Reference of time in speakers of Austrian German with agrammatic aphasia

Theresa M. Seiser, BA
s2599570

Masterscriptie Neurolinguïstiek
Rijksuniversiteit Groningen
Begeleider: Dr. Roel Jonkers
Januari 2015
Acknowledgements

I would like to express my appreciation and thanks to my supervisor Dr. Roel Jonkers for guiding me through the writing process and supporting me with valuable advice. I also want to thank all the speech and language therapists and especially clinical linguist Gusti Tautscher-Basnett at the Gailtal-Klinik for helping me in recruiting subjects who agreed to participate in this study. A special thank you goes to them and to the control participants as well.
Finally, I want to thank my parents who made it possible for me in the first place to attend this Master programme and who have always supported me.
Abstract

Various studies in the past have shown that subjects who are suffering from an agrammatic form of aphasia have difficulties with tense inflection. It has been observed that while noun-verb agreement is mostly spared from impairment, most difficulties occur within Tense, especially within past tense forms (e.g., Stavrakaki & Kouvava, 2003; Nanousi, Masterson, Druks & Atkinson, 2006; Varlokosta et al., 2006; Jonkers & de Bruin, 2009). Various hypotheses have been formulated to account for this observation, e.g. the Tree Pruning Hypothesis (Friedmann & Grodzinsky, 1997), the Tense Underspecification Hypothesis (Wenzlaff & Clahsen, 2004, 2005), the Tense or Agreement Underspecification Hypothesis (Burchert, Swoboda-Moll & De Bleser, 2005) or the Diacritical Encoding and Retrieval Hypothesis (Faroqi-Shah & Thompson, 2007).

All these hypotheses have one thing in common. They suppose that the underlying impairment can be found within Tense. Bastiaanse and colleagues (2011) suggested a different approach. They believe that the observed difficulties are not due to impairment within Tense but within Time reference and discourse linking. In agrammatic aphasia, reference to the past is specifically impaired as this requires discourse linking (the linking between the moment of speech and an event in the past). This hypothesis is called the Past Discourse Linking Hypothesis (Bastiaanse et al., 2011).

In the present study, the German version of the Test for Assessing Reference of Time (the TART, Bastiaanse, Jonkers & Thompson, 2008) was administered in eight speakers of Austrian German with agrammatic aphasia. The results show that in these subjects it is reference of time rather than Tense and especially reference to the past that is impaired in agrammatism. In production, past tense is particularly impaired because it requires discourse linking and therefore, more processing capacity is needed.

Second, this study showed that the German version of the TART which was translated in northern Germany is also suitable for speakers of Austrian German.
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1. Introduction

1.1. Terminology and linguistic background

There are different ways to accomplish a certain time frame. All languages know temporal adverbs like tomorrow, now or adverbial phrases like an hour ago or over a few weeks that define the time frame in which an event happens. In many languages, these adverbs and adverbial phrases require time reference agreement with the finite verb (Bastiaanse, 2013).

1.a. *Tomorrow he will buy a new car.
1.b. *Tomorrow he bought a new car.

In example 1.a. tomorrow and will buy refer to the same time frame, that is future. In example 1.b. tomorrow refers to the future while bought refers to the past. There is no agreement between the two time frames which results in an ungrammatical sentence.

However, lexical adverbs are not obligatory and are not always fully reliable either. In example 2. from German, the lexical adverb ‘gerade’ refers to two different time frames, namely past (2.a.) and present (2.b.).

2.a. Der Mann hat gerade ein Auto gekauft.
    The man has just bought a car.

2.b. Der Mann kauft gerade ein Auto.
    The man is buying a car.

Like it was shown in example 2., in many languages temporal adverbs or adverbial phrases do not give enough information to set a certain time frame. German, as many other languages, uses verb inflection to accomplish time reference. In general, verbs can be inflected for tense and/or aspect.

Tense contains information about the temporal relation between the time of the event and the evaluation time. This relation might be ‘simultaneity’ or ‘precedence’. The evaluation time is

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1 As German does not know verb inflection on aspect (Schwenk, 2012), temporal adverbs are used to define the boundaries of the event.
set by the context. This might be the moment of speaking (speech time) or the time of the matrix clause event (Bos, Dragoy, Stowe & Bastiaanse, 2013).

In some languages, one can tell from verb inflection whether an action is completed (perfective) or ongoing (imperfective). This is called Aspect. Aspect provides information about the boundaries of the event (its point of beginning and its point of ending) (Comrie, 1976).

Verbs can be inflected on the lexical verb or on an auxiliary. One can distinguish between simple verb forms and periphrastic verb forms. In simple verb forms Tense and/or Aspect is marked on the single lexical verb. In German, only present tense and past tense use simple verb forms. Periphrastic verb forms are verb complexes that consist of a finite auxiliary plus an infinite lexical verb. The tense in example 2.a. is Perfekt (present perfect). Perfekt is built by a periphrastic verb form consisting of a finite auxiliary which is either ‘haben’ (‘have’) or ‘sein’ (‘be’) and a past participle (in case of 2.a. the past participle of kaufen (to buy) - ‘gekauft’ (‘bought’)). In example 2.b. the tense is present tense which is inflected on the single lexical verb. An overview of tense forms in German will be given in section 1.3.

Other languages, like Chinese or Indonesian, do not use verb morphology to accomplish reference to time but aspectual adverbs. However, these adverbs are not compulsory and are only used when the temporal context is not clear (Bastiaanse et al., 2011).

One should consider that Tense and Time reference are not the same thing. Tense is a morphological feature of the finite verb (the verb is tense-inflected) whereas Time reference is a semantic feature of the whole verb complex set in a specific time frame. As Bos and colleagues (2013) point out, periphrastic verb forms show that Tense can be decoupled from Time reference since a finite verb in present tense can refer to different time frames depending on whether it is used in a simple verb form or a periphrastic verb form and for the latter case also on which type of periphrastic verb form it is used.

3.a. Er wird ein Auto kaufen.
    He will a car buy.
    *He will buy a car.*

3.b. Er hat ein Auto gekauft.
    He has a car bought.
    *He has bought a car.*

In both 3.a. and 3.b. the finite verb is inflected in present tense. However, none of the sentences actually refers to the present. 3.a. refers to an event that will happen in the future.
It refers to the non-past. 3.b. refers to an event in the past. Bos and colleagues (2013) call this a paradox of periphrastic verb forms.

Taken together, reference to time can be accomplished through temporal adverbs or adverbial phrases and through grammatical morphology (inflection on tense and/or aspect). Throughout languages the way in which a time frame is set can be completely different but what they share is that they can all refer to the past, the present and to the future.

1.2. Discourse linking and binding relations

So far, one can state that since tense refers to a certain time frame, it operates on a level that exceeds the pure syntactic scope. It also acts in agreement with the given context. This context might be given through elements within the sentence, like temporal adverbs, or extrasentential elements, like discourse.

Avrutin (2000, 2006) proposed that there are two levels of linguistic processing. In narrow syntactic processing relationships are established within the sentence. The second level would be linguistic context. Linguistic context needs processing that goes beyond sentence level, addressing information that is given through the context or the discourse.

In theoretical linguistics, narrow syntax has been described as “binding relations”. Such relations are for example Agreement between the finite verb and the subject or a reflexive and its antecedent (Bastiaanse et al., 2011; Dragoy, Stowe, Bos & Bastiaanse, 2012; Bastiaanse, 2013). In example 4.a. ‘the girl’ and ‘herself’ refer to the same person which is indicated by index i. Both ‘the girl’ and ‘herself’ are locally bound. In example 4.b. this is not the case. ‘Her’ refers to another person than the girl, a person that is not mentioned in the sentence. Therefore, ‘her’ is not locally bound.

4.a. The girl is watching herself in the mirror.
4.b. The girl is watching her in the mirror.

In 4.b. ‘her’ accomplishes an extrasententional link. A reference is being established to the discourse or, in terms of Avrutin (2000, 2006), to the linguistic context. Elements that require discourse linking are pronouns (like in example 4.b.) but also wh-questions (except who-questions). In example 5.a. one can presuppose that there are at least two cars from which
the man is going to buy one. An extrasentential link has to be made and thus, ‘which’ is discourse linked. This is not the case in 5.b. No presupposition can be made about the person who is going to buy the car and therefore, no discourse linking is needed.

5.a. Which car is the man going to buy?
5.b. Who is going to buy the car?

Back to Time reference, Avrutin (2006) argues that Tense in general is discourse linked. However, this assumption might be too broad. Zagona (2003) points out that only past tense is discourse linked while present tense assumes some kind of binding relation. Since in present tense the speech time (evaluation time) and the time of the event overlap, no extrasententional link has to be set to the discourse. In past tense, however, a reference is established between the moment of speaking and an earlier event. Therefore, when processing past tense, discourse linking is needed. As far as future tense is concerned, Zagona (2013) argues that it is neither discourse linked nor locally bound. It is not discourse linked since future tense is usually seen as a subclass of present tense and it is not locally bound since there has no event happened yet to which the speech time could refer to. Bastiaanse and colleagues (2011) think that both Avrutin’s (2000, 2006) and Zagona’s (2003, 2013) views are too narrow. As discussed above, Tense is just a feature of the finite verb while reference to a time frame is accomplished by the verb complex as a whole. Bastiaanse and colleagues (2011) propose that it is not only past tense that is discourse linked but reference to the past through verb inflection in general. This hypothesis will be presented in detail in section 1.6.

1.3. Tense and Time reference in German

The referential quality of tense has already been stressed by Reichenbach in 1947. He proposed a model in which Time reference can be expressed through three reference points. The point of speech denotes the moment of the utterance. It already marks three time frames: the time frame before this point, simultaneity and the time frame after this point. In other words, the point of speech defines the boundaries of past, present and future. However, since there are more than three tenses, the model is not sufficient yet. Therefore, Reichenbach (1947) adds the point of the event, which is the moment when the event happens, and the point of reference, which is a moment from which an event is referred to. In
Figure 1: The German Tense system

figure 1 the German Tense system is shown by Reichenbach’s (1947) model of point of speech (S), point of the event (E) and point of reference (R).

Präsen (present tense) and Präteritum (past tense) are simple verb forms. All other tenses are periphrastic verb forms. Präsen refers to the present, Präteritum, Perfekt (present perfect) and Plusquamperfekt (past perfect) refer to the past and Futur I (simple future) and Futur II (future perfect) refer to the future. See 6.a. to 6.f. for examples of the German tense forms.

6.a. Er kauft ein Auto. Präsen
He buys a car.

6.b. Er kaufte ein Auto. Präteritum
He bought a car.

6.c. Er hat ein Auto gekauft. Perfekt
He has a car bought.
He has bought a car.

6.d. Er hatte ein Auto gekauft. Plusquamperfekt
He had a car bought.
He had bought a car.

6.e. Er wird ein Auto kaufen. Futur I
He will a car buy.
He will buy a car.

6.f. Er wird ein Auto gekauft haben. Futur II
He will a car bought have. He will have bought a car.

2 From now on, when talking about Tense in German, the German terms will be used without the English translation. An index is given in appendix I.
Basically, the German tense forms have the same function as the corresponding forms in English. However, especially within tense forms that refer to the past, there are some differences that should be considered. First of all, neither Präteritum nor Perfekt give information on whether an action is completed. German is a language that does not mark aspect and since, the function of German tense forms is temporality only (Schwenk, 2012). Originally, Perfekt was used when there was a reference from the event in the past to the speaker’s present. Nowadays, this is not the case anymore (Thieroff, 2010). While in past contexts Perfekt is the predominant tense form in spoken language, Präteritum becomes more and more the tense of written language (Thieroff, 2010a, 2010b). This development is already highly established especially in the southern parts of the German language area, like Austria. According to Schwenk (2012) this leads to a semantic double function of Perfekt, since it carries both the temporal information \(E < S, R\) and \(E, R < S\) (see figure 2).

1.4. Features of Austrian German

German is a pluricentric language and has three national varieties, which are Austrian German, German spoken in Switzerland (‘Schweizerdeutsch’) and German spoken in Germany (in this section from now on just German). Since German is commonly understood as the variety that is most coinciding with the standard language ‘German’, in this section only the differences between Austrian German and German will be discussed.

Differences between Austrian German and German can be found on every linguistic level. For this study, only the most important semantic and syntactical differences will be listed. Most differences are seen within the lexicon. Besides many words that exist in Austria only but not in Germany or vice versa, it is important to know that some words are the same in both varieties but are set in diverging semantic fields. There may also be differences with gender, for example, \textit{Virus} (engl. \textit{virus}) is masculine in Austrian German (\textit{der Virus}) and both masculine or neuter in German (\textit{der/das Virus}). However, due to influences of the media and the economy, Austrian German is continuously taking over words and features of the
German vocabulary (Muhr, 1995a; Ebner, 2008). In addition, this development is facilitated by the fact that the varieties are located in neighbouring states (Ebner, 2008). As some words, especially verbs, are homonyms and can be set in different semantic contexts, this also leads to different syntactic structures. As Muhr (1995b) points out, this leads to experiencing these structures and words as “foreign”, “inappropriate” or “ungrammatical”. For example, in both varieties the verb *ausgehen* has the meaning of *going out or to act on the assumption* when it is combined with a prepositional phrase (*von etwas ausgehen*). In combination with a reflexive, though, Austrian German knows another meaning for this verb, which can be translated as *succeed, work out or achieve or get something just in time*. However, the combination reflexive + *ausgehen* would sound ungrammatical to somebody from Germany.

Within Tense, one should note that Austrian German never uses past tense in spoken language, except for the past tense form of the verb *sein (to be)*. Past tense is only used for narrations in written language. In spoken language, present perfect is used almost exclusively. Within periphrastic verb forms, certain verbs in Austrian German use a different auxiliary than in German. These verbs are *liegen (to lie)*, *stehen (to stand)*, *sitzen (to sit)*, *hängen (to hang)*, *knien (to kneel)*, *lehnen (to lean)*, *schweben (to float)*, and *stecken (to stick)*. They are used with the auxiliary *haben (have)* in Austrian German and with *sein (be)* in German.1

1.5. Previous studies in agrammatism

Agrammatism has been defined as a clinical symptom of Broca's aphasia that is characterized by omissions or substitutions of both free and bound grammatical morphemes, such as pronouns, determiners or affixes. This results in short utterances and non-fluent, often ungrammatical speech. However, not all functional elements are impaired to the same degree. For example, Goodglass and Hunt (1958) showed that the affix –s can be differently impaired depending on its grammatical function. As a genitive marker (*John's book*) it is less impaired than when it is used as a plural marker (*the book-s*). It is most impaired as Agreement marker in 3rd person singular verb forms (*John reads the book*).

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1 It might be important to know that these differences are essential for at least some speakers of Austrian German since they are closely connected to the Austrian identity. This can be shown by the fact that in 1994, when Austria joined the European Union, 23 terms of Austrian German were registered as terms of the Austrian language and culture that may continue to be used as the official terms in Austrian trade and production (De Cillia, 1995).
Previous studies have shown that Tense is particularly impaired in agrammatic aphasia. Friedmann and Grodzinsky (1997) performed a sentence completion task in a speaker of Hebrew with agrammatism and found that while Agreement was completely intact, Tense was particularly impaired. A similar pattern has been found in the study by Wenzlaff and Clahsen (2004, 2005) in speakers of German with agrammatism. In both production and comprehension, participants faced most difficulties with Tense, while for Agreement the difference to the control group did not reach significance. Faroqi-Shah and Thompson (2007) administered a sentence completion task in ten English speaking subjects with agrammatism. The subjects had to choose out of three verb forms the one that fit either the morphosyntactic context or the morphosemantic context. Participants scored better in selecting the verb form that agreed with the subject in person and number than in selecting the form that fit the temporal context which was set by a temporal adverb.

Faroqi-Shah and Dickey (2009) conducted an online-grammaticality judgement task in ten English agrammatic speakers where violations of tense morphology had to be detected. In line with the findings from Faroqi-Shah and Thompson (2007), participants’ performance on checking whether a verb form matched the temporal context that was given by a temporal adverb was less accurate than checking whether it matched the local syntactic context. In other words, they were more sensitive to morphosyntactic violations than to morphosemantic violations. Lee, Milman and Thompson (2008) found impaired Tense and preserved Agreement in two out of four of their subjects. The other two participants did not produce any correct Tense or Agreement markers. Clahsen and Ali (2009) found a disadvantage for Tense in nine agrammatic speakers of English in comprehension but not in production. Similar, in agrammatic speakers of Greek, Agreement was better preserved than Tense and/or Aspect as shown in the studies of Stavrakaki and Kouvava (2003), Nanousi, Masterson, Druks and Atkinson (2006), Varlokosta and colleagues (2006) and Fyndanis, Varlokosta and Tsapkini (2012).

Better performances of agrammatic speakers in Agreement than in Tense were also found for Dutch (Kok, van Doorn & Kolk, 2007; Jonkers & de Bruin, 2009). Jonkers and de Bruin (2009) tested both subjects with Broca’s aphasia and Wernicke’s aphasia for production and comprehension. Agreement was better than Tense in both groups. Tense errors were mainly substitution errors of present tense verbs in place of past tense verbs and vice versa.

As far as errors are concerned, across languages, substitution errors are the most prominent error pattern (Lee, 2003 for Korean; Burchert, Swoboda-Moll & De Bleser, 2005 for German; 4 This does not hold for Chinese, where aspectual adverbs are used instead of tense inflection. These adverbs are optional and omission would still result in a perfectly grammatical sentence. Grodzinsky (1990) assumes that substitutions occur only when omission would result in a non-word. Therefore, in agrammatic speakers of Chinese, substitutions almost never occur while omission of aspectual adverbs is a prominent pattern (Bastiaanse et al., 2011) as this does not affect the grammaticality of the utterance.

4
Lee, Milman & Thompson, 2008; Clahsen & Ali, 2009 for English; Yarbay Duman & Bastiaanse, 2009 for Turkish; Bastiaanse et al., 2011 for English and Turkish).

1.6. Theoretical accounts

Various theoretical accounts have been proposed to explain the selective impairment of Tense in agrammatic aphasia. They include both representational deficit accounts (Friedmann & Grodzinsky, 1997) as processing deficit accounts (Lee, 2003; Wenzlaff & Clahsen, 2004, 2005; Burchert, Swoboda-Moll & De Bleser, 2005; Nanousi et al., 2006; Varlokosta et al., 2006; Faroqi-Shah & Thompson, 2007; Kok, van Doorn, Kolk, 2007; Bastiaanse et al., 2011).

Based on the results of her study from 1994 in a Hebrew speaking woman with agrammatism, Friedmann proposed the Tree Pruning Hypothesis (TPH). Following the Split-Infl-Hypothesis by Pollock (1989), claiming that the I node of the syntactic tree is split into two nodes, T(ense) and Agr(eement), the TPH claims that in agrammatism the T node is detached from the syntactic tree. Since there is no more T node, it cannot project any higher and the syntactic tree is pruned from the T node up meaning that every node above T is impaired. However, Hagiwara (1994) noted that it does not have to be T that is impaired. She proposed the hypothesis that the higher the node is in the tree, the more likely it is to be impaired. Following Hagiwara’s (1994) comments, Friedmann and Grodzinsky (1997) proposed the revised TPH which claims that in agrammatism, C, T or Agr is underspecified and that an underspecified node cannot project any higher.

However, the TPH has been disproved by various studies. For example, in the study by Clahsen and Ali (2009) participants produced complementizers perfectly although Tense was significantly impaired. The TPH does not hold crosslinguistically either, as shown by Bastiaanse et al. (2011) for Chinese or by Nanousi and colleagues (2006) for Greek. In Chinese, reference to a certain time frame is not expressed through verb inflection but through aspectual adverbs. Nevertheless, reference to time is impaired in agrammatic speakers although Chinese does not feature Tense or Aspect as bound morphemes (Bastiaanse et al., 2011). In Greek, Tense and Aspect are located lower in the syntactic tree than Agreement. Still, Tense and Aspect are more vulnerable to impairment (Nanousi et al., 2006).

Lee (2003) proposed another account which claims that the syntactic tree is built in a top-down fashion where nodes that are located higher in the tree are more vulnerable to impairment. She assumes that (at least in Korean agrammatism) the degree of impairment of
a functional element depends on its linear position to the end of the clause. This would be in line with Bastiaanse (2008) and Bastiaanse and Thompson (2003) who found that in Dutch, finite verbs in base position are easier to produce than in verb-second position. English agrammatic speakers have been shown to find yes/no questions where the auxiliary has been moved to the beginning of the clause more difficult than sentences where the finite verb is in base position (Bastiaanse & Thompson, 2003). However, Lee’s proposal does not explain why Tense is particularly impaired and Agreement is mostly preserved in agrammatism.

In the spirit of Chomsky’s minimalist program and the checking theory (Chomsky, 1995, 2000), Wenzlaff and Clahsen (2004, 2005) propose the Tense Underspecification Hypothesis (TUH). According to the TUH, morphosyntactic features that are necessary for tense morphology in the syntactic representation are underspecified in both agrammatic production and comprehension. The syntactic category T/INFL, which hosts the verb finiteness features T, Mood and Agr, is underspecified for Tense. However, in contrast to the TPH, underspecification does not lead to the inability to project hierarchical syntactic structure. The TUH has been refuted in the past as well, for example by the study of Yarbay Duman and Bastiaanse (2009). They showed that not only finite verb forms but also the infinite past participle is impaired in agrammatism which means that the impairment is not restricted to T/INFL.

Other studies did not find a Tense<Agreement disadvantage in agrammatic speakers (Bastiaanse, 2008; Clahsen & Ali, 2009 for production). This was also the case in the study of Burchert, Swoboda-Moll and De Bleser (2005). In the effort to check the validity of the TPH in nine German speaking agrammatic participants, they found a double dissociation of Tense and Agreement. However, this was significant for only two out of nine participants. Based on their results, the authors formulated the T-Agr Underspecification Hypothesis (TAUH). The TAUH claims that either Tense or Agreement or both can be underspecified in agrammatism.

Both the TUH and the TAUH assume a central impairment whereas the TPH predicts deficits in production only. Studies have shown, though, that agrammatic speakers also have difficulties to comprehend Tense, even though the difficulties are smaller than within production (e.g. Martínez-Ferreiro & Bastiaanse, 2013).

The Interpretable Features’ Impairment Hypothesis (IFIH) by Nanousi and colleagues (2006) and Varlokosta and colleagues (2006), which is also based on Chomsky’s (1995, 2000) minimalist program, claims that categories such as Tense and Aspect have interpretable features. Agreement is not an independent functional category but an operation by which certain interpretable features of Tense are checked against certain interpretable features of
the subject. In agrammatism, this process might be impaired leading to a deficit of certain interpretable features.

Another morphosemantic account that has been put forward by Faroqi-Shah and Thompson (2007), is the Diacritical Encoding and Retrieval hypothesis (DER). The DER claims that speakers with agrammatism are not able to encode Tense into diacritical features such as [+past] or [-past] or to select and retrieve the right diacritical features to produce the verb form that fits the context. Temporal adverbs might support the speakers in this process since they offer additional information to the morphosemantic system.

Kok, van Doorn and Kolk (2007) found a reversed pattern in their study of nine Dutch agrammatic speakers. Overall the participants performed better on Agreement than on Tense but Tense errors increased with syntactic complexity. In one of their tasks participants had to put elements in the right order and inflect the verb correctly. This task was particularly difficult for the participants. Following Avrutin (2000), they propose a processing account. Combining and fitting elements into a sentence needs more computational load or working memory than just verb inflection. With increasing complexity, the working memory demand increases and, as a result, there might not be enough resources to supply this demand. This results in agrammatic speech.

What all these accounts have in common is that they refer to Tense rather than to Time reference. It is an often observed pattern, though, that not Tense in general, but past tense is particularly impaired in agrammatism (e.g. Bastiaanse, 2008; Jonkers & de Bruin, 2009; Yarbay Duman & Bastiaanse, 2009). Furthermore, most of the just presented hypotheses relate the deficit within verb inflection to the position of the moved verb in the syntactic tree. It was shown by Bastiaanse (2008), though, that reference to the past was also impaired in verbs in base position. Therefore, Bastiaanse and colleagues (2011) sought after another explanation.

As mentioned before, Avrutin (2000, 2006) proposed that Tense is discourse linked. Since discourse linking needs more processing resources than narrow syntax, it is particularly impaired in agrammatism. This is supported by the study of Nanousi and colleagues (2006) in which Tense and Aspect were impaired in sentential tasks that required discourse linking but not in single word tasks where no discourse linking was needed. As mentioned before, Zagona (2003) thinks that Avrutin’s (2000, 2006) account is too broad. According to her, only past tense is discourse linked while present tense is locally bound since the moment of speech and the moment of the event coincide and no extrasentential link has to be made. Future tense is thought to be a subclass of present tense and does not require discourse linking either (Zagona, 2013). Following these assumptions, Bastiaanse and colleagues (2011) proposed another account. They think that both Avrutin’s (2000, 2006) and Zagona’s (2003, 2013) views are too narrow since their accounts address Tense only.
Bastiaanse and colleagues (2011) assume that it is not Tense but Time reference and especially reference to the past that is impaired in agrammatism. They propose the *Past Discourse Linking Hypothesis* (PADILIH). The PADILIH claims that reference to the past through grammatical morphology is selectively impaired in agrammatic speakers since it requires discourse linking.

The PADILIH is supported by several studies. For example, Bastiaanse (2008) administered a sentence completion task that tested both finite (verbs in past tense and present tense) and non-finite forms (infinitive and past participle) in ten agrammatic speakers of Dutch. Past participles are inflected but they are not inflected for Tense. Nevertheless, they were as difficult to produce as finite verbs in past tense. Past participles and past tensed verbs together were more difficult than infinitives and present tensed verbs together. In other words, those conditions that referred to the past were more difficult than those conditions that referred to the present. Furthermore, there was a strong correlation between the past tense and the past participle condition. This indicates that it is neither finiteness nor Tense that is impaired in agrammatic aphasia, but reference to the past through verb morphology. This is supported by the study of Yarbay Duman and Bastiaanse (2009) in seven Turkish agrammatic speakers. The subjects in this study produced four times more reference errors in the past tense/perfect aspect condition than in the future tense/imperfect aspect condition.

Also in non-brain-damaged individuals, reference to the past is more difficult than reference to the present, as was shown by the studies of Faroqi-Shah and Dickey (2009), Dragoy, Bos, Stowe and Bastiaanse (2012) and Bos, Dragoy, Stowe and Bastiaanse (2013). Dragoy and colleagues (2012) performed an ERP-experiment in 32 healthy native speakers of Dutch. The participants had to read sentences that contained time violations. Results showed that the violation by a present tensed verb in a past time frame yielded a P600 time-locked to the verb⁵. No such effect was found when a past tensed verb was used in a present time frame. The same P600 effect was found in the studies by Baggio (2008) and Bos, Dragoy, Stowe and Bastiaanse (2013). In the study of Dragoy and colleagues (2012), both conditions showed a sentence-final negativity which has been interpreted as a sign of memory load or processing difficulty. This indicates that violations by past tensed verbs in present time frames are more difficult to detect than violations by present tensed verbs in past time frames. This is further supported by faster reaction times for present tense violations.

Another reason to assume an impairment within Time reference rather than within Tense, is that impairment is not restricted to simple verb forms but occurs in periphrastic verb forms that refer to the past as well. For example, in present perfect, the verb complex as a whole refers to the past but the finite verb (the auxiliary) is in present tense. Nevertheless, present

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⁵ The P600 is an event-related brain potential (ERP) that is evoked by processing grammatical anomalies or syntactical errors (Gouvea, Phillips, Kazanina & Poeppel, 2010).
perfect is impaired in agrammatism (Lee, Milman & Thompson, 2008 for English; Bastiaanse, 2008; Bos et al., 2013 for Dutch).

Some studies did not find a difference between past and present tense in their subjects’ performances (Burchert, Swoboda-Moll & De Bleser, 2005; Clahsen & Ali, 2009; Fyndanis, Varlokosta & Tsapkini, 2012).

Taken together, in previous studies it has been found that not all functional elements are impaired to the same degree in agrammatism. Many studies have shown that within verb inflection, Tense inflection is most impaired while Agreement is mostly spared from impairment. Within Tense inflection, there seems to be a selective deficit in tense forms that refer to the past. Various accounts have been proposed to explain this observation. They locate the underlying impairment within syntactic representations (Friedmann & Grodzinsky, 1997) or suggest a processing deficit (Lee, 2003; Wenzlaff & Clahsen, 2004, 2005; Burchert, Swoboda-Moll & De Bleser, 2005; Nanousi et al., 2006; Varlokosta et al., 2006; Faroqi-Shah & Thompson, 2007; Kok, van Doorn, Kolk, 2007; Bastiaanse et al., 2011). All but one (Bastiaanse et al., 2011) propose an impairment in Tense, while Bastiaanse and colleagues (2011) assume that it is not Tense but discourse linking and Time reference that are impaired in agrammatic aphasia.

2. The present study

In the present study eight speakers of Austrian German with agrammatic aphasia and seven control participants were tested with the German version of the Test for Assessing Reference of Time (the TART, Bastiaanse, Jonkers & Thompson, 2008). The aim of the study is twofold. The first aim is to investigate Time reference in agrammatic Austrian German and compare it to the results of previous studies on agrammatism as well as to the existing theories on agrammatism that have just been mentioned. If it is Time reference and especially reference to the past that is impaired in agrammatism as is stated by the PADILIH, then present perfect and past tense should be equally impaired, even though present perfect tense is more common in Austrian German. The second aim is to check whether the German TART, which was developed in northern Germany, is also suitable for speakers of Austrian German. As mentioned before, there are some differences between Austrian German and German
spoken in Germany. The question is whether the test contains typical German items that might influence the performance of participants who are speakers of Austrian German.

2.1. Method

Participants

Eight agrammatic speakers (two female) and seven healthy control participants (three male) participated in the study. All participants were native speakers of Austrian German.

Aphasia group

Individuals with agrammatic aphasia were recruited in the Gailtal-Klinik, a neurologic rehabilitation institute in southern Austria. In the aphasia group, all participants had a left hemispheric lesion and all but one (P05) were aphasic due to a single stroke. P05 suffered from agrammatic aphasia due to two cerebral bleedings, one in 2002 and one in 2012. Since her performance followed the pattern of the other patients, she was included in the study. The participants ranged between 37 to 85 years of age with a mean age of 61 years and they all received at least nine years of education. They ranged in time post-onset between two and 15 years. All subjects but one were diagnosed with Broca’s aphasia by the German version of the Aachen Aphasia Test (Huber, Poeck, Weniger & Willmes, 1983) and by their speech and language therapists. Participant P04 had a non-classifiable form of aphasia but was included in the study since his speech showed typical agrammatic features. A standardized interview and a description of the Flood Rescue picture (following Olness, 2006) were elicited to ensure aphasia type and the presence of features of typical non-fluent agrammatic speech. The participants were all right-handed (one was both left- and right-handed) and had normal or corrected to normal hearing and vision. None of them suffered from dementia or other cognitive impairment. No patient suffered from apraxia of speech at a level that might have influenced the results.

Personal data of the participants with aphasia are given in table 1.

Control group

In the control group, participants ranged from 59 to 79 years of age with a mean age of 71 years. All control participants received at least nine years of education. They were all right-handed (one was both left- and right-handed) and had normal or corrected to normal hearing
and vision. During testing, none of the participants was under a form of medication that might have influenced their performance.

Personal data of the control participants is given in table 2.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Gender</th>
<th>Age</th>
<th>Years of education</th>
<th>Aetiology</th>
<th>speech pathology</th>
<th>TPO</th>
<th>hearing</th>
<th>visus</th>
<th>handedness</th>
</tr>
</thead>
<tbody>
<tr>
<td>P01</td>
<td>Male</td>
<td>37</td>
<td>9 years</td>
<td>ICH left</td>
<td>Broca's aphasia</td>
<td>2 years</td>
<td>normal</td>
<td>normal</td>
<td>right</td>
</tr>
<tr>
<td>P02</td>
<td>Male</td>
<td>74</td>
<td>9 years</td>
<td>CVA left</td>
<td>Broca's aphasia</td>
<td>7 years</td>
<td>normal</td>
<td>corrected to normal</td>
<td>right</td>
</tr>
<tr>
<td>P03</td>
<td>Male</td>
<td>50</td>
<td>9 years</td>
<td>CVA left</td>
<td>Broca's aphasia</td>
<td>15 years</td>
<td>normal</td>
<td>corrected to normal</td>
<td>right</td>
</tr>
<tr>
<td>P04</td>
<td>Male</td>
<td>73</td>
<td>9 years</td>
<td>ICH left</td>
<td>non-classifiable</td>
<td>8 years</td>
<td>normal</td>
<td>corrected to normal</td>
<td>right</td>
</tr>
<tr>
<td>P05</td>
<td>Female</td>
<td>54</td>
<td>9 years</td>
<td>ICH left</td>
<td>Broca's aphasia</td>
<td>12 years</td>
<td>normal</td>
<td>normal</td>
<td>right</td>
</tr>
<tr>
<td>P06</td>
<td>Male</td>
<td>47</td>
<td>12 years</td>
<td>ICH left</td>
<td>Broca's aphasia</td>
<td>2 years</td>
<td>normal</td>
<td>normal</td>
<td>right</td>
</tr>
<tr>
<td>P07</td>
<td>Male</td>
<td>85</td>
<td>18 years</td>
<td>CVA left</td>
<td>Broca's aphasia</td>
<td>4 years</td>
<td>corrected to normal</td>
<td>corrected to normal</td>
<td>both</td>
</tr>
<tr>
<td>P08</td>
<td>Female</td>
<td>67</td>
<td>9 years</td>
<td>CVA left</td>
<td>Broca's aphasia</td>
<td>7 years</td>
<td>normal</td>
<td>corrected to normal</td>
<td>right</td>
</tr>
</tbody>
</table>

Table 1: Personal data - aphasia group

TPO = time post onset; ICH = intracerebral haemorrhage; CVA = cerebral vascular accident

<table>
<thead>
<tr>
<th>Participant</th>
<th>Gender</th>
<th>Age</th>
<th>Education</th>
<th>Visus</th>
<th>Hearing</th>
<th>Handedness</th>
</tr>
</thead>
<tbody>
<tr>
<td>C01</td>
<td>Male</td>
<td>79</td>
<td>11 years</td>
<td>corrected to normal</td>
<td>corrected to normal</td>
<td>right</td>
</tr>
<tr>
<td>C02</td>
<td>Female</td>
<td>73</td>
<td>11 years</td>
<td>corrected to normal</td>
<td>normal</td>
<td>both</td>
</tr>
<tr>
<td>C03</td>
<td>Female</td>
<td>79</td>
<td>9 years</td>
<td>corrected to normal</td>
<td>normal</td>
<td>right</td>
</tr>
<tr>
<td>C04</td>
<td>Male</td>
<td>63</td>
<td>18 years</td>
<td>corrected to normal</td>
<td>normal</td>
<td>right</td>
</tr>
<tr>
<td>C05</td>
<td>Female</td>
<td>59</td>
<td>17 years</td>
<td>corrected to normal</td>
<td>normal</td>
<td>right</td>
</tr>
<tr>
<td>C06</td>
<td>Male</td>
<td>69</td>
<td>9 years</td>
<td>corrected to normal</td>
<td>normal</td>
<td>right</td>
</tr>
<tr>
<td>C07</td>
<td>Female</td>
<td>73</td>
<td>11 years</td>
<td>corrected to normal</td>
<td>corrected to normal</td>
<td>right</td>
</tr>
</tbody>
</table>

Table 2: Personal data – control group
2.2. Materials

This study can be divided into two parts. For the first part, the German version of the TART (Bastiaanse, Jonkers & Thompson, 2008) was used. The TART can basically be translated to every language and has recently been translated to German in northern Germany (Pille, 2012). To investigate whether the TART contains doubtful items for agrammatic speakers of Austrian German, a questionnaire was developed. This questionnaire was handed to the control group only.

**TART Production**

The production task of the TART consists of eleven pairs of transitive action verbs that can be contrasted, e.g. *schieben – ziehen (push – pull)*. Each pair of verbs can select a common object, e.g. *to sharpen/ to break a pencil*. In combination with temporal adverbs, the verbs are set within three time frames (past, present, future). In the neutral condition (lexical verb + auxiliary) no temporal adverb is used. Each action is depicted on a coloured photograph of a

![schälen essen](image)

**Figure 3:** An example of the TART production task

**Experimenter:** “Das ist der Mann, der jetzt einen Apfel schält [left picture]. Das ist der Mann, der jetzt…”

**Participant:** “… einen Apfel isst [right picture].”
man or a woman. For each action there are three pictures, one for each time frame. In the production task, the verbs are inflected for Präsens, Präteritum, Perfekt and Futur. In the neutral condition (Neutral) the auxiliary is inflected for present tense. In total there are 60 items in the production task. All TART items can be found in Appendix II.

Procedure
The participant saw two pictures side by side with the infinite forms of the verbs written above. Both pictures were set within the same time frame (see figure 3). A sentence production priming paradigm was used. The experimenter offered the first sentence and the first half of the second sentence to the participant. The participant then had to complete the second sentence in the same tense as it was used in the first sentence. Each sentence contained a main clause (This is the man/ the woman…) and a subclause consisting of a reflexive pronoun (…who), the object and the verb. For example, for figure 3 the experimenter would say: “This is the man who peels an apple. And this the man who…”. The participant would have to add “eats an apple”. There were five practice items, one for each condition, at the beginning of the task. During practicing, feedback was provided. No feedback was given during testing. Since this task costs a lot of effort, participants were free to take breaks if they wanted to. The sentence was repeated if the participant asked for it. In such cases the full item was repeated.

TART Comprehension
For comprehension the same verbs were used as in the production task. No temporal adverbs were used so the time frame was established by grammatical morphology only. Only present tense, present perfect and simple future were included. All sentences consisted of simple main clauses.

Procedure
The participant was shown a picture pair depicting the same action in two different time frames. The present was never contrasted with the future since those two time frames would be too difficult to be distinguished just by a photograph. This time no infinite forms were given above the pictures, as is shown in figure 4. The tester read the target sentence to the participant who then had to point to the picture that matched the sentence. For example, in figure 4, the experimenter would say: “The woman has sharpened a pencil”. The participant
would then have to point to the right picture. Before the actual task started, the participant could practice on six practice items. The item was repeated if the participant asked for it.

![Figure 4: An example for the TART comprehension task](image)

Experimenter: “Die Frau hat einen Bleistift angespitzt [right picture].”

**Questionnaire**

To identify potential elements that might be experienced as ‘foreign’ or ‘typical German’ by speakers of Austrian German, a questionnaire was developed. This questionnaire was given to the control participants only. All 22 verbs, including the practice items, were used. The verbs were presented to the control participants in the form of the present tense condition of the production task. The participants were asked to read the sentences and to tell whether they would use them in their common speech. If the answer was no, they were asked to reformulate the sentence in their own way. Attention was given to lexical and morphological differences. Subsequently, the results of the aphasia group were reanalysed for possible effects of elements that were identified as foreign sounding.

**Scoring**

Repetition of items had no influence on whether they were scored as correct or not. In cases of self-correction only the participant’s final answer was recorded. Both quantitative and qualitative analyses were performed on the data. In the TART production task, whether the answer was correct or not was scored. For the qualitative
analysis, eight error types were distinguished: Substitution of the target verb form with Präsens (SubstPräis), Präteritum (SubstPrät), Perfekt (SubstPerf), Futur (SubstFut) or an infinitive (SubstInf), omission and other error. Errors were classified as omission if the participant continued the sentence with the object but left out the verb. For example, if in figure 4 the participant answered “…einen Apfel” instead of “… einen Apfel isst”, this was counted as omission. If the participant gave no answer at all, this was counted as other error.

In the neutral form, other errors were replacement of the auxiliary by another auxiliary or omitting the auxiliary and inflecting the lexical verb. Other errors were also synonyms of the target form even if they were inflected for the correct tense, agreement errors or building a neutral form by adding an auxiliary in a condition that was not the neutral condition (e.g. “…einen Apfel essen muss” instead of “…einen Apfel isst”).

In the TART comprehension task, whether the participant pointed to the correct picture or not was scored.

Since groups were small, non-parametric testing was performed. Friedman tests were applied to determine whether there were differences within groups. A Mann-Whitney-U test was performed to determine differences between the aphasia and the control group in terms of accuracy.

Within the aphasia group, posthoc analyses were performed to compare single tense forms with each other. Wilcoxon signed-rank tests were used to test whether differences between time frames reached statistical significance. Subsequently, tense forms that refer to the past were taken together as the past condition, tense forms that refer to the non-past were taken together as the non-past condition. Finally, those conditions were compared.

The underlying thought of this procedure was to test whether it is Time reference or features of a single tense form, such as syntactic complexity, that causes difficulties in agrammatic speakers.

### 3. Results

Individual scores of the aphasia group and the control group are given in appendix III. The non-brain-damaged participants did not score perfectly. As assessed by boxplot, there was one outlier in this group. This was participant C02. Although C02 had no history of brain damage or disease and was not under any medication, she had an accuracy of only 55% on
the production task. This led to a group score of 89.7% in production. Without C02, the group’s accuracy is 95.5%. For comprehension, C02 had an accuracy of 90% which was the lowest within the control group. In contrast to the production task, this did not have a big impact on the group score, which is 96.2% with C02 and 97.2% without C02.

<table>
<thead>
<tr>
<th></th>
<th>Production</th>
<th>Comprehension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy</td>
<td>55%</td>
<td>90%</td>
</tr>
<tr>
<td>Präsens</td>
<td>4.44%</td>
<td>0%</td>
</tr>
<tr>
<td>Präteritum</td>
<td>35.56%</td>
<td></td>
</tr>
<tr>
<td>Perfekt</td>
<td>26.66%</td>
<td>0%</td>
</tr>
<tr>
<td>Futur</td>
<td>6.67%</td>
<td>100%</td>
</tr>
<tr>
<td>Neutral</td>
<td>26.66%</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Scores of participant C02

Looking at C02’s scores (see table 3) one can see that she performed worst in both past tense forms and in the neutral form while she made only a few errors in Präsens and Futur. In comprehension she performed better but made some errors in identifying pictures that depicted the Futur condition. C02’s performance will be discussed in section 4. For now, her data will not be included in further analysis.

For a better overview, the exact test statistics will be given additionally in appendix V. First, the TART production data will be discussed both quantitatively and qualitatively, followed by the results of the TART comprehension task. A qualitative analysis of the questionnaire will be presented at the end of this section.

**TART Results**

**Group results**
The aphasia group scored significantly worse than the control group on both production⁶ (aphasia group: mean 44.14 (sd 20.748), control group: mean 95.95 (sd 4.97); U=0.00, p=0.001) and comprehension⁷ (aphasia group: mean 48.75 (sd 10.607), control group: mean 58.33 (sd 1.211); U=7.5, p=0.029).

Since the control group scored at ceiling on both production and comprehension, only the data of the aphasia group will be further analysed.

⁶ maximum score on the TART production task = 100
⁷ maximum score on the TART comprehension task = 60
**TART production**

The production task included seven out of eight agrammatic speakers. In participant P07 the task was stopped after he had intimated that it was too exhausting for him. He went on with the comprehension task which he could perform in full.

**Quantitative analysis**

Differences between tense forms reached significance ($X^2 = 13,474; p = 0.009$). The data show that the participants performed relatively well in the future and the neutral condition whereas past tense forms were particularly impaired. Looking at the single tense forms, participants reached the lowest accuracy scores within the two past tense forms Perfekt (14.97%; mean 3.14 (sd 3.338)) and Präteritum (23.31%; mean 4.43 (sd 5.159)), followed by Präsens (47.14%; mean 9.43 (sd 7.138)) and Futur and Neutral (both 67.86%; Futur: mean 13.57 (sd 6.754); Neutral: mean 13.57 (sd 6.373)). Differences between tense forms are depicted in figure 5.

Between tense forms comparisons revealed that only the difference between Futur/Neutral and Präteritum ($z = -2.201, p = 0.028$) and between Futur/Neutral and Perfekt ($z = -2.197, p = 0.028$) reached significance. All other differences did not reach significance (Präsens – Futur/Neutral $z = 1.192, p = 0.233$; Präsens – Perfekt $z = -1.892, p = 0.058$; Präsens – Präteritum $z = 1.192, p = 0.115$; Perfekt – Präteritum $z = 0.954, p = 0.340$).

As is graphically depicted in figure 6, within the production task, past conditions (Präteritum + Perfekt) were significantly worse than non-past conditions (Präsens + Futur) (past: mean...
18,929 (sd 20,659); non-past: mean 53,429 (sd 21,011); z = 2,366, p = 0,018). On individual level, all participants scored lower on the past condition than on the non-past condition (see figure 7). Only one participant (P06) scored higher on Präteritum and Perfekt than on Präsens.

**Figure 7: Difference between past and non-past on individual level in production**

Qualitative analysis
Errors were exclusively substitution errors. No omissions were made. A total of 391 errors were counted. Of these, 95 were substitutions with Präsens (24,3%), 91 were Futur substitutions (23,27%), 89 were substitutions with the neutral form (22,76%), 11 were Perfekt substitutions (2,81%) and 10 were substitutions with Präteritum (2,56%).

One participant (P04) made mainly substitution errors with the infinitive. He made a total of 90 errors of which 46 were infinitive substitutions (51%). This lead to the high percentage of infinitive substitutions at the group level (12,53%).

11,76% were other errors. Those errors were mostly substitutions of the auxiliary (e.g. *können* – *can* instead of *müssen* – *must*). An interesting pattern was shown by P06. This participant produced a total of 16 other errors. Of these, 14 consisted of an infinite lexical verb and an auxiliary inflected for past. Twelve of these constructions occurred in past contexts, meaning that the participant understood the time frame but couldn’t build the right form. None of the participants made errors within agreement.
Looking at the single tense forms, Präsens was mostly substituted by a neutral form (38,36%) or Futur (28,77%). 13,7% were substitutions with an infinitive. Präsens was hardly ever substituted by Präteritum (4,11%) or Perfekt (2,74%).

Präteritum was mostly substituted by Präsens (34,31%), followed by Neutral (22,55%), Futur (21,57%) and Perfekt and infinitives (both 6,86%).

Most errors within Perfekt were Futur substitutions (27,77%), Präsens substitutions (26,98%) and substitutions by a neutral form (21,43%). In only 2,38% of Perfekt errors, Perfekt was substituted by Präteritum.

In Futur, most substitutions were Präsens substitutions (35,56%), Neutral substitutions (24,44%) or substitutions by an infinitive (20%). There was only one substitution by Präteritum. Futur was never substituted by Perfekt.

Finally, Neutral was mostly substituted by Futur or an infinitive (both 26,66%). 22,2% were Präsens substitutions. The fewest errors were made by a substitution with Präteritum or Perfekt (both 4,44%).

Figure 8 depicts the just described results. The raw scores for both errors per tense form and per error type are given in appendix III.
**TART comprehension**

Within comprehension, past was the time frame with the highest accuracy (73.33%; mean 17 (sd 3.464)), followed by present (70%; mean 16.63 (sd 2.825)) and future (56.67%; mean 16.38 (sd 3.998)) (see figure 9). However, the differences were not statistically significant ($\chi^2 = 0.923, p = 0.630$). There was no statistical significant difference between the past and the non-past condition either (past: mean 17 (sd 3.464); non-past: mean 16.5 (3.347); $\chi^2 = \)
On individual level only three participants scored better on the non-past condition than on the past condition. These participants were P01, P02 and P04. In all other participants past was better than non-past (see figure 11).

Questionnaire

A total of 10 elements were identified by the control group as foreign sounding. Five out of six participants would not use the word Lappen (rag) but another word instead (like the typical Austrian word Fetzen which was named by three out of six participants). The verb falten in the meaning of Kleidung falten (folding clothes) was identified as unfamiliar sounding by four out of six participants. They would use zusammenlegen instead. The item Das ist der Mann, der jetzt den Karton entleert. (This is the man who now empties the box.)

<table>
<thead>
<tr>
<th>Item</th>
<th>Identified word</th>
<th>alternative</th>
<th>participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Das ist die Frau, die jetzt einen Lappen strickt. This is the woman who now knits a rag.</td>
<td>Lappen rag</td>
<td>Fetzen rag</td>
<td>5/6</td>
</tr>
<tr>
<td>Das ist die Frau, die jetzt einen Lappen näht. This is the woman who now sews a rag.</td>
<td>falten to fold</td>
<td>zusammenlegen to fold</td>
<td>4/6</td>
</tr>
<tr>
<td>Das ist der Mann, der jetzt den Karton entleert. This is the man who now empties the box.</td>
<td>entleeren to empty</td>
<td>ausleeren to empty</td>
<td>2/6</td>
</tr>
<tr>
<td>Das ist die Frau, die jetzt einen Bleistift anspitzt. This is the woman who now sharpens a pencil.</td>
<td>anspitzen to sharpen</td>
<td>spatzen to sharpen</td>
<td>5/6</td>
</tr>
<tr>
<td>Das ist der Mann, der jetzt das Papier zerreißt. This is the man who now tears the paper.</td>
<td>Papier paper</td>
<td>Blatt sheet</td>
<td>1/6</td>
</tr>
<tr>
<td>Das ist der Mann, der jetzt das Papier klebt. This is the man who now sticks the paper.</td>
<td>bleiben to stick</td>
<td>picken to stick</td>
<td>1/6</td>
</tr>
<tr>
<td>Das ist der Mann, der jetzt den Karton füllt. This is the man who now fills the box.</td>
<td>füllen to fill</td>
<td>einräumen to fill</td>
<td>1/6</td>
</tr>
<tr>
<td>Das ist die Frau, die jetzt einen Bleistift zerbricht. This is the man who now breaks a pencil.</td>
<td>zerbrechen to break</td>
<td>abrechen to break sth. off</td>
<td>2/6</td>
</tr>
<tr>
<td>Das ist die Frau, die jetzt den Boden fegt. This is the woman who now sweeps the floor.</td>
<td>fegen to sweep</td>
<td>kehren to sweep</td>
<td>4/6</td>
</tr>
<tr>
<td>Das ist der Mann, der jetzt die Milch eingießt. This is the man who now pours the milk.</td>
<td>eingießen to pour</td>
<td>einschenken to pour</td>
<td>1/6</td>
</tr>
</tbody>
</table>

Table 4: Identified elements of the TART and alternative words given by the control group in the questionnaire

was reformulated by two out of six participants to Das ist der Mann, der jetzt den Karton ausleert. Five out of six participants would leave out the prefix an- in the verb anspitzen.

One participant would say Das ist der Mann, der jetzt das Blatt klebt/zerreißt (This is the man who now sticks/tears the sheet.) instead of using the uncountable word Papier (paper). In the
same item, another participant would use the Austrian verb form *picken* instead of *kleben*. One participant would use the verb *einträumen* rather than *füllen* in *Das ist der Mann, der jetzt den Karton füllt*. *(This is the man who now fills the box.)* Two out of six participants would change the prefix in *zer-brechen* to *ab-brechen*. This also leads to a semantical difference since *zerbrechen* means *to break* and *abbrechen* means *to break something off*. The verb *fegen* *(to sweep)* was identified by four out of six participants as foreign sounding. They would use the verb *kehren* instead. Finally, one participant would say *einschenken* rather than *eingießen* *(to pour)*. For a better overview, those elements are listed again in table 4.

**Production**

Looking at the items that contain the identified elements, in the aphasia group, one can see that they do not stand out compared to the other items, as is depicted in red in figure 12 for production. Taking together items containing identified elements and items that do not contain one of those elements, they both have a mean accuracy of 44% *(items with identified elements: 44.08%; other items: 44.29%).* Accuracy scores per single item can be found in appendix IV.

![Figure 12: Items that contain the identified elements (red) in production](image-url)
Comprehension

A similar picture is drawn in comprehension. As shown in figure 13, items that contain the identified elements do not differ from the other items. The mean accuracy score of items containing one of those elements is 79.17%. This hardly differs from the accuracy score of the other items which is 82.87%. Individual accuracy scores per item are given in appendix IV.

![Figure 13: Items that contain the identified elements (red) in comprehension](image)

Summary of the results

The control group scored at ceiling except for one participant (C02) who had an accuracy of 90% in the comprehension task and only 55% in the production task.

The aphasia group performed significantly worse than the control group in both production and comprehension. In the production task, differences between time frames reached significance. Participants performed worst in both past tense forms and best in the Futur and
Neutral condition. Präteritum and Perfekt were significantly more impaired than Futur and Neutral. No significant differences were found between Präsens and the other tense forms, between the two past tense forms or between Futur and Neutral. The past condition was significantly more impaired than the non-past condition. Errors were exclusively substitution errors. In the majority of cases the target form was substituted by Präsens, Futur or a neutral form but hardly ever by a past tense form.

In the comprehension task, no significant differences were found between the single time frames or between the past and the non-past condition.

Ten elements of the TART were identified as foreign sounding or typical German by the control participants. Alternative terms that were named by the participants differed from the target words either on lexical level or on morphological level when another prefix was chosen. Nevertheless, the items containing the identified elements did not differ from the rest of items in terms of accuracy in the aphasia group.

4. Discussion

Two aims were formulated for this study. The first aim was to investigate whether speakers of Austrian German with agrammatic aphasia face the same difficulties within Time reference and especially reference to the past as was shown for other languages in various studies before. While most authors assumed an impairment within Tense, Bastiaanse and colleagues (2011) think that the underlying problem lies within discourse linking. They argue that since past tense requires discourse linking, it is particularly impaired in agrammatic aphasia. The results of this study will be discussed on basis of this approach.

The second aim of this study was formulated on a more methodological background. The German version of the TART, which was used in this study, was translated in northern Germany, a language area that shows various differences to the Austrian language area. This means that the test might contain elements that sound “foreign” or “inappropriate” to someone from Austria. Subsequently, this might have an effect on the participants’ performance especially if they are language impaired. Therefore, the second aim of this study was to check whether this version of the TART is also suitable for speakers of Austrian German.
In this section, first the results of the TART will be discussed and compared with findings of previous studies. Before passing on to the questionnaire and by that to the second research question, the results of participant C02 will be discussed once more since this participant showed a rather unusual performance pattern.

**TART results**

As expected, the subjects with agrammatism in this study were impaired in both production and comprehension of tense forms. However, looking at the two tasks of the TART more closely, the picture is quite diverging. In the production task, participants reached the lowest accuracy scores in the two past tense forms which were significantly worse than the future and neutral condition. No such pattern was found in the comprehension task. While in comprehension Tense in general was impaired, there was no difference between past, present and future tense.

In the production task, no difference was found between Perfekt and Präteritum. Two conclusions can be drawn from this fact. First of all, even if Perfekt is the predominant tense form in spoken Austrian German, this had no effect on the participants' performance. Thus, even if the participants are more used to Perfekt than to Präteritum in their everyday language, this had no influence on their test results. In other words, they showed impairment in 'past' in general but not in Tense. Second, there was no influence of verb structure. Perfekt is a periphrastic verb form and might be classified as syntactically more complex than Präteritum which is a simple verb form. In Perfekt, the finite verb is inflected for present tense while the verb complex as a whole refers to the past. Nevertheless, participants scored equal in the two tense forms. In line with Lee, Milman and Thompson (2008) for English, Bastiaanse (2008) and Bos and colleagues (2013) for Dutch who did not find a difference between simple verb forms and periphrastic verb forms that refer to the past either, these findings suggest that it might be neither finiteness nor Tense that is impaired in agrammatism but reference to the past in general.

While there was a significant difference between Präteritum/Perfekt and Futur/Neutral, no difference was found between Präsens and the other tense forms. This is surprising as according to the PADILIH Präsens should be better preserved than past tense forms since it refers to the non-past. In contrast to previous studies (Bastiaanse, 2008 for Dutch; Faroqi-Shah & Dickey, 2009; Dragoy, Bos, Stowe & Bastiaanse, 2012; and Bos, Dragoy, Stowe & Bastiaanse, 2013 for English), the results of this study did not find a difference between present tense and past tense forms which was also the case in the studies of Burchert,

However, looking at the differences between the past and the non-past condition, a reversed pattern is found. Participants in this study scored significantly better on items that referred to the non-past than on items that referred to the past on both individual level (except for one participant) and group level. Since the PADILIH claims that it is Time reference rather than Tense that is impaired in agrammatism, this is actually a more powerful argument in support of the PADILIH. Differences between past and non-past conditions with past being more impaired than non-past were also found in the study of Bastiaanse (2008). Furthermore, the results of this study are in line with the results of Faroqi-Shah and Dickey (2009), Dragoy and colleagues (2012) and Bos and colleagues (2013) who found that reference to the past was more difficult than reference to the present even in non-impaired speakers.

In this study, substitution errors were not only the most prominent error pattern as in many studies before (Lee, 2003 for Korean; Burchert, Swoboda-Moll & De Bleser, 2005 for German; Lee, Milman & Thompson, 2008; Clahsen & Ali, 2009 for English; Yarbay Duman & Bastiaanse, 2009 for Turkish; Bastiaanse et al., 2011 for English and Turkish) but the only error pattern as no omissions were made at all. Across tense forms, target words were hardly ever substituted by Perfekt or Präteritum but mostly by a present, future or neutral form.

This implicates that in cases of retrieving difficulty, participants choose the most coherent solution which seems to be a non-past form. Past forms might require more processing capacities and might therefore not be the first choice in substituting a target form. The question is why it is that past tense forms are more difficult to retrieve. The answer has already been given by Bastiaanse and colleagues (2011) following Zagona (2003). Past or reference to the past is discourse linked. In contrast to non-past forms, an extrasentential link has to be set between the moment of speaking and an earlier event and this requires more processing resources. In other words, when participants struggle with the target verb form, they choose an alternative verb form that refers to the non-past since this does not require discourse linking.

It was mentioned in the introduction that the temporal adverb 'gerade' which is used in the Präteritum and Perfekt condition of the TART can be used for both past and present contexts. One would expect that this might lead to substituting Perfekt and Präteritum predominantly with Präsens since this would result in a grammatical sentence. This was the case in the Präteritum condition but not in the Perfekt condition. In Perfekt, the percentage of Präsens and Futur substitutions is almost the same (Präsens: 26,98% Futur: 27,77%)

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8 This was not the case in participant P06. He replaced target verb forms that referred to the past by verb complexes consisting of a finite auxiliary inflected for past and the infinite lexical verb. It seems that in this participant the problem was not discourse linking but verb morphology.
although ‘gerade’ does not fit the temporal context of future. Therefore, the use of the temporal adverb ‘gerade’ in the TART did not have an impact on the participants’ performance.

In the comprehension task, participants with agrammatism scored significantly worse than the control group. They showed impairment within Tense in general but no differences were found between the single time frames or between the past and the non-past condition. This is in contrast to the studies of Jonkers and de Bruin (2009) and Bastiaanse and colleagues (2011) who found better preserved comprehension of present tense than comprehension of past tense.

The results of the present study can only partially confirm the TPH (Friedmann & Grodzinsky, 1997) which predicts that Tense in general is impaired since the T node is pruned from the syntactic tree. Hence, one would expect that participants would perform similar in all tense forms. In this study, this was the case for comprehension but not for production. In the production task, past tense forms were particularly impaired while Futur and Neutral were significantly better. Therefore, Tense as such cannot be the underlying problem.

The participants of this study were impaired in both production and comprehension which speaks for a central impairment as it was also suggested by Wenzlaff and Clahsen (2004, 2005) in the TUH or by Burchert, Swoboda-Moll and De Bleser (2005) in the TAUH. Both the TUH and the TAUH give reasonable explanations why Tense is impaired in agrammatism but they cannot explain why some tense forms are more impaired than others as was shown in this study.

According to the IFIH (Nanousi et al., 2006; Varlokosta et al., 2006), Tense is impaired in agrammatism since it has interpretable features. For this study, this would mean that past tense forms have more interpretable features than for example future. Both refer to an event that does not overlap with the moment of speech. Therefore, there is no reason why past should have more interpretable features than future.

The DER by Faroqi-Shah and Thompson (2007) does not hold for the present results either. If speakers with agrammatism were not able to select or retrieve the diacritical features [+past] or [-past] to choose the verb form that fits the context then past tense forms and non-past tense forms should be impaired to the same extent.

Since no difference was found between Perfekt and Präteritum even if Perfekt is a periphrastic verb form and Präteritum is a simple verb form, this study does not support the assumptions of Kok, van Doorn and Kolk (2007) that it is grammatical complexity that provokes problems in tense inflection.
The present study showed that there is a central deficit for Time reference in agrammatism that is morphosemantic rather than morphosyntactic in nature. Reference to time is impaired in both agrammatic production and comprehension. In production, reference to the past is particularly impaired as this requires great processing capacity due to discourse linking. Therefore, this study mostly supports the PADILIH (Bastiaanse et al., 2011) at least for production. It can be assumed that in comprehension no difference between time frames could be found because comprehending verb forms inflected for past requires less processing capacity than retrieving them and therefore, they are impaired to the same degree as the other time frames.

**Participant C02**

A rather unusual performance pattern was shown by participant C02. Although this participant had no history of brain damage or disease and was not under any medication she performed very different to the other control subjects. She had most difficulties in production where she reached an accuracy of 55%. Most errors were made in the two past tense forms, a performance pattern that is quite likely to that of participants with language impairment. However, she also made a lot of errors with the neutral condition which was best in the aphasia group. In the comprehension task she had an accuracy of 90%. In this task she made only errors in the future condition and none in the present or past condition.

Reanalysing her spontaneous speech did not reveal any abnormalities and she performed well at the test items. Therefore, it can be assumed that she understood the test procedure. It is not clear what led to C02’s performance. It cannot be excluded from consideration that there might be a cognitive causation. However, this is only an assumption that needs to be treated with caution.

**Questionnaire**

The questionnaire revealed that especially *Lappen, fegen, anspitzen* and *falten* were elements of the TART that were experienced as foreign sounding by most of the control participants. As expected, most elements were identified due to lexical reasons and less because of syntactical differences. Only a few alternative words that were given by the control subjects slightly differed from the original elements because of different or left out prefixes. One should note, though, that none of the identified elements was completely unknown to the participants but simply not common terms in their lexicon and everyday language. As shown in this study, elements that were identified as ‘untypical’ or ‘foreign
sounding’ by healthy speakers of Austrian German did not have influence on the performance of subjects with language impairment.

Conclusion

The present study found a central deficit in reference of time in both production and comprehension in eight speakers of Austrian German with agrammatic aphasia. It shows that it is Time reference rather than Tense that is impaired in agrammatism and especially reference to the past since this requires discourse linking. The results can be mostly explained by the PADILIH because it is the only hypothesis so far that explains why some time frames are more impaired than others. The PADILIH did not hold for the results in comprehension, though. Based on what has been found in this study, it has been assumed that in comprehension past does not need the same amount of processing capacity as in production and therefore it is likewise impaired as the other time frames.

The questionnaire revealed that the German version of the TART which was used in this study contains elements that sound ‘typical German’ or ‘foreign’ to speakers of Austrian German. However, these elements did not affect the performance of language impaired subjects. Thus, the German version of the TART is an appropriate instrument to diagnose impairment in Time reference in speakers of Austrian German.
References


Appendix I - Index of German tense forms

Präsenst | present tense
Präteritum | past tense
Perfekt | present perfect
Plusquamperfekt | past perfect
Futur I | simple future
Futur II | future perfect
Appendix II - TART items

TART production

*Practice items*

Das ist der Mann, der jetzt den Brief liest.
Das ist der Mann, der gerade den Brief las.
Das ist der Mann, der gerade den Brief gelesen hat.
Das ist der Mann, der gleich den Brief lesen wird.
Das ist der Mann, der den Brief lesen muss.

Das ist der Mann, der jetzt den Brief schreibt.
Das ist der Mann, der gerade den Brief schrieb.
Das ist der Mann, der gerade den Brief geschrieben hat.
Das ist der Mann, der gleich den Brief schreiben wird.
Das ist der Mann, der den Brief schreiben muss.

*Test items*

Das ist die Frau, die jetzt einen Lappen strickt.
Das ist die Frau, die gerade einen Lappen strickte.
Das ist die Frau, die gerade einen Lappen gestrickt hat.
Das ist die Frau, die gleich einen Lappen stricken wird
Das ist die Frau, die einen Lappen stricken muss.

Das ist die Frau, die jetzt einen Lappen näht.
Das ist die Frau, die gerade einen Lappen strickte.
Das ist die Frau, die gerade einen Lappen gestrickt hat.
Das ist die Frau, die gleich einen Lappen stricken wird.
Das ist die Frau, die einen Lappen stricken muss.

Das ist die Frau, die jetzt einen Pullover faltet.
Das ist die Frau, die gerade einen Pullover faltete.
Das ist die Frau, die gerade einen Pullover gefaltet hat.
Das ist die Frau, die gleich einen Pullover falten wird.
Das ist die Frau, die einen Pullover falten muss.

Das ist die Frau, die jetzt einen Pullover bügelt.
Das ist die Frau, die gerade einen Pullover bügelte.
Das ist die Frau, die gerade einen Pullover gebügelt hat.
Das ist die Frau, die gleich einen Pullover bügeln wird.
Das ist die Frau, die einen Pullover bügeln muss.

Das ist der Mann, der jetzt den Karton entleert.
Das ist der Mann, der gerade den Karton entleerte.
Das ist der Mann, der gerade den Karton entleert hat.
Das ist der Mann, der gleich den Karton entleeren wird.
Das ist der Mann, der den Karton entleeren muss.

Das ist der Mann, der jetzt den Karton füllt.
Das ist der Mann, der gerade den Karton füllte.
Das ist der Mann, der gerade den Karton gefüllt hat.
Das ist der Mann, der gleich den Karton füllen wird.
Das ist der Mann, der den Karton füllen muss.

Das ist die Frau, die jetzt ein Viereck malt.
Das ist die Frau, die gerade ein Viereck malte.
Das ist die Frau, die gerade ein Viereck gemalt hat.
Das ist die Frau, die gleich ein Viereck malen wird.
Das ist die Frau, die ein Viereck malen muss.

Das ist die Frau, die jetzt ein Viereck zeichnet.
Das ist die Frau, die gerade ein Viereck zeichnete.
Das ist die Frau, die gerade ein Viereck gezeichnet hat.
Das ist die Frau, die gleich ein Viereck zeichnen wird.
Das ist die Frau, die ein Viereck zeichnen muss.

Das ist die Frau, die jetzt einen Bleistift anspitzt.
Das ist die Frau, die gerade einen Bleistift anspitzte.
Das ist die Frau, die gerade einen Bleistift angespitzt hat.
Das ist die Frau, die gleich einen Bleistift anspitzen wird.
Das ist die Frau, die einen Bleistift anspitzen muss.

Das ist die Frau, die jetzt einen Bleistift zerbricht.
Das ist die Frau, die gerade einen Bleistift zerbrach.
Das ist die Frau, die gerade einen Bleistift zerbrochen hat.
Das ist die Frau, die gleich einen Bleistift zerbrechen wird.
Das ist die Frau, die einen Bleistift zerbrechen muss.

Das ist der Mann, der jetzt das Papier zerreißt.
Das ist der Mann, der gerade das Papier zerriss.
Das ist der Mann, der gerade das Papier zerrissen hat.
Das ist der Mann, der gleich das Papier zerreißen wird.
Das ist der Mann, der das Papier zerreißen muss.

Das ist der Mann, der jetzt das Papier klebt.
Das ist der Mann, der gerade das Papier klebte.
Das ist der Mann, der gerade das Papier geklebt hat.
Das ist der Mann, der gleich das Papier kleben wird.
Das ist der Mann, der das Papier kleben muss.

Das ist der Mann, der jetzt einen Apfel schält.
Das ist der Mann, der gerade einen Apfel schälte.
Das ist der Mann, der gerade einen Apfel geschält hat.
Das ist der Mann, der gleich einen Apfel schälen wird.
Das ist der Mann, der einen Apfel schälen muss.

Das ist der Mann, der jetzt einen Apfel isst.
Das ist der Mann, der gerade einen Apfel aß.
Das ist der Mann, der gerade einen Apfel gegessen hat.
Das ist der Mann, der gleich einen Apfel essen wird.
Das ist der Mann, der einen Apfel essen muss.

Das ist die Frau, die jetzt den Boden wischt.
Das ist die Frau, die gerade den Boden wischte.
Das ist die Frau, die gerade den Boden gewischt hat.
Das ist die Frau, die gleich den Boden wischen wird.
Das ist die Frau, die den Boden wischen muss.

Das ist die Frau, die jetzt den Boden fegt.
Das ist die Frau, die gerade den Boden fegte.
Das ist die Frau, die gerade den Boden gefegt hat.
Das ist die Frau, die gleich den Boden fegen wird.
Das ist die Frau, die den Boden fegen muss.

Das ist der Mann, der jetzt den Wagen schiebt.
Das ist der Mann, der gerade den Wagen schob.
Das ist der Mann, der gerade den Wagen gezogen hat.
Das ist der Mann, der gleich den Wagen schieben wird.
Das ist der Mann, der den Wagen schieben muss.

Das ist der Mann, der jetzt den Wagen zieht.
Das ist der Mann, der gerade den Wagen zog.
Das ist der Mann, der gerade den Wagen gezogen hat.
Das ist der Mann, der gleich den Wagen ziehen wird.
Das ist der Mann, der den Wagen ziehen muss.

Das ist der Mann, der jetzt die Milch trinkt.
Das ist der Mann, der gerade die Milch trank.
Das ist der Mann, der gerade die Milch getrunken hat.
Das ist der Mann, der gleich die Milch trinken wird.
Das ist der Mann, der die Milch trinken muss.

Das ist der Mann, der jetzt die Milch eingießt.
Das ist der Mann, der gerade die Milch eingoss.
Das ist der Mann, der gerade die Milch eingegossen hat.
Das ist der Mann, der gleich die Milch eingießen wird.
Das ist der Mann, der die Milch eingießen muss.

**TART comprehension**

*Practice items*

Der Mann liest den Brief.
Der Mann hat den Brief gelesen.
Der Mann wird den Brief lesen.

Der Mann schreibt den Brief.
Der Mann hat den Brief geschrieben.
Der Mann wird den Brief schreiben.

*Test items*

Die Frau strickt einen Lappen.
Die Frau hat einen Lappen gestrickt.
Die Frau wird einen Lappen stricken.

Die Frau näht einen Lappen.
Die Frau hat einen Lappen genäht.
Die Frau wird einen Lappen nähen.

Die Frau faltet einen Pullover.
Die Frau hat einen Pullover gefaltet.
Die Frau wird einen Pullover falten.
Die Frau bügelt einen Pullover.
Die Frau hat einen Pullover gebügelt.
Die Frau wird einen Pullover bügeln.

Der Mann entleert den Karton.
Der Mann hat einen Karton entleert.
Der Mann wird einen Karton entleeren.

Der Mann füllt den Karton.
Der Mann hat den Karton gefüllt.
Der Mann wird den Karton füllen.

Die Frau malt ein Viereck.
Die Frau hat ein Viereck gemalt.
Die Frau wird ein Viereck malen.

Die Frau zeichnet ein Viereck.
Die Frau hat ein Viereck gezeichnet.
Die Frau wird ein Viereck zeichnen.

Die Frau spitzt einen Bleistift an.
Die Frau hat einen Bleistift angespitzt.
Die Frau wird einen Bleistift anspitzen.

Die Frau zerbricht einen Bleistift.
Die Frau hat einen Bleistift zerbrochen.
Die Frau wird einen Bleistift zerbrechen.

Der Mann zerreißt das Papier.
Der Mann hat das Papier zerrissen.
Der Mann wird das Papier zerreißen.

Der Mann klebt das Papier.
Der Mann hat das Papier geklebt.
Der Mann wird das Papier kleben.

Der Mann schält einen Apfel.
Der Mann hat einen Apfel geschält.
Der Mann wird einen Apfel schälen.

Der Mann isst einen Apfel.
Der Mann hat einen Apfel gegessen.
Der Mann wird einen Apfel essen.
Die Frau wischt den Boden.
Die Frau hat den Boden gewischt.
Die Frau wird den Boden wischen.

Die Frau fegt den Boden.
Die Frau hat den Boden gefegt.
Die Frau wird den Boden fegen.

Der Mann schiebt den Wagen.
Der Mann hat den Wagen geschoben.
Der Mann wird den Wagen schieben.

Der Mann zieht den Wagen.
Der Mann hat den Wagen gezogen.
Der Mann wird den Wagen ziehen.

Der Mann trinkt Milch.
Der Mann hat Milch getrunken.
Der Mann wird Milch trinken.

Der Mann gießt Milch ein.
Der Mann hat Milch eingegossen.
Der Mann wird Milch eingießen.
Appendix III - Individual scores

Control group

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<th>SubstPrät</th>
<th>SubstPerf</th>
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<th>SubstInf</th>
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accuracy maximum = 100

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<td>C05</td>
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accuracy maximum = 60

Aphasia group

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<th>SubstFut</th>
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<th>SubstInf</th>
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<td>4</td>
</tr>
</tbody>
</table>

accuracy maximum = 100
### Comprehension accuracy

<table>
<thead>
<tr>
<th>P01</th>
<th>53</th>
</tr>
</thead>
<tbody>
<tr>
<td>P02</td>
<td>42</td>
</tr>
<tr>
<td>P03</td>
<td>57</td>
</tr>
<tr>
<td>P04</td>
<td>32</td>
</tr>
<tr>
<td>P05</td>
<td>53</td>
</tr>
<tr>
<td>P06</td>
<td>60</td>
</tr>
<tr>
<td>P07</td>
<td>57</td>
</tr>
<tr>
<td>P08</td>
<td>36</td>
</tr>
</tbody>
</table>

Accuracy maximum = 60

### Errors per tense form

<table>
<thead>
<tr>
<th>Errors</th>
<th>SubstPräls</th>
<th>SubstPrät</th>
<th>SubstPerf</th>
<th>SubstFut</th>
<th>SubstNeu</th>
<th>SubstInf</th>
<th>Omission</th>
<th>other</th>
<th>Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Präls</td>
<td>3</td>
<td>2</td>
<td>21</td>
<td>28</td>
<td>10</td>
<td>0</td>
<td>8</td>
<td>73</td>
<td>18.67%</td>
<td></td>
</tr>
<tr>
<td>Prät</td>
<td>35</td>
<td>7</td>
<td>22</td>
<td>23</td>
<td>7</td>
<td>0</td>
<td>8</td>
<td>102</td>
<td>26.09%</td>
<td></td>
</tr>
<tr>
<td>Perf</td>
<td>34</td>
<td>35</td>
<td>27</td>
<td>11</td>
<td>0</td>
<td>15</td>
<td>126</td>
<td>32.23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fut</td>
<td>16</td>
<td>1</td>
<td>0</td>
<td>11</td>
<td>9</td>
<td>0</td>
<td>8</td>
<td>45</td>
<td>11.51%</td>
<td></td>
</tr>
<tr>
<td>Neu</td>
<td>10</td>
<td>2</td>
<td>2</td>
<td>12</td>
<td>12</td>
<td>0</td>
<td>7</td>
<td>45</td>
<td>11.51%</td>
<td></td>
</tr>
</tbody>
</table>
## Appendix IV - Accuracy scores per item

### Aphasia group

#### Production

**Mean accuracy scores in percent per item**

<table>
<thead>
<tr>
<th>Item (German)</th>
<th>Accuracy (Percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>malen – zeichnen</td>
<td>52.86%</td>
</tr>
<tr>
<td>zerreifen – kleben</td>
<td>42.86%</td>
</tr>
<tr>
<td>eingießen – trinken</td>
<td>38.57%</td>
</tr>
<tr>
<td>schälen – essen</td>
<td>40%</td>
</tr>
<tr>
<td>schieben – ziehen</td>
<td>40%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item (German)</th>
<th>Accuracy (Percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>anspitzen - zerbrechen</td>
<td>37.14%</td>
</tr>
<tr>
<td>stricken – nähen</td>
<td>45.71%</td>
</tr>
<tr>
<td>entleeren – füllen</td>
<td>44.29%</td>
</tr>
<tr>
<td>bügeln – falten</td>
<td>47.14%</td>
</tr>
<tr>
<td>wischen - fegen</td>
<td>52.86%</td>
</tr>
</tbody>
</table>

#### Comprehension

**Mean accuracy scores in percent per item**

<table>
<thead>
<tr>
<th>Item (German)</th>
<th>Accuracy (Percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>trinken</td>
<td>91.67%</td>
</tr>
<tr>
<td>stricken</td>
<td>79.17%</td>
</tr>
<tr>
<td>entleeren</td>
<td>83.33%</td>
</tr>
<tr>
<td>schieben</td>
<td>79.17%</td>
</tr>
<tr>
<td>zeichnen</td>
<td>75%</td>
</tr>
<tr>
<td>anspitzen</td>
<td>70.83%</td>
</tr>
<tr>
<td>zerreissen</td>
<td>79.17%</td>
</tr>
<tr>
<td>wischen</td>
<td>83.33%</td>
</tr>
<tr>
<td>füllen</td>
<td>91.67%</td>
</tr>
<tr>
<td>bügeln</td>
<td>95.83%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item (German)</th>
<th>Accuracy (Percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ziehen</td>
<td>75%</td>
</tr>
<tr>
<td>kleben</td>
<td>91.67%</td>
</tr>
<tr>
<td>fegen</td>
<td>83.33%</td>
</tr>
<tr>
<td>malen</td>
<td>79.17%</td>
</tr>
<tr>
<td>eingießen</td>
<td>75%</td>
</tr>
<tr>
<td>falten</td>
<td>83.33%</td>
</tr>
<tr>
<td>nähen</td>
<td>75%</td>
</tr>
<tr>
<td>essen</td>
<td>91.67%</td>
</tr>
<tr>
<td>schälen</td>
<td>75%</td>
</tr>
</tbody>
</table>
### Appendix V - Exact test statistics

<table>
<thead>
<tr>
<th>Group differences</th>
<th>Aphasia group</th>
<th>Production</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>44.14 (20.748)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Comprehension</td>
<td>48.75 (10.607)</td>
</tr>
<tr>
<td>Control group</td>
<td></td>
<td>Production</td>
<td>95.95 (4.97)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Comprehension</td>
<td>58.33 (1,211)</td>
</tr>
<tr>
<td>Production</td>
<td>$X^2 = 6$, $p = 0.014$; $U = 0.00$, $z = -3.004$, $p = 0.001$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comprehension</td>
<td>$X^2 = 5$, $p = 0.025$; $U = 7.5$, $z = -2.161$, $p = 0.029$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TART production</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Präsen</td>
<td>9.43 (7.138)</td>
</tr>
<tr>
<td>Präteritum</td>
<td>4.43 (5.159)</td>
</tr>
<tr>
<td>Perfekt</td>
<td>3.14 (3.338)</td>
</tr>
<tr>
<td>Futur</td>
<td>13.57 (6.754)</td>
</tr>
<tr>
<td>Neutral</td>
<td>13.57 (6.373)</td>
</tr>
<tr>
<td>Past</td>
<td>18.929 (20.659)</td>
</tr>
<tr>
<td>Non-past</td>
<td>53.429 (21.011)</td>
</tr>
<tr>
<td>Difference between tense forms: $X^2 = 13.474$, $p = 0.009$</td>
<td></td>
</tr>
<tr>
<td>Perfekt – Präteritum: $z = 0.954$, $p = 0.340$</td>
<td></td>
</tr>
<tr>
<td>Präsen – Präteritum: $z = 1.192$, $p = 0.115$</td>
<td></td>
</tr>
<tr>
<td>Präsen – Futur/Neutral: $z = 1.192$, $p = 0.233$</td>
<td></td>
</tr>
<tr>
<td>Präsen – Perfekt: $z = -1.892$, $p = 0.058$</td>
<td></td>
</tr>
<tr>
<td>Futur/Neutral – Präteritum: $z = -2.201$, $p = 0.028$</td>
<td></td>
</tr>
<tr>
<td>Futur/Neutral – Perfekt: $z = -2.197$, $p = 0.028$</td>
<td></td>
</tr>
<tr>
<td>Past – Non-past: $X^2 = 7$, $p = 0.008$; $z = 2.366$, $p = 0.018$</td>
<td></td>
</tr>
<tr>
<td>Difference between error types: $X^2 = 51.557$, $p &lt; 0.005$</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TART comprehension</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Differences between time frames: $X^2 = 0.923$, $p = 0.630$</td>
<td></td>
</tr>
<tr>
<td>Past – Non-past: $X^2 = 0.143$, $p = 0.705$</td>
<td></td>
</tr>
</tbody>
</table>
Appendix VI - List of tables and figures

**Tables**

Table 1: Personal data – aphasia group  
Table 2: Personal data – control group  
Table 3: Scores of participant C02  
Table 4: Identified elements of the TART and alternative words given by the control group in the questionnaire

**Figures**

Figure 1: The German Tense system  
Figure 2: The semantic double function of Perfekt  
Figure 3: An example for the TART production task  
Figure 4: An example for the TART comprehension task  
Figure 5: Differences between tense forms in production  
Figure 6: Difference between past and non-past in production  
Figure 7: Difference between past and non-past on individual level in production  
Figure 8: Errors in percent per tense form in production  
Figure 9: Difference between past, present and future in comprehension  
Figure 10: Difference between past and non-past in comprehension  
Figure 11: Difference between past and non-past on individual level in comprehension  
Figure 12: Items that contain the identified elements (red) in production  
Figure 13: Items that contain the identified elements (red) in comprehension