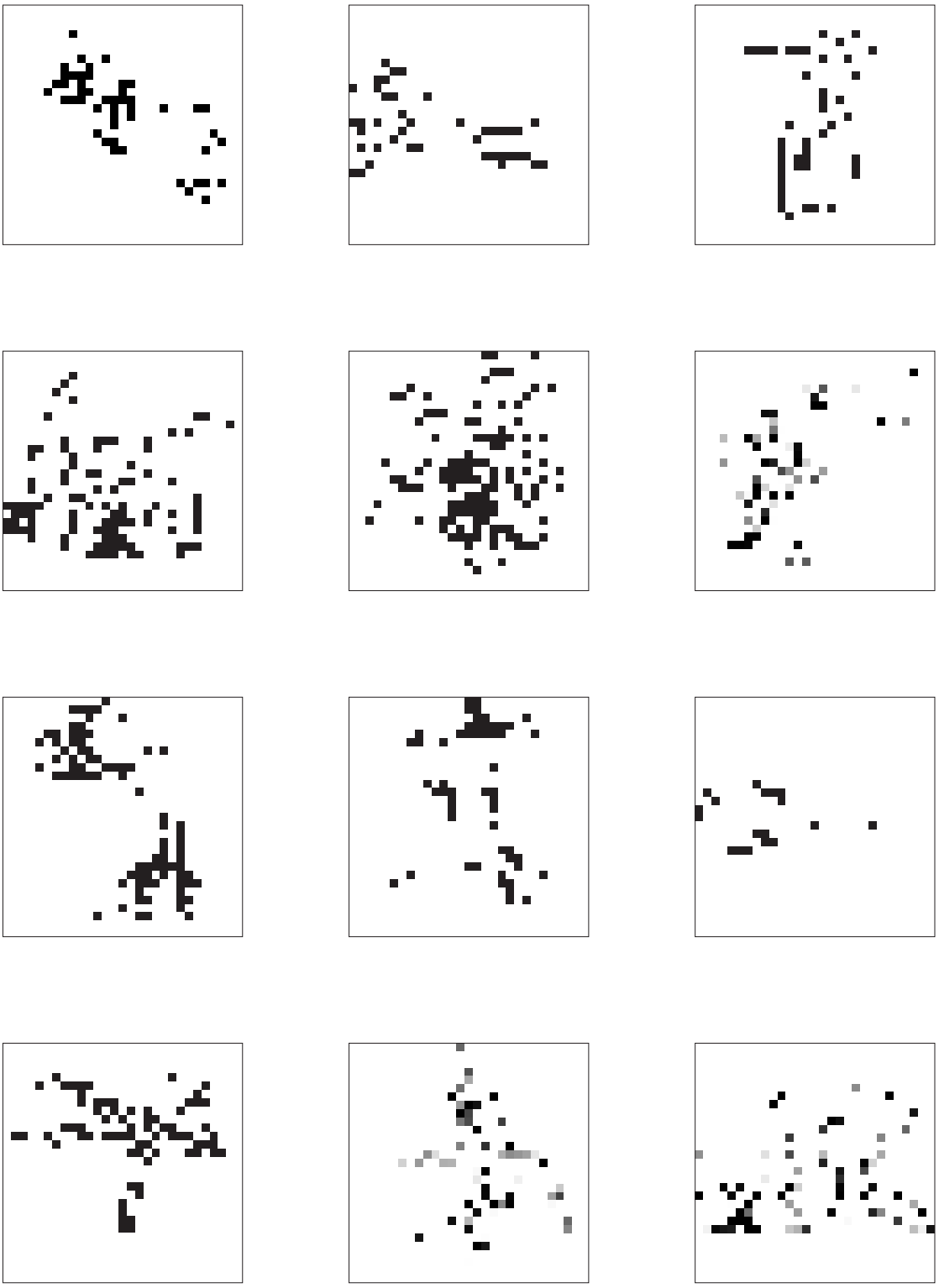
The pictures on the following pages were used for the pre-test described in ch. 3. The original material was provided by Kathryn Bock and Robert Hartsuiker (pers. comm.).

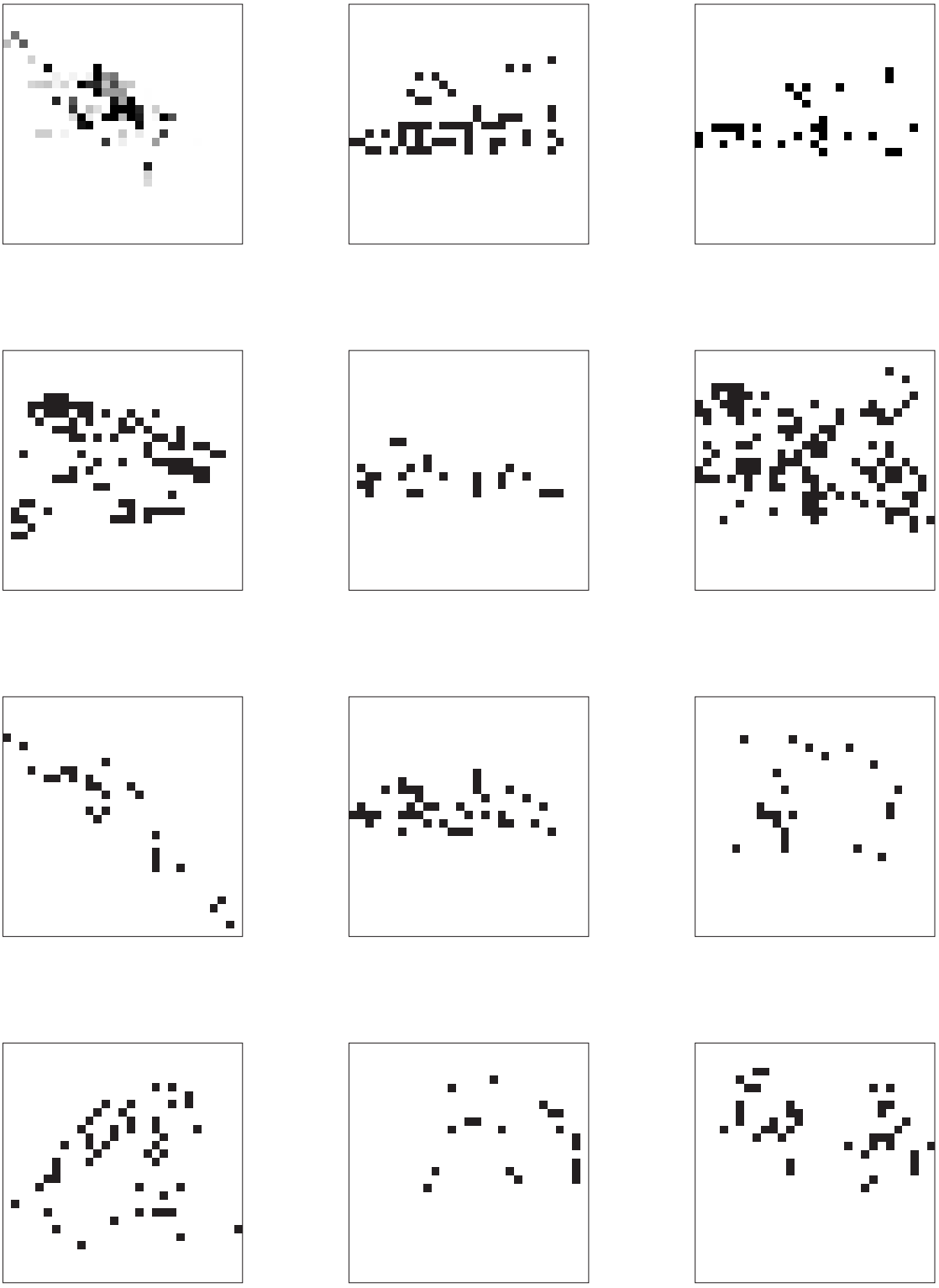














Experiment 1

Table B.1 contains critical items for the experiment on the dative alternation. Items 1–8 are benefactive datives, items 9–16 are transfer datives.

Table B.1.: Items for the experiment on the dative alternation

item	alternation	sentence
1	DO	Der Soldat hob seinem Freund eine Zigarette auf.
	PO	Der Soldat hob eine Zigarette für seinen Freund auf.
	DO	Der Einsiedler kochte dem Touristen einen Pudding.
	PO	Der Einsiedler kochte einen Pudding für den Touristen.
2	DO	Die Sekretärin backte ihrem Chef einen Kuchen.
	PO	Die Sekretärin backte einen Kuchen für ihren Chef.
	DO	Die Kinder malten der Mutter ein Bild.
	PO	Die Kinder malten ein Bild für die Mutter.
3	DO	Der Teenager bastelte seinem Bruder ein Modellschiff.
	PO	Der Teenager bastelte ein Modellschiff für seinen Bruder.
	DO	Die Kellnerin machte den Gästen ein Tablett mit Vorspeisen.
	PO	Die Kellnerin machte ein Tablett mit Vorspeisen für die Gäste.
4	DO	Die Gastgeberin bereitete ihren Gästen eine Überraschung.
	PO	Die Gastgeberin bereitete eine Überraschung für ihre Gäste.
	DO	Die Großmutter nähte ihrer Enkeltochter ein Kleid.
	PO	Die Großmutter nähte ein Kleid für ihre Enkeltochter.
5	DO	Der Händler besorgte seinem besten Freund eine Eintrittskarte.
	PO	Der Händler besorgte eine Eintrittskarte für seinen besten Freund.
	DO	Der Rektor verfasste dem Lehrer ein Empfehlungsschreiben.
	PO	Der Rektor verfasste eine Empfehlungsschreiben für den Lehrer.
6	DO	Der Architekt entwarf dem Firmenchef ein Haus.
	PO	Der Architekt entwarf ein Haus für den Firmenchef.
	DO	Der Koch bereitete dem Butler einige gebratene Eier zu.
	PO	Der Koch bereitete einige gebratene Eier für den Butler zu.
7	DO	Ein Cheerleader hielt ihrer Freundin einen Sitzplatz frei.
	PO	Ein Cheerleader hielt einen Sitzplatz für ihre Freundin frei.
	DO	Der Künstler zeichnete dem Polizeibeamten einen Entwurf.
	PO	Der Künstler zeichnete einen Entwurf für den Polizeibeamten.
8	DO	Der Ölscheich kaufte seiner Geliebten einen Rolls Royce.

item	alternation	sentence
	PO	Der Ölscheich kaufte einen Rolls Royce für seine Geliebte.
	DO	Der Schreiner zimmerte dem Kindergartenkind ein kleines Vogelhaus.
	PO	Der Schreiner zimmerte ein kleines Vogelhaus für das Kindergartenkind.
9	DO	Der Pförtner händigte dem Mitarbeiter die Schlüssel aus.
	PO	Der Pförtner händigte die Schlüssel an den Mitarbeiter aus.
	DO	Der Rechtsanwalt schickte seinem Klienten den Vertrag.
	PO	Der Rechtsanwalt schickte den Vertrag an seinen Klienten.
10	DO	Die Frau lieh ihrem Nachbarn eine Leiter aus.
	PO	Die Frau lieh eine Leiter an ihren Nachbarn aus.
	DO	Der Halter überwies der Versicherung die Prämie.
	PO	Der Halter überwies die Prämie an die Versicherung.
11	DO	Ophelia überreichte jeden Morgen ihrem Liebhaber eine schwarze Rose.
	PO	Ophelia überreichte jeden Morgen eine schwarze Rose an ihren Liebhaber.
	DO	Der Rockstar verkaufte seinem Manager einiges reines Kokain.
	PO	Der Rockstar verkaufte einiges reines Kokain an seinen Manager.
12	DO	Der Inhaber übergab dem Prokuristen die Leitung der Firma.
	PO	Der Inhaber übergab die Leitung der Firma an den Prokuristen.
	DO	Der exzentrische alte Mann vermachte Eva einige Hühner.
	PO	Der exzentrische alte Mann vermachte einige Hühner an Eva.
13	DO	Die Schwester reichte dem Chirurgen den Tupfer.
	PO	Die Schwester reichte den Tupfer an den Chirurgen.
	DO	Die Abteilung übermittelte der Behörde die Daten.
	PO	Die Abteilung übermittelte die Daten an die Behörde.
14	DO	Die Lotterie zahlte dem Gewinner den Jackpot aus.
	PO	Die Lotterie zahlte den Jackpot an den Gewinner aus.
	DO	Die Hausbesitzerin vermietete dem Ehepaar drei Zimmer.
	PO	Die Hausbesitzerin vermietete drei Zimmer an das Ehepaar.
15	DO	Das Land lieferte den USA den Gefangenen aus.
	PO	Das Land lieferte den Gefangenen an die USA aus.

item	alternation	sentence
	DO	Der verschollene Ehemann sandte seiner Frau einen erklärenden Brief.
	PO	Der verschollene Ehemann sandte einen erklärenden Brief an seine Frau.
16	DO	Die Bürger des Landes spendeten dem Roten Kreuz Millionen.
	PO	Die Bürger des Landes spendeten Millionen an das Rote Kreuz.
	DO	Der Kurier überbrachte dem König die Nachricht.
	PO	Der Kurier überbrachte die Nachricht an den König.

Experiment 2

Table B.2 contains critical items for the experiment on the voice alternation. Sentences 1–8 describe events involving inanimate CAUSE and animate PATIENT, items 9–16 contain sentences with inanimate CAUSE and inanimate PATIENT.

Table B.2.: Items for the experiment on the voice alternation

item	alternation	sentence
1	active	Den Mann hat der Krankenwagen angefahren.
	passive	Der Mann wurde von dem Krankenwagen angefahren.
	active	Den Liebhaber hat der Parfümduft betört.
	passive	Der Liebhaber wurde von dem Parfümduft betört.
2	active	Den Erfinder hat der Rückstoß beschleunigt.
	passive	Der Erfinder wurde von dem Rückstoß beschleunigt.
	active	Den Schwimmer hat die große Welle durchnässt.
	passive	Der Schwimmer wurde von der großen Welle durchnässt.
3	active	Den Soldaten hat der Panzer überrollt.
	passive	Der Soldat wurde von dem Panzer überrollt.
	active	Den Mann hat der Wecker geweckt.
	passive	Der Mann wurde von dem Wecker geweckt.
4	active	Den Jungen hat der Baseball getroffen.
	passive	Der Junge wurde von dem Baseball getroffen.
	active	Den Ladendieb hat die Videokamera überwacht.
	passive	Der Ladendieb wurde von der Videokamera überwacht.
5	active	Die fliegende Taube hat der Pfeil getötet.

item	alternation	sentence
	passive	Die fliegende Taube wurde von dem Pfeil getötet.
	active	Den Rentner hat der Sessel massiert.
	passive	Der Rentner wurde von dem Sessel massiert.
6	active	Die Frau hat der Zug überfahren.
	passive	Die Frau wurde von dem Zug überfahren.
	active	Den Bergsteiger hat das Seil gehalten.
	passive	Der Bergsteiger wurde von dem Seil gehalten.
7	active	Den Feuerwehrmann hat der Hydrant nassgespritzt.
	passive	Der Feuerwehrmann wurde von dem Hydranten nassgespritzt.
	active	Die Frau hat der Wirbelsturm fortgeschleudert.
	passive	Die Frau wurde von dem Wirbelsturm fortgeschleudert.
8	active	Den Krieger hat der Zaubertrank gestärkt.
	passive	Der Krieger wurde von dem Zaubertrank gestärkt.
	active	Den Wanderer hat der Stein erschlagen.
	passive	Der Wanderer wurde von dem Stein erschlagen.
9	active	Das Haus hat der Bagger abgerissen.
	passive	Das Haus wurde von dem Bagger abgerissen.
	active	Das Zelt hat der Regen gesäubert.
	passive	Das Zelt wurde von dem Regen gesäubert.
10	active	Den Mähdrescher hat der Traktor abgeschleppt.
	passive	Der Mähdrescher wurde von dem Traktor abgeschleppt.
	active	Die Kirche hat der Blitz beschädigt.
	passive	Die Kirche wurde von dem Blitz beschädigt.
11	active	Das Auto hat der Abschleppwagen mitgenommen.
	passive	Das Auto wurde von dem Abschleppwagen mitgenommen.
	active	Das Fenster hat der Stein zerschlagen.
	passive	Das Fenster wurde von dem Stein zerschlagen.
12	active	Den Apfel hat der Pfeil durchbohrt.
	passive	Der Apfel wurde von dem Pfeil durchbohrt.
	active	Den Büchsenstapel hat der Ball umgeworfen.
	passive	Der Büchsenstapel wurde von dem Ball umgeworfen.
13	active	Den Pfahl hat der Bulldozer gerammt.
	passive	Der Pfahl wurde von dem Bulldozer gerammt.
	active	Den Flaschenhals hat das Projektil zerschossen.

item	alternation	sentence
	passive	Der Flaschenhals wurde von dem Projektil zerschossen.
14	active	Die Münze hat der Magnet angezogen.
	passive	Die Münze wurde von dem Magneten angezogen.
	active	Den Reisebus hat der Zug erfasst.
	passive	Der Reisebus wurde von dem Zug erfasst.
15	active	Die Scheune hat der Wirbelsturm zerstört.
	passive	Die Scheune wurde von dem Wirbelsturm zerstört.
	active	Den Karren hat das Fahrrad gezogen.
	passive	Der Karren wurde von dem Fahrrad gezogen.
16	active	Das Segelflugzeug hat der Aufwind getragen.
	passive	Das Segelflugzeug wurde von dem Aufwind getragen.
	active	Den Frachter hat der Torpedo versenkt.
	passive	Der Frachter wurde von dem Torpedo versenkt.