THE PROCESSING AND COMPREHENSION OF PRONOMINAL ELEMENTS IN DUTCH AS A SECOND LANGUAGE

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1 Introduction

1.1 Processing of pronominal elements

Pronominal elements, reflexive and personal pronouns can be used to refer to someone in the discourse. Pronominal elements need to be resolved for comprehension. However, reflexive and personal pronouns differ with respect to their reference assignment. Consider the sentence *De kapper en de visagist werkten in de kapsalon. De kapper die graag dingen uitprobeerde schoor zich/hem zodat de nieuwe aftershave kon worden uitgeprobeerd* (The hairdresser and the makeup artist worked at the hairdresser's. The hairdresser, who liked to try out things, shaved himself/him so that the new aftershave could be tested). The personal pronoun *hem* can refer to *de visagist* but also to someone else. In case of the reflexive pronoun, it must be interpreted as *de kapper*. Thus, reflexive pronouns need to refer to the next possible element in Dutch, whereas personal pronouns can take several antecedents from the discourse.

Despite the fact that pronominal elements differ in their reference, it is also interesting to look at how pronominal elements behave in different syntactic environments. The environment might also constraint the interpretation of the pronominal element. When the pronominal element is in a co-argument relation with the antecedent, as in *De kapper die graag dingen uitprobeerde schoor zich/hem*, meaning that the pronominal element and *de kapper* are arguments of the predicate *scheren*, reflexive and personal pronouns are in a complementary distribution (Reinhart and Reuland, 1993).

However, in Dutch, both pronominal elements can be used to refer to the same antecedent. The reflexive and personal pronoun in sentences like *De kapper en de visagist werkten in de kapsalon. De kapper verschoof een grote kapperstoel naast zich/hem zodat er beter kon worden gewerkt.* (The hairdresser and the makeup artist worked at the hairdresser's. The hairdresser moved a big barber chair next to himself/him so that one could work better) may refer to *de kapper*. The pronominal element in a PP *naast zich/hem* does not enter a co-argument relation with the antecedent *de kapper*, as the pronominal element is an argument of the preposition and the prepositional phrase, including the pronominal element, is an argument of the predicate *verschuiven*. The antecedent *de kapper* is an argument of the predicate *verschuiven*. Thus, the antecedent and the pronominal element are not co-arguments (Reinhart and Reuland, 1993).

Concerning the processing of reflexive and personal pronouns, Reuland (2011) suggests that reflexive pronouns in co-argumenthood structures can be processed by a syntactic operation, whereas discourse or semantic operations are needed for personal pronouns. Pronominal elements that do not enter a co-argument relation with another element have to be processed

by a discourse operation. Thus, the reflexive pronoun in *De kapper die graag dingen uitprobeerde schoor zich/hem* can be processed by a syntactic operation and the personal pronoun by a discourse operation. Pronominal elements in *De kapper verschoof een grote kapperstoel naast zich/hem* must be processed by a discourse operation.

Processing studies (Nicol and Swinney, 1989; Hendriks, Banga, van Rij and Cannizzaro, 2011) have shown that reflexive pronouns were processed faster than personal pronouns by L1 speakers. Moreover, research has shown that reflexive pronouns in a PP were processed slower than reflexive pronouns in a co-argument structure in L1 speakers in Dutch (Burkhardt, 2005; Schumacher, Piñango, Ruigendijk and Avrutin, 2010). This has led to the conclusion that reflexive pronouns in a co-argument relation and in a PP were processed by different operations.

Furthermore, investigating pronominal elements in L2 speakers might be interesting, as L2 processing differs from L1 processing, in that adult L2 speakers might not be able to use syntactic operations as L1 speakers do (cf. Ullman 2001). This means that L2 speakers are supposed to consult a discourse operation in the processing of pronominal elements anyway. Research has shown that L2 speakers processed reflexive pronouns no different from personal pronouns (e.g. Demirci, 2000; Felser, Sato and Bertenshaw, 2009).

However, processing in the L2 might even get more complicated if the L1 and L2 display cross-linguistic differences. For example, the personal pronoun in a PP in German *Der Friseur verschob einen Stuhl neben ihn* (The hairdresser moved a big barber chair next to him) cannot be interpreted as *der Friseur*, which is possible in Dutch. Thus, differences in L1 and L2 representation might lead to interference and competition. Effects due to interference have been reported by for instance Sabourin (2003). She found that German L2 speakers transferred their L1 grammatical gender system into the L2 Dutch exhaustively, which caused mistakes in cases where German and Dutch do not match with regard to grammatical gender.

Beside the investigation of the processing of pronominal elements in L1 and L2 speakers, another interest of this research concerns the interpretation of these elements. This research therefore has also investigated how pronominal elements in so-called picture NPs were interpreted. Similar to pronominal elements in a co-argument structure *De kapper die graag dingen uitprobeerde schoor zich/hem* and a PP *Der Friseur verschob einen Stuhl neben ihn*, pronominal elements in sentences like *Jan saw that Mike's picture of him/himself has been published* enter a co-argument relation with the possessor *Mike* (Reinhart and Reuland, 1993). Whether the possessor *Mike* is part of the argument structure *a picture of* is debated by for instance Sturt (2003) and Keller and Asudeh (2001). Research has shown, at least for English,

that the personal pronoun can been interpreted as *Mike* and *Jan*, which is also the case for the reflexive pronoun (Sturt, 2003). Thus, reflexive and personal pronouns are not in a complementary distribution. For a better understanding of the behaviour of pronominal elements in picture NPs, this research sheds some light on the interpretation of pronominal elements in picture NPs in Dutch and German. The processing of pronominal elements in picture NPs has rarely been investigated for German (Kiss, 2008, Lee-Schoenfeldt, 2008) and Dutch, so that studies cannot be reported. Therefore, it is interesting to discover, how the pronominal elements in these languages were interpreted. This delivers a picture of the status of the pronominal element in this type of structure and makes it possible to make predictions with regard to processing across three related languages.

1.2 Research questions

The first question that will be tried to answer is what operations do L2 speakers apply in the processing of reflexive and personal pronouns in a co-argument structure and PP. The second question is whether the L2 speakers process pronominal elements different from L1 speakers. Another question that relates to cross-linguistic differences between German and Dutch in the binding behaviour of personal pronouns in a PP is whether L2 speakers are influenced in their processing by properties of the L1 German?

Finally, the interpretation of pronominal elements in picture NPs will be examined. The question that will be answered is how L1 speakers of German and Dutch interpret the pronominal elements in these structures and whether differences exist between German and Dutch in the interpretation of pronominal elements in picture NPs.

1.3 Overview

This research project investigates the processing of pronominal elements in three syntactic environments (co-argument structure, PP and picture NP) with the aim to find out which operations underlie the processing of the pronominal elements in these structures. Two speakers groups will be compared. L1 speakers' processing will be compared to the processing of L2 speakers. This will be done to discover if a late learned L2 is processed different from the L1.

Chapter 2 is concerned with presentation of theories that describe how reflexive and personal pronouns have to be bound. The theories differ from each other in that the starting point of their argumentation is different. These theories will be described to deliver a picture of how pronominal elements behave across languages. Chapter 3 presents models of language comprehension, processing and representation for both L1 and L2 speakers. Showing these

models enables to present similarities and differences between L1 and L2 speakers in the processing of language. Chapter 4 presents studies which investigated the comprehension and processing of pronominal elements in L1 and L2 speakers. Chapter 5 provides the hypotheses that this research projects tests. Chapter 6 describes the method that has been used for this research. The self-paced reading, eye tracking and comprehension studies will be shown. Chapter 7 presents the results of the three studies. The results of the self-paced reading study will be discussed and followed by the eye tracking study. The comprehension study will be presented thereafter. Chapter 8 discusses the results in the light of the linguistic background that has been introduced in chapters 2 and 3. Chapter 9 presents the conclusion.

2 Binding Theory

In chapter 2 three theories of the binding of reflexive and personal pronouns will be presented. I will start with the *Government and Binding Theory* (Chomsky, 1981) which is mainly based on the English language. The second theory which I will discuss is *Reflexivity* (Reinhart and Reuland, 1993) which takes a broader cross-linguistic perspective in describing the binding behaviour of pronominal elements. The third theory is the *HSPG* (Pollard and Sag, 1994) which also aims to describe the behaviour of pronominal binding in English. The three theories will be discussed for two reasons: on the one hand to show that syntactic and non-syntactic factors have an impact on pronominal binding and on the other hand, to be able to describe the behaviour of pronominal elements in Dutch and German as these languages were the focus of this research project.

Thereafter, a fourth theory *Primitives of Binding* (Reuland, 2001) will be presented which is also a theory of pronominal binding like the theories of Chomsky (1981), Reinhart and Reuland (1993) and Pollard and Sag (1994) but which furthermore argues for a hierarchy that directly can be used to derive implications for processing. This hierarchy assumes a syntactic operation being least costly and discourse operations evoking higher costs. I will use this theory to show which "costs" arise in the processing of pronominal elements in German and Dutch.

2.1 Government and Binding – Principles A and B: Chomsky (1981)

Chomsky (1981) proposed a theory of binding with which he aimed to describe the behaviour of pronominal elements in English so his theory might not be able to explain binding of pronominal elements across all languages. The goal now is to present his theory for English and after that to show why his theory does not adequately account for phenomena in Dutch and German.

Consider examples (1) to (5). As expressed by indices the reflexive and personal pronouns are not bound by the same antecedent.

(1) John$_i$ saw him$_{*i}$/himself$_i$[1]

(2) John$_i$ told Bill about him$_{*i}$/himself$_i$

(3) John$_i$ believed to see him$_{*i}$/himself$_i$

(4) John$_i$ expected Mary to catch him$_{*i}$/himself$_i$

(5) John$_i$ expected that he$_i$/himself$_{*i}$ would catch Mary

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[1] Indices are used "to mark anaphoric relations in the linguistic system" (Reuland 2011, p. 39).

Before the examples will be discussed exhaustively, some theoretical notions will be presented. Chomsky (1981, p. 188) introduced Principle A and B to describe the binding of pronominal elements.

(6) Binding principles

Principle A: An anaphor is bound in its governing category

Principle B: A pronominal is free in its governing category

Principle C[2]: An R-expression is free

Principles A and B describe that reflexive and personal pronouns have different binding domains. The clause, in which the reflexive pronoun must be bound is not the clause in which the personal pronoun must be bound. These principles thus predict that reflexive and personal pronouns are in complementary distribution. This holds true for examples (1) to (5). Here, the reflexive and personal pronouns are not bound by the same element.

The notions *free* and *bound* were mentioned in Principles A and B. A definition is given by Chomsky (1981, p. 184f.). He defines the terms *bound* and *free* in the way that:

(7) Binding

(i) α is X-bound by β if and only if α and β are coindexed, β c-commands α, and β is in an X-position

(ii) α is X-free if and only if it is not X-bound

(iii) α is locally bound by β if and only if α is X-bound by β and if γ Y-binds α then either γ Y-binds β or γ = β

Binding defines what distinguishes a reflexive pronoun from a personal pronoun with regard to the binding behaviour. A reflexive pronoun is c-commanded by a higher positioned element and locally bound by it. A personal pronoun may not be bound locally by a c-commanding element.

It is also necessary to give a definition of *c-command* since this term has already be introduced. Chomsky (1981, p.166) defines c-command as:

(8) C-command

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[2] Principle C will not be elaborated on in more detail as this research is not concerned with R-expressions (names).

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α c-commands β if and only if

(i) α does not contain β

(ii) Suppose that $\gamma_1, \ldots, \gamma_n$ is the maximal sequence such that

(a) $\gamma_n = \alpha$

(b) $\gamma_i = \alpha^j$

(c) γ_i immediately dominates γ_{i+1}. Then if δ dominates α, then either (I) δ dominates β, or (II) $\delta = \gamma_1$ and γ_1 dominates β

C-command is a syntactic notion, which describes the grammatical relationship between two elements. Both elements are in an equal relation to each other in the sense that there is no direct domination of one element over the other.

The terms *c-command* and *to dominate* have to be distinguished as these are important notions which exclude each other. For this purpose, examples (1) to (5) will be considered. In (1) *CP* (Complementizer Phrase) dominates all elements contained in the CP, which means also *John* and the pronominal element. Hence *CP* does not c-command any elements. *John* does not dominate the pronominal element, but *John* c-commands the pronominal element. The reflexive pronoun can be interpreted as *John*, as *John* c-commands it and the reflexive pronoun must be locally bound. Contrary, the personal pronoun may not be interpreted as *John* although *John* c-commands it as well. But *him* may not be bound locally. In (2) *PP* dominates the pronominal element and *PP* does not c-command it. P c-commands *him/himself* but in the PP there is no element that binds the pronominal element. Therefore the pronominal element must refer to an antecedent outside the PP. In (3) the VP *to see* dominates the pronominal element. It does not c-command the pronominal element. Here, no c-command relation is present within the VP between the pronominal element and another element as a potential binder is not contained in the VP. In (4) VP *to catch* dominates the maximal projection and there is a c-command relation between *Mary* and the pronominal element, meaning that *Mary* could bind the pronominal element. In (5) *CP* (subordinated clause) dominates *Mary* and the pronominal element. CP, the *subordinated* clause, is the governing category where the reflexive pronoun must be bound. The pronominal element *he/himself* c-commands *Mary* and may bind *Mary*. However, Mary may not be bound by the pronominal element. This is because the reflexive pronoun cannot fulfil the subject position as it does not have nominative case. Anyway, both reflexive and personal pronoun are of masculine grammatical gender and Mary is feminine.

The binding principles already introduced the term *governing category* that is defined in Chomsky (1981, p. 211) as:

(9) Governing category

(i) AGR is coindexed with the NP it governs[3]

(ii) β is a governing category for α if and only if β is the minimal category containing α, a governor of α and a SUBJECT accessible to α

This definition of governing category holds that a governing category has to have a governor and a SUBJECT that is accessible to the pronominal element. Then this governing category is the domain where a reflexive pronoun has to be bound and a personal pronoun has to be free. In the absence of a SUBJECT in the governing category reference with a pronominal element cannot be established. In the presence of a SUBJECT and a governor the reflexive pronoun has to be bound by the subject in the governing category and may not be bound by a subject in a syntactically higher position.

Coming back to the examples (1) to (5) the governing category of the pronominal element in (1) is the entire sentence with the governor *see* and the SUBJECT *John*. As well, the sentence is the governing category in (2) with *about* being the governor and *John* the SUBJECT. In (3) the governing category is the lower CP with *PRO* as the SUBJECT and *see* as the governor. The small clause in (4) is the governing category for the pronominal element and *Mary* being the SUBJECT and *catch* the governor. However, because of the mismatch in grammatical gender, *Mary* cannot bind the reflexive pronoun. The governing category in (5) is the subordinated clause with *would* being the governor and the pronominal element the SUBJECT. The reflexive pronoun is ruled out as ungrammatical as it is underspecified in phi-featurs and therefore cannot function as a subject.

Chomsky (1981) notes that a governing category must consist of a governor and a SUBJECT otherwise it cannot be a governing category for the pronominal element. Sentence (10) contains a governor *about* and the possessor of *story John* is the SUBJECT. So, this complex

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[3] Chomsky (1981, p.209) makes the notion of AGR more explicit with the examples (i) and (ii).

(i) John [INFL past AGR] win

(ii) He wants [for John to win]

Example (i) is (+AGR) which is expressed by *win* as it is marked for Tense. *To win* can function as a SUBJECT since it checks and assigns features. In (ii) the small clause is (–AGR) as the small clause does not contain Tense. When a clause is (-AGR) then the next higher clause must be examined if it could be the proper governing category consisting of a subject. Thus in (ii) the whole sentence then is the governing category. S has a subject *he* and it also contains Tense, which is expressed by *to want*. The clause is (+AGR).

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DP is the governing category. However, the complex DP in (11) lacks a SUBJECT, so that this DP cannot be the governing category for the pronominal element.

(10)   [Mike heard $_{DP}$John's story about him/himself]
(11)   [John heard $_{DP}$a story about him/himself]

Similar to (11) are the examples (12) and (13). Here, the position of the possessor is not filled either, so that a SUBJECT is lacking. The whole sentence is the governing category. Contrary, the possessor is present in (14) and the requirement of governing category is met. Nethertheless, *Mary* is ruled out as a suitable candidate for the pronominal element because of the mismatch in grammatical gender.

(12)   John$_i$ believes $_{DP}$[the description of himself$_i$]
(13)   John$_i$ believes $_{DP}$[any description of himself$_i$]
(14)   John$_i$ believes $_{DP}$[Mary's description of himself$_i$]

To summarize, Chomsky's (1981) Binding Theory has been briefly introduced with the most important terms being introduced and explained. Table 1 gives an overview of the examples explained above with highlighting for each example again the governor, SUBJECT and governing category.

Table 1: final predictions concerning governing category, subject and governor

	item	governor	SUBJECT	governing category
(1)	John saw him/himself	see	John	CP
(2)	John told Bill about him/himself	about	John	CP
(3)	John believed to see him/himself	see	John	CP
(4)	John expected Mary to catch him/himself	catch	John	Lower CP
(5)	John expected that he/himself would catch Mary	would	he/himself	CP (subordinated clause)
(6)	John believes the description of himself	of	John	CP
(7)	John believes Mary's description of himself	of	John	CP

(8)	John believes any description of himself	of	John	CP
(9)	John's story about him/himself	about	John	DP
(10)	John liked a story about him/himself	about	John	CP

2.1.1 Chomsky (1981): Predictions for German and Dutch

As this research is concerned with the processing of reflexive and personal pronouns by German L1 speakers with Dutch as their L2 it is interesting to have a look at in how far principles A and B correctly describe the binding of pronominal elements in German and Dutch. Now, principles A and B (Chomsky, 1981) will be applied to German and Dutch reflexive and personal pronouns in a co-argument structure (15), PP (16) and picture NPs (17-19).

(15)   Dutch

De agent en de acteur$_j$ gingen de winkel in. De agent$_i$ die de grote mensenmassa zag verborg zich$_{i/*j}$/hem$_{*i/j}$ waardoor niemand een foto kon maken.

German

Der Polizist und der Künstler$_j$ gingen in den Laden. Der Polizist$_i$, der die große Menschenansammlung sah, versteckte sich$_{i/*j}$/ihn$_{*i/j}$, wodurch niemand ein Foto machen konnte.

English

The agent and the actor$_j$ went into the shop. The agent$_i$ who saw the big gathering, hid himself$_{i/*j}$/him$_{*i/j}$ so that nobody could take a picture.

Principle A (Chomsky, 1981) applies in (15). The reflexive pronoun in German and Dutch satisfies Principle A because it is bound locally in its governing category CP by the subject of the sentence *de agent/der Polizist*. In addition, the reflexive pronoun cannot refer outside to *de acteur/der Künstler* which is in line with Principle A. Principle B is not violated either. The personal pronoun *hem/ihn* may not refer to the subject of the sentence *de agent/der Polizist*, but must be bound outside its governing category CP to *de acteur/der Künstler*.

Contrary to the binding of pronominal elements in a co-argument structure, binding of personal pronouns is different between German and Dutch in PPs (16).

(16)   Dutch

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De agent$_i$ en de acteur$_j$ gingen de winkel in. De agent$_i$ zette een leuke nieuwe camera naast zich$_i$/hem$_{i/j}$ waardoor een collega aandacht besteedde aan de camera.

German

Der Polizist$_i$ und der Künstler$_j$ gingen in den Laden. Der Polizist$_i$ stellte eine neue Kamera neben sich$_i$/ihn$_{j/*i}$, so dass ein Kollege seine Aufmerksamkeit auf die Kamera richtete.

English

The agent and the actor went into the shop. The agent put a new camera next to himself$_i$/him$_{j/*i}$ so that a collegue centers his attention towards the camera.

For German the complementarity in distribution of reflexive and personal pronouns holds in (16). CP is the governing category. The reflexive pronoun must be bound by *der Polizist* and the personal pronoun *ihn* can be bound by *der Künstler*. Principles A and B thus describe correctly the binding of pronominal elements in PPs. Contrary to that description, Lee-Schoenfeld (2008) and Kiss (2001) argue for a breakdown of complementarity for reflexive and personal pronouns in PPs in German. They argue that both elements may refer to *the agent*. This is against my intuition and also not in accordance with Reuland (2001, 2011).

An examination of the binding of reflexive and personal pronouns in PPs in Dutch shows that the personal pronoun may be bound outside its governing category CP by *de acteur* and as well inside CP by *de agent* contrary to Principle B (Chomsky, 1981). The reflexive pronoun has to be bound inside CP by *de agent*. Principle B makes incorrect predictions for Dutch with regard to personal pronouns in PPs. The complementarity in distribution of reflexive and personal pronouns breaks down.

The interpretation of pronominal elements in complex DPs has also been investigated. Complex DPs can appear with (17) and without a possessor (18).

(17)   Dutch

Jan en Daan staan voor de boekenkast. Jan$_i$ bevestigt dat Daan$_j$'s nieuwe boek over zichzelf$_{j/?i}$/hem$_{i/?j}$ mogelijk in de lente zal worden gepubliceerd.

German

Jan und Daan stehen vor dem Bücherregal. Jan_i bestätigt, dass $Daans_j$ neues Buch über $sich_{j/?i}$/$ihn_{i/?j}$ möglicherweise im Frühling herausgebracht werden wird.

<u>English</u>

Jan and Daan are standing in front of the bookshelf. Jan confirms that Daan's new book about $himself_{j/?i}$/$him_{i/?j}$ will probably be published in spring.

There seems to be no consensus about how reflexive and personal pronouns may be bound in possessed DPs (17). Sturt (2003) pointed out for English that native speakers' judgements were heterogeneous. The reflexive and personal pronoun are argued to take *Jan* and *Daan* as antecedents in (17). Nevertheless, Chomsky (1981) would argue for (17) that the reflexive pronoun has to be bound by *Daan* in its governing category which in this case is the complex DP *Daan's new book about him/himself* and thus that the personal pronoun has to be bound outside the complex DP by for instance *Jan*. It is not clear if binding of the reflexive and the personal pronoun in German and Dutch is in accordance with principle A and B (Chomsky, 1981).

In (18) and (19) the picture NP lacks a possessor which was present in (17) and could bind the reflexive pronoun.

(18)   <u>Dutch</u>

Jan en Daan staan voor de boekenkast. Jan_i bevestigt dat $Daan_j$ een nieuw boek over $zichzelf_{*i/j}$/$hem_{i/*j}$ mogelijk in de lente zal kunnen publiceren.

<u>German</u>

Jan und Daan stehen vor dem Bücherregal. Jan_i bestätigt, dass $Daan_j$ ein neues Buch über $sich_{*i/j}$/$ihn_{i/*j}$ möglicherweise im Frühling herausbringen wird.

<u>English</u>

Jan and Daan are standing in front of the bookshelf. Jan confirms that Daan will probably publish a new book about himself/him in spring.

The governing category in (18) is the subordinated clause, according to principle A is *Daan* the binder of the reflexive pronoun and *Jan* binds the personal pronoun. In example (19) the reflexive pronoun should be ungrammatical for German (Lee-Schoenfeld, 2008). The governing category constitutes the entire sentence with *Daan* as the SUBJECT that could bind the reflexive pronoun. Thus, the ungrammaticality of the reflexive pronoun in German is not

predicted by principle A. In Dutch, the reflexive pronoun may refer to *Daan*. In the case of the personal pronoun, *Daan* may also be the binder of the personal pronoun in German and Dutch, which is a violation of principle B. In both languages, *Jan* may also bind the personal pronoun.

(19)   Dutch

Jan$_j$ en Daan staan voor de boekenkast. Daan$_i$ bevestigt dat een nieuw boek over zichzelf$_i$/hem$_{i/j}$ mogelijk in de lente zal worden gepubliceerd.

German

Jan$_j$ und Daan stehen vor dem Bücherregal. Daan$_i$ bestätigt, dass ein neues Buch über sich$_{*i/*j}$/ihn$_{i/j}$ möglicherweise im Frühling herausgebracht wird.

English

Jan and Daan are standing in front of the bookshelf. Daan confirms that a new book about himself/him will probably be published in spring.

In line with the example (19) Lee-Schoenfeld (2008) and Kiss (2001, 2008) argue for German that reflexive pronouns cannot be bound across a long distance. Kiss (2008) demonstrates this with the examples (20) to (23). In German in contrast to English binding of the reflexive pronoun by an antecedent across the clause boundary is ungrammatical (20). It is also ungrammatical that a non-c-commanding antecedent binds the reflexive pronoun (21). Also binding outside the same clause is ungrammatical (22) to (23).

(20)   *Ulrich$_i$ war sauer. Ein Bild von sich$_i$ war beschädigt worden

"Ulrich$_i$ was mad. A picture of himself$_i$ had been damaged"

(21)   *Schumachers$_i$ Reklame Vertrag verlangte eine Nacktaufnahme von sich$_i$

"Schumacher$_i$'s advertising contract demanded a nude photograph of himself$_i$"

(22)   *Ulrich$_i$ zeigte Klaus$_i$ einige Bilder von sich$_i$

"Ulrich$_i$ showed Klaus$_j$ some pictures of himself$_{i/j}$"

(23)   *Gernot$_i$ erinnerte sich daran, dass die Zeit ein Bild von sich$_i$ veröffentlicht hatte

"Gernot$_i$ remembered that the Times had published a picture of himself$_i$"

2.1.2   Remarks

A governing category which consists of a governor and a SUBJECT creates a domain where the reflexive pronoun has to be bound and a personal pronoun has to be free (Chomsky,

1981). In some cases, the governing category is not the small clause containing the pronominal element but an element in the next higher clause satisfies the requirement of c-command. Principles A and B may therefore apply. Whereas according to Principle A reflexive pronouns have to be bound within the governing category, personal pronouns have to be free within their governing category. Binding of a personal pronoun with an element which c-commands the personal pronoun in the same governing category is impossible according to Chomsky (1981). As we will see, coindexation of the personal pronoun by an antecedent of the same governing category is sometimes possible as in (24). This seems to be true for Dutch and is debatable for German (Lee-Schoenfeld, 2008, Kiss, 2001). In this example, the personal pronoun *hem* may refer to *Jan*. This is against Chomsky's Principle B. Furthermore, it is problematic for Chomsky's (1981) binding theory that reflexive and personal pronouns are not always in complementary distribution as in (24) already be pointed out by Ross (1982).

(24)   John$_i$ put the book next to him$_i$/himself$_i$

        John$_i$ legde het boek naast hem$_i$/zich$_i$

        John$_i$ legte das Buch neben ihn$_{*i}$/sich$_i$

Principle A is respected in (24) because the reflexive pronoun refers to an element in the same governing category. However, Principle B is violated, because the personal pronoun also refers to an element in the same governing category in Dutch and English. Principle B is not a good description for all usages of personal pronouns.

Even Principle A can be violated as is the case in (25). Chomsky (1981) argued that CP is always the outmost governing category. However, this example demonstrates that CP is not always the governing category for the reflexive pronoun.

(25)   Mary still hadn't decided about birthday presents for the twins$_i$. Tiny gilt-
        framed portraits of [each other]$_i$ would be nice, but there was also that life-size
         stuffed giraffe (Pollard and Sag, 1994)

It has been shown that the binding theory of Chomsky (1981) is not always able to describe the binding behaviour for English and that this theory does not always adequately account to describe the binding of pronominal elements in German and Dutch. Other theories have been put forth which will be discussed in the next section.

2.2 The Reflexivity of Reinhart and Reuland (1993)

2.2.1 SE/SELF/HIM

Reinhart and Reuland (1993) proposed the *Reflexivity*, which takes Chomsky's (1981) *Government and Binding Theory* as its starting point. There are problems with the theory of Chomsky (1981). First, reflexive and personal pronouns have been shown to not always be in a complementary distribution as proposed by Principles A and B. Second, Reinhart and Reuland (1993) show that Chomsky (1981) neglects the differentiation of reflexive pronouns in languages like Dutch. For example, GB of Chomsky (1981) does not capture the existence of two reflexive pronouns. Dutch has two reflexive pronouns *zich* and *zichzelf*. The crucial difference here is that these elements may not always appear in the same environment (26) and (27). In (26) *zich* but not *zichzelf* has to be used and vice versa in (27).

(26) Jan_i schaamt $zich_i$/$zichzelf_{*i}$

John is ashamed himself

"John is ashamed of himself"

Jan_i schämt $sich_i$

(27) Jan_i haat $zich_{*i}$/$zichzelf_i$

$John_i$ hates $himself_i$

Jan_i hasst $sich_i$

In English as well as in German there is only one reflexive pronoun in (26) and (27), namely *himself/herself*[4] in English and *sich*[5] in German. Reinhart and Reuland (1993) call *zich* a SE anaphor, and *zichzelf* a SELF anaphor. They have in common that they are referentially dependent (-R). This means that they cannot refer independently to some entity in the broader discourse. The reason is that they lack a full specification of phi-features. In Dutch *zich* and *zichzelf* lack gender and number, but they are specified for third person. These reflexive pronouns are furthermore not specified for case[6]. The German *sich* is also specified for person only but not for gender and number. In English, *himself/herself* are specified for gender,

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[4] English has one reflexive pronoun which shows a distinction between masculine and feminine gender and person. However, there is no functional difference between them in reference assignment.

[5] In German, reflexive pronouns like *sich selbst/selber* also exist. *Selber* and *selbst* have the function to highlight something. For example, *der Familienvater stürmte die Wohnung, erschoss seine Frau und ihre drei Kinder und richtete anschließend die Waffe gegen sich selbst und erschoss sich* (The father stormed the flat, shot his wife and their three children and then directed the weappon against himself and shot himself). In this specific case I would argue that because of the bizarre situation you would use *sich selbst*. A difference in grammatical function between *sich* and *sich selbst/selber* does not exist for German. *Sich* and *sich selbst* mark the predicate reflexive.

[6] The reflexive pronoun is never nominative case.

person and number, yet they are (–R). English reflexive pronouns cannot be used in Spec-position as in *Himself is eating an apple* which distinguishes reflexive pronouns from personal pronouns which may occur in that position. This explains why reflexive pronouns are (–R) although being fully specified of grammatical features.

Beside their difference in specification, Reinhart and Reuland (1993) point out that SE-reflexives do not have the function to reflexive-mark the antecedent. This becomes clear by comparing (26) to (27). *Zich* and *zichzelf* refer to *Jan*. However, the crucial difference between the structures is that (26) contains a lexically reflexive verb (to be ashamed) whereas in (27) the verb is not lexically reflexive. In other words, a lexically reflexive verb does not need to be reflexive-marked in order to be interpreted reflexively as this property is lexically implemented. SELF is excluded in such a case, as it incorporates a reflexivizing function. A SE-reflexive is allowed since it does not carry this function. Of course, English and German also know lexically reflexive pronouns but because there is only one surface form in both languages, an elaboration on the function of the SE- and SELF-reflexive in English and German is superfluous.

Chomsky (1981) does not present this functional difference of SE- and SELF-reflexives; the reason therefore may be that on the surface it is not visible in English. Nevertheless, it constitutes a problem for his theory. Namely, Principle A does not capture this difference and would therefore allow the appearance of SE- and SELF-reflexives in Dutch in sentences like (26). The SELF-reflexive is not ruled out by Principle A, neither is the SE-reflexive in (27).

Thus, the difference between SE- and SELF-reflexives is, that the SE-reflexive does not have the function to reflexive mark the predicate. This function is also missing for personal pronouns. This is illustrated in (28) and (29). As can be seen, only a SELF-reflexive can mark a predicate reflexively if the predicate is not lexically reflexive.

(28) Jan_i schaamt hem_{*i}
    John is ashamed him
    "John is ashamed"
    Jan_i schämt ihn_{*i}

(29) Jan_i haat hem_{*i}
    $John_i$ hates him_{*i}
    Jan_i hasst ihn_{*i}

A difference between a personal pronoun on the one side and SE- and SELF-reflexives on the other side is that personal pronouns are referentially independent (+R). They are also specified for person (3rd person), number and gender. Additionally, they bear a concrete case. Reinhart and Reuland (1993) argue that reflexive pronouns are referential dependent (-R) because of the absence of a full specification of features. Reinhart and Reuland (1993, 659) provide a table that summarises typological similarities and differences between pronominal elements. Their table is presented as table 2.

Table 2: grammatical function of pronominal elements

	SELF	SE	Pronoun
Reflexivizing function	yes	no	no
R(eferential independence)	no	no	yes

The distinction in function and characteristics of the reflexive pronouns SE, SELF and the personal pronoun has been demonstrated. Now, the Reflexivity of Reinhart and Reuland (1993) will be presented and used to describe the binding behaviour of pronominal elements in Dutch and German.

2.2.2   Condition B

As mentioned before, a problem for Chomsky's (1981) Principles A and B arises if we look at the behaviour of reflexive and personal pronouns in PPs (30) and complex DPs (31).

(30)   Jan$_i$ put the pen next to himself$_i$/him$_i$
         Jan$_i$ legt de pen naast zich$_i$/hem$_i$
         Jan$_i$ legt den Stift neben sich$_i$/ihn$_{*i}$
(31)   Jan$_i$ saw a picture of himself$_i$/him$_i$
         Jan$_i$ zag een beeld van zichzelf$_i$/hem$_i$
         Jan$_i$ sah ein Bild von sich$_i$/ihm$_{*i}$

As said, in Dutch – but not in German – there is a breakdown of the complementarity in distribution of reflexive and personal pronouns in PPs (30) and complex DPs (31). This is not accounted for by Principles A and B (Chomsky, 1981). Reinhart and Reuland (1993) argue that co-argumenthood between the pronominal element and its antecedent is an important factor in explaining the binding behaviour of pronominal elements. Examples (26) and (27)

are co-argumenthood structures. That is, the pronominal elements and the subject *Jan* are arguments of the verb's predicate *schamen* and *haten* and are thus considered as co-arguments. Looking at (30) and (31) a co-argumenthood relation between the pronominal element and the subject *Jan* is not present. *Jan* is an argument of the verb's predicate contrary to the pronominal element which is embedded into a PP in (30) and in a complex DP in (31). Thus, no co-argument relation is present in (30) and (31).

Reinhart and Reuland (1993, p.663) introduce their Condition B that captures the difference in binding of pronominal elements in co-argument structures. Condition B is defined as:

(32)   Condition B

A reflexive-semantic predicate is reflexive-marked.

Definitions

The semantic predicate formed of P is P and all its arguments at the relevant semantic level.

A predicate is reflexive iff two of its arguments are coindexed.

A predicate (formed of P) is reflexive-marked iff either P is lexically reflexive or one of P's arguments is a SELF anaphor.

Condition B is defined over the relation between co-arguments. This means that whenever the pronominal element and a possible antecedent are arguments of the same predicate, then condition B may apply. Condition B defines a predicate only as marked reflexively when these arguments are coindexed and if either the predicate is marked reflexively by SELF-reflexive or the predicate is lexically reflexive. It should be noticed that only Vs can be lexically reflexive. Ns and Ps do not bear this property.

Condition B and its definition will be made more explicit with examples (26) to (31). In (26) the predicate is lexically reflexive and *Jan* and *zich* may be coindexed. Condition B may apply. The SELF-reflexive and the personal pronoun are thus excluded. The SELF-reflexive is excluded because the predicate is already reflexive and the personal pronoun does not have the function to reflexive mark the predicate. Contrary, the predicate in (27) *haten* is not a lexically reflexive predicate and in order to be interpreted reflexively, the SELF-reflexive has to be an argument of the predicate. The personal pronoun and the SE-reflexive do not have the function of marking the predicate reflexive. Thus, *zichzelf* but not *zich* or *hem* has to be used.

In German and English, *sich*/*himself* mark the predicate reflexive. *Ihn*/*him* do not have this function. Condition B is met.

Example (30) is not subject to Condition B. Here, a coargumenthood relation between the subject and pronominal element is not present. The antecedent *Jan* is an argument of the verb's predicate *to put*. The pronominal element is not an argument of this verb's predicate. The preposition *next to* constitutes its own predicate of which the pronominal element is an argument. The PP as a whole is an argument of the verb's predicate *to put*. Condition B does not apply and thus does not rule out the reflexive and personal pronoun in referring to *Jan*. This argumentation holds for German, Dutch and English.

Condition B does not apply for (31) as it only applies to co-arguments. The pronominal element is an argument of the complex DP *a picture of* whereas *Jan* is an argument of the verb's predicate *to see*. *Jan* is thus not an argument of *a picture of*. Therefore, a co-argumenthood relation between the pronominal element and *Jan* does not exist. Condition B is not able to rule out the pronominal element, as it does not apply. Again this is true for German, Dutch and English.

If an argument – a possessor – were added to the complex DP *a picture of* (33), this would change the syntactic environment and (33) would be different to (31) with regard to the binding of pronominal elements.

(33) Jan_i saw $Mike_j$'s picture of $him_{i/?j}$/$himself_{?i/j}$
        Jan_i zag $Mike_j$'s foto $hem_{i/?j}$/$zichzelf_{?i/j}$
        Jan_i sah $Mikes_j$ Bild von $ihm_{i/?j}$/$sich_{?i/j}$

In (33), the pronominal element is still an argument of the DP *a picture of* but this structure differs in so far from (31) as *a picture of* contains a possessor *Mike*. *Mike* is situated in the specifier position of *a picture of* and it is its argument as well. In other words, the possessor *Mike* and the pronominal element combined are arguments of the complex DP *a picture of* and are thus co-arguments. Then Condition B can apply. It rules out the personal pronoun in German, Dutch and English because it does not reflexive-mark the predicate *a picture of*. The predicate is not lexically reflexive which is never the case with DPs, but only with Vs. The SE-reflexive would be allowed if the predicate were lexically reflexive. In all other cases, a SELF-reflexive has to be used in order for the predicate to be interpreted as reflexive-marked. Coindexation of the personal pronoun with *Mike* is ruled out by Condition B. Condition B

does not rule out coindexation of *himself/zichzelf/sich* and *Mike*. These reflexive pronouns mark the predicate reflexive.

In addition, coindexation of the pronominal elements with *Jan* is perfectly fine in (33). Condition B does not apply because a co-argument relation is not present between the pronominal element and *Jan*. *Jan* and the pronominal elements are arguments of different predicates. Coindexation of *Jan* and the reflexive pronoun is nevertheless ruled out, because the co-argument relation between *Mike* and the reflexive pronoun blocks an interpretation towards *Jan*. The personal pronoun may be bound by *Jan* as condition B does not apply. Reinhart and Reuland (1993) argued that all reflexive pronouns which are not subject to Condition B are exempt. A reflexive pronoun is exempt if the reflexive pronoun is not in a co-argument relation with the antecedent as in (34). Coindexation of the reflexive and personal pronoun is free. In Dutch, the reflexive pronoun may therefore refer to *Jan* and the personal pronoun may refer to *Jan* as well. In German, the personal pronoun may refer to *Jan*. The use of the reflexive pronoun is ungrammatical. Reflexivity (Reinhart and Reuland, 1993) thus does not explain the differences of pronominal binding between German and Dutch. Conditions A and B are respected in both languages.

(34) Jan_i said that a picture of him_i/$himself_i$ would be nice

          Jan_i zei dat een foto van hem_i/$zichzelf_i$ mooi zou zijn

          Jan_i sagte, das sein Foto von ihm_i/$sich_{*i}$ schön wäre

2.2.3   Conditions A and B

Reinhart and Reuland (1993) make a differentiation between semantic and syntactic predicates. Semantic predicates correspond to Condition B and syntactic predicates are captured by Condition A.

(35)   Condition A (Reinhart and Reuland, 1993) is defined as:

          A reflexive-marked syntactic predicate is reflexive.

          Definitions

          The syntactic predicate formed of (a head) P is P, all its syntactic arguments, and an external argument of P (subject).

          The syntactic arguments of P are the projections assigned Ө-role or Case by P.

Condition A defines that a predicate is reflexive interpreted if one of its syntactic arguments is reflexively marked.

Conditions A and B apply in (37). Both conditions do not apply in (36).

(36)   There were five tourists in the room apart from myself
(37)   *Five tourists talked to myself in the room

Example (36) is grammatical whereas (37) is not. These structures are not identical. In (37) the reflexive pronoun *myself* is an argument of the verb's predicate *to talk to* and the subject *five tourists* is also an argument of the verb's predicate. Condition A applies because it is a co-argument relation and it rules out coindexation of *myself* and *five tourists*. Condition B equally applies and rules out coindexation because *myself* does not mark *talked to* reflexive. Example (36) does neither apply to Condition A nor to Condition B. *Apart from myself* is an adjunct phrase and thus no argument of the predicate.

Conditions A and B also apply to (38). A syntactic and semantic predicate is formed. The SELF-reflexive marks the predicate reflexive although the predicate is not reflexive. In this case, coindexation is then ruled out by both conditions.

(38)   The queen invited both Max and myself for tea

Conditions A and B do not apply to (39) but to (40).

(39)   Lucie$_i$ saw a picture of herself$_i$
(40)   Lucie saw your$_i$ picture of herself$_{*i}$

The complex DP in (39) lacks an argument with which the reflexive pronoun could be coindexed. Since no co-argument relation is present, Conditions A and B do not apply. In (40) *your* and *herself* are co-arguments of the same predicate. Conditions A and B apply but because of the feature mismatch between elements coindexation is impossible.

The examples of (41) and (42) are all instances of Condition B, but not of Condition A. Condition A does here not apply because the personal pronoun is not coindexed with an argument of *picture*.

(41) Marie$_i$ took a picture of herself$_i$/her$_{*i}$
(42) Jan$_i$ told a story of himself$_i$/him$_{*i}$

Reinhart and Reuland (1993) argue for (41) and (42) that a semantic predicate between the subjectless complex DP and the pronominal element is formed as the position of the possessor is realised, although not visible at the surface, by the subject of the matrix clause. The pronominal element is coindexed with the matrix subject. Then Condition B comes into play ruling out the personal pronouns in (41) and (42). The personal pronouns do not reflexive-mark the predicate *a picture of* which is only the case with the reflexive pronoun because it contains a SELF-reflexive. Reinhart and Reuland (1993) argue that the examples in (41) and (42) should be differentiated from example (31). In (41) and (42) a possessor is present though not visible in the complex DP. Such a situation arises with verbs like *to take*, *to tell* and *to give* as in (41) and (42) but not with verbs like *to see* in (31) or *to hear* as Reinhart and Reuland (1993) argue. Thus, condition B is not subject to (31) as here the complex DP lacks a subject whereas it applies to (41) and (42).

With the examples (40) and (41) Reinhart and Reuland (1993) demonstrate that P and N predicates do not always form a syntactic predicate. V predicates form a syntactic predicate as in (37). P, N and V predicate may form a semantic predicate. This means that whenever a syntactic predicate is formed, a semantic predicate is formed as well, whereas the other way around, this does not hold. Condition A then applies to a subset of the cases of condition B.

2.2.4 Chain Condition

It has already been illustrated that in some cases Condition B does not apply. This is for instance the case in *Jan said that a picture of himself will be nice* or *Jan put the book next to him*. In both cases the pronominal element is not in a co-argument relation so that Condition B may not apply. However, this is not the sole problem Condition B encounters. It also needs to explain why *zich* is allowed in (43), but not *hem*.

(43) Jan$_i$ schaamt zich$_i$/hem$_{*i}$
      "Jan is ashamed"

(44)   Jan$_i$ haat zichzelf$_i$/zich$_{*i}$/hem$_{*i}$
         "Jan hates himself/him"

To recapitulate, at the beginning of this chapter similarities and differences between the SE-reflexive and personal pronouns were presented. Their similarity was, that neither of them has the function of reflexive-marking a predicate. Only the SELF-reflexive has the function to reflexive-mark the predicate. The SE-reflexive differs from personal pronouns and behave like the SELF-reflexive with respect to referential dependency. SE- and SELF-reflexives are referentially dependent (-R), whereas personal pronouns are referentially independent (+R). Taking (43) as an example, *zich* needs to get its grammatical features assigned by *Jan* for its interpretation. The personal pronoun in (43) and (44) bears all its grammatical features and is referentially independent (+R). Reinhart and Reuland (1993) argue, that because of the similarity between the SE-reflexive and personal pronouns in that neither of them marks the predicate reflexively, the latter should be allowed in structures like (43), this is however ungrammatical. In Dutch, the personal pronoun is ruled out in (43) but not by Condition B because the presence of personal pronoun does not violate Condition B. Condition B blocks the appearance of the SELF-reflexive because the predicate is lexically reflexive-marked making the SELF-reflexive superfluous. The SE-reflexive and *hem* are ruled out in (44) by Condition B. The contrast between the SE-reflexive and *hem* on the one side and the SELF-reflexive on the other side with respect to the function of reflexive marking is clearly visible in Dutch, but less visible on the surface for English and German as these languages only have one form for the SE- and SELF-reflexives. The reflexive pronoun in these languages may appear with lexically reflexive and non-lexically reflexive verbs as can be seen in (45) and (46). Thus when only considering English and German, it might be more difficult to discover that Condition B does not apply in contexts like (43).

(45)   Jan$_i$ hasst sich$_i$
         Jan$_i$ hates himself$_i$

(46)   Jan$_i$ schämt sich$_i$
         Jan is ashamed SE

There is another instance where the personal pronoun should be equally possible like the SE-reflexive. Consider (47), these structures are known as Exceptional case marking clauses (ECM)[7].

(47)   Jan$_i$ hoorde zich$_i$/hem$_{*i}$ zingen
       "Jan heard himself/him singing"

In (47) only *zich* may refer to *Jan*. However, both pronominal elements should be allowed to refer to *Jan* because they do not have the function to mark the predicate reflexive. ECM-structures differ from structures like (45) in so far as in ECM there are two predicates one in the matrix clause *horen* and another in an infinitival construction *zingen*. *Zich/hem* in (47) are not arguments of the matrix verb's predicate *horen*, but instead are arguments of the small clause *zingen*. *Jan* is an argument of the predicate *horen*. Condition B cannot rule out the pronominal element referring to *Jan*, because there is no coargument relation. Condition B therefore does not apply. The question that at this point cannot be easily answered is why the reflexive pronoun *zich* may refer to *Jan* whereas the personal pronoun *hem* not. Both pronominal elements are not subject to Condition B and anyway both do not mark the predicate reflexive.

In their *Reflexivity*, Reinhart and Reuland (1993) implemented an additional condition that resolves the problem that *zich* but not *hem* may appear in some environments like ECM. The additional condition Reinhart and Reuland (1993) propose is the Chain Condition which has been adapted from Chomsky (1986). Its definition is given below:

(48)   Condition on A-chains
       A maximal A-chain ($\alpha_1,....\alpha_n$) has
   a. exactly one link – α_1, which is both +R and marked for structural Case – and
   b. exactly one Θ-marked link.

The Chain Condition states that there is a link – a syntactic chain – between two elements. The head of the chain has to be referentially independent (+R) and has structural case. The Chain Condition, contrary to Condition B, neglects the syntactic environment where it applies. Reinhart and Reuland (1993) argue that a chain is a syntactic projection where the

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[7] Exceptional case marking (ECM) means that the pronominal element in an infinitival construction is interpreted as the subject of that clause although this pronominal element is not marked for nominative case.

head of this projection assigns its features to the tailed dependent element and enables interpretation. These elements can be seen as one semantic argument. For a more explicit illustration, take a look at (49).

(49) Jan_i hates $himself_i$

Jan is situated in the head position of the syntactic chain and bears the nominative case. *Jan* is also referentially independent (+R) and with the reflexive pronoun it forms one Ɵ-marked link. Chain formation is possible because the reflexive pronoun is a tailed element of the chain and it is (–R). Feature assignment takes place via this chain.

When considering ECM-structures like (47) repeated here as (50) or small clauses like (51), a problem arises to (b) of the Chain Condition as this condition assumes only one Ɵ-marked link. However, in ECM and small clauses, there are two Ɵ-marked links. Reinhart and Reuland (1993) do not believe that (b) of the General Condition on A-chains should be regarded as being part of the chain theory. They only consider (a) as sufficient. This means that a chain is only properly formed if there is a +R head which also bears case. The reason for excluding (b) of the Chain Condition is that structures like (50) and (51) would violate (b) of the Chain Condition and the personal pronoun could therefore not be ruled out.

(50) Jan_i hoorde [$zich_i$/hem_{*i} zingen]
      Jan heard himself/him to sing
      "Jan heard himself/him singing"
(51) He_i believes [$himself_i$ to be smart]

It thus does not matter that in (50) there are two Ɵ-marked links. In this example the reflexive pronoun *zich* forms a chain with the subject *Jan* whereas *Jan* does not form a chain with the personal pronoun *him*. This is because *Jan* is the head of the chain and *Jan* is (+R) – *Jan* is specified for gender, number and person – and *Jan* is nominative case because *Jan* is in the Spec-position. *Jan* may enter a chain with the reflexive pronoun. The reflexive pronoun *zich* in (50) and (51) is not the head of the chain. It is also (–R); it is not specified for gender and person but for number. A chain between *Jan* and *zich* may be established; a coindexation of these elements is allowed and the reflexive pronoun gets its full specification via this chain. If the personal pronoun in (50) is considered, a chain cannot be established with *Jan*. A chain is

not formed because the personal pronoun is (+R). It has gender, number and person features, and it is case-marked. However, the personal pronoun does not head the chain.

Example (51) is similar to (50). The personal pronoun *he* heads the chain. *He* is (+R) – it inherits number, gender and person features – and *he* is nominative case. It is allowed to head a chain. The reflexive pronoun *himself* may form a chain with *he* for the reasons already discussed for (50).

Another example which is ruled out by the chain condition and not by Condition B is (52). Condition B applies because *himself* and *Jan* are co-arguments. The SELF-reflexive marks the predicate reflexive as is required by Condition B. In other words, this example is perfectly fine with regard to Condition B. However, such a sentence is ungrammatical and needs to be ruled out. The Chain Condition rules out coindexation of the reflexive pronoun and *Jan*. The reflexive pronoun *himself* heads the chain. This is a violation of the Chain Condition because the reflexive pronoun is (-R). But an element that is (+R), is required to head a chain.

(52) $Himself_i$ hates Jan_i

A further example of a violation of the Chain Condition constitutes (53). There are two elements in the chain that are (–R) and not marked for case. The chain condition therefore blocks chain formation between these elements because the requirement that the head has to be (+R) is not met. Condition B does not rule out coindexation. The reflexive pronouns are co-arguments of the same predicate *to hate* and the SELF-reflexive marks the predicate reflexive. A problem for Condition B could be that *to hate* is reflexive-marked twice. Double reflexive-marking is superfluous. *Zichzelf* has already been ruled out by Condition B in *Jan schaamt zichzelf* because the predicate is lexically reflexive so that reflexive-marking by SELF is superfluous.

(53) $Himself_i$ hates $himself_i$

As can be seen in (54) the reflexive pronoun may refer to *Jan* in Dutch, German and English. In contrast to the examples already discussed, here the Chain Condition does not apply to English and Dutch. Condition B does not apply because it only applies to co-arguments and the Chain Condition does not rule out the personal pronoun in the PP in (54), because the preposition and verb do not form a thematic complex (Reinhart and Reuland, 1993, p.702). In German, the personal pronoun may not refer to *Jan* in (54). The reflexive pronoun must refer

to *Jan*. Reuland (2011) argues for German that the Chain Condition in (54) applies. His argument is that V *legen* and P *neben* assign case to the complement *sich*/*ihn* of P. V license case. There is thus a grammatical relation between *legen* and the pronominal elements and therefore the Chain Condition may apply.

(54) Jan_i put the pen next to $himself_i$/him_i
       Jan_i legde de pen naast $zich_i$/hem_i
       Jan_i legte den Stift neben $sich_i$/ihn_{*i}

It can be argued that an equal situation arises for (55). Condition B does not apply to (55). There is no co-argumenthood-relation between a pronominal element and a possessor within the complex DP, as there is no possessor present. A semantic predicate is therefore not formed. The Chain Condition does neither apply for Dutch, nor for English because there is no structural relation between the pronominal element and V. German is different from Dutch and English. Here, the personal pronoun may not refer to *Jan*. The Chain Condition may apply because of the same reason as proposed in (54). There could be a structural relation between the pronominal element and V.

In the presence of a possessor (56), condition B and the chain condition both apply. A semantic predicate is formed of *Jack* as an argument of *picture* and the pronominal element being also being an argument of *picture*. In all three languages Condition B would allow coindexation of the reflexive pronoun with *Jack* as both are co-arguments. The reflexive pronoun SELF marks the predicate reflexive. Coindexation of *Jack* and the personal pronoun is ruled out. The personal pronoun lacks the function of reflexive-marking the predicate. The Chain Condition also applies. It rules out the personal pronoun as both elements are (+R) and accounts for the coindexation of the reflexive pronoun with the possessor. The reflexive pronoun is (–R) and may enter a chain with the possessor.

(55) Jan_i saw a picture of $himself_i$/him_i
       Jan_i zag een foto van $zichzelf_i$/hem_i
       Jan_i sah ein Foto von $sich_i$/ihm_{*i}

(56) Jan_i saw $Jack_j$'s picture of $himself_j$/him_i
       Jan_i zag $Jack_j$'s foto van $zichzelf_j$/hem_i
       Jan_i sah $Jacks_j$ Foto von $sich_j$/ihm_i

In the beginning of this section, it has been pointed out that the Chain Condition applies to contexts where Condition B is unable to rule out coindexation as in (58). The question arose why the personal pronoun is not allowed in such a context, whereas the reflexive pronoun is. It is a co-argument structure and Condition B should equally allow both as both do not mark the predicate reflexive as in (57). Condition B rules out coindexation of the SE-reflexive and the personal pronoun with *Jan* as *haten* is not lexically reflexive and needs to be reflexive marked by the SELF-reflexive. *Zichzelf* reflexive-marks the predicate and is thus in line with Condition B. The Chain Condition rules out the personal pronoun only, as *zich* and *zichzelf* both do not violate the Chain Condition.

(57)   Jan$_i$ haat zichzelf$_i$/zich$_{*i}$/hem$_{*i}$

The Chain Condition allows the formation of a chain of the SE- and SELF-reflexives with *Jan* and rules out chain formation between *Jan* and *hem*. SE- and SELF-reflexives are both –R allowing a chain between them and *Jan*. The personal pronoun is (+R) and therefore a chain is impossible. The same situation arises with (58). Again, the Chain Condition does not block the SE or SELF-reflexive as both are (-R) and may therefore enter a chain. The Chain Condition rules out *hem* as otherwise a chain with two (+R) elements would be formed. Only condition B rules out the SELF-reflexive since the predicate is reflexive-marked rendering the SELF-reflexive as a violation.

(58)   Jan$_i$ schaamt zich$_i$/zichzelf$_{*i}$/hem$_{*i}$

2.2.5   Summary

The theory of Reinhart and Reuland (1993) has been discussed in depth. Their theory differs from Chomsky (1981) in so far, as the Reflexivity is concerned with the reflexive-marking of pronominal elements in a co-argument relation as in (1) repeated here as (59).

(59)   John saw him/himself

Reflexive marking of the predicate is described by Condition B. Cases of reflexive usage as in (60) where Condition B does not apply can thus be explained and do not pose a problem for the *Reflexivity* theory (Reinhart and Reuland, 1993). For such an example of reflexive usage, Reinhart and Reuland (1993) argue that reflexive pronouns are free to operate.

(60)   There were five tourists in the room apart from myself

Further, Reinhart and Reuland (1993) take a broader cross-linguistic perspective in their Reflexivity. Whereas Chomsky (1981) mainly concentrates on English, Reinhart and Reuland's (1993) theory also includes languages like German, Dutch and Icelandic with the advantage that their theory does not posit a complementarity in distribution for reflexive and personal pronouns which is argued for in Principles A and B (Chomsky, 1981). The absence of complementarity of distribution has been argued for by Ross (1982).

2.3   Pollard and Sag (1994): HPSG

2.3.1   Some criticism with regard to Chomsky (1981)

Pollard and Sag also recognise that the theory of Chomsky (1981) has some problems explaining all circumstances of binding behaviour of pronominal elements, at least for English. Pollard and Sag (1994) offer some examples to show that Principles A and B of Chomsky's (1981) binding theory are inadequate, examples are inaccurately ruled out, or are even not considered under Principles A and B. Examples (61) to (62) illustrate this problem.

(61)   [The children]$_i$ thought that [each other's]$_i$ pictures were on sale (Pollard and Sag, 1994, p.244)

(62)   Mary still hadn't decided about birthday presents for the twins$_i$. Tiny gilt-framed portraits of [each other]$_i$ would be nice, but there was also that life-size stuffed giraffe (Pollard and Sag, 1994, p.245)

(63)   Jan$_i$ knew there was a picture of himself$_i$ in the post office

In (61) the antecedent *the children* is the subject of the matrix clause and thus *the children* c-command *each other*. The requirement of c-command is thus fulfilled, but still the sentence is ungrammatical. In (62) the coindexation of the antecedent *twins* with *each other* is a violation of Principle A (Chomsky, 1981) because there is no c-command and the elements are not within the same clause. *The twins* is also the object and fails to c-command *each other*. As well, example (63) is perfectly grammatical in English but would be ruled out by Principle A as it lacks a local binder.

2.3.2   Binding theory by Pollard and Sag (1994)

Next, the binding theory of Pollard and Sag (1994) will be presented, which combines parts of the theory of Chomsky (1981) with the parts from Reinhart and Reuland (1993). First, Pollard

and Sag (1994) make predictions concerning pronominal binding with respect to obliqueness of arguments which is comparable to the term co-argument used in Reinhart and Reuland (1993). Their theory only operates on arguments. This implies that their theory does not explain instances of reflexive usage in the examples (61, 62). Pollard and Sag (1994) call these reflexive pronouns exempt from principle A as they are not locally o-bound since a potential antecedent is not available. Therefore, the reflexive pronoun may be coindexed with a non-local antecedent since principle A does not apply. Second, the theory of Pollard and Sag (1994) is similar to the theory of Chomsky (1981) in that it also implements Principles A, B and C as well as o-command and o-binding – all aspects being comparable to Chomsky (1981).

Pollard and Sag adapted for their theory Principles A, B and C. They define the binding principles as follows:

(64)   Binding Principles

Principle A: A locally o-commanded anaphor must be locally o-bound

Principle B: A personal pronoun must be locally o-free

Principle C: A nonpronoun must be o-free

The principles A and B distinghuish reflexive pronouns from personal pronouns. Reflexive pronouns must be bound in the sentence, but personal pronouns must be free. These principles do not differ from Chomsky's (1981) principles of binding.

Now, o-command and o-bind need to be defined.

(65)   Obliqueness-command (o-command) (Pollard and Sag, 1994, p.253):

Let Y and Z be synsem[8] objects with distinct LOCAL values, Y referential.

Then Y o-commands Z just in case Y locally o-commands X dominating Z

Pollard and Sag (1994) state with o-command that Y and Z were arguments of a predicate. Y is the head and o-commands Z, which is referential. Z is a more oblique argument than Y. Y is a less oblique argument and o-commanded by a more oblique argument.

(66)   Obliqueness-binding (o-binding) (Pollard and Sag, 1994, p.254):

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[8] Synsem is a fusion of the words syntactic and semantic.

34

Y (locally) o-binds Z just in case Y and Z are coindexed and Y (locally) o-commands Z. If Z is not (locally) o-bound, then it is said to be (locally) o-free

Pollard and Sag (1994) express with o-binding that an element is only bound when it is also o-commanded otherwise it must be free local binding.

Pollard and Sag (1994) theory can explain pronominal usage in (67) and (71). Here, the pronominal elemet has a co-argument and is o-commanded and therefore o-bound by this element. In (68), (69) and (70) the pronominal elements do not enter a co-argument relation so that the pronominal elements are free to operate.

(67)   John saw him/himself

(68)   John put the pen next to him/himself

(69)   John saw that a picture of him/himself was taken

(70)   John saw that Nick took a picture of him/himself

(71)   John saw that Nick's picture of him/himself was hanging on the wall

2.3.3   Non-syntactic factors influencing binding of pronominal elements

Pollard and Sag introduced the term exempt for reflexive pronouns which are not subject to principle A as the reflexive pronoun is not locally o-commanded and also not locally o-bound by an antecedent for (61) to (63). This does not mean that the coindexations are ungrammatical. Pollard and Sag (1994) argue that the coindexations in these examples can be better explained by non-syntactic factors.

Pollard and Sag (1994) argue that there are at least five non-syntactic factors which have an impact on the interpretation of such exempt reflexive pronouns. The first factor is animacy. The exchange of an animate DP by an inanimate DP as in (72) would improve the acceptability *Jan* as the binder of the reflexive pronoun.

(72) Jan_i suspected that **the silence** meant that [a picture of $himself_i$] would soon be on the post office wall

A second possibility is of exchanging the second animate DP by an expletive intervenor (73) and (74). This would improve the acceptability of *Jan* as a non-local binder of the exempt reflexive pronoun.

(73)   Jan$_i$ thought that **nothing** could make [a picture of himself$_i$] in the Times
            acceptable to Marie

(74)   Jan$_i$ suspected that **there** would soon be [a picture of himself$_i$] on the post
            office wall

A third alternative to improve the acceptability of a non-local antecedent as the binder of an exempt reflexive pronoun is to change the determiner of the complex DP. A definite determiner instead of an indefinite determiner influences the acceptability (75).

(75)   Jan$_i$ suspected that the silence meant that [**the** picture of himself$_i$] with
            Gorbachev had already gone to press

A fourth factor influencing the acceptability towards a non-local antecedent of an exempt reflexive pronoun is the factor point of view. Pollard and Sag (1994) argue that an exempt reflexive pronoun often prefers to take as its antecedent an antecedent whose point of view is expressed explicitly. In (76) *Jan*'s point of view is expressed so the exempt reflexive pronoun *himself* may refer to *Jan*. In (77) the point of view of *Marie* is expressed. Therefore, the exempt reflexive pronoun is illicit, as it does not refer to *Marie*.

(76)   Jan$_i$ was going to get even with Marie. [That picture of himself$_i$] in the paper
            would really annoy her

(77)   *Marie$_i$ was quite taken aback by the publicity Jan was receiving. [That picture
            of himself$_i$] in the paper had really annoyed her

In order to improve the acceptability of (77) the exempt reflexive pronoun *himself* has to be changed into a personal pronoun (78).

(78)   Marie was quite taken aback by the publicity Jan$_i$ was receiving. [That picture
            of him$_i$] in the paper had really annoyed her

According to Pollard and Sag (1994), the last factor to influence the acceptability of exempt reflexive pronouns are English psych verbs. The thematic role of experiencer is assigned to the object. Thus, the viewpoint of the object *Jan* is being expressed (79) to (81). Here *Jan*'s

point of view is expressed and which improves his acceptability of being the binder of the exempt reflexive pronoun.

(79)   [The picture of himself$_i$] in the paper bothered Jan$_i$

(80)   [The picture of himself$_i$] in the paper dominated Jan$_i$'s thoughts

(81)   [The picture of himself$_i$] in the paper made Jan$_i$'s day

2.3.4   Summary: Pollard and Sag (1994)

The theory of pronominal binding by Pollard and Sag (1994) has only shortly been described to give a better picture of theories developed to describe the binding of pronominal elements. However, this theory has not be discussed exhaustively since only the theories of Chomsky (1981) and Reinhart and Reuland (1993) will be applied further. The theory by Pollard and Sag (1994) makes use of Principles A and B and of the obliqueness of arguments. This positions their theory between the theories of Chomsky (1981) and Reinhart and Reuland (1993).

2.4   Comparison of Chomsky (1981), Reinhart and Reuland (1993) and Pollard and Sag (1994)

Three theories of pronominal binding have been elaborated on extensively. These theories are grounded in theory very differently. Chomsky's theory (1981) of pronominal binding is based on structural aspects like c-command, principle A and principle B, whereas the Reflexivity of Reinhart and Reuland (2001) is semantic in nature as it departs from the availability of co-argumenthood. Pollard and Sag (1994) made up their theory from Principles A and B but this theory is restricted to co-arguments. Due to these differences the theories apply differently, as can be seen in table 3. In table 3, some examples for English, German and Dutch are provided. Only examples that have been investigated in this research are shown. For each theory, it is indicated which principles and conditions apply.

Table 3: Comparison of Government and Binding, Reflexivity and HSPG

Example	Chomsky (1981)	Reinhart and Reuland (1993)	Pollard and Sag (1994)
The man$_i$ saw him$_{*i}$/himself$_i$	Principles A/B	Conditions A/B, Chain Condition	Principles A/B

The man_i put the pen next to him_i/himself_i	-	No Conditions A/B, Chain Condition	-
The man_i saw a picture of him_{*i}/himself_i	Principles A/B	No Conditions A/B, Chain Condition	No Principles A/B
Daniel_i saw Jack_j's picture of him_{i/*j}/himself_{*i,j}	Principles A/B	Conditions A/B, Chain Condition	Principles A/B
Daniel_i confirmed that a book about him_i/himself_i will be published	No Principles A/B	No Conditions A/B, Chain Condition	No Principles A/B

• "-" means that the principles do not apply

2.5 Reuland (2001) Primitives of Binding

Three linguistic theories dealing with the behaviour and interpretation of pronominal elements have been presented and applied to Dutch and German. Until this day, there seems to be no consensus of what factors best describe binding in and across languages. The next theory which will be discussed is Primitives of Binding (Reuland, 2001). This theory is concerned with the representation of pronominal elements and proposes a hierarchy of costs involved in the additional interpretational strategies for the computational system. Reuland (2001) thereby distinguishes three possible operations: processes in narrow syntax, processes involving the C-I interface and discourse storage. Processes in narrow syntax are automatic and therefore cheap. Processes in the C-I interface are automatized but not to the extend as processes in the narrow syntax. Processes that involve the discourse are most costly as an antecedent of the pronominal element has to be established from the preceding context. Saying it differently, computations in narrow syntax are cheaper than computations at the C-I interface or at the discourse level.

The question is: Under which circumstances can a pronominal element be interpreted by chain formation – that is, narrow syntaxand when in dicsourse? The economy hierarchy proposed by Reuland (2001) assumes syntax as the preferred operation to resolve pronominal elements whenever possible. Operations at the C-I interface and operations at the discourse level are thus dispreferred. An operation at the C-I interface is preferred over a discourse operation when processes at narrow syntax are not possible. A discourse operation is only taken when narrow syntax and the C-I interface are not accessible. Reuland's (2001) economy hierarchy is based on assumptions about the representation of pronominal binding which had been put forth by Reinhart and Reuland (1993). The representation model thus concentrates on the

representation of pronominal elements in a co-argument relation. The economy hierarchy is based on that representation.

It has been argued that in (82) Condition B and the Chain Condition apply for English, German and Dutch.

(82) Jan_i saw him_{*i}/$himself_i$
         Jan_i zag hem_{*i}/$zichzelf_i$
         Jan_i sah ihn_{*i}/$sich_i$

In a co-argument relation like (82) syntax can be used to resolve the binding of the reflexive pronoun. An interpretation in narrow syntax is possible. Processes in narrow syntax are only possible for the reflexive pronoun and not for the personal pronoun as the latter have to be resolved in discourse.

Pronominal elements in PPs (83) cannot be resolved in narrow syntax. It has been shown that Condition B does not apply for Dutch and English because there is no co-argument relation between the pronominal element and *Jan*. The pronominal elements do not enter a grammatical relation with the predicate. The reflexive and personal pronoun have therefore to be processed in discourse. For German, Reuland (2011) argues that the pronominal element enters a grammatical relation with the V-system. There is a structural relation. Condition B applies in German. Processes at narrow syntax or at the C-I interface are possible.

(83) Jan_i put the pen next to him_i/$himself_i$
         Jan_i legde den pen naast hem_i/$zich_i$
         Jan_i legte den Stift neben ihn_{*i}/$sich_i$

Binding of the reflexive and personal pronouns in (84)[9] cannot be described by condition B nor by the chain condition as there is no co-argument relation between the pronominal element and another element present. The personal pronoun cannot be syntactically encoded anyway and the reflexive pronoun is considered as exempt. Exempt reflexive pronouns behave like personal pronouns and are interpreted alike.The discourse conditions however, are more stringent.

(84) Jan_i said that a picture of him_i/$himself_i$ would be nice

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[9] Thanks for Reuland for discussion of these examples 84-86 in detail.

Jan$_i$ zei dat een foto van hem$_i$/zichzelf$_i$ mooi zou zijn

Jan$_i$ sagte, dass ein Foto von ihm$_i$/sich$_{*i}$ schön wäre

A syntactic operation can be used to process the reflexive pronoun in (85). The DP *a picture of* constitutes a semantic predicate of which the pronominal element and *Mark* are co-arguments. Condition B applies. *Mark* may not bind the personal pronoun but the reflexive pronoun. Reuland (2011) is aware of research that has shown that the reflexive pronouns may also be bound by the subject *Jan* (Runner, Sussman, Tanenhaus, 2002, Keller and Asudeh, 2001) that is in violation with Condition A. "Reuland (2011) discusses the type of variation found in the binding properties of SELF-anaphors in nominals, and suggests that the main factor is the eventiveness of the head noun. The picture noun is not eventive; consequently *himself* in (85) is exempt from condition A and can be bound either locally by *Mark*, or by the farther away *Jan*. For reasons discussed in Reuland (2011), *zichzelf* and *sich* cannot be exempt. Hence in both Dutch and German the more remote element *Jan* is not available as an antecedent. In all cases binding of the pronominal by the possessor is ruled out by the chain condition" (Reuland, 2016, personal communication).

A syntactic operation cannot be applied in (86) to process the reflexive pronoun. Condition B does not apply to (86) since no semantic predicate is formed, and the chain condition does not rule out one of the potential antecedents since both are too far away. Put it differently, both *Mark* and *Jan* could bind the pronominal elements. The reflexive pronoun *zichzelf* and *sich* are not exempt so that only the nearest subject, *Mark*, can function as antecedent. In Durch, neither condition B nor the chain condition apply, meaning that the personal ponoun can be bound by *Jan* and *Mark*. Binding of thee personal pronoun differs in German as it cannot be bound by *Mark*.

(85)   Jan$_j$ said that Mark$_i$'s picture of him$_{*i/j}$/himself$_{i/*j}$ would be nice

Jan$_j$ zei dat Mark$_i$'s foto van hem$_{*i/j}$/zichzelf$_{i/*j}$ mooi was

Jan$_j$ sagte, dass Marks$_i$ Foto von ihm$_{*i/j}$/sich$_{i/*j}$ schön war

(86)   Jan$_i$ said that Mark$_j$ saw a picture of him$_{i/*j}$/himself$_{*i/j}$

Jan$_i$ zei dat Mark$_j$ een foto van hem$_{i/*j}$/zichzelf$_{*i/j}$ zag

Jan$_i$ sagte, dass Mark$_j$ ein Foto von ihm$_{i/*j}$/sich$_{*i/j}$ sah

In summary, Reuland (2001) introduces an economy in interpreting pronominal elements. With this economy, he argues that depending on the type of pronominal element and the type of structure the pronominal element appears in, there are different operations available to represent the pronominal elements, which differ in costs for the processing system. Reflexive pronouns can be resolved via chain formation or at the C-I interface whereas personal pronouns always have to be resolved either via a coreference interpretation or as a bound variable. This means that personal pronouns should be more costly than reflexive pronoun resolved in narrow syntax or at the C-I interface, but personal pronoun should be as costly as exempt reflexive pronouns.

2.5.1 Empirical evidence in support of an economical hierarchy in the processing of pronominal elements

There has been research testing the predictions of the economy hierarchy provided by *Primitives of Binding* (Reuland, 2001). Koorneef (2008), Korneef, Avrutin, Wijnen and Reuland (2011), Piñango and Burkhardt (2005) and Schumacher, Piñango, Ruigendijk and Avrutin (2010) showed that reflexive pronouns in a co-argument relation were read faster than reflexive pronouns in a non-co-argument relation, like pronominal elements in a PP. The authors take these faster reaction times as an indication that reflexive pronouns in a co-argument relation can be resolved by a syntactic operation whereas all other reflexive pronouns must be interpreted via a bound variable or discourse structure. Fewer steps in the interpretation process are required for a syntactic operation. It has also been shown (Baauw, 2002, Philip and Coopmans 1996, Ruigendijk, Baauw, Zuckerman, Vasic, de Lange, and Avrutin, 2011) that pronominal elements in a co-argument structure were acquired earlier than pronominal elements in ECM-structures. Jakubowicz (1984) and Chien and Wexler (1990) furthermore showed that reflexive pronouns were acquired earlier and mastered better than personl pronouns in a co-argument structure and that the mastery of pronominal elements in ECM-structures took longest cross-linguistically. Although on the surface the structures look similar, it has been shown that in ECM the antecedent and the pronominal element are not co-arguments. The repeated observation of those differences indicates different processing demands imposed by the complexity of pronominal element in a particular structure.

3 L2 sentence processing and comprehension

The aim of this chapter is to present and discuss models of language comprehension, representation, processing and localisation in L1 and L2 speakers. First, a short general overview of two approaches to sentence comprehension will be given. These approaches differ in the assumption of how and when during comprehension linguistic strategies will be applied. Second, it will be shown which strategies L1 speakers apply to comprehend sentences. Thereafter, a bridge will be built to language processing and comprehension in L2 speakers. Some factors though are assumed to cause differences between L1 and 2 speaker's processing. Those will be elaborated on. Next, several models to the processing in L2 speakers will be presented to show which strategies L2 speakers apply in contrast to L1 speakers. At last, studies that investigated pronoun comprehension and processing in L1 and L2 speakers will be presented and discussed.

3.1 Principle-based processing vs. constraint-based models

Before any theories of sentence processing in L2 are presented, it is necessary to elaborate on the general dicsussion of sentence processing theories, since they are based on different assumptions concerning the question which strategies are applied, and at which point during the processing.

Harrington (2001) discusses two different approaches to sentence processing: principle-based models such as proposed by Frazier (1987) and Frazier and Fodor (1978), and constraint-based models as introduced by Trueswell and Tanenhaus (1994) and MacDonald (1993). Principle-based models take as their starting point, that syntax precedes all other operations in representation and interpretation, whereas constraint-based models assume a co-occurrence of different operations with the strongest constraint being satisfied. In other words, principle-based models expect a successive progression of strategies interacting independently of each other whereas constraint-based models assume an interactive nature of the relevant processes. Processing might also be influenced by algorithms, heuristics and representations. Algorithms are formal rules such as IF-THEN rules. Heuristics such as minimal attachment guide the processor towards the simplest interpretation of a syntactic structure. Representations are set up by rules of grammar and non-linguistic knowledge.

Principle-based models assume that there is a first parse of the input. At this stage only syntax is considered. When the syntactic parse is finished, lexical, semantic and discourse information bear on the interpretation of the input sentence. Constraint-based models assume the interplay of syntactic, lexical, semantic and pragmatics constraints. Thus, there is no serial ordering of the constraints. The constraints interact leading up to an interpretation and also to

block interpretations. Different interpretations can be set up by the processing system and the interpretation with the greatest activation will be chosen.

A problem in validity of principle-based models could arise, when research shows that syntax does not play a primary role in sentence comprehension. According to Reuland (2001), the processing of syntax should be less costly than the processing of discourse. It has been assumed that reflexive pronouns – but not personal pronouns in a co-argument relation can be processed by a syntactic operation. Syntax should be preferred as it involves fewer computational steps. However, when for instance self-paced reading studies show that there are similar reaction times for reflexive and personal pronouns in a co-argument relation, this implies that that processing did not only make use of syntax alone. An interplay of syntax and discourse can be assumed with both strategies being applied immediately and not in a sequential order. The application of different processing strategies possibly results in equal reaction times for reflexive and personal pronouns in a co-argument relation. In contrast to that, faster reaction times for reflexive pronouns in a co-argument relation compared to personal pronouns in the same structure would provide evidence that syntax precedes all other operations in processing.

There is also another way to see if in the processing of pronominal elements a syntactic operation is applied before any other operations or if different operations were applied altogether at the same time. This can be done by varying information in the discourse. In (87) a reflexive pronoun has to be processed and in the discourse (lead-in sentence) there is only one antecedent, *the biologist*, that can function as antecedent for this pronominal element. The subject *me* cannot be a binder of the reflexive pronoun because of the person mismatch.

(87)   De bioloog en ik$_{*i}$ stonden in de tuin. De bioloog$_i$ die veel studies deed naar apen verbaasde zich$_i$ terwijl de vogels een vrolijk liedje floten

The biologist and me were standing in the garden. The biologist who did a lot of studies on apes was astonished and at the same time the birds were singing a happy song

The processing of only one possible antecedent will be compared to the processing of reflexive pronouns with two possible antecedents such as (88). If a syntactic operation will be applied before other operations, processing differences should not exist. Only if a discourse operation is applied first or early in processing, processing differences could arise.

(88)   De bioloog en de scheikundige$_i$ stonden in de tuin. De bioloog$_i$ die veel studies

deed naar apen verbaasde zich terwijl de vogels een vrolijk liedje floten

The biologist and the chemist were standing in the garden. The biologist who

did a lot of studies on apes astonished and at the same time birds were singing

a happy song

According to Reinhart and Reuland (1993), a syntactic operation can be applied to resolve the reflexive pronoun. The amount of antecedents available in discourse should not impact processing, as a syntactic operation does not consider structurally inaccessible antecedents since these are aspects that are relevant for a discourse operation. If syntax precedes all other operations a self-paced reading study should show similar reaction times, independently of number of antecedents available in discourse. Such a result would point into the direction that syntax only is applied and would therefore support the assumption of principle-based models. If the self-paced reading study shows that it takes longer for reflexive pronouns to be processed with two possible antecedents, this would support constraint-based models since it would show, that the presence of two possible antecedents compared to only one possible antecedent impacts processing. Then discourse immediately comes into play and is not postponed until later.

In the next section a specific model to sentence comprehension will be presented that assumes an interaction of syntactic and non-syntactic factors in the comprehension of active, passive and relative clause sentences. For the interpretation of a sentence like (89) both syntax and world knowledge can be used for interpretation.

(89)   The man bit the dog

3.2   Model of Comprehension

This section deals with the studies that aimed to describe, how L1 speakers consult an interpretation of a sentence. This provides an insight into what sentence comprehension looks like in L1 speakers. The results brought up by these studies led Ferreira, Bailey and Ferraro (2002) to develop the Good-Enough hypothesis that assumes that the comprehension system constructs a representation that does not consist of a detailed hierarchical structure. According to this hypothesis, the made up representation requires the least possibe effort, because other demands on the comprehension system have to be satisfied continually.

3.2.1 Good enough hypothesis

The Good-Enough hypothesis (GE) which has been put forward by Ferreira et al. (2002), is a model of language that decribes how L1 speakers comprehend language. The GE is similar to the SSH (Clahsen and Felser, 2006) and these models differ from each other in one important aspect that the GE assumes shallow processing in L1 speakers. Shallow processing is not assumed by the SSH for L1 speakers. It is therefore interesting to introduce this theory and later on discuss the results in light of these two (GE and SSH) models.

The Good-Enough hypothesis (GE), presented by Ferreira et al. (2002), assumes that sentence comprehension in L1 speakers is in a sense shallow. In this respect, the term shallow means that a detailed representation of the incoming sentence is not consulted. A representation is constructed which is in terms gathered from linguistic and world knowledge. The resulting representation is not necessarily consistent with the actual input. GE can be classified as a constraint-based model. Ferreira et al. (2002) developed the GE on the basis of research that concentrates on sentence comprehension in L1 speakers. These studies will be presented next. Ferreira and Stacey (2000) investigated the comprehension of passive sentences like (90) with the result, that this sentence was hard to understand because world knowledge interfered with grammatical structure.

(90)   The dog was bitten by the man

World knowledge tells us that it was *the dog that bit the man* but not *the dog that the man bit*. This passive sentence seemed even harder to understand than active sentences like (91) although both sentences are equally plausible and both express the same content. In both implausible sentences, *the dog* was the agent of the action and *the man* was the patient.

(91)   The man bit the dog

Thus, semantic role assignment cannot be the problem. Syntax can also be excluded because a more plausible sentence like (92) was comprehended well.

(92)   The man was bitten by the dog

Ferreira et al. (2002) assumed that the comprehension process is influenced by world knowledge rather than by syntactic structure. Active sentences seem to impose fewer problems because in sentences such as (93) although *the man* is not the subject of the sentence

and also not the agent. In the passive sentences such as (94), the role of the theme and subject is fulfilled by *the dog*, while *the man* is the agent. Semantic and syntactic information do not match in active and passive sentences, but only the latter seem to pose a problem for the comprehension system.

(93)   The man bit the dog

(94)   The dog was bitten by the man

Ferreira, Engelhardt and Jones (2009) compared the comprehension of ambiguous sentences such as (95) with non-ambiguous sentences like (96).

(95)   Put the book on the chair in the bucket. Then click on the balloon

(96)   Put the book that's on the chair in the bucket. Then click on the balloon

While hearing the sentence, participants either saw a two referent display (a picture with a book and a picture with a chair with a book on it) or a one referent display (a picture with the book on the chair). Participants made more comprehension errors with the ambiguous sentence, which was interpreted by the authors as an indication for the application of a GE-interpretation. Ferreira et al. (2009) argued that the participants had to process more than just the ambiguity, so that reanalysis did not take place directly. With eyetracking, it has been possible to discover that in the one referent display most looks were directed towards the target, whereas in the two referent display the distractor was often fixated. According to the authors' interpretation, visual information does not help if comprehension demands are high. Ferreira (2003) (see also Ferreira and Patson, 2007) compared the comprehension of active and passive sentences using decision accuracy and reaction time studies. The active and passive sentences could either be plausible or less plausible and reversible (the dog bit the man/the man bit the dog), semantically normal or anomalous and non-reversible (the mouse ate the cheese/the cheese ate the mouse) and symmetrical (the woman visited the man/the man visited the woman). Participants were always less accurate in understanding passive sentences which, as Ferreira (2003) argued, results from the problem of matching the syntactic positions and the thematic roles. Ferreira (2003) also tested the comprehension of subject-cleft sentences like (97) in comparison to passive sentences like (98)

(97)   It was the man that bit the dog

(98)   The dog that was bitten by the man

Ferreira (2003) pointed out that subject-cleft sentences are less frequent in the input and if frequency matters, this structure should be harder to understand than passive sentences. Again, these sentences could either be plausible and reversible or not. Here as well, passive sentences were understood worse. Frequency of structure thus seemed not to influence the comprehension, but rather thematic role assignment. She then also compared the comprehension of subject-cleft sentences to active sentences and did not find an effect, once more indicating that frequency is not a factor that has an impact on comprehension. At last, Ferreira (2003) compared the comprehension of passive sentences to object-cleft sentences like (99) and found that both structures were comprehended equally well. Thus, the differences in surface structure did not have an impact on comprehension. She concluded that sentences containing an agent in subject position and a patient placed in the object position were comprehended better than any structure neglecting this order. This finding has already been made earlier by Grodzinsky, Pierce, Marakovitz (1991), Grodzinsky (1995), Caplan, Baker, Dehaut (1985) and Friedmann and Shapiro (2003).

(99)   It was the dog the man bit

Ferreira (2003) and Ferreira and Patson (2007) concluded from their studies that the comprehension process can be described not only as driven by syntax or semantics, but rather by a constraint-based approach – that is the combination of syntax and semantics. They further argued, that whenever comprehension demands were high, the representation of the input was sometimes shallow and inconsistent with the input. During comprehension, a GE-representation of the current input was consulted due to the pressure in a normal conversation setting. Little time to process the input can result in a simplified and incorrect representation. These studies have shown that in L1 sentence comprehension a hierarchical analysis of the incoming input is not consulted. Sentence comprehension rather seems to be superficial in the sense, that the least possible effort is made for interpretation, and that non-linguistic information like plausibility/world knowledge is used for sentence comprehension. Departing from these results, Ferreira et al. (2002) presented the GE, which assumes that sentence comprehension can be shallow and incomplete. GE describes that during comprehension an interpretation of an ambiguous sentence is consulted, which is not consistent with the actual sentence. The comprehension system seems to consult little information for interpretation

(Ferreira and Patson, 2007). Often the interpretation is consistent with the knowledge of the world (Ferreira, Engelhardt & Jones, 2009).

Applying the GE to the comprehension of pronominal elements, it could not be assumed that reflexive pronouns should be comprehended quicker than personal pronouns since a hierarchical analysis should not be conducted. A difference in syntactic position of the pronominal element in a co-argument structure and a PP should not influence comprehension as the pronominal elements were always the object. GE only makes predictions with regard to comprehension. So nothing can be said about processing of pronominal elements.

3.3 Critical period, age of acquisition, transfer and proficiency

Above, it has been described how sentences were comprehended by L1 speakers. The next step is to show how this is done by L2 speakers. The following section focuses on adult L2 speakers. This means that the comprehension and processing of the L2 has been acquired after puberty and thus demands a seperate description. The literature on L2 acquisition generally assumes that factors like the endowment of a language faculty (critical period), age of acquisition[10], proficiency and transfer have an impact on sentence comprehension and processing. These factors were argued to be able to explain the differences that exist between L1 and L2 speakers in this field.

3.3.1 Critical period and age of acquisition

Lenneberg (1967) suggested that there is a biological endowment, that makes it possible to acquire language in general. The time between birth and late childhood is called critical period[11]. It is assumed that language acquisition after the critical period becomes more and more effortful which also entails that language acquisition after that point is not as successful as before. The ultimate attainment may be not quite L1-like[12]. According to current research, a critical period is seen as being responsible for the success in acquiring a language. A critical period is defined as "a peak period of plasticity, occurring at some maturationally defined

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[10] Critical period and age of acquisition will not be used synonymously. The Critical period is a time window in which language learning is assumed to be unproblematic. The Age of acquisition is the specific time in life when someone started learning a language.

[11] The term critical period is nowadays rarely used. The term implies that there is an abrupt offset in the ability to learn. For language acquisition this means that language acquisition is successful only within this critical period and that afterwards acquiring a language is impossible. However it is well known that language can be learned throughout life. This has led researchers (Johnson and Newport, 1989, Oyama (1976) and Patkowski (1980)) to introduce the term sensitive period, which is a weaker notion to describe the decrease in ability to acquire a language. According to the sensitive period, there is no abrupt offset in the acquisition of a language and it may proceed until adulthood.

[12] White (2006) assumes that the availability of UG (universal grammar) constitutes this language endowment. Principles and parameters are present and can be set according to the input. The question raised by White (2006) is, whether the UG is also available to L2 speakers who start learning a language after puberty. To White (2006), it seems quite reasonable to assume that L2 acquisition is also determined by UG, at least partially.

time in development, followed by reduced plasticity later in life. In contrast, in many domains and systems, there may be plasticity uniformly throughout life (open-ended learning), or plasticity may increase with age as experience or higher-level cognitive skills increase" (Newport, Bavelier & Neville, 2001, p.482).

Assumptions surrounding the critical period would be falsified, if one found that L2 speakers who started learning their L2 after puberty could actually reach an L1-like competence. Surely, with this research it is not possible to invalidate the critical period hypothesis as we only investigate a single part of language. Nevertheless, this research can provide useful insights regarding the question whether a critical period is present in the domain of syntax. If the results of eyetracking and self-paced reading should reveal, that eye movements and reaction times were different for L1 and L2 speakers, this would point into the direction of the existence of a critical period. It can be assumed that the representation and processing of language in L1 and L2 speakers is different.

Newport et al. (2001) further argued that the ultimate L2 proficiency level someone can achieve depends on age of acquisition. Thus, is it impossible to reach L1-like competence after a certain age of acquisition? Newport et al. (2001) raised the question if there is one critical period or if there are multiple critical periods. If there is only one critical period, all domains of language should be equally affected. If there are, on the other hand, several critical periods, language domains should be affected differently over time. A decline of proficiency leading to the inability to reach L1-like competence may already be present at four to six years of age, and even later. If syntax has an early critical period, maybe already in childhood, learning an L2 as an adult should thus result in incomplete acquisition of syntax. Newport et al. (2001) pointed out that some aspects of syntax may be learned after the critical period such as word order, but that other aspects are more vulnerable to age of acquisition. Newport et al. (2001) as well as Hyltenstam and Abrahamsson (2006) and Selinger (1978) assumed, that there is not only one specific critical period for the acquisition of language, but several critical periods with different durations and cut-off points. Johnson and Newport (1989) showed in their studies that morpho-syntax can be acquired up to the age of 7 years. Oyama (1976) argued that there is a correlation between the age of acquisition and proficiency level with the L2. This means, the younger someone starts learning a language, the likelier this person is going to achieve a high proficiency level. Butler (2000) has shown that young learners of an L2 performed differently from L1 speakers who started learning from birth. Thus, the capacity to acquire a language L1-like is subject to maturation.

Lenneberg (1967) equalises the end-point of the critical period with the completion of lateralization.

The assumption of a critical period for language acquisition is also proposed by Ullman (2001). He assumed that age of acquisition and practice with the L2 are crucial factors that might influence the learning, representation and processing of language. He furthermore argued that learning of grammar in adult L2 is not impossible, but computed and represented differently in L1 and L2 speakers. Moreover, Newport et al. (2001) discussed the questions if firstly, a critical period exhibits an abrupt decline in learning a language so that an L2 late learned in life will never be learned in an L1-like fashion and secondly, if instead of a critical period interference from L1 to L2 causes the problems in L2 speakers. Newport et al. (2001) proposed that critical periods vary in length with early developing systems having short critical periods and late-developing systems displaying long critical periods. Newport et al. (2001) also argued along the same lines when they assume that some language domains may not be affected by the critical period. However, it should be noticed that the ultimate attainment that L2 speakers can achieve, varies to a great extent. The difference between L1 and L2 language acquisition can be described in terms of L1 acquirers having a language endowment availabe, whereas adult L2 speakers have a greater verbal memory and a high verbal analytical ability (DeKeyser, 2000). L2 speakers may also benefit from their knowledge of the L1, which might however hinder the L2 acquisition.

3.3.2 Transfer

Transfer can generally be defined as forms and functions of the L1 that are taken over into the L2 (Gass, 1979) and more concrete as "The influence of the Native Language of the language learner on his/her performance in the second language. Positive Transfer, which consists in characteristics of the two languages that are similar, is claimed to facilitate performance in the second language whereas Negative Transfer, respects in which the two languages differ, is claimed to interfere with performance" (Ritchie and Bhatia, 1996, 704).

Schlachter (1983) described transfer as the influence of existing knowledge on the acquisition of a language. Existing knowledge can be any language that the speaker commands and even the language, which is now the target language. Kellerman (1979, 1983) furthermore made the point that perception of the distance between L1 and L2, as well as the markedness of an L1 structure determine what is actually transferred. Consider the cross-linguistic difference in reference resolution of personal pronouns in PPs in German and Dutch. Coming from their L1, German, they perceive from the input that in Dutch the personal pronoun may refer to the subject as in (100).

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(100)   Jan legte het boek naast hem

"Jan put the book next to him"

This reference, however, is not allowed in German. The L2 speaker has to recognize that such a reference in their L2 Dutch is possible. The L2 speaker might fail to recognize this difference and therefore may never be able to acquire it. Markedness of an L1 structure could be interpreted in such a way that L2 speakers of Dutch with German as L1 might have problems in recognizing, that in PPs the personal pronoun may refer to the subject since the German structure is more marked for these speakers.

According to Sabourin (2003), there are three kinds of transfer – full, partial and no transfer. No transfer claims, that the acquisition of the L2 is not influenced by properties of the L1. Thus, there is no transfer taking place. Partial transfer refers to the possibility of initially transferring some properties of the L1 into the L2. Lastly, full transfer means that the initial L2 acquisition process is determined by properties of the L1. It is clear that the transferred structures from the L1 to the L2 depend on the L1, be it in full, or partial transfer. Hence, L2 speakers from different L1s may transfer different properties into the L2. Coming back to the pronoun example from above, we could make assumptions about the behaviour of German speakers with Dutch as their L2. In Dutch (as well as in English), PPs may be bound sentence internally by the subject. In German, however, this is not possible. As a consequence, the L2 speakers of Dutch with German as their L1 might chose to bind the PP to an antecedent outside of the sentence, which is the only valid option they know. In contrast, English L1 speakers might bind the Dutch PPs to both a sentence internal- and external pronoun since both options are available in their L1.

The question can be asked of the impact that the L1 has on the learning, representation and processing of the L2. Eubank (1993) argued, that lexical and functional projections can indeed be transferred whereas morphological information does not transfer. Schwartz and Sprouse (1996) argued that initially all of the principles and parameter settings of the L1 will be transferred into the L2 and that at a later stage of language acquisition, these principles and parameters will be reset. This change may be determined by the input, the L1, UG and the learnability. Schwartz and Sprouse (1996) argued, that the mechanisms guiding L1 acquisition are the same in the L2 acquisition process because universal principles do not change. Schwartz and Sprouse (1996) explored the acquisition of word order – placement of adverbs – in the L2, and found that the L1 principles and parameters were indeed transferred into the

L2, at least initially. In contrast to those findings, Håkansson, Pienemann, Sayehli (2002) found, that although the L1 and L2 were both V2 languages, there was initially no V2 pattern present in the L2 output. Furthermore, Clahsen and Muysken (1986) showed that L2 speakers did not rely initially on transfer of the syntactic structure from L1 to L2, but were aware of the L2 word order. Turkish L2 speakers of German, although both languages are SOV languages, initially produced V2 structures. Perani, Dehaene, Grassi, Cohen, Cappa, Dupoux et el. (1998) also argued against transfer playing a role in L2 acquisition. The authors concluded that the absence of any transfer effects might be due to proficiency (for more details of Perani et al. (1998) see section 3.4.1.2). A somewhat different starting point to the investigation of the role of transfer was taken by Müller (1998), who argued that transfer will be applied whenever the input is ambiguous. In German, word order is verb second in main clauses and the verb is sentence final in subordinated clauses. However, sometimes verbs in subordinated clauses can be moved to the second position as in (101).

(101)   Ich mag Nebensätze, weil sie sind so kompliziert

        I like subordinated clauses because they are so difficult (Müller, 1998)

Müller (1998), after considering data, came to the conclusion that English is not influenced by transfer from German ambiguous subordinate clause types. However, the formation of subordinated clauses in German is erroneous. Müller (1998) concluded that there are two grammatical representations, one for each language. For German, the parameter has to be set, which takes more time than parameter setting in a language with a clear value.

Gass (1979) found, that knowledge about and production of relative clauses is only partially determined by transfer, namely if features across L1 and L2 were shared, which contrasts the study of for example Håkansson et al. (2002). A common pattern for L2 speakers from different L1s emerged, indicating that rather the UG than the native language constrained their behaviour. Obviously it does not play a role whether the L1 and the L2 share the same features, or not.

Transfer effects have been found in several studies. Zdorenko and Paradis (2008) and Goad and White (2008) found, that L2 speakers with no articles in their L1 could use articles in the L2, but their performance was worse than that of such L2 speakers who do have articles in their L1. Transfer effects have also been attested by White (1985), who found that Spanish L2 speakers did not recognize the omission of pronominal elements in English, thus applying the

pro-drop parameter to English, which is a violation of the English grammar. This mistake was present especially for the low proficiency group.

Vainikka and Young-Scholten (1996) and Hawkins and Chan (1997) attested transfer effects for syntactic structures, but only for beginning L2 speakers. Additionally, the study of Leung (2003) confirmed transfer effects, however, here the role of the L2 on the acquisition of the L3 was investigated. Leung (2003) investigated the possibility of transfer of features like finiteness, agreement and past tense of the L2 English on the acquisition of the L3 French. The L1 was Chinese and all participants were advanced speakers of English and had differing proficiency levels in their L3 French. English and French dispose subject-verb agreement, finiteness and past tense, but these features are stronger morphologically realized in French. For the low proficiency group, there were transfer effects of the L2 into the L3 for finiteness, agreement and past tense. The intermediate group applied finiteness, agreement and past tense continually to L3 and the advanced group performed L1-like. These results show that transfer is present but declines with increasing proficiency. In addition, the L1 Chinese seemed not to influence the L3. Similar to Leung (2003), White (2003) also found transfer effects in the field of inflectional morphology even after years of exposure in the L2. She also came to the conclusion that shared values in L1 and L2 facilitate the acquisition of features as was earlier proposed by Gass (1979).

The studies that were presented showed, that transfer is sometimes present in L2 speakers, but there is not much evidence of the presence of transfer. Transfer seemed to be applied when languages were related but relatedness of languages did not lead automatically to transfer.

3.3.3 Proficiency

Several studies have reported effects of proficiency in L2 language acquisition with low proficiency L2 speakers differing from highly proficient L2 speakers (White, 1985, Hawkins and Chan, 1997, Leung, 2003). Low proficiency L2 speakers rely more on the L1 than highly proficient L2 speakers. Concerning the localization of language, Abutalebi, Rosa, Ding, Weekes, Costa and Green (2013) investigated how proficiency in L2 affects the neural representation of language. They therefore compared L2 speakers with different proficiency levels in their ability to switch from L1 (most proficient) to L2 (less proficient)/L3 (least proficient) or in the other direction. The study showed that proficiency played a role in the neural representation of the L2 and that proficiency affects its localization.

McLaughlin, Tanner, Pitkänen, Frenck-Mestre, Inoue, Valentine and Osterhout (2010) discussed some of their own studies (e.g. Tanner, Osterhout, & Herschensohn, 2009) and

found that proficiency affects the way language is processed and further, that knowledge and processing strategies of the L1 were not applied in the L2. Agreement violation like (102) elicited a P600 effect for advanced L2 and L1 speakers. Intermediate L2 speakers showed N400/P600 effects. It seems that proficiency affects the processing in L2 speakers. L2 speakers with a good command of the L2 were able to process like L1 speakers. L2 speakers with a low proficiency in the L2 cannot process L1-like.

(102)   Ich wohnt in Berlin (I live_{3pers.} in Berlin)

In summary, it seems that proficiency is a factor that influences the L2 acquisition process. A higher proficiency in the L2 might allow more complex input to be more accurately parsed under the assumption that L2 speakers use syntactic parsing. Therefore, proficiency influences processing or automaticity of processing. If we consider the processing of pronominal elements in Dutch by German L2 speakers, it can be assumed that highly proficient L2 speakers will be different from low proficiency L2 speakers, as the latter have little experience/practice with the L2 and might rely more on their L1. Highly proficient L2 speakers might be faster in the processing of pronominal elements, meaning that they show faster RTs while reading pronominal elements. It can also be argued that proficiency inhibits transfer from L1 into L2. As has already been shown, there are differences between German and Dutch reference resolution in PPs. In (103) the personal pronoun may refer to *Jan* in Dutch which is contrary to the binding in German. Proficiency might supress influence of the L1, meaning that only the reference possibilities for Dutch were activated, leading to faster RTs for the highly proficient L2 group compared to the low proficiency L2 group. A high proficiency in L2 places these speakers closer to the L1 speakers and distinguishes them from low proficiency L2 speakers, who – in turn – are different from both groups.

(103)   Jan legde het boek naast hem
        "Jan put the book next to him"

Proficiency may have an impact on the processing even if the L1 and L2 behave similarly as in the reference of pronominal elements in a co-argument relation. In (104) the reflexive pronoun refers to *Jan* which is impossible for the personal pronoun. Maybe, with a high proficiency only the grammatical system of the L2 is activated. The L1 is not activated or inhibited. Low proficiency L2 speakers with an incomplete grammatical knowledge of the L2

might use both languages in processing. Differences in processing could lead to differences in RTs.

(104)   Jan haat zichzelf/hem

"Jan hates himself/him"

3.4   Models of language representation and processing

L2 acquisition is affected by several factors like transfer, age of acquisition and proficiency, which do not play a role in L1 acquisition. These factors thus may affect the L2 acquisition process, but they do not yet explain differences between L1 and L2 speakers. In line with that, the following section goes into greater detail about the differences in the processing between L1 and L2 speakers.

Models with the focus on language representation and processing of an L2 will be presented. These models are the Declarative and Procedural Model (Ullman, 2001), the shallow structure hypothesis (Clahsen and Felser, 2006), the Convergence Hypothesis (Green, 2003) and the Competition Model (MacWhinney, 2008). These models assume differences in language representation and processing which are due to the factors described above.

3.4.1   The declarative and procedural model (DP-model) (Ullman, 2001)

Ullman (2001) proposed the declarative and procedural model (DP-model) that he uses to describe the processing, representation and localization of language in L1 and L2 speakers. He assumes two memory systems. The declarative memory system is responsible for the "learning, representation, and use of knowledge about facts ("semantic knowledge") and events ("episodic knowledge") (Ullman 2001, p.106). Arbitrarily related information may also be stored in the declarative memory system. Concerning language, the declarative memory system is capable of the learning, the representation and the use of lexicon, pronunciation and semantics and all information that is not rule-based. The neural bases of the declarative memory system are the medial temporal lobe regions.

The procedural memory system is in charge of "the learning of new, and the control of long-established, motor and cognitive "skills" or "habits" (Ullman 2001, p.106). The procedural memory system is subserved by frontal/basal-ganglia circuits. With regard to language, it is responsible for the learning, the representation and use of grammar, which includes all linguistic domains like syntax, phonology and morphology. Ullman (2001) does not introduce any rules and does not distinguish between syntactical, phonological or discourse rules. This makes it difficult to explain which pronominal element – reflexive or personal pronoun – causes difficulties in the processing. Personal pronouns are resolved by syntactical and discourse rules and reflexive pronouns primarily by syntactical rules. PoB of Reuland (2001)

can here be used to examines this more specifically than can be done on the basis of DP. Reuland (2001) distinguishes between syntactic and discourse processing, the latter causing more processing demands. If this holds for the processing of reflexive and personal pronouns, then personal pronouns should evoke higher costs than reflexive pronouns.

To make the DP-model more explicit, consider the processing of reflexive pronouns in a co-argument structure (Jan hates himself/him). It has been assumed that reflexive pronouns in such a structure can be processed with a syntactic operation. The antecedent and the reflexive pronoun form a chain. According to the DP-model, this operation takes place in procedural memory, because as a grammatical process it is not affected by explicit knowledge from declarative memory. Personal pronouns however cannot be processed via such a syntactic operation. These have to be processed in discourse. Thus, the interpretation of personal pronouns is guided by explicit decisions, meaning that all available persons from the discourse have to be considered and features have to be checked. In addition, information provided by the sentence (verbs favouring an interpretation) influences the choice of the antecedent. Thus, it can be said that a grammatical rule/process is not used. The declarative memory is capable of reference resolution in the case of personal pronouns.

Ullman (2001) argues that there are four specifications distinguishing the DP-model from other models. The first specification is that the DP-model assumes two cognitive systems. The DP-model is a dual and not a single mechanism model. It entails the declarative memory system and the procedural memory system. Both have distinct neural correlates. A second difference between this model and the other models is, that the DP-model postulates, that computation is different in declarative and procedural memory. The declarative memory is an associative memory whereas the procedural memory is a symbolic memory. Furthermore, the DP-model puts forward that each system has a specific function. In the declarative memory, everything belonging to the lexicon and all lexical knowledge is stored, learned, represented and processed. Everything which can be built up by a rule is learned, represented and located in the procedural memory system. Another aspect that distinguishes the DP-model from other models is that it makes precise predictions about the localization of the two memory systems. The declarative memory is located in temporal/temporo-parietal structures whereas the procedural model is situated in left frontal/basal-ganglia structures.

3.4.1.1 DP-model adapted to L2

General assumptions about the functioning of the DP-model have been exemplified and now this model will be discussed in the light of the learning, representation and processing of an L2 in comparison to an L1. For L1 language acquisition, Ullman, Corkin, Coppola, Hickok,

Growdon, Koroshetz and Pinker (1997) initially discussed that language is mapped into two different brain regions. The lexicon is considered to be stored in the declarative memory and the grammar in the procedural memory. Later, Ullman (2001) recognized that the learning, representation and processing of language may be different for L2 speakers compared to L1 speakers. The difference between L1 and L2 speakers might stem from the fact that L2 acquisition succeeds L1 acquisition. A language system is available which might affect and interfere with L2 learning, representation and processing. For this purpose, Ullman (2001) reviewed studies about L2 acquisition and processing (for example Birdsong, 1999; Johnson and Newport, 1989) and noticed that the acquisition of grammar is more affected in older language learners as well in L1 and L2 speakers than the acquisition of lexical knowledge. Ullman (2001) concluded from these findings that age of acquisition – in this case acquiring a language in late childhood/early adulthood – plays a crucial role in L2 acquisition. This is a major difference between L1 and L2 acquisition. This distinction between lexicon and grammar has implications for the DP-model. In L2 speakers, the declarative memory system should be intact and open to access because acquiring lexical knowledge does not seem to pose any problems for L2 speakers. The access to the procedural memory system however seems to be more problematic/less available leading to problems in the acquisition of grammar. The result is that the end-state of L2 acquisition is not L1-like. In contrast, L1 speakers do not suffer from problems concerning lexical and grammatical knowledge and therefore the DP-model assumes that L1 speakers have access to declarative and procedural memory for their L1. Thus, the DP-model makes different predictions with regard to L1 and L2 speakers' language representation and processing.

The question arises, what causes the differences between L1 and L2 speakers and why only grammar is affected.[13] The age of acquisition of the L2 has already been introduced as a distinguishing factor. Yet, age alone is not a satisfactory explanation. Ullman (2001) provided the explanation that there is a maturational change involved[14]. This implies, that before the maturational change, language should be learned identically in L1 and L2 speakers. No serious problems should arise and the mastery of language with an L1-like competence should be possible. The time before the maturational change is termed critical period. The DP-model thus assumes that tasks involving the procedural memory should be difficult to learn after the end of the critical period, leading to qualitative differences between L1 and L2 speakers.

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[13] To provide any answers to this question is not the purpose of this research. It is not the aim to explore why grammar and not the lexicon poses problems in L2 acquisition.

[14] It is not under the scope of this research to discover the reason that causes the maturational change. It seems sufficient to assume that after a certain point in life, the organization of language changes.

Concerning grammar, which, according to Ullman (2001), is processed in procedural memory, he (2001) does not assume that it can no longer be learned by L2 speakers, but rather that the procedural memory is no longer available or only partially available for this purpose. He proposed that the problem of accessing the procedural memory can be circumvented by letting the declarative memory take over the function of the procedural memory. It should be kept in mind, that the declarative memory system is associated with the acquisition and representation of primarily lexical knowledge. L2 speakers who learn an L2 after the critical period should therefore rely to a greater extend on the declarative memory for the acquisition of grammar compared to L2 speakers learning an L2 before puberty, or L1 speakers. The declarative memory system is not the place where grammar is processed. Other operations that are not used in the procedural memory might be operating in the declarative memory.

Consider the acquisition of regular and irregular verbs. Regular verbs can be made up by a rule. Irregular verbs are not formed by a simple rule and therefore need to be stored in the declarative memory in both L1 and L2 speakers. The formation of regular verbs can be computed in the procedural memory. The rule underlying the formation can be stored. This way there is no need to recognise each verb form individually. If the access to the procedural system is not available for L2 speakers, this system does not support the acquisition of regular verbs. In spite of the procedural memory, the declarative memory can take over the function of the procedural memory in L2 acquisition. However, this is not a rule system meaning that the formation of regular verbs is not guided by this underlying rule. In the declarative memory, knowledge is conscious. It could be possible to store all regular verb forms or the rule underlying its formation so that regular verb forms can always be made up by explicitly using this rule. Even though L1 and L2 speakers make use of different memory systems when processing grammar – and consequently use different strategies – this does not mean, that the outcome is different in L1 and L2 speakers.

From the perspective of the DP model it can be argued that reflexive and personal pronouns are processed in the declarative memory of L2 speakers. Reflexive pronouns in a co-argument relation could in principle be processed in procedural memory, but because of the problem of the availability of this system, a syntactic chain between the pronominal element and the antecedent is impossible for L2 speakers. The declarative memory is not a rule system, which implies that a syntactic operation cannot be performed. The reflexive pronoun has to be processed by a discourse operation in the declarative memory. Features of the reflexive pronoun can be checked against all DPs. Additionally, information provided by the sentence can be used to guide interpretation. L1 speakers are not assumed to make use of such

information, as they are thought to have access to procedural memory and therefore be able to run a syntactic operation. Reuland (2001, 2011) assumed that a syntactic operation is cheaper, because it involves fewer computational steps. The consequence may be that reflexive pronouns could be processed faster than personal pronouns in L1 speakers, but not in L2 speakers. The personal pronoun in both L1 and L2 speakers has to be processed by discourse, which is done in declarative memory. The pronominal element might correctly be resolved, but different operations might be at work.

Ullman (2001) is not stating that L2 speakers, who started learning the L2 after the critical period, will never be able to access the procedural memory, nor does he assume that it is impossible for L2 speakers to reach L1-like competence. He emphasizes that practice with the L2 could affect the working of the DP-model. L2 speakers with more practice in the L2 are argued to be able to access the procedural memory for processing grammar. This implies that highly proficient L2 speakers should then not be different from L1 speakers in the processing, representation and localization of grammar and lexicon. In other words, Ullman (2001) makes the point that L2 speakers having learned a language after the critical period will initially rely more exhausively on the declarative memora for lexicon and grammar than young L2 and L1 speakers. Later, a shift is in principle possible, if the L2 speakers have had enough practice with the L2. With regard to the processing of pronominal elements, this implies that highly proficient L2 speakers should be able to access procedural memory and therefore process reflexive pronouns in a co-argument structure with a syntactic operation. Highly proficient L2 speakers' processing should be similar to that of L1 speakers.

Summarizing, the DP-model makes the assumption that the separation between the declarative and the procedural memory is less clear in L2 speakers than it is in L1 speakers. Furthermore, the processing of grammar in L2 speakers should, at least in the initial stages of L2 acquisition, be done by the declarative memory. The assumption with regard to L2 processing is, that low proficiency L2 speakers' processing of lexicon and grammar should not show a division of labour between the declarative and procedural memory. The division in functioning of the DP-model is thus assumed in highly proficient L2 speakers only. Lexical knowledge should be represented, processed and located in the declarative memory and grammar in procedural memory.

3.4.1.2   Discussion of the DP-model
Next, the prediction of the DP-model that L1 and L2 speakers will be different from each other will be more deeply elaborated. Various studies with the focus on the acquisition of

grammar and lexicon will be presented. First, studies supporting the DP-model will be presented and after that, studies that argue against the DP-model will be discussed.

There are a number of studies that showed that regularly formed forms (walk – walked) were made up by a rule, whereas irregular forms were stored (go – went) in L1 speakers (Bybee & Moder, 1983; Bybee & Slobin, 1982, Halle & Mohanan, 1985, Hoard & Sloat, 1973) which supports the assumption of the working of the DP-model.

The study of Baayen, Dijkstra and Schreuder (1997) investigated the representation in L1 speakers with the aim to explore, if singular and plural words were stored (lexical entry), or if they were always made up by a rule. Furthermore, they were interested in frequency as a factor involved in representation. The results showed that singular nouns were always processed equally fast, regardless of their frequency. In the case of plural nouns, highly frequent plural nouns were reacted to faster than low frequency plural ones. Therefore, it seems likely that plural nouns, at least high-frequency plurals, were stored, and not generated by a rule every single time. This study supports the DP-model for L1 speakers. However, there seems to be a distinction in the representation of plural nouns. Highly frequent plural nouns seem to be stored in procedural memory but not low frequent plural nouns. The formation of these plural nouns is regular, which means that it follows a rule, which is stored in procedural memory. However, it seems that frequency influences the way of how words were represented. Highly frequent plural nouns have a lexical entry but not low frequent plural nouns. Baayen's et al. (1997) finding that highly frequent plural nouns were reacted faster to shows, that a lexical search process precedes a rule formation process.

For L2 speakers, behavioural studies (Weber-Fox and Neville, 1996) have shown that grammatical performance was worse in L2 speakers compared to L1 speakers, and that even L2 speakers' judgements on syntactically ill-formed sentences were worse if the speakers were exposed to an L2 later in life than early in life.

Furthermore, researchers considered other factors than proficiency and age of acquisition to be responsible for differences in the representation of language between L1 and L2 speakers. Paradis (1994) and Fabbro (2000) have found that an L2 is represented in the cerebral cortex if this language is learned in a formal school setting and more widely represented in subcortical brain regions if it is learned informally like the L1. Thus, the way an L2 is learned seems to be a factor that causes differences between L1 and L2 speakers. Paradis (1994) and Fabbro (2000) do not directly contribute to the assumptions of the DP-model. Nevertheless, they point into the direction, that differences between L1 and L2 speakers exist.

A closer look at the localisation of lexical and syntactic knowledge in L1 speakers is provided by the study of Bhatnagar, Mandybur, Buckingham and Andy (2000). They found that morpho-syntax is located in the frontal, parietal and temporal cortex and lexical-semantics is associated with the temporo-parietal cortex. The authors concluded from these results that at least these domains of language were subserved by distinct brain regions. These outcomes also support the claims of the DP-model, as there is a distinction between lexicon and grammar.

With regard to L2 acquisition, the study of Abutalebi (2008) provides important insights into the impact of proficiency on language representation and localization in L1 and L2 speakers. Abutalebi (2008) argued that localization of language is the same in L1 and L2 for grammar and lexicon. Initially, there may be some activation differences in the prefrontal cortex between L1 and L2 speakers, but when the proficiency increases in the L2, this activation decreases so that L1 and L2 speakers converge in their neural activation. This result underpins the assumption of the DP-model, that proficiency/practice with the L2 plays a major role in L2 acquisition in so far, that it opens access to procedural memory. In line with Abutalebi (2008), Chee, Tan and Thiel (1999) showed by employing fMRI that both L1 and L2 speakers activated the left prefrontal region in a word stem completion task. Ullman (2001) argued that the frontal region is the brain structure, which is subserved by the procedural memory. In contrast to Abutalebi (2008), Chee et al. (1999) did not argue that proficiency gives access to procedural memory but they pointed out the importance of age of acquisition instead. Thus, the localisation of language is differently and partially overlapping with L1 speakers, which supports the DP-model.

Studies have also shown that localization patterns in L1 and L2 were the same, although in L2 speakers there is more variation (Dehaene, Dupoux, Mehler, Cohen, Paulesu, Perani, van de Moortele, Lehericy, & Le Bihan, 1997). In the study of Dehaene et al. (1997), subjects listened to stories in either their L1 or their L2. Stories told in L1 elicited brain activity in the left temporal lobe as well as activation near the intersection of the inferior frontal sulcus and precentral sulcus. Listening to stories in the L2, most L2 speakers also showed activation of the temporal lobe, but this activation was not as wide-spread as in L1 speakers. In L2 speakers, activation was smaller in the temporal lobe and activation was also found in the right temporal lobe. Some L2 speakers also showed activation in Broca's area and in the inferior precental sulcus, left and right anterior cingulate. Dehaene et al. (1997) concluded that the observed variability in L2 speakers may arise because of the application of different language processing strategies, differences in brain organization and age of acquisition.

The factors age of acquisition and proficiency were looked at in more detail in Perani et al. (1998), who investigated auditory sentence processing in L2 speakers from different language backgrounds (Italian-English and Catalan-Spanish) while listening to stories in the L1 and L2. The L2 speakers differed with respect to their age of acquisition, but all had a high proficiency level. Perani et al. (1998) compared the results with Perani, Paulesu, Galles, Dupoux, Dehaene, Bettinardi, Cappa, Fazio, Mehler (1996) who tested L2 speakers with a low proficiency level. Both high proficiency groups showed the same activation pattern in the cortical region, but differed from the low proficiency group. Perani et al. (1998) interpreted this result as an indication, that the level of proficiency, but not the age of acquisition is a determining factor in L2 localization. Furthermore, they denied the influence of transfer from the L1 on the L2, meaning that regardless of the distance between L1 and L2, the same activation pattern arises. Perani et al. (1998) concluded from the results of the low proficiency group that various brain regions were activated to be able to manage the L2. After a certain threshold, if proficiency is high, L2 language representation resembles that of the L1. Thus, proficiency as well as practice with the L2 affect the working of the declarative and procedural memory. This contradicts the results of Dehaene et al. (1997), who found an effect of age of acquisition.

Further support for proficiency as an important factor in L2 representation comes from Bowden, Steinhauer, Sanz and Ullman (2013). In an ERP-study they investigated how lexical/semantic and syntactic violations were processed in the L1 by low and advanced L2 speakers. They found a dissociation between the L1 and L2 speakers' processing of syntax, at least in the initial stages of L2 acquisition. Low proficiency L2 speakers showed other ERP responses than L1 speakers, higher proficiency L2 speakers seemed to go into the direction of L1 speakers, as their ERP responses are similar. Bowden et al. (2013) argued that highly proficient L2 speakers and L1 speakers engage the same neurocognitive system in processing syntax, that is the procedural memory system and the low proficiency group relies on another neurocognitive system, which processes syntax in a different way. That is the declarative system. For lexical-semantics, all groups, independent of proficiency, show the same ERP responses indicating that they made use of the same underlying neurocognitive system in this domain. Because different ERP-results were detected for grammar and lexicon, the authors took this as an indication that there are two systems responsible for language processing.

Differences in representation between L1 and L2 speakers were also reported by Osterhout and McLaughlin (2000). They showed that L2 speakers displayed an N400 or no effect for semantic and syntactic anomalies whereas L1 speakers showed an N400 for semantic and a

P600 for syntactic anomalies. This study supports the assumption of the DP-model, that L1 speakers represent language differently from L2 speakers. Other ERP-studies have found that the early anterior negativity was absent or located in the right-hemisphere in L2 speakers, which was found in L1 speakers in left frontal structures (Friederici, Hahne, & Mecklinger, 1996, Hahne & Friederici, 1999, Friederici, von Cramon, Kotz, 1999).

Evidence for the DP-model has been put forward, but there is also evidence against it. Hahne, Müller and Clahsen (2006) showed that regular and irregular verbs were processed differently in L2 speakers; a dissociation that was also found for L1 speakers (Baayen et al., 1997). Clahsen and Felser (2006) argued that the DP-model does not account for this distinction, as the DP-model would assume no distinctive representations for regular and irregular verbs. Both should be processed in the declarative memory. Clahsen and Felser (2006) also criticized Ullman's (2001) notion that the access to the procedural system is less available for L2 speakers. They would like to know what exactly less available means.

3.4.2 The Shallow Structure Hypothesis (Clahsen and Felser, 2006)

The next model which will be discussed is the shallow structure hypothesis (SSH) proposed by Clahsen and Felser (2006). It clearly differs from the DP-model, as it does not try to link language to specific regions of the brain. Its aim is to describe how language is represented and which strategies were employed in L2 speakers compared to L1 speakers. The SSH differs from the DP-model (Ullman, 2001) in so far as it is a purely psycholinguistic model which thus does not incorporate neurolinguistics. It also differs from the DP-model because it does only assume problems to syntax (syntactic computation), leaving other parts of grammar spared. The SSH thus predicts that syntax is problematic/shallow in L2 speakers but not in L1 speakers, meaning that all other domains should not be affected differently in L1 and L2 speakers.

By the term *shallow* Clahsen and Felser (2006) mean, that syntactic structure building in L2 speakers does not consist of a fine-grained syntactic in depth analysis as is build up in L1 speakers. L2 syntactic structure building seems to be less detailed, as it does not depend on syntactic processes but on non-syntactic operations like lexical, semantic and pragmatic information. Thus, the processes in L1 and L2 speakers in analysing syntax are argued to be different. This does not imply that the outcome of the different strategies will differ, solely that the processes that are employed are not the same. Clahsen and Felser (2006) point out that a syntactic structure building process can only be applied if grammar – all rules and constraints – is available and only if all mechanisms necessary for processing are available. Then it is possible to build a detailed syntactic structure, which consists of a hierarchical

structure and abstract elements. L1 sentence representation is assumed to represent a detailed hierarchical structure. This includes the reactivation of empty categories at all traces. This is called full parsing because the representation is syntactically fully specified (Clahsen and Felser, 2006a). Full syntactic parsing means that in a sentence like (105), *who* should be reactivated after *argued* because when encountering *that* it is signalled that a second subordinated clause is introduced. *Who* is also reactivated after *angered*. This is called full parsing. Figure 1 illustrates this.

(105)   The nurse who the doctor argued that the rude patient had angered is refusing to work late. (Marinis, Roberts, Felser, Clahsen, 2005)

Figure 1: full parsing (Clahsen and Felser, 2006)

[DP The nurse [$_{CP}$ [*who$_i$*] the doctor argued [$_{CP}$ [*e$_2$*] that the rude patient had angered [*e$_1$*]]]] . . . is refusing to work late.

Contrary, the L2 representation is not assumed to represent such a hierarchical structure (full parse), because L2 syntactic representation is shallow. Clahsen and Felser (2006) do not assume that representation in L2 is driven by non-syntactic strategies because of a lack of knowledge in L2 speakers, but rather because of the failure to build a syntactic structure. Later Clahsen and Felser (2006a) revised their original argumentation in stating that L1 and L2 speakers have the same parsing mechanisms available, but that L2 speakers have problems in applying a structural parse because of their restricted knowledge of the L2 grammar, which has to be available to conduct a parse. Shallow parsing does not constitute a barrier for L2 speakers because it does not require such detailed and implicit grammatical knowledge of the L2 grammar.

Shallow parsing consists of a less detailed representation which is not build up on syntax, but on lexical-semantics and interpretational cues (Clahsen and Felser, 2006a). Thus, this means that the L2 representation should not include any reactivation of raised elements at gap sites (Figure 1). For L2 speakers, Clahsen and Felser (2006) assume that they might try to integrate all information immediately after encountering it. Confronted with a sentence like (112), when encountering *argued* the L2 speaker is considered to assign the thematic roles of agent to *the doctor* and the thematic role of theme to the subordinated clause introduced by *that*. Further down in the sentence, at *angered*, L2 speakers assign the thematic role of theme to *the rude patient* and the thematic role of experiencer to *the nurse*. Figure 2 is an illustration of

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that shallow parse. Comparing L1 and L2 representations the strategies which are employed work differently. Nevertheless, they could lead to the appropriate interpretation of the sentence.

Figure 2: shallow parsing (Clahsen and Felser, 2006)

[The nurse] who [the doctor] argued [that…

| Agent | Theme |
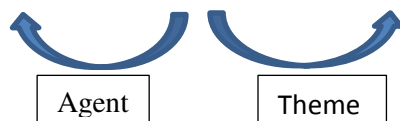
[The nurse] who [the doctor] **argued** [that…

    [the rude patient] had **angered**…

| Theme |

[The nurse] who [the doctor] **argued** [that…

    [the rude patient] had **angered**] is refusing to work late.

| Experiencer |
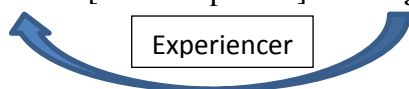
The question arises of how pronominal elements were processed according to the SSH. L1 speakers are not thought to process shallow but instead to make a full parse of the syntactic structure. Reflexive pronouns can syntactically be resolved – a full parse – but this is not the case with personal pronouns, that always have to be processed by information from the discourse as well. This information is not shallow. The SSH would thus assume differences in processing for L1 speakers. However, for L2 speakers the SSH would not assume a full parse for reflexive pronouns. Both reflexive and personal pronouns would be argued to be processed shallow leading to no differences in processing in L2 speakers.

Clahsen and Felser (2006) based their assumption about differences in representation on studies that examined aspects of morphology, syntactic gap-filling and sentence ambiguity (Hahne and Friederici, 2001, Hahne et al., 2006, Ardal, Donald, Meuter, Muldrew and Luce, 1990). In the field of inflectional morphology, the study of Hahne et al. (2006) investigated the brain responses to regular and irregular constructions. Their ERP-results showed that the misapplication of regular rules elicited an anterior negativity as well as a P600. Violations of irregular inflection yielded an N400. These results showed that in L2 speakers, regular inflection is made up by a rule and irregular inflection is stored and retrieved from memory,

as was also found for L1 speakers (Baayen et al., 1997). In the first place, the study of Hahne et al. (2006) could be argued to provide evidence against the SSH. However, the SSH assumes problems with syntax and all other domains of language like morphology being intact. Clahsen and Felser (2006) argued that morphological processing is not shallow, because the internal morphological structure is not complex as it is the case for syntax.

With regard to syntactic processing, L2 speakers seem to be able to make use of lexical, semantic and pragmatic strategies, but not of a syntactic operation in resolving ambiguous sentences. Regarding syntactic dependencies, L2 speakers seem to immediately want to resolve gap structures, but not with syntactic strategies as is the case with L1 speakers. Instead, they use a semantic operation like assigning thematic roles as has been shown in figure (2), or with discourse information (plausibility). The SSH thus assumes that the processing of morphology should be easily done in L2 speakers and these speakers should not differ from L1 speakers. This is argued for syntax. The SSH (Clahsen and Felser, 2006) would argue that reflexive pronouns in a co-argument structure will be processed by lexical-semantics in L2 speakers. L2 speakers are not considered to be able to make use of a syntactic operation, this means that no differences in reaction times and eye movements should be found for L2 speakers in the processing of reflexive and personal pronouns. L2 speakers should be easily distinguishable from L1 speakers, as the latter should process reflexive pronouns in a co-argument relation with a syntactic operation.

The SSH (Clahsen and Felser, 2006) reject proficiency as a factor that gives access to the use of syntax. Therefore, highly proficient L2 speakers should process similarly to low proficiency L2 speakers. Both groups should in turn differ from L1 speakers, meaning that both L2 speaker groups should show similar reaction times and eye movements. This assumption is contrary to the DP-model. In addition to that, the SSH neglects transfer as a factor with the consequence that L2 speakers of Dutch with German as their L1 should not be affected by a competition of grammatical systems. Thus, the cross-linguistic difference between German and Dutch in the binding of personal pronouns in PPs should not affect L2 processing. Higher reaction times for personal pronouns compared to reflexive pronouns in a PP are not expected.

In trying to answer the question of what causes the differences in processing syntax between L1 and L2 speakers, Clahsen and Felser (2006, 2006a) do not assume that L2 speakers suffer from a limited knowledge of the L2 grammar. In the studies they reviewed (e.g. Frenck-Mestre, 2002, Hahne & Friederici, 2001, Weber-Fox & Neville, 1996), the L2 speakers were advanced to highly proficient L2 speakers. Clahsen and Felser (2006) therefore assume that

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they should be in command of the grammar. This means that L2 speakers' processing, at least their failure to apply a syntactic operation to resolve ambiguous sentences and syntactic dependencies, is not caused by a lack of grammatical knowledge. This contrasts the assumption made by the DP-model. Ullman (2001) assumed, that with enough practice/high proficiency with the L2, problems in representing grammar should decrease.

Clahsen and Felser (2006, 2006a) also deny the possibility of differences in processing speed that distinguishes L2 processing from L1 processing. The studies Clahsen and Felser (2006) reviewed (Felser, Roberts, Gross and Marinis, 2003, Hoover & Dwivedi, 1998, Papadopoulou and Clahsen, 2003, Marinis, Roberts, Felser, Clahsen, 2005, Williams, Möbius, Kim, 2001) showed that L2 processing speed differs among L2 speakers with different L1s and compared to L1 speakers – it can be slower, or even faster. However, speed does not affect the strategies which L2 speakers employ. Fast reading L2 speakers seem to adapt the same processing strategies as slow reading L2 speakers and processing strategies in these two groups are different from L1 processing strategies.

Clahsen and Felser (2006, 2006a) dismiss greater working memory resources required in L2 processing as a factor which might affect L2 processing. They are aware that some studies (Juffs, 2004, 2005) attested a greater demand of working memory resources in L2 compared to L1 processing, but evidence is currently not strong enough.

A factor possibly influencing L2 processing could be transfer/interference of the L1 grammar and processing strategies into the L2. Again, Clahsen and Felser (2006, 2006a) reject transfer as a factor in L2 processing, as studies (Felser et al., 2003, Papadopoulou & Clahsen, 2003) have shown that L2 speakers' processing is similar even though their L1s might differ with regard to their proximity to the respective L2s. L2 speakers with a close relation between L1 and L2 do not seem to transfer from the L1 to the L2 and behave like L2 speakers, whose L1 is distant from the L2 (Marinis et al., 2005, Williams et al., 2001).

3.4.2.1 Discussion of the SSH

In the following section, some studies will be presented that do or do not support the assumptions made by the SSH. Juffs (2004) compared the processing of garden path structures like (106) to non-garden path structures like (107) and to a mild-garden path structure like (108) in L2 speakers with different L1s.

     (106)   After the children cleaned the house looked very neat and tidy

     (107)   When the student arrived the professor asked her about her trip

     (108)   The doctor knew the nurse liked the man from England

The grammaticality judgement task revealed that L2 speakers were different from L1 speakers. The reading study showed that the processing of both the garden path and non-garden path structures posed processing difficulties for L2 speakers. For both L1 and L2 speakers, reading patterns were alike for the (mild-) garden path structure and different for the non-garden path structure, where L2 speakers needed more time reading it. Juffs (2004) concluded that the processing of garden path structures was more costly than that of non-garden path structures for both L1 and L2 speakers, and that processing was slower and less accurate. Moreover, Juffs (2004) made the point that all verbs independent of transitive (garden path structure) or intransitive (non-garden path structure) evoked a garden path effect. By comparing the results, Juffs (2004) came to the conclusion, that the grammaticality judgement task did not show the distinction between structures, but that the reading study did. Juffs' (2004) study furthermore showed that L2 speakers did not always process shallowly, but rather like L1 speakers, even though at a more slowly rate. It seemed that the processing of sentences in the L2 is more demanding than in an L1 and that L2 speakers cautiously process each structure step by step. Juffs' (2004) study can serve as partial support for the SSH, as it showed that in sentence processing L2 speakers were different from L1 speakers. However, this seems not always to be the case.

Partial overlap in processing between L1 and L2 speakers has also been attested by Rossi, Gugler, Friederici and Hahne (2006). They investigated whether L2 speakers with a high proficiency in the L2 showed the same ERP pattern as L1 speakers, and whether they differed from low proficiency speakers while hearing sentences with a category error such as (109) or an agreement error (110) or a combined category-agreement error like (111).

(109) Der Junge im <u>singt</u> ein Lied
       The boy in sings a song

(110) Der Junge im Kindergarten <u>singst</u> ein Lied
       The boy in the Kindergarden $sing_{2pers.}$ a song

(111) Der Junge im <u>singst</u> ein Lied
       The boy in $sing_{2pers.}$ a song

The ERP results showed that highly proficient L2 speakers resembled L1 speakers in so far as both groups showed the same neural response in processing a category error. These were an early anterior negativity, which the authors interpreted as reflecting phrase structure building,

an additional negativity reflecting the processing of reference-related information and a late positivity for the reanalysis processes. The low proficiency group showed effects that were delayed and reduced in amplitude, which was interpreted by the authors as reanalysis problems, which could be caused by the reduced availability of resources to reanalyse. The highly proficient L2 group, compared to the L1 group, showed larger amplitudes for the additional negativity and the late positive effect, but not for the early anterior negativity, which the authors interpreted as indication that L2 speakers needed more resources for processing. The ERP pattern for the agreement error was the same for the highly proficient L2 and the L1 speakers, but the low proficiency group showed delayed positive effects indicating that they had problems initiating the process of reanalysis. The combined category-agreement error elicited the same effects as were found for the category error with the low proficiency L2 group, again showing a delayed and reduced late positive effect. The study of Rossi et al. (2006) can serve as an indication that it is in principle possible for L2 speakers to process sentences in the same way as L1 speakers, if the proficiency level is high. High proficiency seems to overrule shallow parsing.

Proficiency is an important factor in L2 processing was also supported by the study of McLaughlin, Tanner, Pitkänen, Frenck-Mestre, Inoue, Valentine and Osterhout (2010). They came to the conclusion that highly proficient L2 speakers' brain responses resemble that of L1 speakers. L2 speakers with a low proficiency level showed different brain responses compared to the former groups. The studies of Rossi et al. (2006) and McLaughlin et al. (2010) hence only partially give support for the SSH. The SSH does not incorporate proficiency as a factor and does not assume that L2 speakers can process sentences like L1 speakers anyway. The pattern of the low proficiency L2 group is in accordance with the SSH.

The article of Clahsen and Felser (2006) is a keynote article that was reviewed by some researchers and the reviews were put together in an article *Commentaries* (2006) consisting of criticism and questions. Some of the criticism and questions made will now be presented.
Dowens and Carreiras (2006) asked the question what the SSH predicts with regard to balanced bilinguals and they further critizised – as did Frenck-Mestre (2006) and Libben (2006) – the limited scope of the article (Clahsen and Felser, 2006), since it only presented studies concerned with morphosyntax, ambiguity resolution and syntactic dependencies. Ullman (2006) also criticized the limited scope of the SSH, as the SSH is only a representational model which limits its range of influence. Another critic of the limited scope of the SSH is Sabourin (2006), who argued that the factor of proficiency should be accounted

for in the sense that she would like to have acknowledged the factor proficiency. This criticism is shared by Libben (2006), who also would like transfer and age of acquisition considered as important factors. Steinhauer (2006) recommended the necessity to include factors like first exposure of the L2, the relative use of the L2 compared to the L1, and a variety of sociocultural factors. Sabourin (2006) further argued that the differences between L1 and L2 speakers could indeed be the result of an incomplete knowledge of the L2 grammar, cognitive limitations or interference from the L1. Clahsen and Felser (2006) rejected any of these possibilities, but Sabourin (2006) pointed out that studies (for example Sabourin, 2003) have shown that these factors do play a role. Ullman (2001) emphasized that the SSH neglects the role of experience with the L2 as a key factor giving access to proceduralization. Sabourin (2006) and Libben (2006) made the point that highly proficient L2 speakers should show an in depth and detailed representation of syntactic structure like L1 speakers. This means, that L2 processing is not shallow and that it is in a hierarchical structure, just as in L1 speakers.

Dowens and Carreiras (2006) asked why L2 speakers can make use of morphosyntactic information but still show shallow processing in the field of syntax. Duffield (2006) raised the question whether a disruption in representation (shallow versus full parsing) is due to the grammar or the processing system. Sorace (2006) further raised the question if shallow processing is restricted to particular domains of language because these domains are more complex. She also asked if shallow processing takes different forms. Sorace (2006) pointed out that interfaces between syntax and other domains seem to be quite vulnerable, a notion which is not captured by the SSH. Moreover, Steinhauer (2006) argued that morphology may well be complex and therefore its processing might also be shallow in L2 speakers. Steinhauer (2006) claimed that subject-verb agreement and inflectional morphology are examples of complex morphology, which could serve as a demonstration of shallow processing in L2 speakers. Similarly, Frenck-Mastre (2006), Juffs (2006) and Sekerina and Brooks (2006) argued that based on the studies reviewed by Clahsen and Felser (2006) that one cannot say with certainty, that L2 speakers' processing is shallow, as it resembles that of L1 speakers. L1 speakers are also shown to apply non-syntactic strategies. Along the same lines, Sekerina and Brooks (2006) pointed out that L1 representation is not only hierarchical structure building but that sometimes representations are "good enough". This argument of a "good-enough" type of processing might stem from Ferreira (2003), who proposed the GE hypothesis to sentene comprehension presented earlier. Contrary to the SSH, Ferreira (2003) also assumes shallow processing to be available for L1 speakers. In line with Sekerina and Brooks (2006),

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Sorace (2006) asked if shallow processing is the sole option in L2 processing and if so, under which circumstances could it be possible for L2 speakers to process the L2 in greater depth. A similar question was put forward by Traxler (2006). Traxler (2006) asked when exactly such minimal strategies (shallow parsing) apply and when- and in how far – differences in lexical knowledge and cognitive resources affect the way of processing.

Ullman (2006) wanted to know why and to what extend L1-like grammatical processing is missing in L2 speakers. Ullman (2006) argued, that the SSH is a mere replication of the DP model, as it draws on chunking and lexical-semantic structure, which is already implemented into the DP-model. Ullman (2006) rectifies that his DP-model does not rule out the possibility of L1-like processing in L2 speakers. This could be achieved with a high proficiency in the L2. Moreover, Clahsen and Felser (2006) criticized that Ullman (2001) describes the access to the procedural system as less available for L2 speakers. Ullman (2006) counters that the SSH is also vague in its terminology.

Clahsen and Felser (2006a) responded to the criticism they received on their SSH. They again argue that the studies they reviewed do not give any support for the assumption that transfer and proficiency play any important role and provide evidence with the study of Papadopoulou and Clahsen (2003). They also criticize Sabourin's (2003) study as from that study it is not really clear if proficiency or transfer affected the German group's sensitivity with regard to the Dutch gender system. They put forward a last comment: There are only a few studies providing evidence for transfer in the field of morpho-syntactic processing.

Clahsen and Felser (2006) originally mentioned, that L2 speakers process syntax shallowly even though they have sufficient grammatical knowledge. In 2006a article, the authors argue somewhat differently. They say, that shallow processing is the result of insufficient grammatical knowledge of the L2. In essence, L2 speakers could process L1-like. Shallow processing is used in L2 speakers in combination with metalinguistic knowledge, world knowledge and associative abilities. It could be argued, that with a high proficiency in the L2, grammatical knowledge is present, that enables L2 speakers to process L1-like. This is not denied anymore by Clahsen and Felser (2006a). However, they do not swift away from their assumption that L2 speakers are not able to process L1-like. This is an option that should be possible only for some L2 speakers with a high proficiency level. Still, Clahsen and Felser (2006a) think that L1-like processing is possible for L2 speakers. Nevertheless, it remains restricted to local domains of language.

Clahsen and Felser (2006) were also criticized for the limited scope of their model. Their answer is that their SSH is a purely psycholinguistic model leaving questions such as localisation of language – among others – unanswered.

To summarize, two models of language representation have been presented, which both share the assumption that lexical knowledge does not pose any problems in L2 speakers, but the models also differ from each other in their assumptions about the problems concerning grammar in L2 speakers. The DP-model assumes a problem with the representation of grammar in general, but this model does not exclude the possibility that practice and a high proficiency in the L2 can lead to L1-like mastery of grammar. The SSH is somewhat more limited in its prediction about the problems concerning grammar in L2 speakers in the sense that it assumes a failure in representing syntax exclusively. In contrast to the DP-model, the SSH denies the possibility of L1-like competence almost exclusively. Ullman (2001) assumed that L1-like competence could be achieved as a result of a high proficiency in L2. Additionally, the scope of the DP-model is broader than that of the SSH, as the latter is solely a representational model of language. In contrast, the DP-model is concerned with the representation, localization and processing of language.

3.4.3   Convergence (Green, 2003)

The Convergence hypothesis (CH) (Green, 2003) which will be presented next, differs from the DP-model and the SSH in the sense that it does not argue, that only some domains of language are problematic or different in L2 from L1 representation. It thus does not make any distinctive predictions about the representation of lexical/semantic information and grammar, as is assumed in the DP-model. Nor does it assume problems with syntax, as they are proposed by SSH only. The CH predicts that the representations of the L1 and L2 converge, when the proficiency in the L2 increases. With the term convergence of systems Green (2003) means, that in L1 as well as L2 speakers, the same neural substrates for the same task were activated, which can be achieved by a high proficiency in the L2. A high proficiency leads to the same neural representation of various linguistic devices as in the L1. Differences in the representation are considered to be the result of a low proficiency level in the L2. In these low proficiency L2 speakers the CH predicts a declarative representation of grammar and all other subdomains of language. At a higher proficiency level, a shift of the representation of grammar to the procedural memory as has been argued for by Ullman (2001). In higher proficiency L2 speakers, there is thus a division of representations across declarative and procedural memory, which is in line with Ullman (2001).

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Despite the assumption of convergence of the L1 and L2 system, Green (2003) assumes that there may be differences in the processing profiles. L2 speakers may show greater activity in the brain compared to L1 speakers. It is not really clear, how Green (2003) captures this increase. Is it due to the two languages stored in one mind? Can this increase be explained by proximity between the L1 and the L2? The assumption of the CH is quite similar to the one made by the DP-model. Highly proficient L2 speakers should be similar to L1 speakers and both should be different from low proficiency L2 speakers in the processing of reflexive and personal pronouns in a co-argument relation. For instance, equal fast RTs for highly proficient L2 and L1 speakers are predicted. Those RTs are in turns assumed to be shorter than those of low proficiency speakers. Also, syntax should not constitute a problem for highly proficient L2 speakers. Transfer is only expected to be problematic for low proficiency L2 speakers, as their two grammatical systems have not converged yet.

There is evidence that suggests that there may be convergence of two systems. For example, Abutalebi (2008) reviewed several fMRI studies, which addressed the question of how language is processed. Abutalebi (2008) concluded that grammar and the lexicon in L2 were processed by the neural structures also responsible for the L1. A slight difference between L1 and L2 speakers was, that greater activity in L1 processing was found. Abutalebi (2008) argued for the point of view that L1 and L2 systems converged with increasing proficiency in L2. Abutalebi, Rosa, Ding, Weekes, Costa and Green (2013) also showed, that with increasing proficiency in L2, the L1 and L2 systems converge. Other studies that were already mentioned also point into the direction, that the L1 and L2 systems converge (Chee, Tan and Thiel, 1999, Dehaene et al., 1997, Perani et al., 1998)

However, there are also studies showing that L1 and L2 systems do not converge, not even when proficiency in the L2 is high. Green, Crinion, and Price (2006) investigated the representation of semantics in L1 and L2 speakers. In the semantic decision task, participants activated the left inferior and middle temporal regions. In naming and reading tasks L2 speakers activated other regions than L1 speakers. L2 speakers activated left-lateralized frontal regions showing a growing difficulty in semantic retrieval, as well as between language competitions. Green et al. (2006) concluded from this study, that L1 and L2 did not converge to one system. L1 and L2 speakers seem to apply different substrates and the authors argued that L1 speakers might be able to make use of different substrates and methods. This study is quite interesting as its focus relies on semantics. A different representation of semantics in L1 and L2 speakers would not be argued for by the CH, the DP-model or the SSH. The DP-model would argue for its representation in declarative

memory with its specific neural organisation, which should be the same in L1 and L2 speakers.

Other studies that argued against an overlap in representation were Friederici et al. (1996), Hahne & Friederici (1999) and Friederici et al. (1999), who showed that language was activated differently in L1 and L2 speakers.

3.4.4 Competition model (MacWhinney)

The next model which will be discussed is the competition model (CM) (MacWhinney, 2008). Differently from the DP-model and the SSH, it does not assume problems with grammar alone, nor does it assume that two systems converge as was proposed by Green (2003). CM views language representation in L1 and L2 as a "constructive, data-driven processes" (MacWhinney, 2001, 69). The main argument of CM is, that comprehension of language is based on the detection of several cues, and the cue with the most reliability and availability wins the competition in comprehension. MacWhinney (2001) moreover emphasises that the stronger cues are always learned before weaker cues. CM assumes that the activation of lexical items precedes the establishment of a syntactic structure.

MacWhinney (2001) takes cue reliability as a key factor in language acquisition. Reliability means that the probability of the selection of an interpretation depends on the availability of a cue. The validity of the cues is also evaluated. In this aspect, MacWhinney (2001) proposes four dimensions: These are task frequency, availability, simple reliability and conflict reliability. MacWhinney (2001) considers task frequency as especially important in L2 acquisition. The term task frequency circumscribes the frequency with which linguistic properties are present in the input, for example to determine the agent of a verb or establish the reference of a pronominal element. Both of them are high frequency tasks. Availability of a cue can be subdivided into the general or simple availability of a cue. Availability means to discover if a cue is present but also to determine its strength. Strength thereby means to explore if it has a contrastive effect, that distinguishes it from other cues. Adapting this to pronominal elements, one could say that these elements are present in the input and they are frequent. The strength of availability of pronominal elements can be defined as their contrast in reference. Generally, reflexive pronouns refer to an element in its governing category, whereas personal pronouns refer to some referent outside their governing category (Chomsky, 1981). Therefore, reflexive pronouns contrast with personal pronouns. Simple reliability means that a cue is reliable if it leads to the right functional choice. For pronominal elements, this could mean that reflexive pronoun has the function of reflexive marking, thus a function which is absent in the case of personal pronouns. Conflict reliability is a conflict between two

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cues. An example of this could be the overlapping reference of pronominal elements. In Dutch and English PPs, both reflexive and personal pronouns may refer to the same referent, that is the subject of the sentence (112).

(112)   John put the book next to himself/him

Another conflict reliability could be the cross-linguistic difference between German one the one side and Dutch and English on the other side concerning the reference of pronominal elements in PPs. In German, personal pronouns may not refer to the subject, but it takes an antecedent outside the clause. In Dutch and English, reference of the personal pronoun to the subject in the sentence is possible, as well as to an antecedent outside that sentence. There is thus a conflict not only between languages, but also within one language. This could cause an interpretation in L2 speakers, which is different from the interpretation by L1 speakers due to interference and competing cues. It should be mentioned, that there is always a conflict reliability in the case of personal pronouns as they chose their antecedent in discourse. All possible antecedents will be evaluated.

MacWhinney (2001) implements transfer as a factor for his CM. He argues that an L2 speaker commands of a fully developed "well-organized neurolinguistic system" (MacWhinney, 2001, 80). Knowledge of the L1 might then, at least initially, be used to guide interpretation in the L2. Van Hell and Tokowicz (2010) pointed out that a competition only becomes visible when the L1 and L2 systems differ. Structures which are shared by the L1 and the L2 cannot compete. Dissimilar structures might compete, which may result in transfer from the L1 into the L2.

For example, when an L2 speaker of Dutch with German as L1 wants to interpret the reflexive pronoun in (113) there will be no competition in reference assignment, as both languages assign the reflexive pronoun in a so called co-argument-structure to *Harry*.

(113)   Harry wast zich
        "Harry washes himself"

However, in (114) and (115) a competition between German and Dutch arises. In German, reference of *sich* is ungrammatical, whereas in Dutch *zichzelf* refers to *Jan*. When both representations compete, it might be the case that the Dutch sentence is judged as ungrammatical by German L1 speakers of Dutch as L2 – at least initially. Either, the L1 cue is

strong and overrules the L2 cue, or the L2 cue is not even realised yet. L2 speakers with sufficient knowledge of the L2 might get the right interpretation, thus the L2 representation wins over the L1 representation.

(114) Jan denkt, dat een korte film over zichzelf op het strand zou kunnen worden gemaakt

"Jan thinks that a short film of himself at the coast should be made"

(115) Jan denkt, dass ein kurzer Film über sich am Strand aufgenommen werden kann

"Jan thinks that a short film of himself at the coast should be made"

MacWhinney (2008) argues that every aspect of the L1 can be transferred into the L2 and that interference decreases with repetitions (which means with practice). Transfer can be helpful when the L1 and the L2 systems are similar, but it can also hinder the comprehension process when there are differences, as transfer might lead to an incorrect comprehension. Other factors influencing the competition could be restricted social contacts and declining of cognitive abilities. Herandez, Li and MacWhinney (2005) argued that adult L2 speakers are hindered by their L1 and therefore have to rely on non-language areas to avoid effects of the L1 in L2 processing.

While learning the L2, the L2 speaker is required to form a separate L2 system by linking L2 forms to representations. The necessity of building up a separate L2 system in order to prevent influence from the L1 on the L2 is argued for by MacWhinney (2008). Thus, this idea is different from Green (2003), who argued that L1 and L2 representations converge to one system. MacWhinney (1987) argued, before an L2 system is fully developed, the L2 comprehension is determined by transfer of L1 onto L2, abandonment of L1 for L2, merger of L1 and L2, and partial attainment of separate L1 and L2 systems. The L2 is initially weighted towards the L1 and over time develops in the direction of L2. MacWhinney (2001, 2008) does not mention what exactly causes this shift. Is proficiency favouring that shift?

MacWhinney (2001) explains the necessity of a separate L2 system due to possible interference of two available languages. Surely, the L1 and the L2 system might be different, but why should the integration of new knowledge of the L2 into the L1 system, as proposed by Green (2003) not be possible. Moreover, it is not clear, what this assumption of a new system means for neuro- and psycholinguistics. Are the two systems that are being subserved neurologically different? Is there any overlap in interpretation strategies? Ullman (2001) for

instance proposed a different neurological localisation of lexicon and grammar in L1 speakers, but not in L2 speakers. Furthermore, it is not clear if L2 speakers can reach L1-like proficiency and how this might affect the processing and representation. Another question is, under which circumstances transfer from the L1 to the L2 is likely to occur.

The establishment of a new system benefits from "high-quality input, working on meaningful relations in dialogues, and shadowing native speaker productions" (MacWhinney, 2001, 88). MacWhinney (2001) argues that it is also possible for L2 speakers to overcome the reduction of neural plasticity. However, it is not clear what this means for CM and how this is implemented into CM.

In line with Ullman (2001), the CM assumes that automaticity in L2 is possible. However, the CM contrasts the DP-model in the sense that it does not say, that practice and proficiency can open up the access to automaticity. It rather establishes links between different forms as well as between forms and meanings while also restructuring the system according to the input. Most importantly, automaticity in the DP-model is assumed for grammar (procedural memory), and not connected to lexical knowledge (declarative memory). CM does not distinguish between grammar and lexicon. All aspects of language can compete. It should be recognised, that CM does not rule out the effect of transfer when automaticity is reached.

CM also contrasts sharply with the DP-model (Ullman, 2001) with regard to lexical knowledge. CM assumes that the reorganisation of lexical knowledge could cause a problem in L2 acquisition because of the loss of plasticity (Herandez et al., 2005). This problem can be overcome through practice (Herandez et al., 2005). Problems with the acquisition of lexical knowledge were not assumed in the DP-model (Ullman, 2001), as studies have not reported such problems (Birdsong, 1999; Johnson and Newport, 1989).

MacWhinney (2008) extends his CM compared to MacWhinney (2001). MacWhinney (2008) assumes that the most difficult area to acquire/master is phonology whereas the least problems should least problems should arise with the acquisition of lexical knowledge. However, the question of other linguistic subdisciplines like semantics, morphology, or the interfaces remains unanswered.

CM thus assumes that with enough practice, inhibition of transfer, sufficient social contacts and cognitive abilities, L2 speakers should not be different from L1 speakers regarding comprehension. However, is this enough to become L1-like? Consider child L2 acquisition. Phonology already poses early problems (Flege, 1991, Gottardo, Yan, Siegel, Wade-Woolley, 2001). It has been shown that young L2 speakers are not able to reach L1-like competence. Surely, adult L2 speakers differ from young learners in, for example, their greater cognitive

abilities. However, if there are early problems with the acquisition of some aspects of language, how can it be assumed that adult L2 speakers become L1-like?

To sum up, several theories have been presented. First, theories that aim to describe the comprehension process in L1 speakers have been put forward and thereafter theories that are concerned with the comprehension and processing in L2 speakers have exhaustively been discussed and also factors that are known to influence the L2 comprehension and processing have been introduced. Doing so, differences and similarities between L1 and L2 speakers in the comprehension and processing have been illustrated.

4 Pronouns in L1 and L2

Several theories of L1 and L2 sentence comprehension and processing have been presented and extensively discussed. It will now be shown how L1 and L2 speakers comprehend and process pronominal elements. First, studies that examined the comprehension and processing of pronominal elements in L1 speakers will be presented. These studies show that several factors can influence comprehension and processing.

4.1 Pronoun comprehension and processing in L1

Studies examining pronoun comprehension showed that the matching of grammatical gender in sentences such as (116) or (117) and distance between an antecedent and a pronominal element as in (118) affected comprehension of pronominal elements (Clark and Sengul, 1979; Garnham and Oakhill, 1985; Matthews and Chodorow, 1988; Badecker and Straub, 2002). These results have been confirmed by eye-tracking studies (Ehrlich and Rayner, 1983; Clark and Sengul, 1979; Arnold, Eisenband, Brown-Schmid and Trueswell, 2000; Sturt, 2003a).

(116)   After the bartender served the woman, he got a big tip

(117)   After the bartender served the woman, she left a big tip (Matthews and Chodorow, 1988)

(118)   Yesterday I met a woman$_i$ who had written a book$_j$ on viruses. <u>She$_i$</u> had studied them for years and years. <u>It$_j$</u> was selling very well (Clark and Sengul, 1979)

However, there were also studies that denied the role of gender in the interpretation of pronominal elements. Crawley, Stevenson and Kleinman (1990) investigated, which strategies L1 speakers apply in the interpretation of pronominal elements. When the possible antecedents were of the same gender as the personal pronoun as in (119) participants interpreted the personal pronoun more often as referring to the subject. When the personal pronoun was interpreted as the subject, reading times were faster than when the personal pronoun was assigned to the object.

(119)   Brenda copied Harriet and Bill watched her

In the unambiguous sentences (120) there were no differences in reading times between subject reference and object reference. Crawley et al. (1990) concluded from this study, that cues like gender only have a limited impact on the interpretation of pronominal elements. Participants preferred interpreting the pronominal element as belonging to the subject only in

ambiguous sentences. It seemed that saliency (prominence of the subject) influenced the interpretation. A strategy of parallel assignment, meaning that a personal pronoun in object position was interpreted as referring to the antecedent in object position, was not adapted for the interpretation of the pronominal elements.

(120)   Brenda (Harry) copied Harry (Brenda) and Bill watched her/him

Ehrlich (1980) investigated three possible factors, which all may influence the interpretation of pronominal elements. These are the conjunction that connects the main clause with the subordinated clause[15], implicit causality[16] and gender. An example is (121).

(121)   John/Jane blamed Bill because/and he split the coffee

Participants' choices of interpretation were guided by all three factors. Gender overruled the effect of the conjunction and the implicit causality. The implicit causality was overruled by the conjunction. Similar to Ehrlich (1980), Garnham, Oakhill and Cruttenden (1992) were interested in investigating the effects of gender, the verb's semantics and implicit causality on the interpretation of personal pronouns. They found, that it was easier for participants to interpret the personal pronoun, when the verb's semantics of the main clause was consistent with the implicit causality of the same clause. This means that the interpretation of the personal pronoun in (122) is easier than in (123).

(122)   John sold his car to Bill because he had taken up cycling
(123)   John sold his car to Bill because he needed a means of transport

Other studies investigated how the factors that already influenced processing affected the processing of pronominal elements in L1 speakers. Vonk (1985) also used eyetracking to investigate the effect of gender and implicit causality of the verb on the processing of personal pronouns. There were no effects of gender and implicit causality at the pronoun or at the post-critical region, nor was there an interaction between both. Reading times showed that congruent sentences like (124) – when the implicit causality of the verb fits the meaning of the subordinated clause – were read faster than incongruent ones like (125).

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[15] The conjunction can influence/bias the interpretation of a pronominal element towards a particular antecedent.
[16] Verbs like *to blame* are object directed verbs, whereas *to confide* is subject oriented (Garvey and Caramazza, 1974, Garvey, Caramazza & Yates, 1976)

(124)   Harry won the money from Albert because he was a skillful player

(125)   Harry won the money from Albert because he was a careless player

This demonstrates that readers make use of the verb's semantics in processing the sentence. This study also shows that different measures of processing lead to different results.

Garrod, Freudenthal and Boyle (1994) employed eyetracking to investigate how discourse focus[17], pragmatic inference constraints[18] and linguistic properties of the anaphor[19] interact in the processing of personal pronouns. Their results showed that all three factors immediately apply. All three factors evenly affect processing. They assumed that the factors operate together with the result of an early interpretation.

A somewhat different study was carried out by Shillcock (1982), who was interested in the exact moment of the resolution of the pronominal element during sentence comprehension. Shillcock (1982) tested if the antecedent was semantically activated while processing a personal pronoun by applying a cross-modal priming technique. The prime was either inserted directly after the antecedent or some little further down in the sentence, either before the personal pronoun, or directly after the personal pronoun, as in (126).

(126)   The teacher ^ did not board the train, for the ^ simple reason that it/he ^ was
         not going to the South Coast of England[20]

The results showed that a related prime compared to an unrelated prime facilitated sentence interpretation at all three prime-inserting points and for both *he* and *it*. Semantic activation was greater further down in a sentence and activation was greater for *he* than for *it*. Shillcock (1982) concluded that whenever the personal pronoun unambiguously referred to an antecedent, activation of the antecedent with the personal pronoun takes immediately place at the personal pronoun. Shillcock (1982) further concluded that at the personal pronoun, there could have been something in place like a "pragmatic check" but he does not rule out the possibility that a "unique on-line selection" might have taken place where all DPs have been activated (Shillcock, 1982, 394). Similarly, Nicol and Swinney (1989) showed that when

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[17] "Discourse Focus, which reflects constraints on the availability of information from the prior discourse" (Garrod et al., 1994, 40)

[18] "Pragmatic interference constraints which relate the broader interpretation of the sentence to the representation of the text as a whole" (Garrod et al., 1994, 40)

[19] "Linguistic properties of the anaphor - whether a pronoun, definite description or repeated name – which reflect constraints on antecedent identiability as well as contextual presupposition" (Garrod et al., 1994, 40)

[20] The symbol ^ shows the place of possible insertion of the prime.

there was only on suitable antecedent, only this antecedent is activated. When there were more accessible antecedents, all antecedents were activated.

McDonald and MacWhinney (1995) also investigated the effect of implicit causality of verbs and gender cue on the pronominal interpretation with a probe recognition task. In line with Shillcock (1982) they found that the probe was identified faster further down in a sentence, which can be explained by the fact that the more the participants heard, the more relations were unresolved. There was also an effect of the antecedent mentioned first compared to the one mentioned second – a saliency effect which was also reported in Shillcock (1982) – and which could be overruled by the effect of implicit causality of the verb. Also in line with Shillcock (1982), they could not find a gender effect, which they took as indication that the use of gender depends on the task and will be used if necessary.

Wolf, Gibson and Desmet (2004) investigated if the processing of personal pronouns was affected by the verb's semantics in the introductory sentence and target sentence. When the verb in the target sentence was semantically similar to the verb in the introductory sentence, the personal pronoun was read faster when it referred to the object than when it referred to the subject. When the verb's semantics were dissimilar in the introductory sentence and target sentence, the personal pronoun was read faster when it referred to the subject but not the object.

Furthermore, studies found that the processing of reflexive pronouns was faster than that of personal pronouns in co-argument structure such as (127).

(127) Brenda watched herself/her (Nicol and Swinney, 1989; Hendriks, Banga, van Rij and Cannizzaro, 2011)

Sekerina, Stromswold and Hestvik, (2004) confirmed these findings for adults for reflexive and personal pronouns in PPs such as (128).

(128) John put the book next to herself/her

For L1 speakers, studies testing the comprehension of reflexive and personal pronouns showed that factors like distance, grammatical gender, implicit causality and the semantic of the verb can influence the comprehension process. This shows that not only structural factors were applied in the comprehension of pronominal elements but that also L1 speakers made use of non-structural factors as has been argued by the GE-hypothesis (Ferreira, 2003).

Similar to the results of the comprehension studies, it has also been shown that the processing of pronominal elements in L1 speakers can be influenced by these non-structural factors. Additionally, Burkhardt (2005) and Schumacher, Piñango, Ruigendijk and Avrutin (2010) showed for English and Dutch, that the processing of reflexive pronouns in a co-argument structure is more economical than that of reflexive pronouns in PP's, providing support for the assumption of an economical hierarchy in the processing of pronominal elements (Reuland, 2001, 2011). In contrast to Burkhardt (2005) and Schumacher et al. (2010), Ruigendijk and Schumacher (2011) could not replicate these results for German, probably due to cross-linguistic differences between these languages.[21]

It has also been put forward by Reuland (2001), among others, that personal pronouns can be resolved as a bound variable or resolved in discourse. Cunnings, Patterson and Felser (2014) investigated if the personal pronoun was interpreted as referring to the quantified antecedent by making use of a bound variable interpretation or to a non-quantified (name) antecedent by applying a coreference interpretation. As mentioned earlier, Reuland (2001, 2011) assumes a hierarchy in the processing in the sense that a bound variable interpretation (semantics) should be cheaper than a coreference interpretation (discourse). The results of this study show that a personal pronoun was interpreted as the next possible antecedent. Thus, the personal pronoun either referred to the next quantified, or to the named antecedent, independently of eventual cost which might arise. Cunnings et al. (2014) concluded from this outcome that both a bound variable and a coreference interpretation may be established at the same representational level, thus rejecting the assumption of a hierarchy in representation. Cunnings et al. (2014) also denied that gender affects pronominal interpretation.

In summary, the studies that investigated the comprehension and processing of pronominal elements have reported almost exclusively that the interpretation of personal pronouns was affected by several factors like, for example, gender and distance. Reflexive pronouns in a co-argument relation were resolved faster than personal pronouns and reflexive pronouns in PPs. This difference in processing is argued for by Reuland (2001, 2010). He proposed that

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[21] This difference between German and Dutch with regard to the processing of pronominal elements in PPs and a co-argument relation is argued to be caused by differences in the case system. The preposition and the predicate in *Jan legte das Buch neben sich* (Jan put the book next to himself) enter a grammatical relation with the pronominal element which is argued to be absent in Dutch (Reuland, 2011). In Dutch PPs, a grammatical relation is not established. However, a grammatical relation is present between a pronominal element and a predicate in a co-argument relation as in *Jan ziet zichzelf* (Jan sees himself), which is also the case for German. Thus, pronominal elements in PPs can be resolved with a syntactic operation in German because of the grammatical relation in both structures, whereas in Dutch syntax can only be applied to resolve the pronominal element in a co-argument relation. Pronominal elements in PPs have to be resolved in discourse.

pronominal elements that can be resolved via a syntactic operation involve fewer computational steps than processes involving the C-I interface or discourse storage. In a co-argument structure syntax can be applied, but not for personal pronouns. In PPs, syntax is also not an option (with the exception of German). Thus, these results are in line with the economical hierarchy proposed by Reuland (2001). It is also not surprising that the interpretation of personal pronouns is driven by several non-syntactic factors, as these have to be resolved in discourse.

In chapter 2 theoretical considerations with regard to the representation of pronominal elements in (possessed) PNPs (129) have been presented.

(129)   Jan saw (Jack's) picture of him/himself

There is still an ongoing discussion about how exactly the pronominal elements are bound in PNPs. Now some studies will be shown that tested (possessed) PNPs in L1 speakers. Sturt (2003) discusses the need to investigate how syntactic and discourse factors interact in the processing of reflexive pronouns in structures where the reflexive pronoun is an argument of the verb's predicate, either with or without an accessible antecedent, like (130).

(130)   Jonathan was pretty worried at the City Hospital. He remembered that the surgeon had pricked herself/himself with a used syringe needle. There should be an investigation soon.

Reviewing the literature, he concluded that whenever the reflexive pronoun is an argument of the verb's predicate, syntax precedes discourse in the application, which is fully in accordance with the theory of Reinhart and Reuland (1993), as they would rule out discourse to apply in such a context. Sturt (2003) emphasized that structures such as PNPs where Principle A (Chomsky, 1981) does not apply are also interesting to look at, as the validity of the theories of Pollard and Sag (1994) and Reinhart and Reuland (1993) can be evaluated. According to these theories, reflexive pronouns in PNPs should behave differently from reflexive pronouns in a co-argument structure because only in the latter, syntax immediately applies.
In contrast to Pollard and Sag (1994) and Reinhart and Reuland (1993), Runner and Kaiser (2005) are not sure about the role of the processor in PNPs. They brought up the question

whenever the possessor is part of the argument structure, or whether it should not be considered as a part of the argument structure (131).

(131)   Jan thought that Mike's picture of him/himself would have already been sold

According to Runner and Kaiser (2005), it is debatable if *Mike* is indeed part of the argument structure. If *Mike* is part of the argument structure, then data can be explained that show that a reflexive pronoun is bound by the possessor *Mike*, whereas a personal pronoun is not. However, it cannot be explained why the reflexive pronoun can also be bound by the subject *Jan*. If the possessor is not part of the argument structure, it cannot be explained why a personal pronoun is not bound by the possessor *Mike*, whereas binding of the reflexive pronoun by *Jan* and *Mike* can be explained.

A study that sheds more light on the question of the role of the possessor in PNPs comes from Kaiser, Runner, Sussman and Tanenhaus (2009). They investigated the processing of pronominal elements in (possessed) PNPs such as (132) to see how structural and semantic constraints guide the interpretation and how both constraints influence the interpretation process.

(132)   Peter told Andrew about the (Greg's) picture of him/himself on the wall

In non-possessed PNPs, reflexive pronouns were primarly guided by a structural subject constraint in the sense that the participants preferred the subject *Peter* as antecedent. Personal pronouns were evenly guided by structural and semantic constraints. The structural constraint prevents an interpretation towards the subject and the semantic constraints biases the interpretation towards a perceiver as antecedent. The eyetracking data revealed that structural and semantic constraints appear quite early on in processing. In possessed PNPs, reflexive pronouns were interpreted as referring to the possessor, showing that their interpretation is guided by a structural constraint and these structural constraints also apply to personal pronouns ruling out an interpretation whenever the possessor is the antecedent. The semantic constraint is weaker in possessed PNPs than in possessed PNPs. This study provides evidence that the processor should be considered as part of the argument structure.

Asudeh and Keller (2001) argued that the possessor is not an argument of a PNP, as there is no semantic relationship between these two elements. As empirical support they referred to their own work (Keller and Asudeh, 2001) that showed that a reflexive pronoun in a possessed PNP may not be bound by the possessor, but may also refer to the subject. Another

interesting finding was that reflexive pronouns in non-possessed PNPs more referred to the subject than personal pronouns. Moreover, personal pronouns were not considered as ungrammatical when referring to the possessor of a PNP. Asudeh and Keller (2001) concluded that the possessor is not part of the argument structure, making reference of the reflexive pronoun not obligatory, and, in the case of the personal pronoun, allowable.

Runner, Sussman and Tanenhaus (2002, 2003, 2006) first tested if reflexive and personal pronouns were in a complementary distribution and second, how these elements were processed. Therefore, they tested these pronominal elements in a co-argument structure like (133) and found that the reflexive pronoun was interpreted as referring to the subject *Ken* and the personal pronoun was mostly interpreted as referring to *Joe*. Thus, there seems to be a complementarity in distribution of reflexive and personal pronouns in a co-argument structure and in a PNP like (134).

(133) Look at Joe. Have Ken touch him/himself
(134) Look at Joe. Have Ken touch a picture of him/himself

In possessed PNPs such as (135) there was an overlap in interpretation. Participants interpreted the personal pronoun as referring to *Ken* or *Joe* and the reflexive pronoun was in 69% of the cases interpreted as referring to *Harry* and in 31% of the cases as *Joe* or *Ken*.

(135) Look at Ken. Pick up Joe. Have Joe touch Harry's picture of him/himself

The latter result contrasts Reinhart and Reuland (1993) because, if we assume that the possessor *Harry* is an argument of the PNP, reference of the reflexive pronoun should be to the possessor almost exclusively. This result replicates findings of Asudeh and Keller (2001) and seems to support their view that the possessor is not part of the argument structure. Thus, the reflexive pronoun does not need to refer to the processor but can also refer to the subject. Runner et al. (2002, 2003, 2006) therefore argue that reflexive pronouns in (possessed) PNPs are exempt reflexive pronouns. Reflexive pronouns are argued to operate freely and to take any NP as antecedent. The eyetracking data support the notion of an exempt reflexive pronoun in a PNP, as there was no indication of early looks to the possessor only. The proportion of looks was equally distributed over the possessor *Harry* and the subject *Joe* from the first moment of processing. For the personal pronoun, the participants looked either to the *Joe* or *Ken* from the earliest moments of processing, which is in accordance with the binding

theory (Principle B) (Chomsky, 1981). However, there are also looks to the possessor *Harry*. It seemed, that reflexive pronouns in PNPs were not guided by syntax in their interpretation initially, otherwise the possessor would be chosen as the appropriate antecedent for the reflexive pronoun. In the case of personal pronouns, however, binding theory seems to guide interpretation; the possessor is not chosen and while processing, is not chosen as potential antecedent.

Goldwater and Runner (2006) investigated, if reflexive pronouns in PNPs were analysed as a structural reflexive pronoun or as acting independently from structural principles. For this purpose, they compared structures like (136) to (137) in a visual world paradigm. The participants did not always interpreted the reflexive pronoun as referring to *Ken*, but also to *Joe*, which shows that this reflexive pronoun is not exclusively guided by a structural constraint.

(136)   Joe is seated below a picture of himself and Ken is seated below a picture of himself, too (no-ellipsis structure)

(137)   Joe is seated below a picture of himself and Ken is, too (ellipsis structure)

In referring to Pollard & Sag (1994), Jaeger (2004) examined, which factors affect pronominal interpretation in possessed PNPs. He therefore examined the factors of creation verbs like *to take* and of salient antecedent. He showed that personal pronouns were judged as less acceptable than reflexive pronouns when the verb was a creation verb in comparison to when the verb was a non-creation verb like *to burn*. Jaeger (2004) further found that a subject was accepted more as a referent for a personal pronoun when it was less salient, which is the other way around for reflexive pronouns. This study shows that it is not only structural factors, that influence the interpretation of personal pronouns.

4.2   Pronoun comprehension and processing in L2

Hirakawa (1990), Thomas (1991), Kim, Montrul and Yoon (2010), Matsumura (1994), Sorace and Filiaci (2006), Demirci (2000) and White, Bruhn-Garavito, Kawasaki and Prevost (1997) all tested the comprehension of reflexive pronouns in second languages like English such as (138) or languages which are freer in the assignment possibilities of reflexive pronouns like Japanese and Korean (Thomas, 1991).[22]

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[22] The reflexive pronoun in the sentence *John said that Bill hit himself* may refer in Japanese to *Bill* and *John*. *John* is not the local antecedent and in English *himself* is only allowed to refer to *Bill*. The possibility for *himself* to refer to *John* is called long-distance binding.

(138)   Mary$_i$ heard that Sue$_i$ told the doctor about herself$_i$,

These studies indicate that L2 speakers tend to prefer to interpret the reflexive pronoun to antecedents as they do in their L1. Some of these studies also found that L2 speakers with a high proficiency rely more on the properties of the L2 than on the L1 (e.g. Thomas, 1991, 1995, Wakabayashi, 1996). The reliance on the L1 seems to be reduced with increasing proficiency in the L2. For example, Jegerski, van Patten and Keating (2011) explored whether L2 speakers were able to manage pronominal processing and whether they were able to apply an L1-like strategy. The intermediate L2 speakers of Spanish did neither interpret null pronouns as referring to the subject, nor overt pronominal elements as referring to the object, as would be L1-like. Advanced L2 speakers displayed a distinction in the interpretation of null and overt pronominal elements in the direction of L1 speakers, but not always. Jegerski et al. (2011) conclude that an L1-like interpretation can be learned as L2 speakers get more proficient. They furthermore pointed out that the L1 affects the L2 in the sense that interpretation strategies were taken over to the L2 until an advanced proficiency level was achieved. White (1998) also showed that L2 speakers apply Principle B in the interpretation of personal pronouns, allowing the personal pronoun to corefer to an antecedent outside its governing category. Their reference assignment is guided by Principle B (Chomsky, 1981).

Researchers were also interested to find out if L2 speakers were able to acquire and to apply such features in the L2, that were absent in their L1. Therefore, Rothman (2009) tested if L2 speakers of Spanish with the L1 English could acquire the distinction between overt and null subjects. He emphasizes that the pronominal system has been acquired when the Φ-features of Spanish morphology have been acquired, which allows the speakers to draw on syntactic knowledge licencing null subjects. Furthermore, the distinction between overt and null subjects, which is constraint by pragmatics, has to be acquired. Rothman (2009) concludes from his study that L2 speakers with an advanced proficiency level in the L2 performed like L1 speakers and that intermediate L2 speakers showed syntactic knowledge, but also demonstrated a lack of knowledge concerning the distinction between null and overt subjects. This distinguished intermediate L2 speakers from L2 advanced speakers on the one hand and L1 speakers on the other hand. This study also revealed that syntactic knowledge is acquired before knowledge about the pragmatic distribution of pronominal elements and thus, that syntactic-pragmatic interfaces were harder to acquire than features at syntactic level. However, this is only interesting with regard to the assumption of the SSH. Rothman (2009)

argues that the acquisition of the pragmatic distribution is delayed, because the syntax-pragmatic interface provides more information that has to be acquired than the syntactic level. However, with increasing proficiency in the L2, the syntax-pragmatic interface seems to be acquired with the result that differences between L1 and L2 speakers were no longer apparent. The eyetracking study of Roberts, Gullberg and Indefrey (2008) showed that German and Turkish L2 speakers of Dutch slow-down in reading of personal pronouns opposed to L1 speakers in structures like (139) and (140)

> (139) De werknemers zitten in het kantoor. Terwijl Peter aan het werk is, eet hij/eten zij een boterham
> "The workers are in the office. While Peter is working, he is eating/they were eating a sandwich"

> (140) Peter en Hans zitten in het kantoor. Terwijl Peter aan het werk is, eet hij een boterham
> Peter and Hans are in the office. While Peter is working, he is eating a sandwich

A comprehension questionnaire showed no comprehension differences between L1 and L2 speakers, except for the ambiguous pronouns like (141). The Turkish L2 group differed from the L1 and L2 German group in the sense that the Turkish group preferred the local antecedent *Peter* only half of the time.

> (141) Peter and Hans are in the office. While Peter is working, he is eating a sandwich

It has also been of interest if L2 speakers were guided by structural constraints in their interpretation of personal pronouns. Patterson, Trompelt and Felser (2014) investigated the application of structural constraints like condition B in co-argument structures such as (142) and non-co-argument structures (PP) like (143).

> (142) The boy remembered that Matthews had bought him a new computer game
> (143) Harry heard William pull the curtain around him in a quiet hospital ward

In the co-argument structure, both the L1 and the L2 speakers chose the non-local antecedent *the boy* as the antecedent for the personal pronoun. In the non-co-argument structure however, the L1 speakers do not seem to have a preference, whereas the L2 speakers' choise correlate with the language proficiency score: L2 speakers with a low proficiency score chose *Harry* as the non-local antecedents. Highly provicient speakers on the other hand behaved like L1 speakers. The eyetracking data showed that in the co-argument structure the local antecedent was never considered during processing. However, in later eye movement measures, gender seemed to influence processing. There was a later effect when the gender of the non-local antecedent mismatched the personal pronoun. Increased reading times were found for L1 speakers at the critical region (personal pronoun) and for non-co-argument structures (PP), when the local antecedent mismatched the personal pronoun's gender. L2 speakers showed increased reading times in non-co-argument structures in the critical and post-critical regions when the non-local antecedent mismatched personal pronoun's gender. Patterson et al. (2014) interpreted differences between L1 and L2 speakers as a consequence of their reading style. L1 speakers read faster and therefore showed late effects, whereas L2 speakers read rather slowly and showed earlier effects in processing. Patterson et al. (2014) ruled out the possibility of a cross-linguistic effect in non-co-argument structures. It is important to note that the L2 speakers were German, since in German, the non-local antecedent *Harry* is the only possible antecedent in such non-co-argument structures. Thus Patterson et al. (2014) tested if the L2 speakers could be guided by L1 properties. However, when tested for German, the German L1 speakers had no preference. It could either be the subject or the object. Patterson et al. (2014) therefore argued that L2 speakers have a preference for salient subjects. The different results for co-argument and non-co-argument structure show that L1 speakers recognised the differences in structure and let condition B only apply to co-argument structures.

It has also been of interest if L2 speakers were able to employ structural constraints in their interpretation of reflexive pronouns. The eyetracking studies of Felser, Sato and Bertenshaw (2009) and Felser and Cunnings (2012) examined the processing of reflexive pronouns in English by German L2 speakers and found opposing results. Felser et al. (2009) found, that in a co-argument structure – with two potential antecedents - longer reading times for reflexive pronouns in L2 speakers were observed than in sentences were only one antecedent matched the reflexive pronoun's features as in (144).

(144) Jane noticed that Richard had cut himself with a very sharp knife

Felser and Cunnings' (2012) found longer reading times for reflexive pronouns in co-argument structures with only a single match than in co-argument structures with two accessible antecedents for L2 speakers. The results of Felser et al. (2009) and Felser and Cunnings (2012) differ from each other. Felser and Cunnings (2012) explain this difference by the discourse saliency of the non-matching antecedent like first-mentioning and frequency of mentioning. Thus, discourse factors guide the processing of reflexive pronouns from the very beginning. These last two studies show that L2 speakers' processing is different from that of L1 speakers. While L2 processing is influenced by information from the discourse, this is different for L1 speakers. Also processing proceeds differently in L1 and L2 speakers leading to different processing profiles.

Summing up, it has been shown for L1 speakers that manipulating discourse information affects the comprehension and processing of pronominal elements which is also been found for L2 speakers. Further, the processing in L1 speakers also differs from L2 speakers' processing. L1 speakers, but not L2 speakers, apply a syntactic operation whenever possible. These results fit the GE-hypothesis (Ferreira, 2003) that argues for shallow processing in L1 speakers and contradicts the SSH (Clahsen and Felser, 2006) that assumes that L1 speakers processing is not shallow. The results of the L2 speakers suit the DP-model (Ullman, 2001) that argues against syntactic processing in L2 speakers. These results are interesting for the purpose of the present study as here processing of pronominal elements in Dutch by L2 speakers has been investigated. As well the comprehension of pronominal elements has been investigated which up to this point has rarely been investigated.

5   Aim of the study

The aim of this research project was to investigate how adult L2 speakers process reflexive and personal pronouns in their L2 Dutch in comparison to L1 speakers of Dutch. We were interested in similarities and differences in the strategies these two speaker groups employed while reading pronominal elements. We therefore tested the processing of these elements with a self-paced reading and an eyetracking study. The processing of reflexive and personal pronouns have already been compared in two different structures. First of all, reflexive and personal pronouns have been investigated because it is assumed in the literature that different strategies can be applied for their processing (Reuland, 2001, 2011). It has also already been shown that L1 speakers apply different processing strategies for reflexive and personal pronouns (Arnold, Eisenband, Brown-Schmid & Trueswell, 2000; Badecker & Straub, 2002; Burkhardt, 2005; Ehrlich & Rayner, 1983; Sturt, 2003; Hendriks, Banga, van Rij & Cannizzaro, 2011; Ruigendijk & Schumacher, 2011; Sekerina, Stromswold & Hestvik, 2004). Moreover, it has been shown that the applied processing operations depend on the structure the pronominal element appears in (Burkhardt, 2005). Finally, researchers as for instance Ullman (2001) and Clahsen and Felser (2006) assume, that the representation and processing of syntax pose a problem for L2 speakers, so that other non-syntactic operations have to be applied.

Therefore, this research project investigated the processing of reflexive and personal pronouns in co-argument structures like (145) and in PPs like (146).

> (145)   De jongen zag zichzelf/hem
>
>   "The boy saw himself/him"
>
> (146)   De jongen grooide de pen naast zich/hem
>
>   "The boy threw the pen next to himself/him"

By doing so, we were able to discover, which strategies L1 and L2 speakers applied in the processing of reflexive and personal pronouns. Furthermore, we shed light on how the syntactic environment affects their processing. This enabled us to determine, if the operations applied in L2 processing were qualitatively different from those of L1 speakers. Furthermore, we were also able to evaluate the influence of the L1 on the processing of the L2. This is relevant, because there are cross-linguistic differences between German and Dutch in the interpretation possibilities of personal pronouns in a PP[23].

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[23] The data of the self-paced reading study will be published in Ziemann, H., & Ruigendijk, E. (sub.). L2 speakers' processing of reflexives and personal pronouns. A self-paced reading study of German learners of

A third experiment has also been carried out investigating the comprehension of reflexive and personal pronouns in a *picture NP* in L1 speakers only. Picture NPs are similar to the co-argument structures and PPs, as in all of these structures, a syntactic operation and a discourse operation can be applied to process the pronominal element. We tested the comprehension of these elements in three types of picture NP constructions in German and Dutch to see how the pronominal elements were interpreted. The processing of them will not be investigated as these picture NPs have rarely been investigated in German and Dutch, but there are some studies for English. Therefore, the aim is to get an impression of whether these picture NPs are grammatical in Dutch and German and which antecedents the pronominal elements take.

The first structure of the comprehension study was a non-processed picture NP (PNP) as in the Dutch (147) and the German example (148).

(147) Jan en Frank$_j$ bekijken foto's. Jan$_i$ merkt op dat <u>een mooie foto van zichzelf$_{i/*j}$/hem$_{i/j}$</u> jammer genoeg in het album zal missen

"Jan and Frank watch pictures. Jan remembers that a beautiful picture of himself/him unfortunately misses in the photo album"

(148) Jan und Frank$_j$ planen eine Ausstellung. Jan$_i$ denkt, dass <u>eine schöne Zeichnung von sich$_{*i/*j}$/ihm$_{i/j}$</u> unmöglich im Schaufenster aufgestellt werden kann

"Jan and Frank plan an exhibition. Jan thinks that a beautiful drawing of himself/him not be set up in the shop window"

There are differences between German and Dutch in the use of the reflexive pronoun in PNPs as the examples (147) and (148) show. The reflexive pronoun in such a structure is ungrammatical in German as has been argued for by Kiss (2001, 2008) and Lee-Schoenfeldt (2008). However, Principle A (Chomsky, 1981) would predict that the matrix clause is the governing category and *Jan* should thus bind the reflexive pronoun. The personal pronoun *ihm* can be interpreted as *Jan* or *Frank* and *hem* as *Jan* or *Frank*. Condition B (Reinhart and Reuland, 1993) does not apply, as it only applies to co-arguments. The reflexive and personal pronoun may refer to any object.

The second structure that had been tested with the comprehension study was a possessed picture NP (p-PNP) like the Dutch (149) and the German example (150).

Dutch. In: *The impact of pronominal form on interpretation*. Studies in Generative Grammar. De Gruyter Mouton.

(149) Jan en Frank staan voor de boekenkast. Jan$_i$ bevestigt dat <u>Frank$_j$'s nieuwe boek over zichzelf$_{*i/j}$/hem$_{i/*j}$</u> mogelijk in de lente zal worden gepubliceerd

"Jan and Frank were standing infront of the bookshelf. Jan confirms that Frank's new book of himself/him possibly will be published in spring"

(150) Jan und Frank planen eine Komödie. Jan$_i$ findet, dass <u>Franks$_j$ niveauvoller Witz über sich$_{*i/j}$/ihn$_{i/*j}$</u> besser am Ende gemacht werden kann

"Jan and Frank were planning a comedy. Jan thinks that Frank's intelligent joke of himself/him could be better told at the end"

Principle A (Chomsky, 1981) and Condition B (Reinhart and Reuland, 1993) would predict that the reflexive pronoun in Dutch and German should be bound by the possessor *Frank* and the personal pronoun should not be bound by the possessor according to principle B. The personal pronoun could be bound by *Jan*.

The third structure of the comprehension study was a picture NP with a subject (s-PNP) in Spec-position like (151) and (152).

(151) Jan en Frank zitten bij de koffie. Jan$_i$ legt uit dat <u>Frank$_j$ een uitgebreide beschrijving van zichzelf$_{i/*j}$/hem$_{*i/j}$</u> goed in de brochure zou kunnen zetten

"Jan and Frank were drinking coffee. Jan explains that Frank could easily publish a detailed description of himself/him in the booklet"

(152) Jan und Frank betrachten Fotos. Jan$_i$ fällt auf, dass <u>Frank$_j$ ein schönes Foto von sich$_{*i/j}$/ihm$_{i/*j}$</u> leider im Album nicht finden kann

"Jan and Frank watch pictures. Jan notices that Frank will not find a beautiful picture of himself/him in the photo album"

According to Principle A (Chomsky, 1981) and Condition B (Reinhart and Reuland, 1993), the reflexive pronoun should be bound by the subject of the subordinated clause *Frank*. The personal pronoun should be bound by *Jan* as is predicted by Principle B and Condition B.

We carried out a grammaticality judgement and an interpretation task in German with L1 speakers of German and as well in Dutch with L1 speakers of Dutch. The third study was an attempt to get an impression of how reflexive and personal pronouns behave in these different syntactical environments in both German and Dutch. Moreover, this study will serve as empirical evidence for or against theoretical assumptions about the status of picture NPs.

5.1 Hypotheses

5.1.1 L1 speakers: syntax versus discourse

Syntax is accessible for L1 speakers. Research has shown that L1 speakers make use of syntax to process the reflexive pronoun in a co-argument structure, but not for the processing of a personal pronoun or reflexive pronouns in a PP (Nicol and Swinney, 1989; Hendriks et al., 2011; Burkhardt, 2005; Schumacher et al., 2010)

The first hypothesis thus is:

Hypothesis 1:

L1 speakers apply a syntactic operation to process reflexive pronouns in a co-argument structure, whereas they adapt a non-syntactic operation in the processing of reflexive pronouns in a PP and personal pronouns in general.

This hypothesis is confirmed if faster RTs in the self-paced reading study were found for reflexive pronouns in a co-argument structure compared to personal pronouns and pronominal elements in PPs. In eyetracking, shorter fixations on reflexive pronouns compared to personal pronouns in a co-argument structure and compared to pronominal elements in a PP should be found. Moreover, fewer/shorter fixations should be directed to the syntactically legal antecedents of reflexive pronouns in a co-argument structure than to the antecedents of the personal pronouns in a co-argument and PP structure and reflexive pronouns in a PP.

If the hypothesis was confirmed by the processing studies, this would provide evidence of the division of labour between syntactic and non-syntactic operations, as has theoretically been assumed by Reinhart and Reuland (1993) and Reuland (2001, 2011) and substantiated by psycholinguistic research (Arnold et al., 2000; Badecker & Straub, 2002; Burkhardt, 2005; Ehrlich & Rayner, 1983; Sturt, 2003; Hendriks et al., 2011; Ruigendijk & Schumacher, 2011; Sekerina et al., 2004).

5.1.2 L2 speakers: syntax versus discourse

It has been argued that syntax is difficult to access for L2 speakers (Ullman, 2001, Clahsen and Felser, 2006) but it seems to be controversial in how far syntax is affected in L2 speakers and if L2 speakers with a high proficiency in the L2 can overcome problems concerning syntax.

The second hypothesis with regard to the L2 speakers says that:

Hypothesis 2:

L2 speakers' processing will be interfered by information of the context so that they apply a discourse operation in the processing of pronominal elements in both the co-argument structure and the PP.

This hypothesis would be confirmed if no differences in RTs were found between reflexive and personal pronouns within and across structures in the self-paced reading study. Also, fixation should be equally distributed between reflexive and personal pronouns within and across structures. Moreover, fixations should also be equally distributed across antecedents.

5.1.3 Proficiency: highly proficient versus low proficiency L2 speakers

Research (Rothman, 2009; Patterson et al. 2014; White, 1985; Hawkins and Chan, 1997; Leung, 2003) has shown that highly proficient L2 speakers process like L1 speakers and different from low proficiency L2 speakers. However, the role of proficiency is controversially debated in the L2 literature. For instance, Ullman (2001) assumed that with a high proficiency in the L2, syntax is accessible. Clahsen and Felser (2006) reject proficiency as a factor giving access to syntax. This research project can provide insight into the role of proficiency.

The hypothesis relating to the issue of proficiency is that:

Hypothesis 3:

Highly proficient L2 speakers process reflexive pronouns in a co-argument relation with a syntactic operation and personal pronoun in the same structure, as well as pronominal elements in a PP with a discourse operation. Low proficiency L2 speakers are hypothesised to apply a discourse operation in the processing of pronominal elements in both types of structures.

As a consequence, it should be found that highly proficient L2 speakers behave like L1 speakers and these groups should be different from low proficiency L2 speakers in processing pronominal elements.

5.1.4 Accessible antecedent

It is also interesting to know if manipulating the context influences, how pronominal elements were processed. The lead-in sentence provided either two grammatical accessible antecedents (119) or only one accessible antecedent, although two persons were introduced (120). The hypothesis is that L1 speakers' processing is not influenced by information of the context, so that a syntactic operation will be applied in the processing of reflexive pronouns in a co-argument structure. The hypothesis for L2 speakers is that they apply a discourse operation

anyway. However, Felser and Cunnings (2012) have shown that the number of accessible antecedents influences the processing of reflexive pronouns. They found that reflexive pronouns with only one accessible antecedent – although the context provided two antecedents – were processed more slowly than with two accessible antecedents. A mismatch in gender between the antecedent and the reflexive pronoun slowed down processing. Therefore, the hypothesis that will be tested is:

Hypothesis 4:

L2 speakers in this study will also be interfered by information of the context.

L2 speakers showed show a slower processing of reflexive pronouns in sentences like (154) compared to sentences like (153).

(153) De kapper en de visagist$_j$ werkten in de kapsalon. De kapper$_i$ die graag dingen uitprobeerde schoor zich$_i$ zodat de nieuwe aftershave kon worden uitgeprobeerd

"The hairdresser and the stylist were working in the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested"

(154) De kapper en ik$_j$ werkten in de kapsalon. De kapper$_i$ die graag dingen uitprobeerde schoor zich$_i$ zodat de nieuwe aftershave kon worden uitgeprobeerd

"The hairdresser and me were working in the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested"

5.1.5 Interference

German and Dutch are related languages and therefore show a lot of similarities in the field of pronominal binding. The binding of the pronominal elements in a co-argument structure is not different between German and Dutch. But differences in binding exist in PPs. The processing of personal pronouns contained in a PP provides a broader spectrum of interpretation in Dutch. Sabourin (2003), for instance, has shown that transfer is used by L2 speakers and employed at large in closely related languages.

The hypothesis that relates to interference in the processing of pronominal elements in PPs is:

Hypothesis 5:

L2 speakers' processing of pronominal elements is influenced by the grammatical representation of the L1 and L2.

This hypothesis would be substantiated if the self-paced reading study showed RTs that were longer for L2 speakers on the personal pronoun in a PP compared to reflexive pronouns.

5.1.6 Interference and proficiency

However, proficiency could be a factor that blocks interference. Highly proficient L2 speakers have developed a fully detailed grammatical L2 system, which is used for processing. Low proficiency L2 speakers do not have sufficient L2 knowledge, so that an L2 grammatical system has not yet been built.

The hypothesis regarding proficiency is:

Hypothesis 6:

Highly proficient L2 speakers only consult the L2 representation in the processing of pronominal elements and low proficiency L2 speakers are hypothesised to apply the L1 representation as well.

The processing of highly proficient L2 speakers should be different from low proficiency L2 speakers, as only differences in the processing of reflexive and personal pronouns in PPs should appear for low proficiency L2 speakers. Highly proficient L2 speakers should process reflexive and personal pronouns in PPs equally.

5.1.7 Comprehension study

The purpose of the comprehension study was to get information of the grammaticality of three types of picture NP structures and how pronominal elements in these structures were interpreted in German and Dutch. The comprehension will only be investigated in L1 speakers. The three structures were picture NPs (PNP) (155), possessed PNPs (p-PNP) (156) and picture NPs with a subject in Spec-position (s-PNP) (157).

(155) Jan$_j$ en Daan bespreken de verhuizing. Daan$_i$ vertelt dat een mooi portret van zichzelf$_{i/*j}$/hem$_{*i/j}$ zorgvuldig in papier moet worden ingepakt

"Jan and Daan discuss the moving. Daan says that a nice picture of himself/him carefully has to be carefully wrapped in paper"

(156) Jan en Daan bespreken de verhuizing. Jan$_j$ vertelt dat Daan$_i$'s mooie portret van zichzelf$_{i/*j}$/hem$_{*i/j}$ zorgvuldig in papier moet worden ingepakt

"Jan and Daan discuss the moving. Jan says that Daan's nice picture of himself/him has to be carefully wrapped in paper"

(157)   Jan en Daan bespreken de verhuizing. Jan$_j$ vertelt dat Daan$_i$ een mooi portret van zichzelf$_{i/*j}$/hem$_{*i/j}$ zorgvuldig in papier moet inpakken

"Jan and Daan discuss the moving. Jan says that Daan has to wrap the picture of himself/him carefully in paper"

Above, it has been described how the reflexive and personal pronouns should be bound according to the structural factors like Principles A and B and Condition B. Research (e.g. Sturt, 2003; Runner et al. 2002, 2003, 2006) has shown that binding of reflexive and personal pronouns in this case is not always in accordance with the theory (Chomsky, 1981; Reinhart and Reuland, 1993). Except for the reflexive pronoun in PNPs (119), the theories make the same predictions with regard to the binding of the pronominal elements for German and Dutch. The similarity between the structures is that discourse can be applied to guide the interpretation. The difference is that a syntactic operation can only be applied in (120) and (121).

The hypothesis concerning the comprehension of pronominal elements is that:

Hypothesis 7:

Whenever possible, reflexive pronouns will be primarily guided in their interpretation by syntactic factors and personal pronouns will be guided by structural and non-structural factors.

According to that hypothesis, the choices of antecedents should be as predicted by the theory (Reinhart and Reuland, 1993).

6 Methods

6.1 Self-paced reading

6.1.1 Participants

29 L1 speakers of Dutch (26 women, 3 men; mean age: 21,45 years) participated and served as the control group (L1). Each of them grew up in the Netherlands monolingually[24]. They were all students either at the University of Nijmegen (20 students), the University of Amsterdam (4 students) or the University of Groningen (35 students). The L2 group consisted of 32 German (7 men, 25 women; mean age: 23 years[25]) native speakers who had (at that point) lived in the Netherlands for at least half a year. The L2 speakers grew up monolingually and started learning Dutch at school or university, which means not before the age of 15. None of the participants suffered from a neurological disorder or dyslexia. The proficiency of the L2 speakers had been accessed with Dialang (http://www.lancaster.ac.uk/researchenterprise/dialang/about; 04.01.2016). One of the participants had the proficiency level A1 (lowest proficiency), two A2, five B1, six B2, eight C1 and ten C2 (highly proficient).

6.1.2 Materials

The processing of pronominal elements had been tested in two structures. These were a co-argument structure (table 4, 1a, 1b) and a PP (table 4, 1c, 1d). In each structure, a reflexive pronoun and a personal pronoun were used. Two structures and two pronominal elements results in four conditions. Each condition contained 21 items which is a total of 84 items. The lexical material of the two co-argument structures was identical with the exception of the pronominal element used. Moreover, the lexical material of the PP structures was the same with the exception of the pronominal element. The lexical material contained differences between the co-argument structure and the PP due to the types of structures tested. The similarity between the co-argument and the PP structure was that the number of words and syllables was kept constant (table 4). Furthermore, the frequency of the verbs in the two structures was matched. Frequencies were collected from Celex (http://celex.mpi.nl/, 04.01.2016).

There was always a lead-in sentence that was identical for both structures. This lead-in sentence contained two possible antecedents (table 4: lead-in sentence). These antecedents matched the grammatical features of the pronominal elements.

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[24] The L1 speakers learned English at school as their first L2.
[25] Two L2 speakers did not provide their age.

As shown in table 4, we tested a fifth condition (1e). This condition was also a co-argument structure which was lexically identical to the co-argument structure (1a, 1b) but here the lead-in sentence only provided one antecedent that matched the grammatical features of the pronominal element. There was also a non-matching antecedent. Here, the first person personal pronoun *ik* was used. The fifth condition (1e) also consisted of 21 items so that in total the material consisted of 105 items.

There were also 120 filler items that had a lead-in sentence and a pronominal element. The filler items were structurally similar to the test items.

For the presentation, the items were divided into segments. This was done for all items in the same way. The pronominal element was always contained in the ninth segment. This was the critical region (see Table 4: **bold** words). The segment immediately before the pronominal element was either a preposition, as was the case in the PP, or a verb, as in the co-argumenthood structure. This is our pre-critical region (in Table 4: *italics*). After the pronominal element, we had two post-critical regions (in Table 4: <u>underlined</u>). The first post-critical region was always a conjunction and the second post-critical region consisted of a determiner phrase or a prepositional phrase. The segmentation of the items is marked by | in table 4. Fillers were constructed in the same way as the items.

Table 4: example of items

lead-in sentence		
De kapper en de visagist| werkten| in de kapsalon.| The hairdresser and the stylist were working at the hairdresser's.		
reflexive pronoun in a co-argument structure	**words**[26]	**syllables**[27]
1a De kapper| die| graag| dingen uitprobeerde| *schoor*| **zich**| <u>zodat</u>| <u>de nieuwe aftershave</u>| kon worden uitgeprobeerd.| (The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.)	7	12
personal pronoun in a co-argument structure		

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[26] Words were counted from the beginning of the sentence up to the pronominal element.
[27] Syllables were counted from the beginning of the sentence up to the pronominal element.

1b	De kapper| die| graag| dingen uitprobeerde| *schoor*| **hem**| <u>zodat</u>| de <u>nieuwe aftershave</u>| kon worden uitgeprobeerd.| (The hairdresser who liked to try things shaved him so that the new aftershave could be tested.)	7	12
reflexive pronoun in a PP			
1c	De kapper| verschoof| een grote| kapperstoel| *naast*| **zich** | <u>zodat</u>| <u>er beter</u>| kon worden gewerkt.| (The hairdresser moved a big barber's chair next to himself so that one could work more easily.)	7	12
personal pronoun in a PP			
1d	De kapper| verschoof| een grote| kapperstoel| *naast*| **hem**| <u>zodat</u>| er <u>beter</u>| kon worden gewerkt.| (The hairdresser moved a big barber's chair next to him so that one could work more easily.)	7	12
reflexive pronoun in a co-argument with one grammatical antecedent			
1e	De kapper en ik[28]| werkten| in de kapsalon.| De kapper| die| graag| dingen uitprobeerde| *schoor*| **zich**| <u>zodat</u>| <u>de nieuwe aftershave</u>| kon worden uitgeprobeerd.| (The hairdresser and I were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.)	7	12

6.1.3 Procedure

The E-Prime 2.0 software (Psychology Software Tools, Pittsburgh, PA) was used to program the experiment. The items were divided into two sessions. 105 test items and 120 filler sentences resulted in a total of 225 items. 113 items were tested in session 1 and 112 items in session 2. Each session started out with a practice trial that included five practice items. Then, four blocks with 28 items each followed[29]. Between the blocks, there was always a break that had no restriction in time. To finish the break, the participants had to click the mouse. Each session lasted about 45 to 60 minutes. The sessions took place on two different days.

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[28] To test for the influence of context information on the processing of reflexive pronouns it has been decided to add a condition that contains two antecedents but only one of these antecedents matches in person features with the reflexive pronoun. Comparing this condition to condition 1a of table 4 provides insight in possible influences of the context on the processing of pronominal elements.

[29] Session 1 contained 113 items so that in block 1, 3 and 4 28 items had been tested but in block 29 items.

The material of the self-paced reading study was presented as segments as has already been shown in table 8. E-prime was instructed to present the segments in the centre of the screen with bold letters. The colour of the words was grey and the background colour was black. The letter size was 18 and the words were written in courier new.

Participants were told, that the sentences would not be presented as a whole, but in segments in the centre of the screen. The first segment was always given automatically, but each following segment only appeared after pressing the space button, which they were asked to press as quickly as possible. After pressing the button, the segment on the screen disappeared and the following segment appeared. When the sentence was finished, a question mark appeared on the screen to signal, that a question would be asked. This was a yes/no question, which tested the comprehension of the sentence to ensure that participants not just clicked through the experiment without reading for comprehension. When the participants wanted to say "yes", they had to press a button with a green sticker on it and when they wanted to say "no", they had to press a button with a red sticker on it. An example of such a question is (158) that followed the item (159).

(158)   Verschoof de kapper een stoel?
        "Replaced the hairdresser a chair?"

(159)   De kapper verschoof een grote kapperstoel naast hem zodat er beter kon worden gewerkt
        "The hairdresser moved a big barber's chair next to himself/him so that one could work more easily"

A proficiency test was also carried out after the participants had finished the second session. They did the online test Dialang (http://www.lancaster.ac.uk/researchenterprise/dialang/about, 04.01.2016) and only the grammaticality task. The participants got 30 tasks. These were questions which they had to answer by either writing down a word or by choosing the right answer out of various offered answers; some tasks gave incomplete sentences which the participants had to complete by either writing down a word or by choosing the right answer out of a set of possible answers given to them. After they had answered 30 questions, Dialang reported the proficiency level.

6.1.4   Analysis

We gathered two edat-output files per participant, one output file per session. This resulted in 122 output files that were merged together to one text file and entered into R (https://www.r-project.org/, 21.07.2015). All RTs that were beyond 200 and above 1100 milliseconds were

removed. It is assumed that RTs below 200 milliseconds were too fast to have read the element (Rayner and Pollatsek, 2006) and RTs above 1100 milliseconds are quite long for reading a word[30]. For the critical region, 97,7%, for the first post-critical region (conjunction) 96,9%, and for the second post-critical region 91,3% of the data remained. Furthermore, the data were log-transformed because the data were not normally distributed.

The percentage of correct responses on the comprehension questions was calculated. The RTs of those participants, who had answered at least 75 percent correct, were analysed. The data of 3 German participants were dismissed. Only the items where the questions were correctly answered were analysed. 84 percent of the items remained.

The statistical analyses were based on the hypotheses. This means that for each hypotheses a hypothesis driven model was run. The dependent variables were the RTs for the critical and post-critical regions. The independent variables were *pronountype* (reflexive and personal pronoun), *structure* (co-argument structure and PP), *group* (L1 and L2 speakers), *proficiency* (low vs. high proficiency L2 speakers), *accessible antecedent* (one vs. two antecedents) and *locality* (Groningen vs. Amsterdam vs. Nijmegen).

6.1.4.1 Syntactic versus discourse processing

The first analysis that was carried out concerned the hypothesis, that reflexive pronouns in a co-argument structure can be processed with a syntactic operation, whereas personal pronouns in this structure and pronominal elements in a PP can be processed by a discourse operation. The data of the conditions (1a), (1b), (1c) and (1d) of table 4 were entered into R. A mixed effect regression model *lmer* was built and the dependent variables *RT* as well as the independent variables (fixed factors) *structure*, *pronountype* and *group* were adapted to the regression model. The random factors *subj* (subject) and *trial* were added. The regression model looked like this: *RT~pronountype+structure+group+[1\subj]+[1\trial]*. This regression model was also changed into an interaction that took the form *RT~pronountype*structure*group+[1\subj]+[1\trial]*.

The second analysis was conducted to discover the impact of proficiency on the processing of pronominal elements in co-argument and PP structures. This time, the regression model included the dependent variable *RT*, the independent variable *structure*, *pronountype* and *proficiency* as well as the random factors *subj* and *trial*. The mixed effect regression model

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[30] Rayner and Pollatsek (2006) mentioned that fixations can last up to 500ms. It was decided to remove fixations longer than 1100ms because L2 speakers participated. L2 speakers are generally somewhat slower in reading (e.g. Patterson et al. 2014). Fixations can therefore be longer.

had the form of *RT~pronountype+structure+proficiency+[1\subj]+[1\trial]* which was also changed into an interaction *RT~pronountype*structure*proficiency+[1\subj]+[1\trial]*.

6.1.4.2 Interference

It had been hypothesised that personal pronouns in a PP could be subject to interference. The data of (1c) and (1d) of table 4 were entered into R. The mixed effect regression model that contained the dependent variables *RT*, the independent variables *pronountype* and *group* and the random factors *subj* and *trial* were run *RT~pronountype+group+[1\subj]+[1\trial]*. This model was also changed into an interaction *RT~pronountype*group+[1\subj]+ [1\trial]*. *Proficiency* was also considered. Therefore, the fixed factor *group* was removed and *proficiency* was added to the model.

6.1.4.3 Regional variation

The RTs of the L1 speakers could be influenced by regional variation. Not all L1 speakers might consider the subject *de kapper* as antecedent of the personal pronoun in the PP structure (1c). The data of (1c) and (1d) were therefore entered into R and only the data of the L1 speakers. The dependent variable *RT*, the independent variables *pronountype* and *locality* and the random factors *subj* and *trial* were added to the model *RT~pronountype+locality+[1\subj]+[1\trial]* which was also changed into an interaction.

6.1.4.4 Single versus double antecedents

One assumption was, that reflexive pronouns in a co-argument structure can in principle be processed by a syntactic operation. This would imply that a syntactic chain between the reflexive pronoun and the accessible antecedent is formed immediately. Other antecedents that appear in the discourse should be neglected. To see if discourse impacts the processing of reflexive pronouns and overrules a syntactic operations, the RTs of (1a) and (1e) of table 4 were analysed. The dependent variable *RT*, the independent variables *accessible antecedent* and *group* and the random factors *subj* and *trial* were added to the model that took the form *RT~single+group+[1\subj]+[trial]*. This model was also changed into an interaction. *Proficiency* was also considered. Therefore, the fixed factor *group* was removed and *proficiency* was added to the model.

6.2 Method: Eyetracking

6.2.1 Participants

32 L1 speakers (men: 4, women: 28; mean age: 20,92[31]) and 28 German L2 speakers (men: 8; women: 20; mean age: 22,2) participated in the eyetracking study. All were students at the University of Groningen. The L2 speakers had (at that point) stayed in the Netherlands for at least half a year. The L2 speakers grew up monolingually and started learning Dutch at school or university, which means not before the age of 15. None of the participants suffered from a neurological disorder or dyslexia. The proficiency of the L2 speakers was accessed with Dialang (http://www.lancaster.ac.uk/researchenterprise/dialang/about; 04.01.2016). Nine of the participants had the proficiency level A1 (lowest proficiency), one had a level of A2, two scored a B1-level, three achieved a B2-level, seven a C1 and six a C2-level (highly proficient)

6.2.2 Materials

The lexical material used was the same as in the self-paced reading study. The only difference was, that in the eyetracking study, the items and filler sentences were presented as a whole on the screen (figure 3, 4). The segmentation was removed. The pre-critical region in the co-argument structure was the verb before the pronominal element and in the PP structure the preposition. The critical region was the pronominal element. The first post-critical region was the conjunction that followed the critical region and the second post-critical region was the phrase thereafter. The sentences were presented in such a way that the regions of investigation were in the centre of the screen. Thus, not so far at the right or left of the screen because the eyes do not always fixate these parts (Rayner and Pollatsek, 2006). The background colour was white, the words were written in black. Letter type courier new had been used and letter size 18.

Figure 3: co-argument structure

```
De bioloog en de scheikundige stonden in de tuin.

De bioloog die veel studies deed naar

apen verbaasde zich, terwijl de vogels een vrolijk

liedje floten.
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[31] Six L1 speakers did not report their age. The mean age was thus based on 26 L1 speakers.

"The biologist and the chemist were standing in the garden. The biologist, who studied apes, was surprised while the birds were singing a happy song."

Figure 4: PP structure

```
De bioloog en de scheikundige stonden in de tuin.

De bioloog plantte een bloem met prachtige

kleuren voor hem terwijl één van de buren van een

afstandje toekeek.
```

"The biologist and the chemist were standing in the garden. The biologist planted a flower with beautiful colours in front of him while one of the neighbours was looking from a distance."

6.2.3 Procedure

The E-prime software (Psychology Software Tools, Pittsburgh, PA) was used to program the experiment. The items were divided into two sessions. 105 test items and 120 filler sentences resulted in a total of 225 items. 113 items were tested in session 1 and 112 items in session 2. Each session started out with a practice trial that included five practice items. Then, four blocks with 28 items each followed[32]. Between the blocks, there was always a break that had no restriction in time. To finish the break, the participants had to click the mouse. Each session lasted about 60 minutes. The sessions took place on two different days.

The participants were told, that the items would appear on the screen as a whole. They were asked to look at the fixation cross on the screen and to wait as long as they got a read rectangle around that fixation. The participants were requested to press the space button, when the rectangle appeared constantly on the screen. Pressing the space button released the sentence on the screen. They were asked to read the sentences as quickly as possible and when finished, to press the space button. Analogous to the self-paced reading study, a comprehension question was asked that was signalled by a question mark. The questions were the same as for the self-paced reading study. These were yes/no questions, which tested the comprehension of the sentence to ensure that participants not just clicked through the experiment without reading for comprehension. If the participants wanted to say "yes", they had to press a button with a green sticker on it and if they wanted to say "no", they had to

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[32] Session 1 contained 113 items so that in block 1, 3 and 4 28 items had been tested but in block 29 items.

press a button with a red sticker on it. An example of such a question is (160) that followed the item (161)

(160)   Verschoof de kapper een stoel?
        "Replaced the hairdresser a chair?"
(161)   De kapper verschoof een grote kapperstoel naast hem zodat er beter kon worden gewerkt "
        "The hairdresser moved a big barber's chair next to himself/him so that one could work more easily"

A proficiency test was also carried out after the participants had finished the second session. They did the online test Dialang (http://www.lancaster.ac.uk/researchenterprise/dialang/about; 04.01.2016) and only the grammaticality task. The participants got 30 tasks. These were questions which they had to answer by either writing down a word or by choosing the right answer out of various offered answers; some tasks gave incomplete sentences which the participants had to complete by either writing down a word or choosing the right answer out of a set of possible answers that were given to them. When they had answered 30 questions, Dialang reported the proficiency level.

6.2.4   Analysis

The Tobii TX300 eyetracker was used for testing which has a resolution of 300 Hz. The eyetracker was connected to another computer that made two recordings. It collected per session and participant a gazedata-output file and an edat-file. In total, 120 gazedata-output files and 120 edat-files were gathered. The gazedata-file contained all recordings from the eyetracker, these were the fixation on the pre-critical, critical and post-critical regions. The edat-files saved all information surrounding the material and how the questions were answered. The gazedata-files and edat-files were merged into two files respectively and entered in R (https://www.r-project.org/, 21.07.2015).

A script was written in R (https://www.r-project.org/, 21.07.2015) that run through the gazedata-files and removed all fixations that were below 80 milliseconds. This means that if a participant looked too shortly at one of the regions of interest (pre-critical, critical, post-critical regions) and got to fast further in reading, such a fixation was excluded for further analyses.

Moreover, the data were log-transformed because the data were not normally distributed. The percentage of correct responses on the comprehension questions per participant was analysed.

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Participants had been dismissed that answered less than 75 percent correct. The data of 3 German participants was removed. In a next step, all items whose question was answered incorrectly, were removed. 87 percent of the data remained.

Then mixed effect regression models were run in order to test the hypotheses. The dependent variables were the *first fixation*, *first pass time*, *total time*, *second pass time* and *regressions* on the critical and post-critical regions. Rayner and Pollatsek (2006, p. 620) define a first fixation as "the duration of a first fixation on a word", a first pass time as "the sum of all fixations in a region from first entering the region until leaving the region", total time as "the sum of the durations of all fixations on a word including regressions", second pass time as "the sum of all fixations in a region following the initial first pass time" and regressions as "the sum of all fixations in a region from first entering the region, including any regression that are made, until moving to the right of the region".

The fixed factors were *pronountype* (reflexive and personal pronoun), *structure* (co-argument structure and PP), *group* (L1 and L2 speakers), *proficiency* (low proficiency vs. highly proficient L2 speakers), *accessible antecedent* (one vs. two antecedents)[33] and aoi (antecedent 1, antecedent 2, repetition of antecedent 1)[34]. The random factors *subj* (subject) and *trial* were also added to the mixed effect regression model.

In contrast to the self-paced reading study, there was only one post-critical region in the eyetracking study. Originally, there had been two, but to get stronger effects, the first and second post-critical regions were put together forming one large post-critical region.

The analyses do not have to be discussed extensively. The same analyses have been run. The only difference is that the dependent variables were not RTs, but fixations and regressions. Since no regressions were analysed for the self-paced reading study, the analyses of those will be described below.

6.2.4.1 Syntactic versus discourse processing

The setup of the regression models with regard to the analysis at the critical and post-critical region is the same as for the self-paced reading study. However, the number of regressions to the antecedents was also analysed with mixed effect models *regressions~aoi*pronountype*structure*group+[1|subj]+[1|trial]*. The total times on the

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[33] The fixed factor locality was not analysed, as all L1 speakers were tested in Groningen.
[34] The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested. → Antecedent 1: hairdresser, antecedent 2: visagist, repetition of antecedent 1: hairdresser

antecedents were analysed with the model *tt~aoi*pronountype*structure*group+[1\subj]+[1\trial]*.

6.2.4.2 Proficiency

The setup of the regression models with regard to the analysis at the critical and post-critical region is the same as for the self-paced reading study. However, the number of regressions to the antecedents was also analysed with mixed effect models *regressions~aoi*pronountype*structure*proficiency+[1\subj]+[1\trial]*. The total times on the antecedents were analysed with the model *tt~aoi*pronountype*structure*proficiency+[1\subj]+[1\trial]*.

6.2.4.3 Interference

The setup of the regression models with regard to the analysis at the critical and post-critical region is the same as for the self-paced reading study. However, the number of regressions to the antecedents was also analysed with mixed effect models *regressions~aoi*pronountype*group+[1\subj]+[1\trial]*. The total times on the antecedents were analysed with the model *tt~aoi*pronountype*group+[1\subj]+[1\trial]*.

6.2.4.4 Single versus double antecedents

The setup of the regression models with regard to the analysis at the critical and post-critical region is the same as for the self-paced reading study. However, the number of regressions to the antecedents was also analysed with mixed effect models *regressions~aoi*accessible antecedent*group+[1\subj]+[1\trial]*. The total times on the antecedents were analysed with the model *tt~aoi*accessible antecent*group+[1\subj]+[1\trial]*.

6.3   Method: Comprehension study

6.3.1   Participants

91 German L1 speakers from the University of Oldenburg and 96 L1 speakers of the Universities of Utrecht, Amsterdam and Nijmegen took part in this experiment. No personal information was collected from the participants.

6.3.2   Materials

The comprehension of reflexive and personal pronouns in non-possessed PNPs (PNP), possessed PNPs (p-PNP) and subject PNPs (s-PNP) was tested with a questionnaire in German and Dutch. There were 24 PNPs, 24 p-PNPs and 24 s-PNPs with a reflexive pronoun and 24 PNPs, 24 p-PNPs and 24 s-PNPs with a personal pronoun. This made in sum 144 items. Examples of these structures for German are provided in table 5. The Dutch questionnaire was designed in the same way. Out of this material, six short questionnaires

were made for German. Lists 1 to 3 tested the comprehension of pronominal elements in PNPs and p-PNPs and list 4 to 6 tested the comprehension in p-PNPs and s-PNPs. Table 5 shows that the material of the PNPs and p-PNPs had been matched for number of words and syllables. This was also the case for p-PNPs and s-PNPs. No filler items were added to lists 1 to 3, because we already tested PNPs with a reflexive pronoun. As it is argued by Lee-Schoenfeld (2008), reflexive pronouns in this structure are ungrammatical. Thus, it was decided not to add filler sentences. Lists 4 to 6 contained in total 36 filler sentences. Lists were randomised.

The material for Dutch was distributed across eight lists. PNPs and p-PNPs were tested in list 1 to 4 and p-PNPs and s-PNPs were tested in lists 5 to 8. Again, the material was matched for number of words and syllables. 33 filler items were added. Lists were randomised.

Table 5: items comprehension study

structure	item	words	syllables
lead-in sentence	Jan und John stehen vor dem Bücherregal. „Jan and John were standing in front of the bookshelf."		
PNP	Jan bestätigt, dass ein neues Buch über sich/ihn möglicherweise im Frühjahr herausgebracht wird. "Jan confirms that a new book about himself/him will probably be published in spring."	7	11
p-PNP	Jan bestätigt, dass Johns neues Buch über sich/ihn im Frühjahr herausgebracht wird. "Jan confirms that John's new book about himself/him will be published in spring."	7	11
s-PNP	Jan bestätigt, dass John neue Bücher über sich/ihn möglicherweise im Frühjahr verkaufen wird. "Jan confirms that John will probably sell a new book about himself/him in spring."	7	12
p-PNP	Jan bestätigt, dass Johns neue Bücher über sich/ihn möglicherweise im Frühjahr verkaufen werden. "Jan confirms that John's new book about himself/him will probably be sold in spring."	7	12

6.3.3 Procedure

The students got the questionnaire during a lecture and were kindly asked to read the instruction carefully and after that to follow the instructions. The German and Dutch questionnaires contained an introduction that explained the task to the participants. Then, items were listed, that the participants could either judge them as grammatical or ungrammatical. If they indicated that the sentence was ungrammatical, they were required to indicate what was wrong. Finally, they had to interpret the pronominal element. Therefore, they had to cross the name of the person the pronominal element was referring to. They got four options. It could either be the person that was mentioned first, the second mentioned, or both or someone that was not been mentioned at all. An example is provided.

(162) Jan und Frank packen die Kamera in die Tasche. Jan denkt munter, dass Franks kurzer Film über sich am besten auf der Insel gemacht werden kann

"Jan and Frank put the camera into the bag. Jan thinks happy that Frank's short film of himself could best be made on the island"

□ Jan □ Frank □ Jan und Frank □ someone else

To fill in the questionnaire did not last longer than 15 minutes.

6.3.4 Analysis

The first step of the analysis was to analyse the grammaticality judgement task. For that purpose, the German questionnaires 1 to 3 and 4 to 6 were and the Dutch questionnaires 1 to 4 and 5 to 8 were put together and analysed separately. Filler items were also removed. The first step in the analysis concerned the grammaticality. It was assessed, how the items were judged by all participants. Then, it was calculated how each participant judged the items. Participants were excluded from further analyses if they judged less than 50 percent of the sentences as grammatical (German list 1 to 3: 1 participant, German list 4 to 6: 4 participants; Dutch list 1 to 4: 2 participants, Dutch list 5 to 8: 2 participants). Again, it was investigated, how the items were scored by all participants.

For the comprehension task, only the data of the participants who judged above 50 percent of the items grammatical as well as items that were scored at least 75 percent grammatical were further analysed. The items that were judged as grammatical in less than 75 percent of all cases were removed (German list 1 to 3: 22 reflexive pronouns of PNP, 8 reflexive pronouns of p-PNP, German list 4 to 6: 4 personal pronouns and 12 reflexive pronouns of p-PNP, 10 personal pronouns and 6 reflexive pronouns of s-PNPs, Dutch list 1 to 4: 4 personal pronouns

and 11 reflexive pronouns of PNP, 4 personal pronouns and 6 reflexive pronouns of p-PNP, Dutch list 5 to 8: 4 personal pronouns and 1 reflexive pronoun of p-PNP, 7 personal pronouns and 3 reflexive pronouns of s-PNP). It was calculated per condition how often an antecedent was chosen.

7 Results

7.1 Self-paced reading

The results of the self-paced reading study will be presented. First an overview of the raw data will be given. Examples of the structures that were tested can be found in table 4. As can be seen, personal pronouns in a co-argument structure (CO P), reflexive pronouns in a co-argument structure (CO R) and reflexive pronouns in a co-argument structure (CO A) with only one accessible antecedent have been tested. The material also contained personal pronouns in a PP structure (PP P) and reflexive pronouns in a PP (PP R).

Table 6 provides an overview of the reaction times (RT) for the L1 speakers and table 7 for the L2 speakers. A comparison of the RTs shows that L1 speakers' RTs were overall faster than that of the L2 speakers. The fastest RTs for the L1 speakers can be found for reflexive pronouns in a co-argument structure with one accessible antecedent (CO A) at the post-critical region 1 and slowest RTs for the personal pronoun in a co-argument structure (CO P) at the post-critical region 2. L2 speakers showed the fastest RTs for reflexive pronouns in a PP structure (PP R) at the critical region and the slowest RTs for the reflexive pronoun in a PP structure (PP R) at the post-critical region 2.

Table 6: averaged RTs per structure of the critical, post-critical region 1 and post-critical region 2 (L1 speakers)

	mean	sd	skew	kurtosis
critical region				
CO P	428.62	204.7	3.22	13.89
CO R	426.74	171.43	2.56	9.12
CO A	422.88	215.3	5.07	44.2
PP P	435.23	193.88	3.7	25.21
PP R	436.06	224.07	4.24	25.35
average	429.91	202.66	3.99	27.01
post-critical region 1				
CO P	468.7	266.68	3.01	12.12
CO R	432.18	203.21	3.22	14.35
CO A	402.44	179.46	3.62	20.25
PP P	441.25	211.62	3.69	18.53
PP R	437.58	228.75	4.14	24.97

average	436.44	220.76	3.60	18.53
post-critical region 2				
CO P	544.57	378.63	5.69	57.96
CO R	480.36	235.19	2.9	14.8
CO A	462.31	225.18	2.92	13.54
PP P	509.48	245.2	2.97	14.09
PP R	527.66	298.59	3.74	25.92
average	504.90	283.82	4.70	49.23

• CO P=co-argument structure with a personal pronoun, CO R=co-argument structure with a reflexive pronoun, CO A=co-argument structure with a reflexive pronoun and one grammatical antecedent, PP P=PP structure with a personal pronoun, PP R=PP structure with a reflexive pronoun

• The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.

• critical region: himself, post-critical region 1: so that, post-critical region 2: the new aftershave

Table 7: averaged RTs per structure of the critical, post-critical region 1 and post-critical region 2 (L2 speakers)

	mean	sd	skew	kurtosis
critical region				
CO P	512.14	194.72	2.04	6.71
CO R	517.6	203.07	2.04	6.32
CO SG	500.47	202.56	3.26	21.06
PP P	498.99	217.13	2.48	9.11
PP R	480	200.6	4.07	35.27
average	501.86	204.04	2.77	15.19
post-critical region 1				
CO P	557.87	286.53	2.84	14.16
CO R	509.31	218.97	2.49	10.29
CO SG	500.08	246.65	4.05	29.01
PP P	537.52	253.67	2.55	10.85
PP R	494.58	182.55	1.53	3.09
average	519.88	241.31	2.99	16.84
post-critical region 2				
CO P	717.57	470.44	2.54	7.92

CO R	702.42	410.35	2.04	5.12
CO SG	682.83	467.41	3.73	22.55
PP P	768.5	435.67	1.76	4.49
PP R	803.59	516.14	1.91	4.52
average	734.95	463.21	2.43	9.07

• CO P=co-argument structure with a personal pronoun, CO R=co-argument structure with a reflexive pronoun, CO A=co-argument structure with a reflexive pronoun and one grammatical antecedent, PP P=PP structure with a personal pronoun, PP R=PP structure with a reflexive pronoun

• The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.

• critical region: himself, post-critical region 1: so that, post-critical region 2: the new aftershave

Table 8 shows that the comprehension questions for all structures were answered correctly between 85 and 89 percentage by L1 speakers and between 81 and 86 percentage by the L2 speakers.

Table 8: averaged correct responses per structure

		mean	sd
CO P	L1	0.85	0.36
	L2	0.86	0.35
CO R	L1	0.85	0.35
	L2	0.86	0.35
CO A	L1	0.89	0.32
	L2	0.86	0.35
PP P	L1	0.84	0.37
	L2	0.81	0.39
PP R	L1	0.89	0.32
	L2	0.86	0.35

• CO P=co-argument structure with a personal pronoun, CO R=co-argument structure with a reflexive pronoun, CO A=co-argument structure with a reflexive pronoun and one grammatical antecedent, PP P=PP structure with a personal pronoun, PP R=PP structure with a reflexive pronoun, L1=L1 speakers, L2=L2 speakers

7.1.1 Syntax versus discourse

Statistical analyses will be presented to test the hypothesis, that only a reflexive pronoun in a co-argument structure can be processed by a syntactic operation, whereas personal pronouns in a co-argument structure and pronominal elements in a PP structure are processed by using a

discourse operation. The RTs of personal pronouns in a co-argument structure (CO P), reflexive pronouns in a co-argument structure (CO R), personal pronouns in a PP structure (PP P) and reflexive pronouns in a PP structure (PP R) were entered into R and log-transformed, as these were not normally distributed. This can be seen in table 6 for L1 speakers and table 7 for L2 speakers.

The graphs 1, 2 and 3 show that L1 speakers tend to read faster than L2 speakers. Furthermore, it seems that an effect of structure arose at the critical and post-critical region 1, especially for the L2 group. L2 speakers read the co-argument structure (CO P, CO R) slower than the PP structure (PP P, PP R) at the critical region and the reversed pattern can be found at the post-critical region 1. Finally, it seems to be the case that the L1 speakers – but not the L2 speakers – read reflexive pronouns in the co-argument structure (CO R) faster than personal pronouns (CO P) and pronominal elements in a PP (PP P, PP R) at both post-critical regions.

Graph 1: critical region   Graph 2: post-critical region 1 Graph 3: post-critical region 2
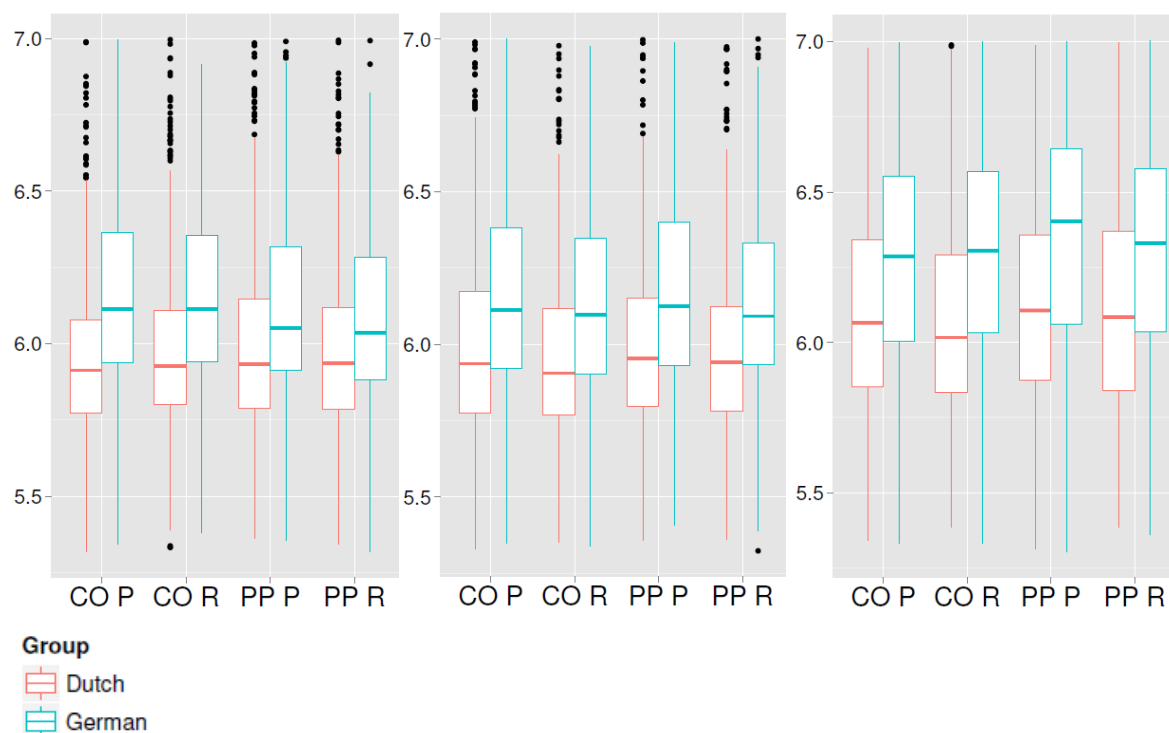
Group
Dutch
German

• CO P: co-argument structure with a personal pronoun, CO R: co-argument structure with a reflexive pronoun, PP P: PP structure with a personal pronoun, PP R: PP structure with a reflexive pronoun, Dutch: L1 speakers, German: L2 speakers

• The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.

• critical region: himself, post-critical region 1: so that, post-critical region 2: the new aftershave

Statistical analyses were carried out for the log-transformed RTs at the critical and post-critical regions that tested the hypothesis. The mixed effect regression model contained the dependent variable *RT* entailing the RTs of the critical and post-critical regions, the fixed factors *pronountype*, *structure* and *group* and the random factors *subj* (subject) and *trial*. The regression model *RT~pronountype*structure*group+[1\subj]+[1\trial]* was applied. This model demonstrated at the critical region a main effect of *group* (β= 0.166, SE= 0.050, t= 3.300, p< .001), and an additional negative interaction of *structure* and *group* (β= -0.062, SE= 0.020, t= -3.158, p< .005). The group effect highlighted that the L2 group overall read slower than the L1 speakers and the interaction indicated that the L2 speakers, but not the L1 group, read the co-argument structure slower than the PP structure.

At the post-critical region 1, the mixed effect model showed a main effect of *group* (β= 0.162, SE= 0.055, t= 2.943, p< .005) and a main effect of *pronountype* (β= -0.078, SE= 0.026, t= -3.059, p< .005). This indicates that the L2 speakers read more slowly than the L1 speakers and that personal pronouns took longer to read than reflexive pronouns, even at the region after the critical item. No interaction has been found.

The analyses of the RTs at the post-critical region 2 revealed a main effect of *pronountype* (β= -0.229, SE= 0.033, -6.835, p< .001), *group* (β= 0.181, SE= 0.059, 3.088, p< .005) and *structure* (β= -0.135, SE= 0.033, -4.068, p< .001). Again, reflexive pronouns were read faster than personal pronouns, the L2 group read slower than the L1 group and the co-argument structure was read faster than the PP structure. There was an interaction of *structure* and *pronountype* (β= 0.242, SE= 0.048, 5.000, p< .001), showing that personal pronouns in a PP were read slower than reflexive pronouns in a PP structure and pronominal elements in a co-argument structure. There was also an interaction of *pronountype* and *group* (β= 0.074, SE= 0.024, 3.135, p< .005) that indicated that L1 speakers, but not L2 speakers, read reflexive pronouns faster than personal pronouns. A third two-way interaction of *structure* and *group* (β= 0.088, SE= 0.024, 3.688, p< .001) illustrated that the L1 group, but not the L2 group, read the co-argument structure faster than the PPs. There was also a negative three-way-interaction of *structure*, *pronountype* and *group* (β= -0.109, SE= 0.033, -3.253, p< .005), highlighting that reflexive pronouns in L1 speakers, but not in L2 speakers were read faster than personal pronouns in a co-argument structure and pronominal elements in a PP. Statistical analyses did not reveal that L2 speakers, but not L1 speakers, processed personal pronouns in a PP different from reflexive pronouns in this structure and from pronominal elements in a co-argument structure.

The analyses of the RTs at the second post-critical region show that L1 speakers read reflexive pronouns faster than personal pronouns in a co-argument structure, and also faster than pronominal elements in a PP. This has not been found for the L2 speakers. This result demonstrates that L1 speakers process reflexive pronouns in a co-argument structure differently from personal pronouns in the same structure and also differently from pronominal elements in a PP. L2 speakers did not show this pattern so that it can be said that they were different from L1 speakers. Different strategies seem to be applied in the processing of pronominal elements by L1 and L2 speakers. L1 speakers were argued to apply a syntactic operation in the processing of reflexive pronouns and a discourse operation in both the processing of personal pronouns and pronominal elements in a PP. L2 speakers always apply a discourse operation for the processing of pronominal elements. This contrast in processing strategies led to the discovered differences between the groups in processing pronominal elements.

7.1.2 Proficiency

A further aim of this research was to find out, if proficiency has an impact on the processing of pronominal elements. It has been argued by Ullman (2001), for instance, that a high proficiency in the L2 might give access to syntactic processing. As a consequence, highly proficient L2 speakers should be able to process reflexive pronouns in a co-argument structure (CO R) faster than personal pronouns (CO P) and also faster than pronominal elements in a PP (PP P, PP R). This implies that highly proficient L2 speakers should be similar to L1 speakers and both should be different from low proficiency L2 speakers in the processing of pronominal elements. Proficiency is a factor that is not assumed by Clahen and Felser (2006) to give access to the use of syntax. According to the SSH (Clahsen and Felser, 2006), highly proficient L2 speakers should be similar to low proficiency L2 speakers. Both groups should be different from L1 speakers.

The graphs 4, 5 and 6 display that low and highly proficient L2 speakers read slower than L1 speakers. Both L2 speaker groups do not appear to read reflexive pronouns in the co-argument structure (CO R) faster than personal pronouns in a co-argument structure (CO P) and pronominal elements in a PP (PP P, PP R) at the critical and post-critical regions. Thus, the graphs convey the impression that the highly proficient L2 speaker group is not similar in the processing of reflexive pronouns in a co-argument structure to L1 speakers. It rather seems that highly proficient and low proficiency L2 speakers process pronominal elements in a similar way.

Graph 4: critical region   Graph 5: post-critical region1   Graph 6: post-critical region 2
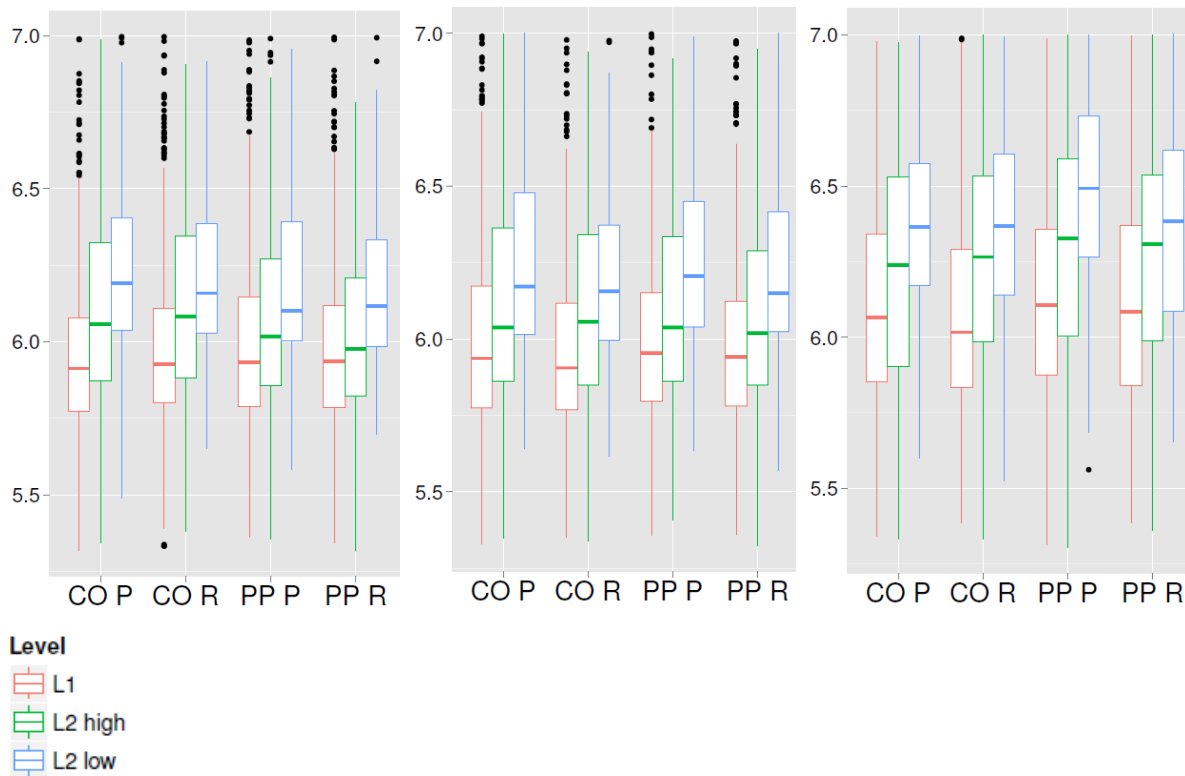
Level
L1
L2 high
L2 low

• CO P: co-argument structure with a personal pronoun, CO R: co-argument structure with a reflexive pronoun, PP P: PP structure with a personal pronoun, PP R: PP structure with a reflexive pronoun, L1: L1 speakers, L2 high: highly proficient L2 speakers, L2 low: low proficiency L2 speakers

• The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.

• critical region: himself, post-critical region 1: so that, post-critical region 2: the new aftershave

A regression model similar to that just described was run. The fixed factors *pronountype*, *structure* and *proficiency* and the random factors *subject* and *trial* were introduced in the model *RT~pronountype*structure*proficiency+[1\subj]+[1\trial]*. Analyses at the critical region demonstrated a main effect of *proficiency* in the sense that low proficiency L2 speakers were slower in reading than L1 speakers (β= 0.243, SE= 0.066, 3.674, p= .001) and highly proficient L2 speakers were also slower than L1 speakers (β= 0.117, SE= 0.057, 2.046, p= .05). The interaction of *structure* and *proficiency* was significant and showed that low proficiency L2 speakers (β= -0.062, SE= 0.026, -2.344, p= .05) and highly proficient L2 speakers (β= -0.062, SE= 0.022, -2.744, p= .05), but not the L1 group were slower in reading the co-argument structure than the PP structure. The main effect of *proficiency* and the interaction of *proficiency* and *structure* should be interpreted as a group effect, as both the

low proficiency and highly proficient L2 speakers were different from L1 speakers. There was no three-way interaction of *proficiency*, *structure* and *pronountype*, meaning that both L2 groups did not process reflexive pronouns faster than personal pronouns in a co-argument structure and pronominal elements in a PP, as has been found for the L1 group.

Analyses at the post-critical region 1 displayed main effects of the *proficiency* (β= 0.238, SE= 0.069, 3.415, p< .001) and *pronountype* (β= -0.061, SE= 0.015, -4.149, p< .001). The low proficiency L2 group was overall slower in reading than the L1 speakers. Reflexive pronouns were read faster than personal pronouns. There was no interaction.

Analyses at the post-critical region 2 exposed, that there were main effects of *proficiency* (β= 0.283, SE= 0.076, 3.729, p< .001), *pronountype* (β= -0.029, SE= 0.033, -6.824, p< .001) and *structure* (β= -0.134, SE= 0.033, -4.041, p< .001). Overall, low proficiency L2 speakers read slower than the L1 speakers, reflexive pronouns were read faster than personal pronouns and the co-argument structure was read faster than the PP structure. An interaction of *structure* and *pronountype* (β= 0.241, SE= 0.048, 4.976, p< .001) arose that showed that personal pronouns in a PP were read slower than reflexive pronouns and pronominal elements in a co-argument structure. The interaction *pronountype* and *proficiency* also reached significance, indicating that L1 speakers, but neither low proficiency L2 speakers (β= 0.079, SE= 0.032, 2.431, p< .05) or highly proficient L2 speakers (β= 0.071, SE= 0.027, 2.657, p< .01) read reflexive pronouns faster compared to personal pronouns. Other interactions emerged with *structure* and *proficiency* that showed that the co-argument structure was read faster than the PP in L1 speakers, but not in highly proficient L2 speakers (β= 0.078, SE= 0.027, 2.890, p< .005) and low proficiency L2 speakers (β= 0.103, SE= 0.034, 3.071, p< .005). There was a negative three-way-interaction of *structure*, *pronountype* and *proficiency* that showed that L1 but neither highly proficient L2 speakers (β= -0.090, SE= 0.038, -2.382, p< .05) or low proficiency L2 speakers (β= -0.141, SE= 0.047, -2.988, p< .005) processed reflexive pronouns in a co-argument structure faster than personal pronouns and pronominal elements in a PP. These interactions were a replication of the earlier mentioned three-way-interaction of *structure*, *pronountype* and *group*. The three-way interaction demonstrated that both L2 groups were different from L1 speakers in the processing of reflexive pronouns in a co-argument structure.

Although the L2 speakers were divided into groups according to their proficiency level, the analysis did not confirm the hypothesis, that a high proficiency in the L2 can lead to L1-like processing. Highly proficient L2 speakers did not read reflexive pronouns in a co-argument

structure faster than personal pronouns and pronominal elements in a PP. The analysis revealed that both high and low proficiency L2 speakers showed the same pattern, as both groups did not show differences in the processing of pronominal elements. However, L1 speakers read reflexive pronouns in a co-argument structure faster than personal pronouns and pronominal elements in a PP. Therefore, low and high proficiency L2 speakers showed the same pattern, which was however different from L1 speakers. Once more, the results point into the direction, that L1 speakers employ a syntactic operation in the processing of reflexive pronouns in a co-argument structure and a discourse operation for the processing of personal pronouns and pronominal elements in a PP. L2 speakers however, only seem to apply a discourse operation for the processing of reflexive and personal pronouns in a co-argument structure and PP.

7.1.3 Regional variation

Remember that personal pronouns in PPs (PP P) can be bound within CP by the subject in Dutch. However, this binding possibility seems not to be possible for all L1 speakers. Reference to the subject could be affected by regional variation. Therefore, it seems reasonable to investigate, if differences could be found within the L1 speaker group in the processing of personal pronouns in a PP due to regional variation. The L1 group was divided into three sub-groups depending on the place they were tested. These were Nijmegen, Amsterdam and Groningen[35].

The graphs 7, 8 and 9 illustrate that reflexive pronouns were not read faster than personal pronouns by the L1 speakers at the critical and post-critical regions. At the critical and post-critical region 1, it seems that L1 speakers from Groningen were faster in reading than L1 speakers from Amsterdam and Nijmegen.

Graph 7: critical region   Graph 8: post-critical region 1 Graph 9: post-critical region 2

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[35] The division into groups is based on the location of study. This implies that the L1 speakers did not necessarily grew up there.
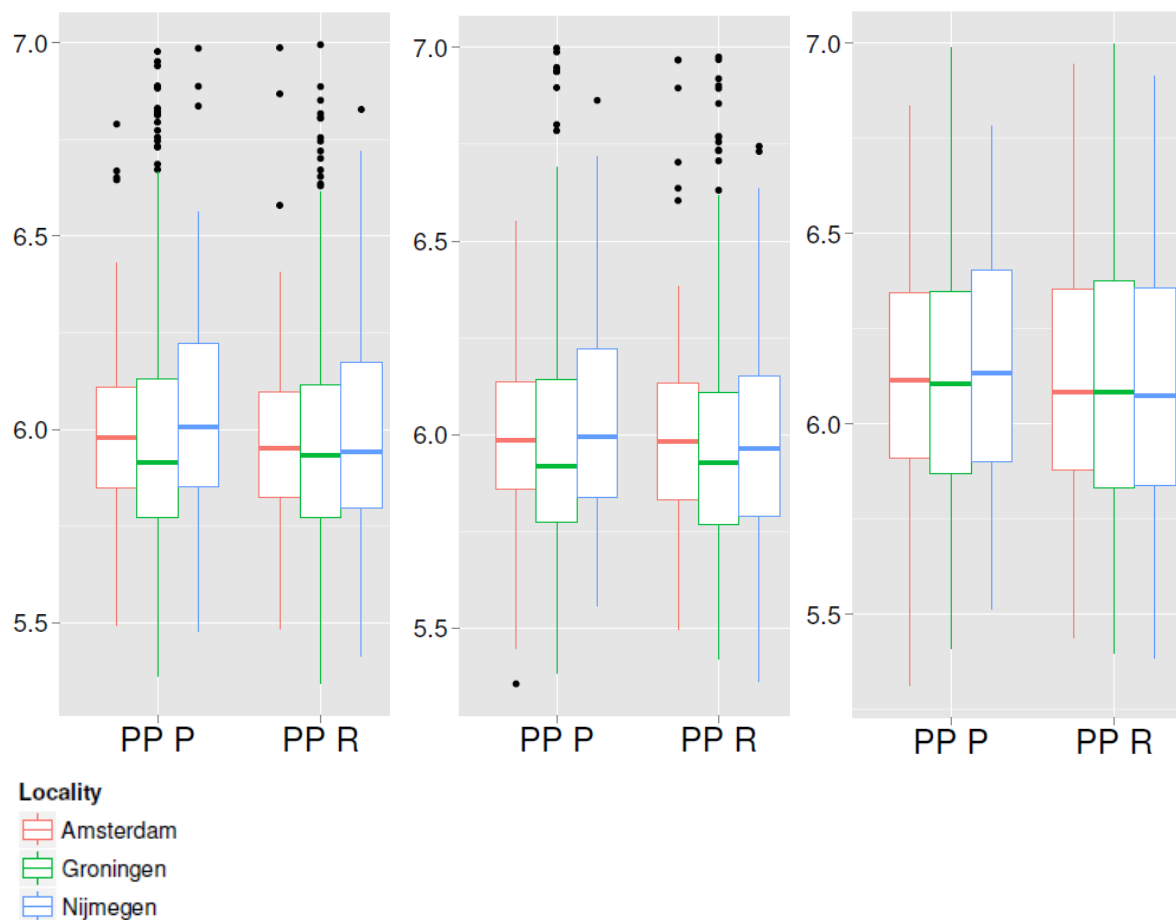
• PP P: PP structure with a personal pronoun, PP R: PP structure with a reflexive pronoun, Amsterdam: L1 speakers from Amsterdam, Groningen: L1 speakers from Groningen, Nijmegen:L1 speakers from Nijmegen

• The hairdresser and the visagist were working at the hairdresser's. The hairdresser moved a big barber's chair next to him/himself so that one could work more easily

• critical region: himself, post-critical region 1: so that, post-critical region 2: one could work

The regression model contained the fixed factor *locality* that divided the L1 group into three groups – Nijmegen, Groningen and Amsterdam. The data of the L2 group were discarded. The log-transformed RTs of the PP structure (PP P, PP R) were entered into R. The model *RT~pronountype*locality+[1\subj]+[1\trial]* was analysed.

The mixed effect model did not reveal an interaction of *pronountype* and *locality* at the critical region. There was a main effect for *pronountype* (β= -0.060, SE= 0.028, -2.108, p< .05). At the post-critical region 1, there was a main effect of *pronountype* (β= -0.073, SE= 0.028, -2.617, p< .05) and no interaction. The effects of *pronountype* showed that reflexive pronouns were read faster than personal pronouns. No main effects or interaction could be found at the post-critical region 2.

The results point into the direction that the processing of personal pronouns in PPs by L1 speakers is not influenced by regional variation, as none of the groups read personal pronouns slower than reflexive pronouns. Thus, it cannot be argued that L1 speakers have different L1 representations that lead to differences in RTs of personal pronouns compared to reflexive pronouns.

7.1.4 Interference

German and Dutch differ in their binding possibilities of personal pronouns in PPs (PP P). In Dutch, the personal pronoun contained in a PP may refer to the subject of the sentence. This reference is impossible in German. Here, the personal pronoun must refer to a someone outside CP. Due to this cross-linguistic difference, it is interesting to investigate if the L1 German interfered with the L2 Dutch while processing personal pronouns in PPs. It could be the case that the L1 and L2 representations were activated, leading to interference and competition. This shoud then result in higher RTs for personal pronouns (PP P) compared to reflexive pronouns in a PP (PP R) for L2 speakers.

The graphs 10 and 11 do not seem to substantiate the assumption of interference in L2 speakers. Personal pronouns seem not to be processed slower than reflexive pronouns in PPs. Graph 12 could be interpreted in the way that L2 speakers, but not L1 speakers, were slower in processing personal pronouns in a PP compared to reflexive pronouns.

Graph 10: critical region Graph 11: post-critical region 1 Graph 12: post-critical region 2
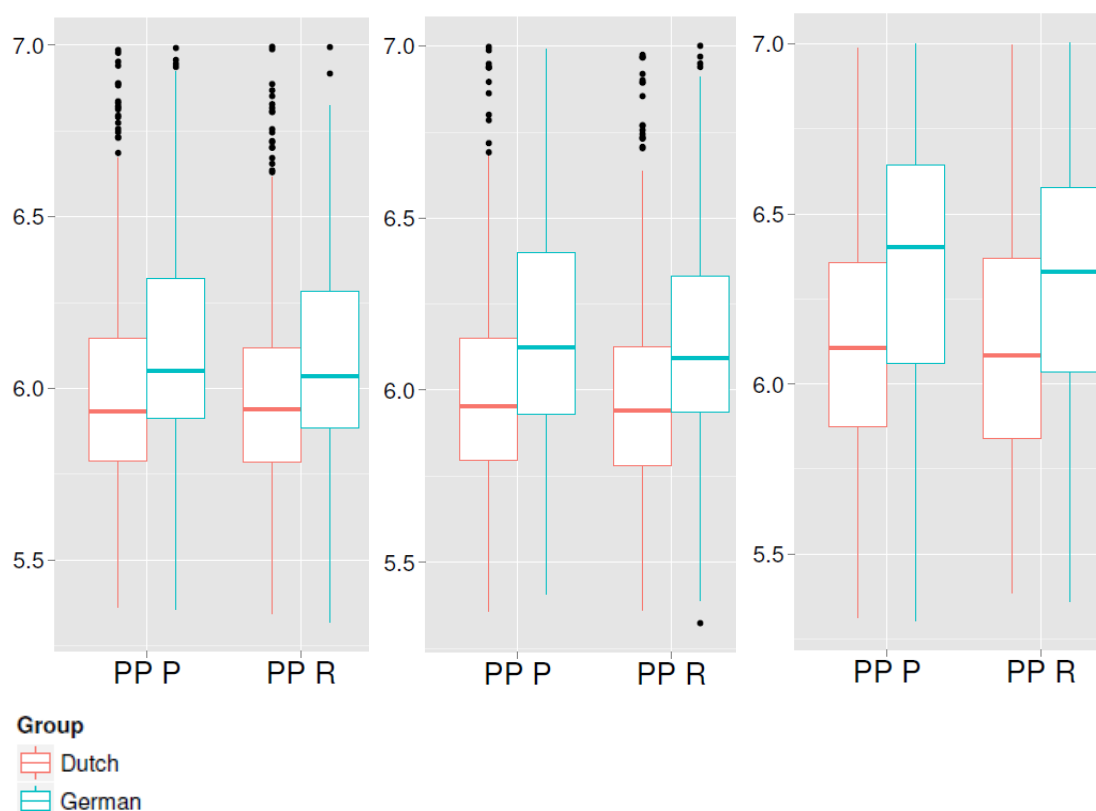
Group
- Dutch
- German

• PP P: PP structure with a personal pronoun, PP R: PP structure with a reflexive pronoun, L1: L1 speakers, Dutch: L1 speakers, German: L2 speakers

• The hairdresser and the visagist were working at the hairdresser's. The hairdresser moved a big barber's chair next to him/himself so that one could work more easily

• critical region: himself, post-critical region 1: so that, post-critical region 2: one could work

The log-transformed RT-data of the PP (PP P and PP R) were entered into R and the mixed-effect regression model with the fixed factors *pronountype* and *group* and the random factors *subj* (subject) and *trial* was analysed (*RT~pronountype*group+[1|subj]+[1|trial]*). At the critical region, there were main effects of *pronountype* (β= -0.113, SE= 0.028, -4.028, p< .001) and *group* (β= 0.100, SE= 0.051, 1.975, p< .05). No interaction was found. Again, the L2 group read more slowly than the L1 group. Reflexive pronouns were read faster than personal pronouns.

As before, RTs at the post-critical region 1 exposed main effects of *pronountype* (β= -0.133, SE= 0.029, -4.578, p< .001) and *group* (β= 0.150, SE= 0.052, 2.855, p< .005), but no interaction. The direction of the effects was the same as for the critical region. At the post-critical region 2 there was only a main effect of *group* (β= 0.255, SE= 0.057, 4.484, p< .001) showing again that L2 speakers were slower in reading than L1 speakers.

There were also analyses carried out to discover if proficiency had an effect on the processing of personal pronouns in a PP. The mixed effect model was slightly adjusted, so that the fixed factor *group* was replaced by *proficiency (RT~pronountype*proficiency+[1\subj]+[1\trial])* . The graphs 13, 14 and 15 show that low and high proficiency L2 speakers were overall slower in reading than L1 speakers. Highly proficient L2 speakers do not seem to be slower in reading personal pronouns in a PP at the critical or post-critical regions. It seems for the low proficiency L2 speakers that they were slower in reading the personal pronoun compared to the reflexive pronoun at the post-critical region 2 (Graph 15).

Graph 13: critical region Graph 14: post-critical region 1 Graph 15: post-critical region 2

Level
L1
L2 high
L2 low

• PP P: PP structure with a personal pronoun, PP R: PP structure with a reflexive pronoun, L1: L1 speakers, L2 high: highly proficient L2 speakers, L2 low: low proficiency L2 speakers
• The hairdresser and the visagist were working at the hairdresser's. The hairdresser moved a big barber's chair next to him/himself so that one could work more easily
• critical region: himself, post-critical region 1: so that, post-critical region 2: one could work

The log-transformed RT-data of the PP (PP P and PP R) were entered into R and the mixed-effect regression model *RT~pronountype*proficiency+[1\subj]+[1\trial]* was analysed. This

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model did not show an interaction at the critical region. There were main effects of *pronountype* (β= -0.113, SE= 0.028, -4.022, p< .001) and *proficiency* (β= 0.179, SE= 0.067, 2.690, p< .01). Reflexive pronouns were read faster than personal pronouns and low proficiency L2 speakers were slower in reading than L1 speakers.

The analyses at the post-critical region 1 did not report an interaction of *pronountype* and *proficiency*. Again, there were main effects of *pronountype* (β= -0.134, SE= 0.029, -4.585, p< .001) and *proficiency* (β= 0.245, SE= 0.068, 3.608, p< .001), that pointed in the same direction as for the critical region.

The analyses of the RTs at the post-critical region 2 only showed a main effect of *proficiency*. Low proficiency L2 speakers were slower than L1 speakers (β= 0.362, SE= 0.074, 4.909, p< .001) and highly proficient L2 speakers were also slower than L1 speakers (β= 0.186, SE= 0.063, 2.939, p< .005).

The L2 speakers seem not to be influenced by the L1 German in the processing of personal pronouns in PPs. Longer reading times for the personal pronoun compared to the reflexive pronoun should have been found, if the L1 and L2 representations interfered. The division of the L2 speakers into subgroups according to their proficiency level did not provide a different picture. Still, personal pronouns took no longer to process.

7.1.5 Single versus double antecedents

It has been shown that only L1 speakers read reflexive pronouns in a co-argument structure faster than personal pronouns in a co-argument structure and pronominal elements in a PP, which holds for the post-critical region 2. For L2 speakers, such a difference was not found, not even for highly proficient L2 speakers. L2 speakers seem to make use of a non-syntactic operation in the processing of pronominal elements, whereas L1 speakers are argued to apply a syntactic operation in the processing of reflexive pronoun in a co-argument structure, and a non-syntactic operation in the processing of personal pronoun and pronominal elements in a PP. The term non-syntactic operation in this respect refers to a discourse operation. It is also interesting to look at the effect of discourse in the processing of pronominal elements in more detail. Felser and Cunnings (2012) for example have shown that L2 speakers were a bit slower in the processing of reflexive pronouns when these had only one accessible antecedent like (CO A), compared to reflexive pronouns that had two accessible antecedents (CO R). Felser and Cunnings (2012) showed that discourse information such as a gender mismatch can extend the time spend processing the reflexive pronoun in L2 speakers compared to a missing gender difference. Thus, although L2 speakers make use of a discourse operation in the

processing of pronominal elements anyway, their processing is interfered by extra information from the discourse. This research aimed to find out if L2 speakers of Dutch also show such a discourse effect and furthermore to see what L1 speakers' processing looks like. L1 speakers are not assumed to be interrupted in their processing, as they should apply a syntactic operation (Reuland, 2001).

The analysis that was run considered the log-transformed RTs of the reflexive pronouns in a co-argument structure with one grammatical antecedent (CO A) and with two grammatical antecedents (CO R).

The graphs 16, 17 and 18 illustrate that L1 speakers were not slower in reading the reflexive pronoun in a co-argument structure with one accessible antecedent (CO A), compared to the reading of a reflexive pronoun with two accessible antecedents (CO R). L2 speakers were a bit slower at the post-critical region 2 in reading the reflexive pronoun that matches both antecedents in grammatical features (CO R), compared to the reflexive pronoun with one matching antecedent (CO A).

Graph 16: critical region   Graph 17: 1.post-critical region Graph 18: 2.post-critical region
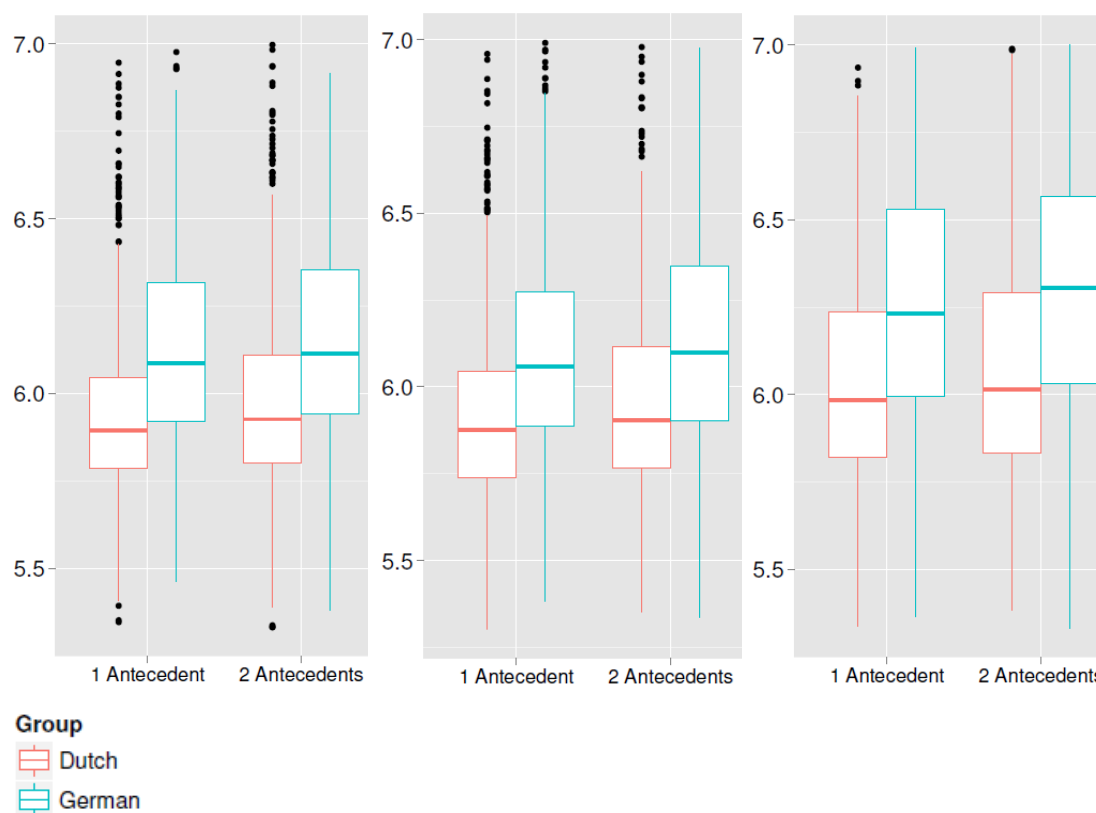
Group
- Dutch
- German

• 1 Antecedent: co-argument structure with a reflexive pronoun and one accessible antecedent, 2 Antecedents: co-argument structure with a reflexive pronoun and two accessible antecedents, Dutch: L1 speakers, German: L2 speakers

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• The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.

• critical region: himself, post-critical region 1: so that, post-critical region 2: the new aftershave

The fixed factors *accessible antecedent* and *group* were entered into the regression model. The model *RT~accessible antecedent*group+[1|subj]+[trial]* displayed an effect of *group* (β= 0.158, SE= 0.050, 3.148, p< .005) and no interaction of *accessible antecedent* and *group* at the critical region. A main effect of *group* (β= 0.158, SE= 0.054, 2.943, p< .005) arose at the post-critical region 1, which was also present at the post-critical region 2 (β= 0.251, SE= 0.055, 4.523, p< .001). The group effect again demonstrated that L2 speakers were slower in reading than L1 speakers.

Additionally, analyses considering proficiency as a factor were run. It could be the case that highly proficient L2 speakers behaved more like L1 speakers and differed from low proficiency L2 speakers in processing reflexive pronouns in a co-argument structure. The graphs 19, 20 and 21 display that low and high proficiency L2 speakers were slower in reading than L1 speakers. The graphs provide the impression that reflexive pronouns in a co-argument structure with one accessible antecedent (CO A) were not processed faster than reflexive pronouns in a co-argument structure with two grammatical antecedents (CO R).

Graph 19: critical region Graph 20: post-critical region 1 Graph 21: post-critical region 2
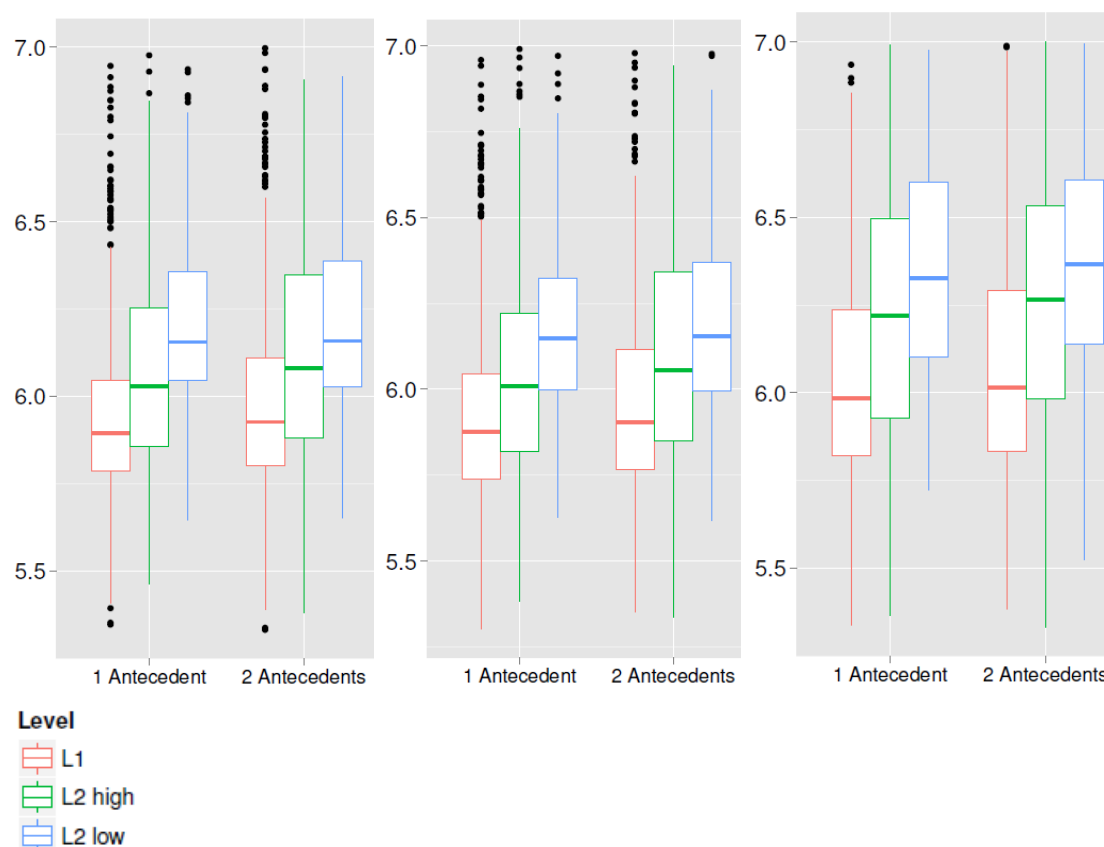
Level
- L1
- L2 high
- L2 low

• 1 Antecedent: co-argument structure with a reflexive pronoun and one accessible antecedent, 2 Antecedents: co-argument structure with a reflexive pronoun and two accessible antecedents, L1: L1 speakers, L2 high: highly proficient L2 speakers, L2 low: low proficiency L2 speakers
• The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.
• critical region: himself, post-critical region 1: so that, post-critical region 2: the new aftershave

The fixed factors *accessible antecedent* and *proficiency* were entered into the regression model. The model *RT~accessible antecedent*proficiency+[1|subj]+[trial]* did not display an interaction of *accessible antecedent* and *proficiency*. There was a main effect of *proficiency* that showed that low proficiency L2 speakers were slower in reading than L1 speakers (β= 0.232, SE= 0.066, 3.491, p< .001) and highly proficient L2 speakers were also slower than L1 speakers (β= 0.112, SE= 0.057, 1.952, p< .05). For the post-critical region 1, only a main effect of *proficiency* was found (β= 0.236, SE= 0.070, 3.355, p< .001) highlighting, that low proficiency L2 speakers were slower in reading than L1 speakers. Analyses of the data at the post-critical region 2 showed a main effect of *proficiency*, indicating again that low proficiency L2 speakers (β= 0.359, SE= 0.072, 5.004, p< .001) and highly proficient L2 speakers (β= 0.181, SE= 0.062, 2.931, p< .005) were slower than L1 speakers.

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L1 and L2 speakers did not process reflexive pronouns in a co-argument structure with only one matching antecedent (CO A) slower than in structures with two matching antecedents (CO R) at the critical and post-critical regions. Even when the L2 group was divided according to their proficiency level, this did not lead to differences in the processing of reflexive pronouns in a co-argument structure with one or two accessible antecedents. Thus, L2 speakers were assumed to apply a discourse operation while processing pronominal elements anyway, but a change in discourse information (person mismatch) did not lead to longer reading times of the reflexive pronoun.

7.1.6 Summary

The analyses of the self-paced reading study demonstrated that L1 speakers processed reflexive pronouns in a co-argument structure faster than personal pronouns in the same structure and pronominal elements in a PP at the post-critical region 2. This difference was not found for the L2 speakers, not even for highly proficient L2 speakers. Based on this result it can be argued that the operations underlying the processing of pronominal elements are different in L1 and L2 speakers. L1 speakers are argued to apply a syntactic operation in the processing of reflexive pronouns in a co-argument structure and a discourse operation in the processing of personal pronouns and pronominal elements in a PP. L2 speakers, in contrast, only apply a discourse operation in the processing of pronominal elements in a co-argument structure and PP.

Furthermore, the analyses showed that personal pronouns in a PP were not processed slower than reflexive pronouns in L1 and L2 speakers. This implies that L1 speakers' processing of pronominal elements in this structure is not influenced by regional variation. Moreover, L2 speakers were not influenced by their L1 in the processing of personal pronouns in a PP. The L1 representation seemingly did not compete with the L2 representation.

L1 and L2 speakers did not process reflexive pronouns in a co-argument structure with one accessible antecedent (CO A) slower than a reflexive pronoun with two accessible antecedents (CO R). Thus, the presence of an antecedent that mismatches the reflexive pronoun's number features did not result in longer reading times compared to a reflexive pronoun of which both antecedents match the grammatical features of the reflexive pronoun.

7.2 Eyetracking

The statistical analyses that were carried out for the self-paced reading study were also run for the eyetracking study. There were three differences to the statistical analyses done for the self-paced reading study. For analyses of the eyetracking data, the critical region and the post-

critical region 1 were merged to maximize the effects. The original critical region is small as it only contains the pronominal element so that fixations on that region might fall on the post-critical region 1. Thus, there is a critical region for eyetracking that contains the pronominal element and the original post-critical region 1 (conjuntion). The original post-critical region 2 is the only post-critical region and will be referred to as post-critical region. Second, the factor *regional variation* has not been analysed because the data of the L1 speakers were from one location, namely Groningen. Finally, there were several dependent variables at the critical and post-critical region. These were first fixation, first pass time, second pass time and total time. There were also data collected for the antecedents. These were total times and number of regressions. In this section, the data of the total times at the critical and post-critical regions and regressions to the antecedents will be reported. The analyses of the other dependent variables can be found in Appendix 1. The results of these variables resemble the results of the total times and regressions and therefore it was decided to relocate these measurements to Appendix 1.

Descriptive statistics of the raw data are provided in table 9 for L1 speakers and table 10 for L2 speakers. The comparison of the total times of the two groups shows that L2 speakers had longer fixations than L1 speakers. L1 speakers showed the longest fixations on the personal pronoun in the co-argument structure (CO P) at the critical region and the shortest fixations for the reflexive pronoun in a co-argument structure (CO R) at the pre-critical region. L2 speakers had the longest fixations at the personal pronoun in a co-argument structure (CO P) at the critical region and the shortest fixations for the reflexive pronoun in a co-argument structure (CO R) at the pre-critical region.

Table 9: averaged total times (ms) per structure and region on interest (L1)

L1	mean	sd	skew	kurtosis
Antecedent 1				
CO P	3574.92	3043.83	2.54	11.87
CO R	3398.53	2694.44	2.33	11.88
CO A	3540.36	3248.14	3.32	19.16
PP P	3833.04	3205.38	2.42	12.34
PP R	3790.77	2971.02	2.09	8.15
average	3627.49	3041.51	2.61	13.43
Antecedent 2				

CO P	3996.66	2812.65	1.34	2.4
CO R	3715.98	2495.77	1.45	3.43
CO A	3928.93	2591.33	1.72	5.25
PP P	4080.36	2858.96	1.36	2.46
PP R	4098.91	2808.54	1.41	3.03
average	3964.12	2719.06	1.46	3.26
Repetition of Antecedent 1				
CO P	3119.2	2564.42	1.88	5.54
CO R	2905.36	2409.6	1.78	5.18
CO A	3027.9	2350.87	1.7	5.16
PP P	3164.38	2542.73	1.47	3.46
PP R	2972.5	2383.7	1.91	8.64
average	3037.86	2452.14	1.75	5.54
Pre-critical region				
CO P	1474.43	1591.72	1.26	1.98
CO R	1443.48	1461.9	1.17	2.41
CO A	1497.77	1642.31	1.5	3.46
PP P	2105.94	1995.33	1.94	8.18
PP R	2134.92	2102.67	2.03	7.96
average	1731.26	1803.19	1.84	7.29
critical region				
CO P	5970.8	5193.89	1.33	2.41
CO R	5104.96	4285.36	1.29	2.72
CO A	5302.68	4488.27	1.22	2.36
PP P	4956.03	3878.8	1.16	2.18
PP R	4444.74	3728.07	1.14	1.66
average	5155.81	4371.39	1.34	2.86
Post-critical region				
CO P	2671.21	2846.06	2.01	8.67
CO R	2354.38	2298.96	1.31	2.2
CO A	2474.73	2825.68	2.25	7.97
PP P	2873.93	2892.7	1.76	5.19
PP R	2845.66	3221.8	3.2	19.15

average	2643.91	2838.06	2.33	11.35

• CO P=co-argument structure with a personal pronoun, CO R=co-argument structure with a reflexive pronoun, CO A=co-argument structure with a reflexive pronoun and one grammatical antecedent, PP P=PP structure with a personal pronoun, PP R=PP structure with a reflexive pronoun

• The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.

• Antecedent 1: hairdresser, antecedent 2: visagist, repetition of antecedent 1: hairdresser, pre-critical region: shaved, critical region: himself so that, post-critical region: the new aftershave

Table 10: averaged total times (ms) per structure and region on interest (L2)

L2	mean	sd	skew	kurtosis
Antecedent 1				
CO P	4017.85	3388.3	1.64	5.75
CO R	4274.51	3772.12	1.77	4.88
CO A	4199.67	3475.68	1.65	5.32
PP P	4169.73	3649.95	1.87	7.09
PP R	4163.74	3559.92	1.52	4.29
average	4165.15	3570.12	1.71	5.55
Antecedent 2				
CO P	4455.8	3729.76	1.32	2.38
CO R	4360.38	3370.62	1.04	1.95
CO A	4485.33	3244.25	1.18	3.38
PP P	4691.7	3993.72	2.07	10
PP R	4557.42	3775.3	1.73	7.33
average	4510.15	3632.17	1.57	6.04
Repetition of Antecedent 1				
CO P	4185.47	3234.53	1.91	7.06
CO R	4215.44	2995.13	1.68	4.34
CO A	4284.84	3230.23	1.85	6.59
PP P	4427.47	3226.72	1.53	3.2
PP R	4135	3010.06	1.44	3.27
average	4249.67	3140.62	1.70	5.08
Pre-critical region				
CO P	2585.5	2224.86	1.49	3.58

CO R	2373.85	2033.3	1.23	2.51
CO A	2480.16	2478.14	2.6	14.45
PP P	3534.89	2783.78	1.19	2.08
PP R	3482.58	3000.89	1.81	5.89
average	2891.51	2578.02	1.79	6.37
Critical region				
CO P	8207.56	7479.5	1.59	4.08
CO R	6933.3	6009.19	1.28	2.27
CO A	7188.46	6718.96	1.46	3.18
PP P	6383.68	5614.39	1.68	5.7
PP R	5825.49	4869.72	1.01	1.19
average	6907.22	6250.33	1.58	4.37
post-critical region				
CO P	2936.64	3084.34	1.61	4.14
CO R	2792.91	3099.06	1.54	3.15
CO A	2927.58	3266.99	1.88	6.44
PP P	3629.18	4168.54	2.02	6.01
PP R	3615.05	4099.44	2	6.02
average	3180.36	3593.02	1.99	6.52

• CO P=co-argument structure with a personal pronoun, CO R=co-argument structure with a reflexive pronoun, CO A=co-argument structure with a reflexive pronoun and one grammatical antecedent, PP P=PP structure with a personal pronoun, PP R=PP structure with a reflexive pronoun

• The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.

• Antecedent 1: hairdresser, antecedent 2: visagist, repetition of antecedent 1: hairdresser, pre-critical region: shaved, critical region: himself so that, post-critical region: the new aftershave

The questions that the participants had to answer after each item were answered between 88 and 95 percent correctly by L1 speakers and between 81 and 86 percent correctly by L2 speakers as shown in table 11.

Table 11: averaged correct responses per structure

		mean	sd
CO P	L1	0.9	0.3
	L2	0.84	0.36
CO R	L1	0.89	0.31
	L2	0.86	0.35
CO A	L1	0.88	0.32
	L2	0.82	0.39
PP P	L1	0.89	0.31
	L2	0.81	0.39
PP R	L1	0.95	0.22
	L2	0.85	0.36

• CO P=co-argument structure with a personal pronoun, CO R=co-argument structure with a reflexive pronoun, CO A=co-argument structure with a reflexive pronoun and one grammatical antecedent, PP P=PP structure with a personal pronoun, PP R=PP structure with a reflexive pronoun, L1: L1 speakers, L2: L2 speakers

7.2.1 Syntax versus discourse

It was investigated, whether reflexive pronouns were processed faster than personal pronouns in a co-argument structure and pronominal elements in a PP. The data of the pronominal elements in a co-argument structure (CO P, CO R) (163) and in a PP structure (PP P, PP R) (164) were entered into R. Analyses were conducted that considered the dependent variables first fixation (ff), first pass time (fpt), second pass time (spt), total times (tt) and regressions. In this section, the only the total times and the regressions will be reported. The analyses of the other dependent variables can be found in the Appendix 1.

> (163) De kapper die graag dingen uitprobeerde schoor **hem/zichzelf zodat** <u>de nieuwe aftershave</u> kon worden uitgeprobeerd[36]
> "The hairdresser who liked to try things shaved him/himself so that the new aftershave could be tested"

> (164) De kapper verschoof een grote kapperstoel naast **hem/zichzelf zodat** <u>er beter</u> kon worden gewerkt
> "The hairdresser moved a big barber's chair next to him/himself so that one could work more easily"

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[36] Bold=citical region, underlined=post-critical region

The graphs of the total times show that L2 speakers had longer fixations than L1 speakers at the critical (graph 22) and post-critical regions (graph 23). The co-argument structure was fixated longer than the PP at the critical region, which is reversed at the post-critical region. It seems for L1 speakers, but not L2 speakers, that reflexive pronouns were fixated shorter than personal pronouns at the critical and post-critical region. It furthermore seems, that L1 speakers, but not L2 speakers, have shorter fixations at the reflexive pronoun in a co-argument structure than at the personal pronoun and pronominal elements in a PP.

Graph 22: critical region   Graph 23: post-critical region
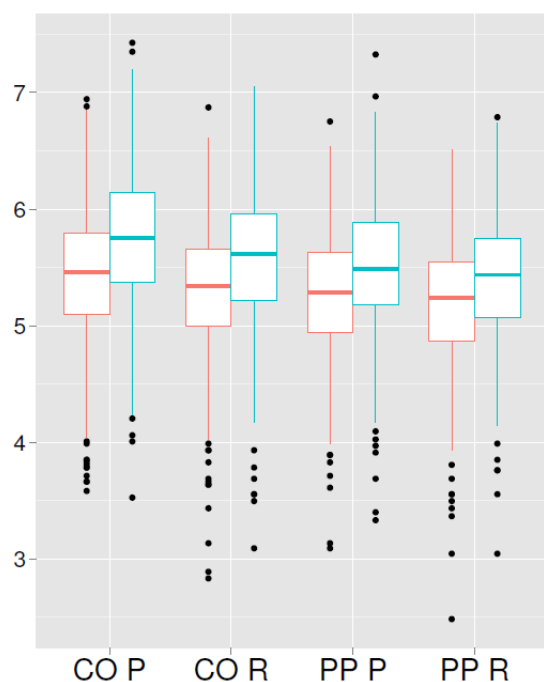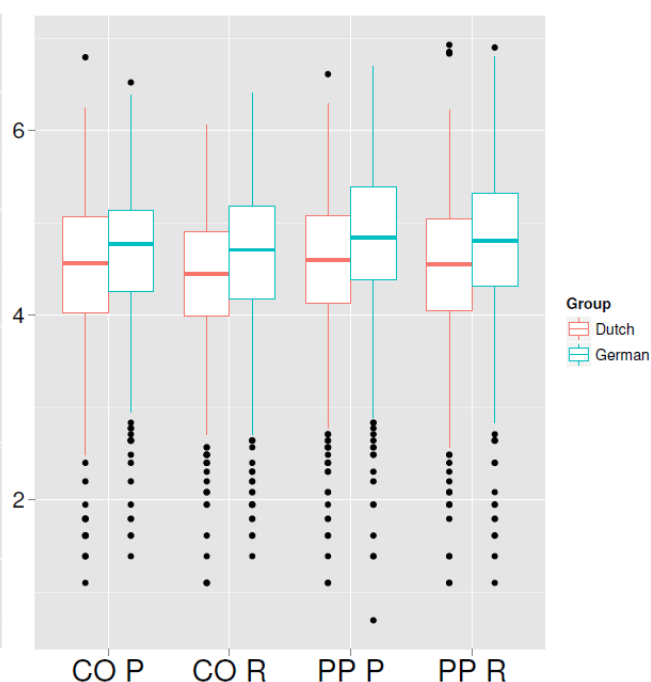
• CO P: co-argument structure with a personal pronoun, CO R: co-argument structure with a reflexive pronoun, PP P: PP structure with a personal pronoun, PP R: PP structure with a reflexive pronoun, Dutch: L1 speakers, German: L2 speakers

• The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.

• critical region: himself so that, post-critical region: the new aftershave

The model *fixation~pronountype*structure*group+[1\subj]+[1\trial]* considered the *fixation* at the critical and post-critical region as dependent variable and *pronountype*, *structure* and *group* as fixed factors and *subj* (subject) and *trial* as random factors. The analysis of the total times at the critical region revealed main effects of *group* (β= 0.313, SE= 0.088, 3.555, p< .001), *structure* (β= -0.155, SE= 0.068, -2.294, p< .05) and *pronountype* (β= -0.151, SE= 0.068, -2.216, p< .05). L2 speakers had overall longer fixations than L1 speakers. The co-

argument structure was fixated longer than the PP-structure and reflexive pronouns were fixated longer than personal pronouns. There was also a negative interaction of *structure* and *group* (β= -0.110, SE= 0.056, -1.939, p= .05) that showed that the L2 group, but not the L1 speakers, had longer fixations on the co-argument structure than on the PP.

No effects or interactions were found at the post-critical region.

The number of regressions to the antecedents was also analysed with mixed effect models. Table 12 provides an overview of the regressions that were made by the L1 and L2 speakers. Table 12 shows that L1 speakers made more regressions than L2 speakers. Regressions back to the antecedents were in most cases directed to the repetition of antecedent 1.

The mixed effect model used for analysing the regressions contained the fixed factors *aoi*, *pronountype*, *structure* and *group*. The random factors *subj* (subject) and *trial* were also added. The dependent variable was *regressions*, that is the number of regressions that were made for antecedent 1, antecedent 2 and the repetition of antecedent 1. The regression model regressions~aoi*pronountype*structure*group+[1|subj]+[1|trial] revealed main effects of *group* (β= -0.056, SE= 0.022, -2.537, p< .05), *structure* (β= -0.013, SE= 0.007, -1.973, p< .05) and *antecedent* (β= 0.031, SE= 0.006, 5.397, p< .001). L1 speakers made more regressions back to the antecedents than the L2 speakers. More regressions were made in the co-argument structure than in the PP structure and the repetition of antecedent 1 was fixated more often than antecedent 1 and antecedent 2.

A mixed effect model was run that analysed the total times on the antecedents after the critical region has been read. Fixed and random factors stayed the same, but the dependent variable was changed into total times. The regression model *tt~aoi*pronountype*structure*group+[1|subj]+[1|trial]* reported a negative interaction of *antecedent* and *structure* (β= -4.488, SE= 1.739, -2.580, p< .01) indicating that antecedent 2, but not antecedent 1, was fixated longer in the co-argument structure than in the PP. There was also a three-way interaction of *antecedent*, *structure* and *pronountype* (β= 5.360, SE= 2.459, 2.179, p< .05) that showed that reflexive pronouns in a co-argument structure led to longer fixations on antecedent 2 than on antecedent 1. There was also a main effect of *antecedent*. Antecedent 2 was fixated longer than antecedent 1 (β= 3.286, SE= 1.230, 2.671, p< .01) and antecedent 3 was fixated longer than antecedent 1 (β= 2.745, SE= 1.230, 2.230, p< .05).

Table 12: regressions to antecedents

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		L1	L2
CO P	antecedent 1	60	16
	antecedent 2	74	21
	repetition of antecedent 1	66	36
CO R	antecedent 1	49	15
	antecedent 2	57	15
	repetition of antecedent 1	71	36
PP P	antecedent 1	52	16
	antecedent 2	44	11
	repetition of antecedent 1	70	31
PP R	antecedent 1	62	15
	antecedent 2	75	9
	repetition of antecedent 1	95	29

• CO P=co-argument structure with a personal pronoun, CO R=co-argument structure with a reflexive pronoun, PP P=PP structure with a personal pronoun, PP R=PP structure with a reflexive pronoun, L1: L1 speakers, L2: L2 speakers

• The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.

• Antecedent 1: hairdresser, antecedent 2: visagist, repetition of antecedent 1: hairdresser

To summarise, the total times at the critical and post-critical region demonstrate that the fixations of L1 and L2 speakers were not shorter for reflexive pronouns in a co-argument structure compared to personal pronouns and pronominal elements in a PP. The analysis of the number of regressions back to the antecedents after the fixations of the pronominal element did not substantiate the hypothesis, that L1 and L2 speakers processed the reflexive pronoun in a co-argument structure differently from personal pronouns and pronominal elements in a PP. The total times of the antecedents indicate a difference in the processing of reflexive pronouns in a co-argument structure compared to personal pronouns and pronominal elements in a PP.

7.2.2 Proficiency

It was also analysed if the processing of pronominal elements in a co-argument structure and PP is influenced by proficiency, since it is argued that highly proficient L2 speakers were similar to L1 speakers and different from low proficiency L2 speakers. The regression model used before to analyse the total times at the critical and post-critical regions was modified in the sense that the fixed factor *group* was replaced by *proficiency*. All other factors and

dependent   variables   stayed   the   same
(*fixation~pronountype*structure*proficiency+[1|subj]+[1|trial]*).

Graph 24 of the total times at the critical region shows that the co-argument structure was fixated longer than the PP. This contrast seems to diminish at the post-critical region (graph 25). Both L2 speaker groups fixated longer than the L1 group at the critical and post-critical region. Reflexive pronouns in a co-argument structure were not fixated shorter than personal pronouns and pronominal elements in a PP.

Graph 24: total time at critical region   Graph 25: total time at post-critical region
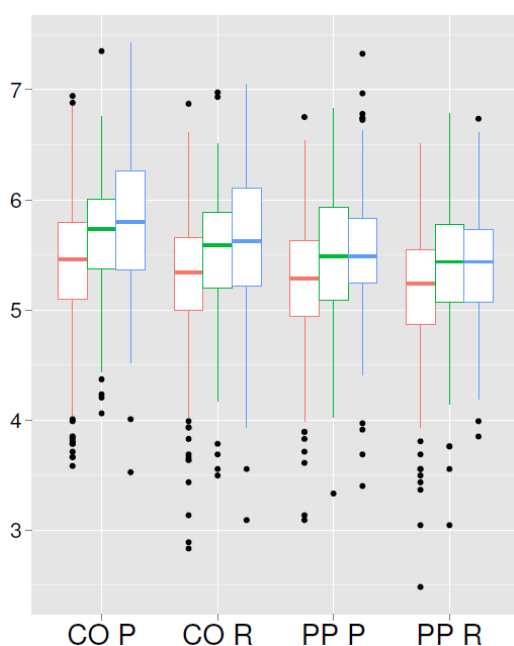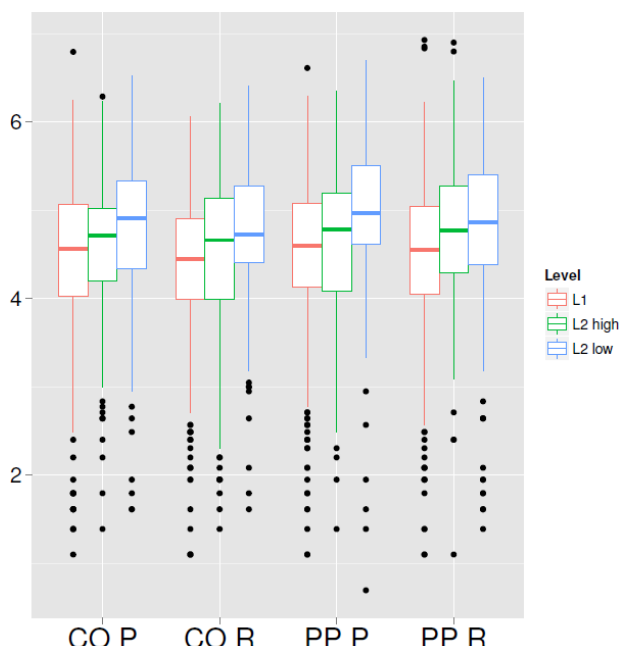
• CO P: co-argument structure with a personal pronoun, CO R: co-argument structure with a reflexive pronoun, PP P: PP structure with a personal pronoun, PP R: PP structure with a reflexive pronoun, L1: L1 speakers, L2 high: highly proficient L2 speakers, L2 low: low proficiency L2 speakers
• The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.
• critical region: himself so that, post-critical region: the new aftershave

The regression model that analysed the total times at the critical region demonstrated main effects of *proficiency* in the sense that low proficiency L2 speakers fixated longer than L1 speakers (β= 0.391, SE= 0.116, 3.373, p< .001) and the highly proficient L2 group also fixated longer than L1 speakers (β= 0.250, SE= 0.107, 2.346, p< .05). This effect of proficiency should be considered as a group effect, since both L2 proficiency groups show the same pattern and are in turns different from L1 speakers. There were also main effects of

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structure (β= -0.155, SE= 0.068, -2.291, p< .05) and *pronountype* (β= -0.151, SE= 0.068, -2.218, p< .05). The co-argument structure was fixated longer than the PP, and personal pronouns were fixated longer than reflexive pronouns. There was also a negative interaction of *structure* and *proficiency* (β= -0.142, SE= 0.073, -1.964, p< .05), showing that low proficiency L2 speakers, but not the L1 speakers, fixated the co-argument structure longer than the PP.

At the post-critical region the model only revealed a main effect of *proficiency* (β= 0.318, SE= 0.149, 2.130, p< .05). Low proficiency L2 speakers fixated longer than L1 speakers.

The number of regressions to the antecedents was also analysed with mixed effect models, but this time, L2 speakers were divided according to their proficiency level to see if a high proficiency makes L2 speakers' processing more L1-like and distinguishes them from low proficiency L2 speakers. Table 13 provides an overview of the regressions that were made by the L1 speakers and low and highly proficient L2 speakers. Table 13 shows that L1 speakers made more regressions than low and highly proficient L2 speakers. Highly proficient L2 speakers did not make more regressions than low proficiency L2 speakers. Thus, both L2 proficiency groups were different from L1 speakers in the number of regressions they made.

The regression model that analysed the number of regressions to the antecedents took the form *regressions~aoi*pronountype*structure*proficiency+[1|subj]+[1|trial]*. The dependent variable was *regressions*. The fixed factors were *aoi*, *pronountype*, *structure* and *proficiency*. The random factors were *subj* (subject) and *trial*. The model did not report an interaction. There was a main effect of *antecedent* (β= 0.031, SE= 0.006, 5.397, p< .001) that revealed that the repetition of antecedent 1 got more regressions than antecedent 1. Additionally, an effect of *structure* (β= -0.013, SE= 0.007, -1.973, p< .05) showed up that displaying again, that more regressions were made in the co-argument structure than in the PP structure. Finally, a main effect of *proficiency* (β= -0.057, SE= 0.027, -2.122, p< .05) arose, showing that highly proficient L2 speakers made fewer regressions than L1 speakers.

A last analysis was carried out that considered the total times on the antecedents. The dependent variable was *total times* and the random factors and fixed factors were the same as in the former analysis. The mixed effect regressions model *tt~aoi*pronountype*structure*proficiency+[1|subj]+[1|trial]* reported the negative interaction *structure* and *antecedent* (β= -4.489, SE= 1.739, -2.581, p< .01) and the interaction *antecedent, structure* and *pronountype* (β= 5.360, SE=2.459, 2.180, p< .05). These interactions have already been found for the group analyses above and again showed that

antecedent 2, but not antecedent 1, was fixated longer in the co-argument structure than in the PP and that reflexive pronouns in a co-argument structure leading to longer fixations on antecedent 2 than on antecedent 1.

Table 13: regressions back to the antecedents

		L2 low	L2 high	L1
CO P	antecedent 1	6	10	60
	antecedent 2	5	16	74
	repetition of antecedent 1	21	15	66
CO R	antecedent 1	5	10	49
	antecedent 2	7	10	57
	repetition of antecedent 1	19	17	71
PP P	antecedent 1	1	15	52
	antecedent 2	1	10	44
	repetition of antecedent 1	19	12	70
PP R	antecedent 1	5	10	62
	antecedent 2	4	5	75
	repetition of antecedent 1	16	13	95

• CO P=co-argument structure with a personal pronoun, CO R=co-argument structure with a reflexive pronoun, PP P=PP structure with a personal pronoun, PP R=PP structure with a reflexive pronoun, L2 low: low proficiency L2 speakers, L2 high: highly proficient L2 speakers, L1: L1 speakers

• The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.

• Antecedent 1: hairdresser, antecedent 2: visagist, repetition of antecedent 1: hairdresser

The analysis of the total times at the critical and post-critical regions showed that L1 and L2 speakers did not fixate reflexive pronouns in a co-argument structure shorter than personal pronouns and pronominal elements in a PP. Neither did the analyses of the regressions to the antecedents or the total times on the antecedents show, that highly proficient L2 speakers were different from low proficiency L2 speakers and similar to L1 speakers in the processing of pronominal elements.

7.2.3 Interference

Analyses have also been conducted testing if personal pronouns in a PP were fixated longer than reflexive pronouns in a PP due to interference from German to Dutch. A mixed effect regression model was built that included the dependent variable *fixation* of the critical and

post-critical region, the fixed factors *pronountype* and *group* as well as the random factors *subject* (subj) and *trial*. The data of the PP structure with a reflexive (PP R) and a personal pronoun (PP P) were entered into R and the model *fixation~pronountype *group+[1|subj]+[1|trial]* was run.

The graphs of the total times at the critical region (graph 26) and post-critical region (graph 27) seem to indicate that personal pronouns were not fixated longer than reflexive pronouns. At both regions, L2 speakers again fixated longer than L1 speakers.

Graph 26: total time at critical region   Graph 27: total time at post-critical region
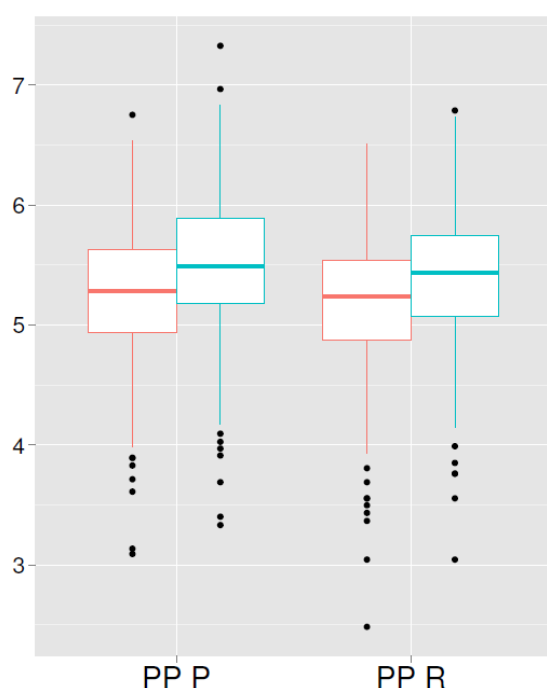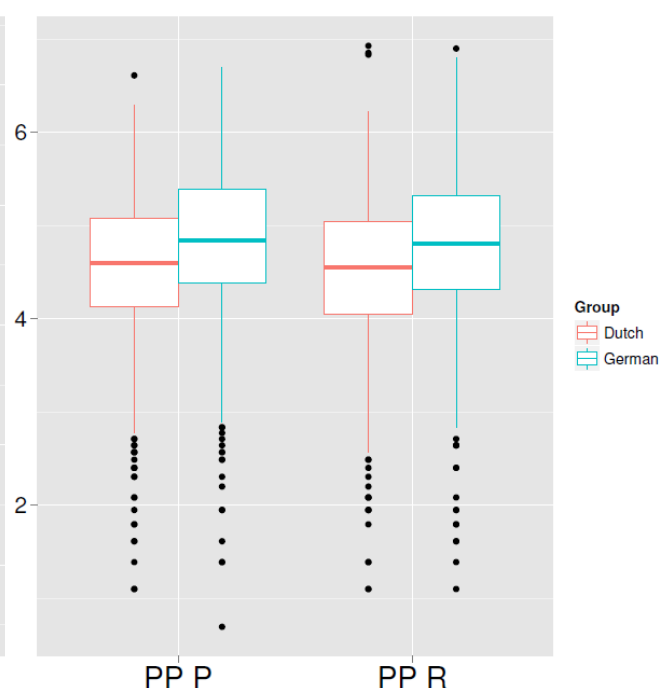
• PP P: PP structure with a personal pronoun, PP R: PP structure with a reflexive pronoun, Dutch: L1 speakers, German: L2 speakers

• The hairdresser and the visagist were working at the hairdresser's. The hairdresser moved a big barber's chair next to him/himself so that one could work more easily

• critical region: himself so that, post-critical region: one could work

The analyses of the total times revealed that g*roup* was significant at the critical (β= 0.207, SE= 0.084, 2.465, p< .05) and post-critical regions (β= 0.217, SE= 0.112, 1.939, p= .05). L2 speakers fixated longer than the L1 group. An interaction could not be found.

The number of regressions to the antecedents was also analysed. The regression model contained the dependent variable *regressions*, the fixed factors *aoi*, *pronountype* and *group*

and additionally the random factors *subj* (subject) and *trial*. The regression model took the form *regressions~aoi*pronountype*group+[1|subj]+[1|trial]*.

Table 14 shows that L1 speakers made more regressions than L2 speakers. Both groups made more regressions to the repetition of antecedent 1 than to antecedent 1 and antecedent 2.

The analysis of the number of regressions demonstrated a main effect of *group* (β= -0.050, SE= 0.020, -2.539, p< .05), *pronountype* (β= 0.027, SE= 0.013, 2.166, p< .05) and *antecedent* (β= 0.029, SE= 0.008, 3.700, p< .001). L2 speakers made fewer regressions than L1 speakers, more regressions were found for the reflexive pronoun than for the personal pronoun and more regressions were directed to the repetition of antecedent 1 than to antecedent 1. No interaction was found.

The total times on the antecedents were also analysed with the model *tt~aoi*pronountype*group+[1|subj]+[1|trial]*. The analysis of the total times at the antecedents showed main effect of *group* (β= -3.632, SE= 1.522, -2.387, p< .05), *pronountype* (β= 2.162, SE= 1.024, 2.111, p< .05) and *antecedent* (β= 1.635, SE= 0.629, 2.599, p< .01). L2 speakers had longer fixations than L1 speakers. The fixations on the antecedents were shorter for the reflexive pronoun than for the personal pronoun. Longer fixations were directed to the repetition of antecedent 1 than to antecedent 1. No interaction was found.

Table 14: regressions of L1 and L2 speakers

		L1	L2
PP P	antecedent 1	52	16
	antecedent 2	44	11
	repetition of antecedent 1	70	31
PP R	antecedent 1	62	15
	antecedent 2	75	9
	repetition of antecedent 1	95	29

• PP P=PP structure with a personal pronoun, PP R=PP structure with a reflexive pronoun, L2 low: low proficiency L2 speakers, L2 high: highly proficient L2 speakers, L1: L1 speakers

• The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.

• Antecedent 1: hairdresser, antecedent 2: visagist, repetition of antecedent 1: hairdresser

Proficiency has also been considered as a possible factor distinguishing low and high proficiency L2 speakers from each other and placing highly proficient L2 speakers closer to L1 speakers in the processing of pronominal elements in PP. The mixed effect regression

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model that analysed the fixations at the critical and post-critical regions was slightly modified by adding *proficiency* as a fixed factor and removing *group* (*fixation~pronountype*structure*proficiency+[1|subj]+[1|trial]*).

The graphs of the critical (graph 28) and post-critical regions (graph 29) show that both L2 speaker groups had longer fixations than L1 speakers. Low and high proficiency L2 speakers seem not to be different from each other in the processing of pronominal elements in a PP. It also seems that refexive pronouuns are not fixated shorter than personal pronouns.

Graph 28: total time at critical region   Graph 29: total time at post-critical region
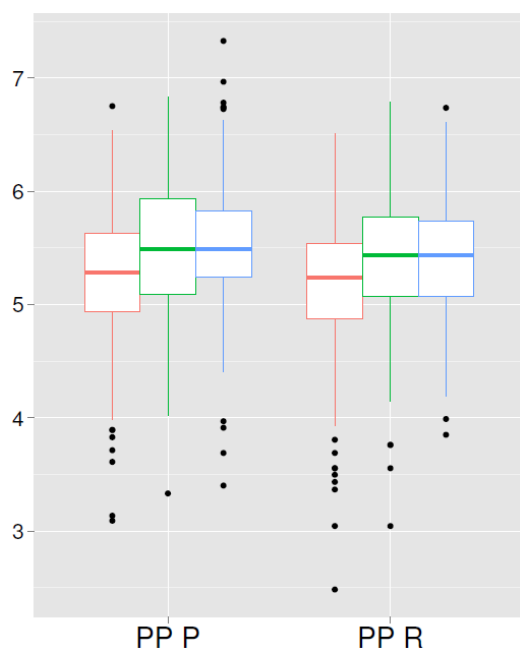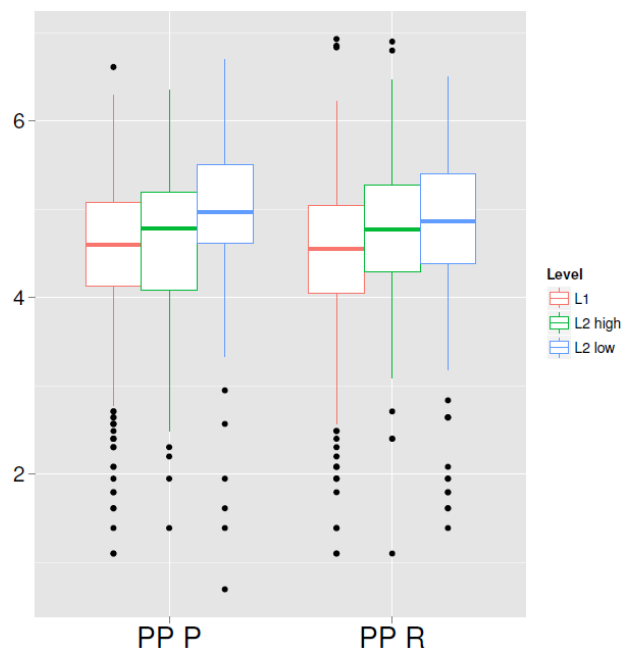
• PP P: PP structure with a personal pronoun, PP R: PP structure with a reflexive pronoun, L1: L1 speakers, Le high: highly proficient L2 speakers, L2 low: low proficiency L2 speakers

• The hairdresser and the visagist were working at the hairdresser's. The hairdresser moved a big barber's chair next to him/himself so that one could work more easily

• critical region: himself so that, post-critical region: one could work

The regression model did not show an interaction at the critical region. There was a main effect of *proficiency* (β= 0.243, SE= 0.112, 2.168, p< .05) that pointed out that low proficiency L2 speakers have longer fixated than L1 speakers. The analysis at the post-critical region showed a negative interaction of *proficiency* and *pronountype* (β= -0.223, SE= 0.107, -2.090, p< .05) and a main effect of *proficiency* (β= 0.441, SE= 0.157, 2.183, p< .005). The interaction revealed that low proficiency L2 speakers, but not L1 speakers, had longer fixations at the personal pronoun than at the reflexive pronoun. Low proficiency L2 speakers also had longer fixation times than L1 speakers.

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The analysis of the regressions was also modified by incorporating the factor *proficiency* (*regressions~aoi*pronountype*proficiency+[1\|subj]+[1\|trial]*). The analysis of the number of regressions demonstrated a main effect of *proficiency* in the sense that low proficiency L2 speakers (β= -0.054, SE= 0.027, -2.047, p< .05) and highly proficient L2 speakers (β= -0.047, SE= 0.024, -1.966, p< .05) made fewer regressions to the antecedents than L1 speakers. Main effects of *pronountype* (β= 0.027, SE= 0.013, 2.166, p< .05) and *antecedent* (β= 0.029, SE= 0.008, 3.700, p< .001) were also present and showed, that more regressions were made for the reflexive pronoun than for the personal pronoun and more regressions were directed to the repetition of antecedent 1 than to antecedent 1 itself.

The regression model used to analyse the total times at the antecedents was modified with *proficiency* as a fixed factor (*total times~aoi*pronountype*proficiency+[1\|subj]+[1\|trial]*). The analysis of the total times at the antecedents showed a main effect of *antecedent* (β= 1.635, SE= 0.629, 2.600, p< .01) and *pronountype* (β= 2.163, SE= 1.024, 2.111, p< .05). The fixations on the antecedents were shorter for the reflexive pronoun than for the personal pronoun. Longer fixations were directed to the repetition of antecedent 1 than to antecedent 1 itself.

Summarising, the analysis of the total times for the critical or post-critical regions did not show that personal pronouns were fixated longer than reflexive pronouns in L2 speakers. The analyses of the regressions to the antecedents and total times at the antecedents were also not informative, as they did not show significant effects. Thus, it seems that the L1 German does not influence the processing of personal pronouns in a PP in the L2.

7.2.4 Accessible antecedent

As with the self-paced reading study, it will be investigated if L2 speakers' processing is influenced by information from the discourse. Felser and Cunnings (2012) showed that reflexive pronouns with one accessible antecedent were processed slower than those with two accessible antecedents. The following analysis will test if the number of accessible antecedents affects the processing of reflexive pronouns. Therefore, the processing of reflexive pronouns in a co-argument structure with two accessible antecedents (CO R) will be compared to the processing of reflexive pronouns in a co-argument structure that have only one accessible antecedent (CO A).

The data of reflexive pronouns in a co-argument structure with two (CO R) and one matching antecedent (CO A) were entered into R. The mixed effect regression model that analysed the fixations at the critical and post-critical regions contained the dependent variables *total times*,

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the fixed factors *accessible antecedent* and *group* and the random factors *subj* (subject) and *trial* (*fixation~accessible antecedent*group+[1|subj]+[trial]*).

The graphs of the total times display longer fixations for L2 speakers than for L1 speakers at the critical (graph 30) and post-critical region (graph 31). The structures seem not to differ from each other.

Graph 30: total time at critical region   Graph 31: total time at post-critical region
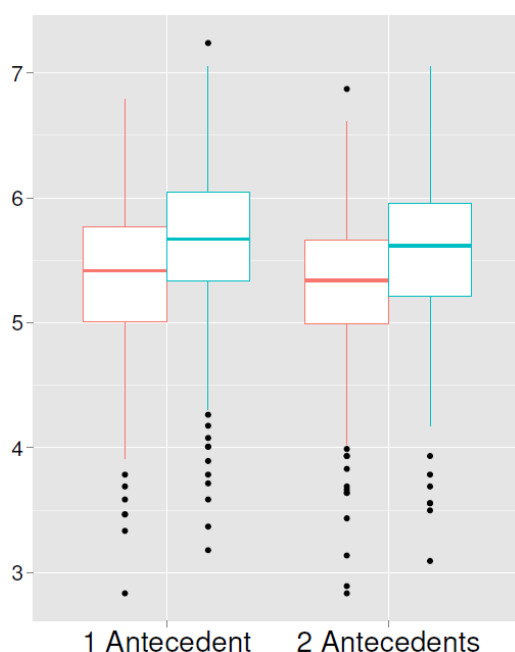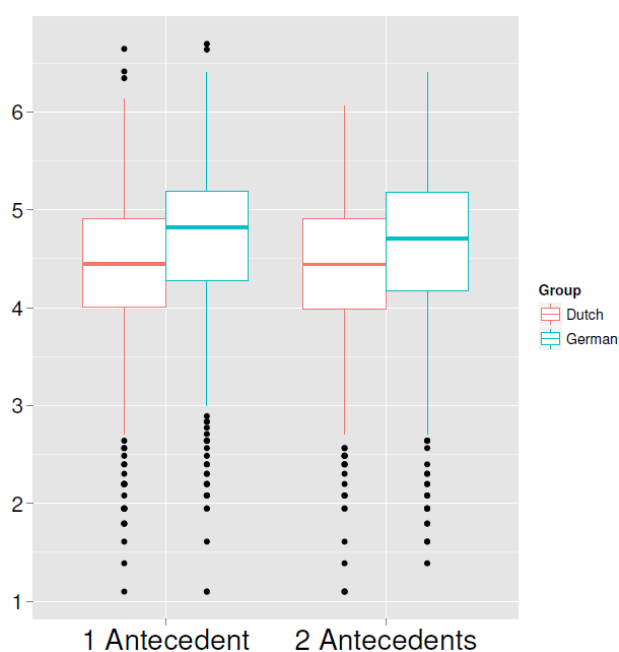
• 1 Antecedent: co-argument structure with a reflexive pronoun and one accessible antecedent, 2 Antecedents: co-argument structure with a reflexive pronoun and two accessible antecedents, Dutch: L1 speakers, German: L2 speakers

• The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.

• critical region: himself so that, post-critical region: the new aftershave

The analysis reported a main effect of *group* (β= 0.281, SE= 0.083, 3.373, p< .001) at the critical region. L2 speakers fixated longer than L1 speakers. There was no interaction.

No effects were found at the post-critical region.

Table 15 gives an overview of the number of regressions to the antecedents that L1 and L2 speakers made after they read the reflexive pronoun with one (CO A) or two accessible antecedents (CO R). Overall, L1 speakers made more regressions than L2 speakers. Both groups made more regressions to the repetition of the antecedent 1 than to antecedent 1 and 2.

Table 15: regressions of L1 and L2 speakers

		L1	L2
CO A	antecedent 1	36	11
	antecedent 2	44	8
	repetition of antecedent 1	64	26
CO R	antecedent 1	49	15
	antecedent 2	57	15
	repetition of antecedent 1	71	36

• CO R=co-argument structure with a reflexive pronoun, CO A=co-argument structure with a reflexive pronoun, L2 low: low proficiency L2 speakers, L2 high: highly proficient L2 speakers, L1: L1 speakers

• The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.

• Antecedent 1: hairdresser, antecedent 2: visagist, repetition of antecedent 1: hairdresser

The number of regressions was analysed with the regression model *regressions~aoi*accessible antecedent*group+[1|subj]+[1|trial]*. The analysis of the number of regressions to the antecedents showed a main effect of *group* (β= -0.050, SE= 0.021, -2.396, p< .05) and *antecedent* (β= 0.035, SE= 0.008, 4.124, p< .001), but no interaction. The L2 speakers made fewer regressions back to the antecedents than the L1 speakers, and the repetition of antecedent 1 received more regressions than antecedent 1.

The total times at the antecedents were also analysed by applying the model *total times~aoi*pronountype*proficiency+[1|subj]+[1|trial]*. Thus, the regression model contained the dependent variable *total times*, the fixed factors *aoi*, *pronountype* and *proficiency* and also the random factors *subj* (subject) and *trial*. The analysis of the total times on the antecedents also showed main effects of *group* (β= -3.755, SE= 1.513, -2.482, p< .05) and *antecedents* (β= 2.178, SE= 0.673, 3.236, p< .005). Overall, the L2 had longer fixations than the L1 group and fixations were longer for the repetition of antecedent 1 than for antecedent 1 itself.

Again, it was investigated if effects arose due to the factor proficiency. The graphs of the total times display longer fixations for low and high proficiency L2 speakers than for L1 speakers at the critical (graph 32) and post-critical region (graph 33). The structures do not seem to differ from each other.

The regression model for the critical and post-critical region (*fixation~accessible antecedent*proficiency+[1|subj]+[trial]*) considered *proficiency* as a factor and demonstrated a main effect of *proficiency* at the critical region. Low proficiency L2 speakers (β= 0.352,

SE= 0.110, 3.208, p< .005) and highly proficient L2 speakers (β= 0.225, SE= 0.100, 2.237, p< .05) fixated longer than L1 speakers. The analysis at the post-critical region again showed a main effect of *proficiency* (β= 0.272, SE= 0.132, 2.057, p< .05) that is the same as for the critical region.

Graph 32: total time at critical region   Graph 33: total time at post-critical region
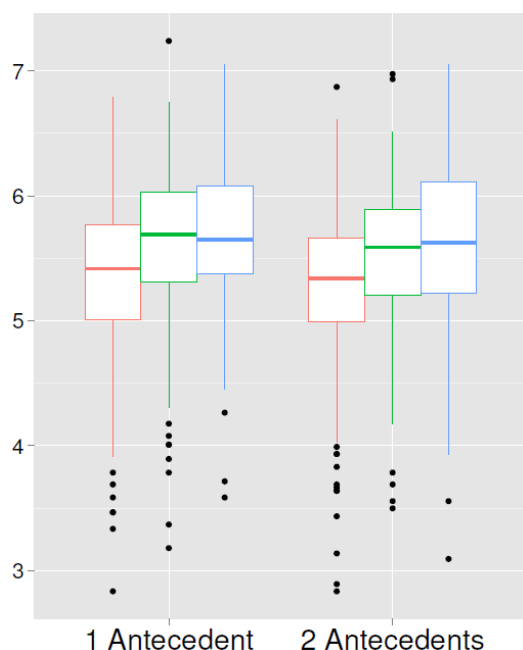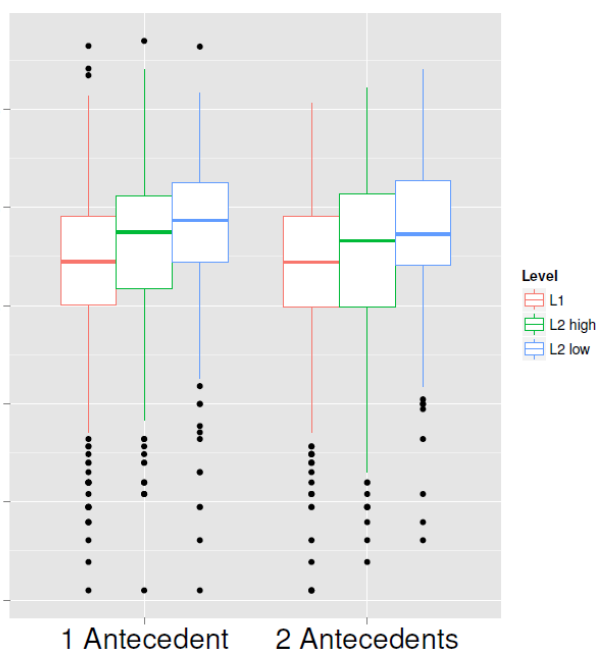
• 1 Antecedent: co-argument structure with a reflexive pronoun and one accessible antecedent, 2 Antecedents: co-argument structure with a reflexive pronoun and two accessible antecedents, L1: L1 speakers, L2 high: highly proficient L2 speakers, L2 low: low proficiency L2 speakers
• The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.
• critical region: himself so that, post-critical region: the new aftershave

The analysis of the regressions back to the antecedents also considered proficiency as a factor. The fixed factor *proficiency* replaced *group*. The regression model *regressions~aoi*accessible antecedent*proficiency+[1\subj]+[1\trial]* revealed only a main effect of *antecedent* (β= 0.035, SE= 0.008, 4.124, p< .001). The repetition of antecedent 1 received more regressions than antecedent 1.

Finally, the total times at the antecedents were analysed, and this time considered proficiency as a fixed factor (*total times~aoi*accessible antecedent*proficiency+[1\subj]+[1\trial]*. The analysis of the total times showed a main effect of *proficiency* (β= -3.767, SE= 1.838, -2.050, p< .05) in the sense that highly proficient L2 speakers made longer fixations than L1

speakers, and a main effect of *antecedent* (β= 2.178, SE= 0.673, 3.236, p< .005). Longer fixations were directed to the repetition of antecedent 1 than to antecedent 1 itself.

To summarise, reflexive pronouns were not fixated shorter when the context provided two antecedents (CO R) compared to reflexive pronouns that had only one accessible antecedent. The analyses of the regressions to the antecedents and also the total times at the antecedents did not show that the conditions differed. It can be concluded that L2 speakers were not to interrupted in their processing of the pronominal element by the number of accessible antecedents.

7.2.5   Summary

The results of the eyetracking study that include the analyses of the fixations at the critical and post-critical regions and the analyses of the regressions and total times at the antecedents do not give support for the assumption, that reflexive pronouns in a co-argument structure were processed differently from personal pronouns in a co-argument structure and pronominal elements in a PP. The division of the L2 group into subgroups of high and low proficiency L2 speakers did not show that highly proficient L2 speakers were more like L1 speakers in the processing of pronominal elements.

Moreover, there was no indcation, that the L2 speakers were influcenced by their L1 in the processing of personal pronouns in a PP. Personal pronouns were not fixated longer than reflexive pronouns at the critical and post-critical region, nor were there differences found for the antecedents. The L1 German did seemingly not interrupted processing of personal pronouns in the L2 Dutch.

Furthermore, the analysis did not provide any evidence that L2 speakers were infuenced in the processing of reflexive pronouns in a co-argument structure by differing numbers of accessible antecedents. The fixations at the critical and post-critical region and antecedents, as well as the regressions did not provide such information.

7.3 Comprehension study

In addition to the self-paced reading and eyetracking studies that investigated the processing of pronominal elements in L2 speakers, a third, different study was carried out that concentrated on the interpretation of pronominal elements in L1 German and L1 Dutch. The comprehension study had the aim to find out how reflexive and personal pronouns were interpreted in picture NP-constructions. The similarity between the processing studies and the comprehension study is that pronominal elements in picture NPs, co-argument structures and PPs can either be processed by a syntactic operation, or a discourse operation. The difference

between the studies is, that the interpretation, but not the processing of pronominal elements in picture NPs, has been investigated. The reason for doing so was that so far, only a few studies were conducted to investigate how pronominal elements in picture NPs are interpreted. Moreover, this has only been done for English. Theoretical approaches like Principles A and B (Chomsky, 1981) and Reflexivity (Reinhart and Reuland, 1993) provide insight into how pronominal elements should be bound. However, empirical research (e.g. Sturt, 2001) has shown that the way how pronominal elements are interpreted does not fit theoretical approaches.

The comprehension study was carried out in German and Dutch with the aim to get an impression of reflexive and personal pronouns in these languages are interpreted. Pronominal elements in three types of picture NP-constructions were investigated. These were pronominal elements in PNPs like (165), p-PNPs (166) and s-PNP (167).

(165) Jan en Frank staan voor de boekenkast. Frank bevestigt dat een nieuw boek over zichzelf/hem mogelijk in de lente zal worden gepubliceerd
"Jan and Frank were standing in front of the bookshelf. Frank confirms that a new book over himself/him will probably published in spring"

(166) Jan en Frank staan voor de boekenkast. Jan bevestigt dat Frank's nieuwe boek over zichzelf/hem mogelijk in de lente zal worden gepubliceerd.
"Jan and Frank were standing in front of the bookshelf. Jan confirms that Frank's new book over himself/him will probably be published in spring"

(167) Jan en Frank staan voor de boekenkast. Jan bevestigt dat Frank een nieuw boek over zichzelf/hem mogelijk in de lente zal publiceren.
"Jan and Frank were standing in front of the bookshelf. Jan confirms that Frank will probably sell new books over himself/him in spring"

In the PNP with a reflexive pronoun, the L1 German speakers should judge that sentence ungrammatical and therefore an interpretation of that sentence should be impossible. L1 Dutch speakers should judge the PNP grammatical and interpret the reflexive pronoun as referring to *Jan*. The personal pronoun should be bound by *Jan* in Dutch and German according to Principle B (Chomsky, 1981). In the case of p-PNPs Principles A and B would predict that the reflexive pronoun should be interpreted as the possessor *Frank* and the

personal pronoun as a someone who is not the possessor *Frank*. In s-PNPs the reflexive pronoun in both Dutch and German should refer to *Frank*, but *Frank* should not be the antecedent of the personal pronoun, as it would be predicted by Principles A and B (Chomsky, 1981) and Condition B (Reinhart and Reuland, 1993).

The first task of the comprehension study was the grammaticality judgement task. Graphs 34 and 35 show the grammaticality divided by condition, pronountype and group.[37] As can be seen, the German and Dutch participants judged the PNP structure with a reflexive pronoun worst. The German participants judged PNPs with a personal pronoun as most grammatical and the Dutch group the p-PNPs with a personal pronoun. Overall, the Dutch group rated more items grammatical than the German group. Graphs 36 and 37 display the grammaticality of s-PNPs with a reflexive and personal pronoun. These conditions were judged equally well by the German and Dutch group. S-PNPs with a reflexive pronoun were judged equally well as with personal pronouns.

Graph 34: Grammaticality in German
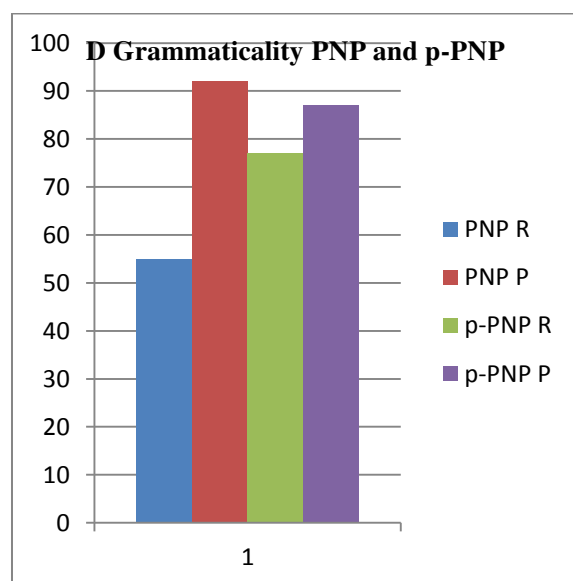
Graph 35: Grammaticality in Dutch
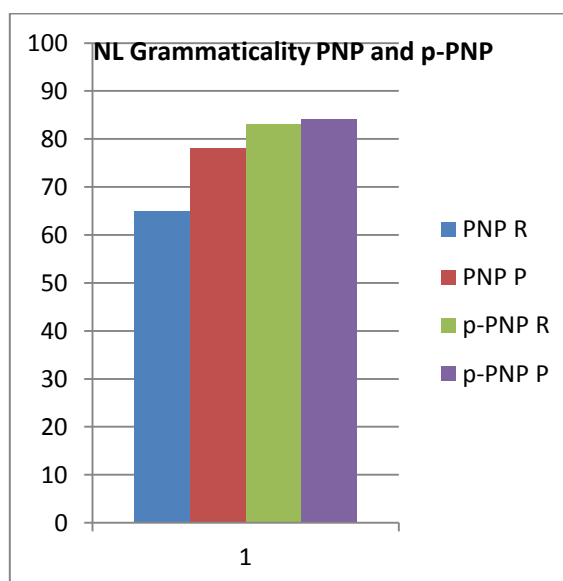
• PNP R: PNP with a reflexive pronoun, PNP P: PNP with a personal pronoun, p-PNP R: p-PNP with a reflexive pronoun, p-PNP P: p-PNP with a personal pronoun

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[37] For this analysis only the fillers have been removed. Each condition contains 24 items.

Graph 36: Grammaticality in German   Graph 37: Grammaticality in Dutch

• s-PNP R: s-PNP with a reflexive pronoun, s-PNP P: s-PNP with a personal pronoun, p-PNP R: p-PNP with a reflexive pronoun, p-PNP P: p-PNP with a personal pronoun

The interpretation of reflexive and personal pronouns in the PNP and p-PNP for German is shown in graph 38. Graph 38 displays that personal pronouns in a PNP (PNP P) were interpreted frequently as *Jan* and reflexive pronouns (PNP R) were interpreted predominantly as *Jan* as well[38]. Graph 39 also shows that personal pronouns in a p-PNP (p-PNP P) were interpreted as *Jan* in most cases and reflexive pronouns (p-PNP R) as *Frank.*

Graph 38: Interpretation of pronominal elements in PNPs and p-PNPs in German

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[38] It has to be kept in mind that reflexive pronouns in a PNP were judged as ungrammatical for German. The interpretation of the reflexive pronouns in German is only based on 2 out of 24 items.

Several statistical analyses, chi-square tests, were carried out comparing the choices of antecedents within the conditions and between conditions. For German, the difference between *Jan* and *Frank* as antecedents for the personal pronoun in a PNP (PNP P) was significant ($p< .001$) and also in a p-PNP (p-PNP P) ($p< .001$), displaying that the antecedent *Jan* was chosen more frequently than *Frank*. The interpretation of the reflexive pronoun in a p-PNP (p-PNP/REF) as *Frank* compared to *Jan* was also significant ($p< .001$), showing that *Frank* was chosen more often than *Jan*. The interpretation of reflexive pronouns compared to personal pronouns in a PNP was different (PNP: $p< .005$) which has also been the case in p-PNPs (p-PNP: $p< .001$), meaning that the pronominal elements within the structures have been interpreted differently.

Graph 39 displays the choices of antecedents of pronominal elements in PNPs and p-PNPs for Dutch. It can be seen, that the personal pronoun has been interpreted in a PNP as *Jan* or *Frank* or *Jan* and *Frank*. This is different to German, as the choices were directed more frequently towards *Jan*. The reflexive pronoun was clearly interpreted as *Jan* in a PNP. The personal pronoun in a p-PNP was predominantly interpreted as *Jan*, but not exclusively. The possessor *Frank* also seems to be accessible. The reflexive pronoun in a p-PNP was interpreted as the possessor *Frank*.

Graph 39: Interpretation of pronominal elements in PNPs and p-PNPs in Dutch
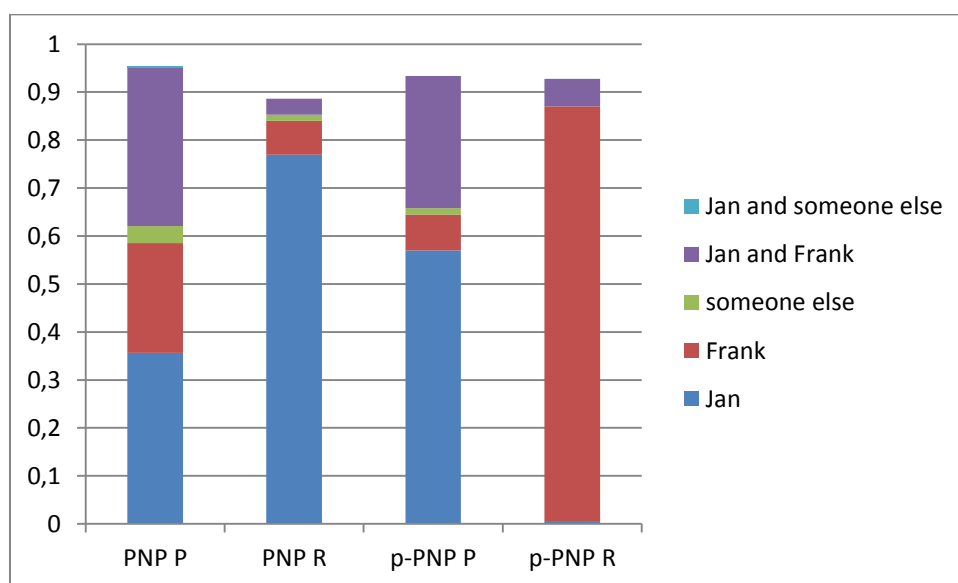
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In Dutch, the comparison of *Jan* with *Frank* as antecedent for the personal pronoun in a PNP does not reach significance (p> .05), neither does the comparison between *Jan*, *Frank* and *Jan and Frank* (p> .05). This means that none of the antecedents was chosen more frequently over the others. The difference between *Jan* and *Frank* was significant for the reflexive pronoun in a PNP (p< .001) and p-PNP (p< .001), highlighting that *Jan* was chosen more often than *Frank*. In the p-PNP condition with a personal pronoun, *Jan* was chosen significantly more often than *Frank* and *Jan and Frank* (p< .001). The comparison of the interpretation of pronominal elements in a PNP and p-PNP showed significant differences (PNP: p< .005, p-PNP: p< .001). Pronominal elements in a PNP took different antecedents and as well in a p-PNP.

The comparison of the condition between German and Dutch showed that personal pronouns in a PNP were interpreted significantly different in both languages (p<. 001) which had also been the case of reflexive pronouns in PNPs (p< .001). The comparison of reflexive pronouns in a p-PNP between German and Dutch reached significance (p< .001). The interpretation of the personal pronoun in a p-PNP was also different between German and Dutch (p< .001). This analysis showed that pronominal elements in German and Dutch took different antecedents in PNPs and p-PNPs.

Graph 40 shows the interpretation of the pronominal elements in s-PNPs and p-PNPs for German. The personal pronoun in an s-PNP was predominantly interpreted as *Jan* and the reflexive pronoun in the same structure was interpreted as *Frank*. In both conditions, other choices seem also to be possible.

Graph 40: Interpretation of pronominal elements in s-PNPs and p-PNPs in German
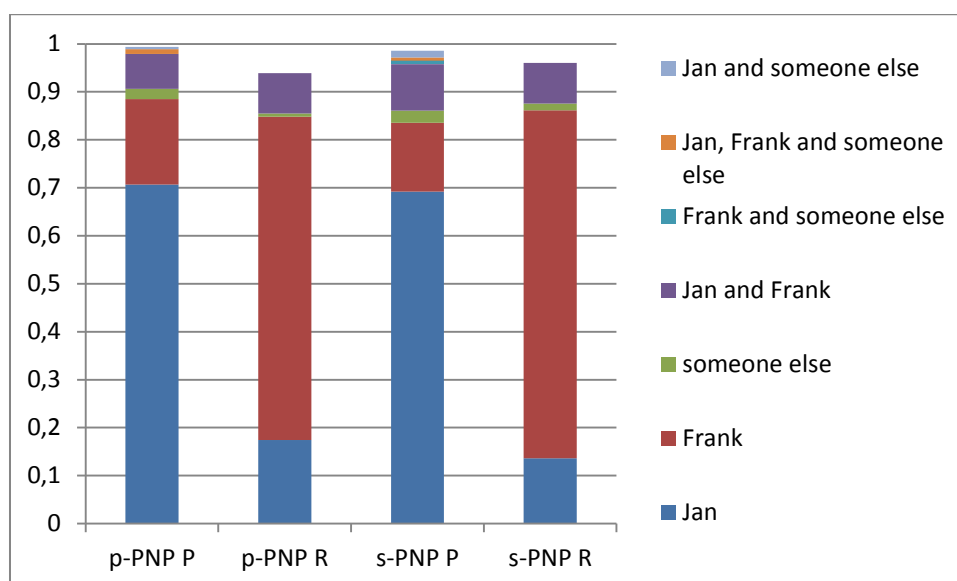
• s-PNP R: s-PNP with a reflexive pronoun, s-PNP P: PNP with a personal pronoun, p-PNP R: p-PNP with a reflexive pronoun, p-PNP P: p-PNP with a personal pronoun

The analyses revealed that *Jan* was significantly different from *Frank* in both the s-PNP with a personal pronoun ($p < .001$) and a reflexive pronoun ($p < .001$), meaning that reflexive pronouns more often took *Frank* and not *Jan* as antecedent and personal pronouns took *Jan*, but not *Frank*. The comparison of *Jan* and *Frank* as antecedents was also significant for the pronominal elements in p-PNPs (p-PNP R: $p < .001$, p-PNP P: $p < .001$). Reflexive pronouns in p-PNPs were significantly different interpreted from personal pronouns.

Graph 41 displays the interpretation of pronominal elements in s-PNPs and p-PNPs for Dutch. The interpretation of the personal pronoun in s-PNPs is not clearly directed towards one particular antecedent. *Jan* and *Jan and Frank* were chosen most frequently. The interpretation of the reflexive pronoun is directed primarily towards *Frank*.
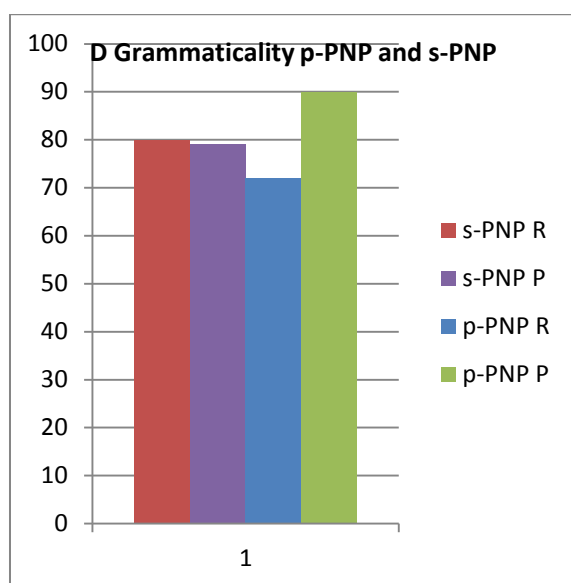
Graph 41: Interpretation of pronominal elements in s-PNPs and p-PNPs in Dutch
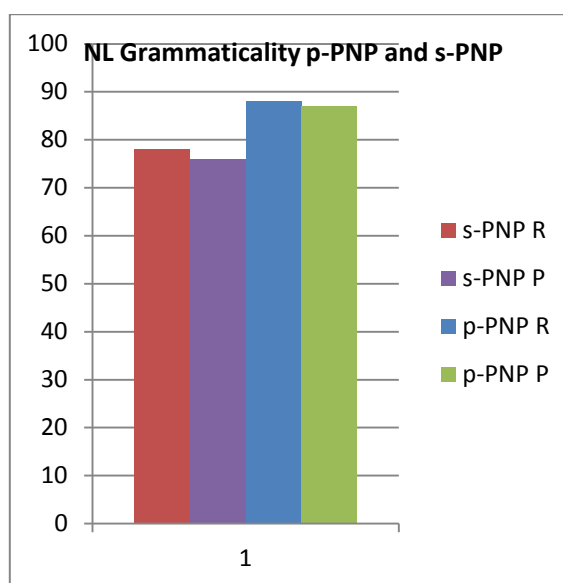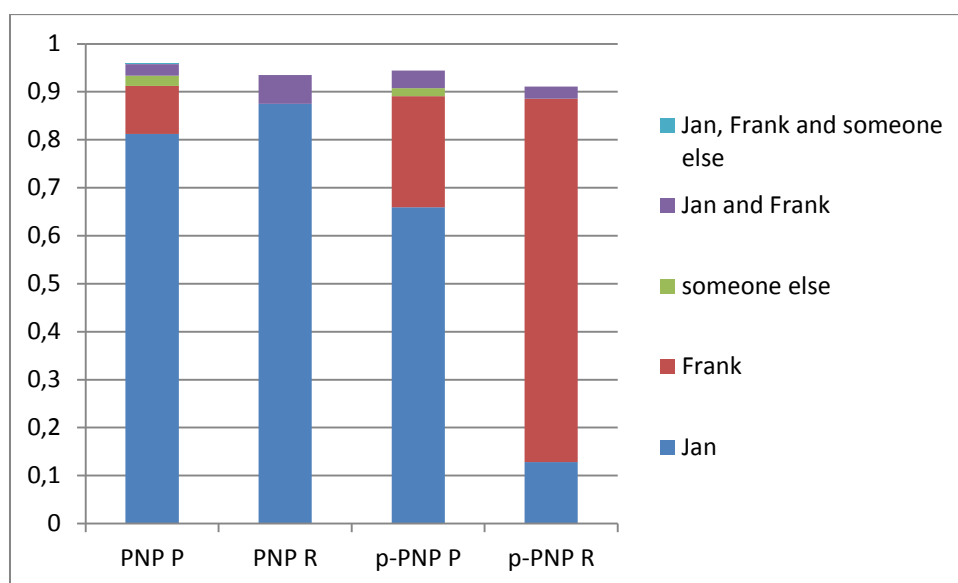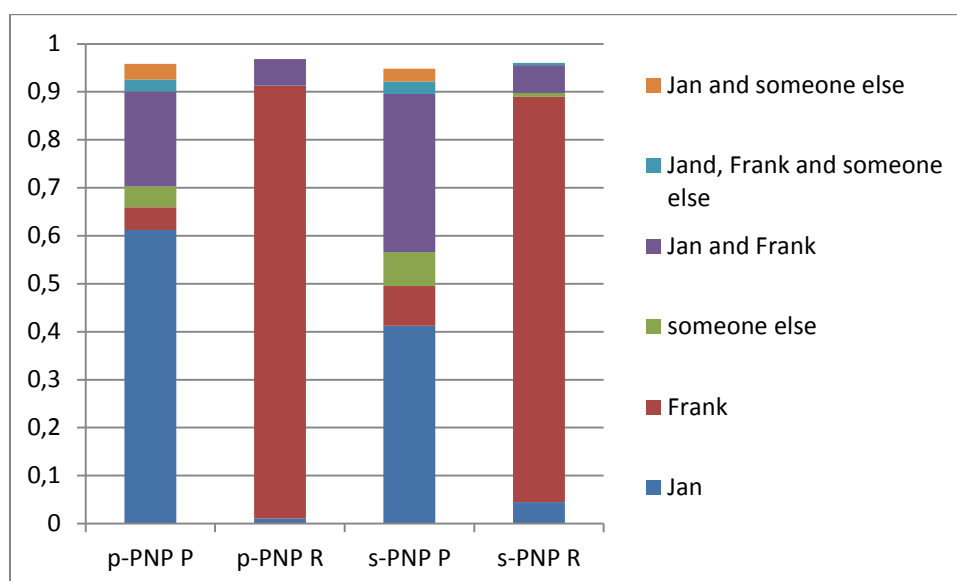

• s-PNP R: s-PNP with a reflexive pronoun, s-PNP P: s-PNP with a personal pronoun, p-PNP R: p-PNP with a reflexive pronoun, p-PNP P: p-PNP with a personal pronoun

Statistical analyses revealed that *Jan* and *Frank* significantly differed from each other in the interpretation of personal pronouns ($p< .001$) and reflexive pronouns ($p< .001$) in s-PNPs. In s-PNPs with a reflexive pronoun *Frank*, but not *Jan*, was chosen more often as antecedent and with a personal pronoun *Jan* but not *Frank*. The interpretation of *Jan* and *Frank* reached significance for reflexive pronouns in p-PNPs ($p< .001$) and personal pronouns in p-PNP ($p< .001$). Personal pronouns took *Frank* as antecedent and reflexive pronouns took *Jan*.

The comprehension of the pronominal elements in s-PNPs was compared between German and Dutch. The comparison showed that the interpretation of the personal pronoun and the reflexive pronoun in s-PNPs was different between languages (s-PNP P: $p< .001$, s-PNP R: $p< .001$). Also, the interpretation of personal pronouns in p-PNPs was different between German and Dutch ($p< .05$), as was the interpretation of reflexive pronouns ($p< .001$). These significant effects display that pronominal elements in s-PNPs and p-PNPs in German and Dutch were interpreted differently.

7.3.1 Summary

Pronominal elements in PNPs, s-PNPs and p-PNPs were judged grammatical in Dutch. This also holds for German with the exception of reflexive pronouns in PNPs. In both languages, reflexive pronouns more often take the local element as antecedent and personal pronouns were interpreted more often as the non-local antecedent. However, these choices were not absolute, meaning that the reflexive pronoun could also take the non-local element as

antecedent and personal pronoun could take the local person. Thus, the interpretation of pronominal elements in the three types of structures were guided by syntactic and discourse factors. German and Dutch seem to differ especially in the interpretation of personal pronouns. More variation in the choices of antecedents is visible for the Dutch group.

8 General discussion

This research project had the aim to investigate how reflexive and personal pronouns were processed in a co-argument structure and in a PP by German L1 speakers who learnt Dutch as their L2. Moreover, it was investigated how these pronominal elements were interpreted in so-called picture NPs in German and Dutch. The discussion will be divided into two parts. First, the results of the processing studies that investigated the processing of pronominal elements in a co-argument structure and in a PP will be discussed. Then, the results of the comprehension study that tested the interpretation of pronominal elements in so-called picture NPs will be discussed.

8.1 Discussion part 1: Self-paced reading and eyetracking

A self-paced reading and an eyetracking study were been carried out with the aim of investigating, how reflexive and personal pronouns are processed in a co-argument structure and in a PP. Four theories of theoretical linguistics were presented – *Government and Binding* (Chomsky, 1981), *Reflexivity* (Reinhart and Reuland, 1993), *HSPG* (Pollard and Sag, 1994) and *Primitives of Binding* (Reuland, 2001) – that describe pronominal binding.[39] It is not the purpose of this research project to validate the theories for German and Dutch. The theories served as a description with the aim to formulate hypotheses about how pronominal elements are processed. This can only be done when a clear picture of pronominal binding has been provided, as processing depends on the type of pronominal element used and on the structure in which the pronominal element appears. *Primitives of Binding* (Reuland, 2001) differs from the other three theories in so far as it makes predictions with regard to processing. Thus, this theory will be adapted for the discussion of the processing of reflexive and personal pronouns. This research project more specifically investigates the processing of reflexive and personal pronouns in L1 and L2 speakers. Therefore, theories that describe how processing is achieved in L1 and L2 speakers were presented. Moreover, factors like proficiency have been discussed, which might play a role in L2 processing. With these theories and factors, it should be possible to evaluate similarities and differences in the processing of pronominal elements in L1 and L2 speakers.

The discussion of the self-paced reading and eyetracking study will begin with the hypothesis that L1 speakers but not L2 speakers should process reflexive pronouns in a co-argument structure by a syntactic operation and all other pronominal elements in a co-argument

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[39] Chomsky (1981) and Pollard and Sag (1994) based their theory primarily on English and therefore cross-linguistic variation is not considered. Reinhart and Reuland (1993) consider also languages like Dutch and German. Due to this broader perspective on binding, their theory better matches the behaviour of pronominal elements in German and Dutch.

structure and PP by a discourse operation. Thereafter, the hypothesis will be elaborated on in more depth that highly proficient L2 speakers process reflexive pronouns in a co-argument relation with a syntactic operation and personal pronoun in the same structure, as well as pronominal elements in a PP with a discourse operation, whereas low proficiency L2 speakers are hypothesised to apply a discourse operation in the processing of pronominal elements in both types of structures. Then, the discussion will be concerned with the difference in the number of accessible antecedents provided by the context. The hypothesis states that L1 speakers' processing is not influenced by information of the context, meaning that a syntactic operation will be applied in the processing of reflexive pronouns in a co-argument structure, that provides one or two accessible antecedents. The hypothesis with regard to the L2 speakers' processing is that discourse should be applied in the processing of pronominal elements anyway, but also that the processing of reflexive pronouns that have only one matching antecedent − and also a person mismatching antecedent − should evoke longer processing of the reflexive pronoun than the processing of reflexive pronouns with two grammatically matching antecedents.

Finally, the discussion will deal with the hypothesis that the processing of personal pronouns in L2 speakers could be subject to interference because of differences in binding possibilities between German and Dutch. The hypothesis was that the processing of pronominal elements in PPs in L2 speakers is influenced by the grammatical representation of the L1 and L2.

8.1.1   The processing of pronominal elements in a co-argument structure and PP

Reuland (2001) has put forward that the application of a syntactic operation in language processing should be more economical than the application of, for example, a discourse operation. This research picked up this assumption by investigating if reflexive pronouns in a co-argument structure are being processed by a syntactic operation in comparison to personal pronouns in also a co-argument structure and pronominal elements in a PP, which should be processed by a discourse operation.

Reinhart and Reuland (1993) formulated Condition B that applies to semantic predicates and only to pronominal elements that appear in a co-argument relation with their antecedent. Thus, Condition B (Reinhart and Reuland, 1993) makes a difference between pronominal elements in a co-argument structure (168) and those pronominal elements that do not, as for example pronominal elements in a PP (169).

(168) De kapper en de visagist werkten in de kapsalon. De kapper die graag dingen uitprobeerde schoor **zich/hem** *zodat* <u>de nieuwe aftershave</u> kon worden uitgeprobeerd

"De hairdresser and the make-up artist were working at the hairdresser's. The hairdresser who liked to try things shaved himself/him so that the new aftershave could be tried"

(169) De kapper en de visagist werkten in de kapsalon. De kapper verschoof een grote kapperstoel naast **zich/hem** *zodat* <u>er beter</u> kon worden gewerkt.

"The hairdresser and the make-up artist were working at the hairdresser's. The hairdresser replaced a big chair next to himself/him so that it could be worked better"

Condition B applies to (168) and reference of the reflexive pronoun to the antecedent *Jan* is in accordance with Condition B as the reflexive pronoun marks the predicate reflexively. Turning to the personal pronoun *hem* in (168), coindexation of *Jan* and *hem* is ruled out. The personal pronoun does not mark the predicate reflexively. As discussed in chapter 2 Reuland's (2001, 2011) economy hierarchy can be interpreted in such a way, that reflexive pronouns in a co-argument structure (168) can be processed by a syntactic operation and personal pronouns by discourse. Concerning pronominal elements in a PP (169) Condition B does not apply. The pronominal element does not enter a co-argument relation with the antecedent *Jan* as both are not arguments of the same predicate. A syntactic relation between them does not exist. This means that a syntactic operation in the processing of reflexive pronouns cannot be applied. Discourse is the sole option when reflexive and personal pronouns have to be processed in PPs, as a syntactic operation is only possible when the predicate and the pronominal element have a close syntactic relation (Reuland, 2001, 2011).

The difference between these operations is that syntax involves fewer operational steps, that is 2. A discourse operation even involves four steps. As a consequence, the processing of reflexive pronouns in a co-argument structure should be easier, which should become apparent in shorter RTs in the self-paced reading study. The processing of personal pronouns – independent of syntactic environment – and reflexive pronouns in a PP should be more costly due to the discourse operation which results in longer RTs.

8.1.2 The application of a syntactic or discourse operation

The results of the self-paced reading study showed that the processing of reflexive pronouns in a co-argument structure like (168) was not faster than the processing of personal pronouns

in a co-argument structure (168) or pronominal elements in a PP (169) directly at the critical region (168, 169: bold) and at the first post-critical region (140, 141: italics). The RTs at the post-critical region 2 (168, 169: underlined) revealed that L1 speakers, but not L2 speakers, read reflexive pronouns in a co-argument structure (168) faster than personal pronouns in the same structure, and also faster than pronominal elements in a PP (169). This distinction between reflexive and personal pronouns has already been reported by Nicol and Swinney (1989), Hendriks et al. (2011). Moreover, Burkhardt (2005) and Schumacher et al. (2010) showed for English and Dutch that the processing of reflexive pronouns in co-argument structure is more economical than that of reflexive pronouns in PP's.

The outcome of this research has two important implications. First, it points into the direction that the processing of reflexive pronouns in a co-argument structure is qualitatively different from the processing of personal pronouns and reflexive pronouns in a PP. It seems to be the case that reflexive pronouns in a co-argument structure can be processed by a syntactic operation, whereas personal pronouns in a co-argument structure and pronominal elements in a PP have to be processed by a discourse operation. Thus, this result underpins the assumption made by Reuland (2001) that the processing of syntax is more economical than the processing of discourse which – for this study – is reflected in shorter RTs for reflexive pronouns in a co-argument structure compared to other pronominal elements in a co-argument structure or in a PP. This difference in processing also reflects that two types of processing operations guide the interpretation process. L1 speakers make use of syntax for reflexive pronouns in a co-argument structure, which means that they build an abstract structure of the sentence into which they integrate the reflexive pronoun and form a chain with the syntactically matching antecedent. Personal pronouns in a co-argument structure or pronominal elements in PP have to be processed by discourse. This involves that linguistic and world knowledge is used for the interpretation process. Remember that Ferreira et al. (2002) formulated the GE-hypothesis, which takes the view that sentence comprehension is superficial. The studies of Ferreira and Stacey (2000), Ferreira et al. (2009), Ferreira (2003) and Ferreira and Patson (2007) emphasised that the comprehension process is controlled by linguistic and world knowledge. In other words, the results of the self-paced reading study contradict the GE-hypothesis insofar that the L1 speakers build up a detailed syntactical analysis of the sentence and do not rely on discourse only – at least not in the case of reflexive pronouns in a co-argument structure. Of course, it has to be emphasised that the comprehension of the pronominal elements has not been directly investigated, as this would have put too much attention on the aim of the study. Thus, it is not clear how well participants actually

interpreted the pronominal element. However, a question was asked after each sentence and only those RTs of participants who answered at least 75 percent of the questions correctly were included in the analyses. Additionally, all items that were answered incorrectly were removed. The differences in RTs that were found can thus be taken as evidence that different processes underlie the interpretation of pronominal elements. This is an interpretation that is driven by a syntactic operation and a discourse operation that relied on for example world knowledge.

The results of the eyetracking study do not replicate the finding of the self-paced reading study. Here, no differences were detected in the processing of reflexive pronouns in a co-argument structure to personal pronouns in a co-argument structure and pronominal elements in a PP. However, the eyetracking study showed an effect of antecedent. In the co-argument structure with the reflexive pronoun the subject of the sentence, the antecendent, has been processed quicker compared to the other conditions with reflexive and personal pronouns. It seems that reflexive pronouns in a co-argument structure can be processed by a syntactic operation leading to shorter processing times. If one would neglect the results found in the self-paced reading study one had to conclude from the eyetracking study that both L1 and L2 speakers employ the same operation in processing of reflexive and personal pronouns in a co-argument and PP-structure. Thus, no difference between L1 and L2 speakers have been found and also no difference in the processing of pronominal elements in different structure were detected.

The three-way-interaction of *structure*, *pronountype* and *group* in the self-paced reading study was found relatively late at the post-critical region 2 and not directly at the pronominal element. Thus, the participants read further through the sentence and did not immediately process the information they encountered. It seems rather to be the case that the processing of the pronominal element is delayed until the post-critical region 2. At that point, the application of a syntactic operation comes into play with the result that reflexive pronouns in a co-argument structure were processed faster than personal pronouns in the same structure and pronominal elements in a PP. Hence, one the one side, this result is in accordance with findings from other studies (Burkhardt, 2005; Schumacher et al., 2010) and one the other side it substantiates the economy hierarchy of Reuland (2001, 2011) insofar as it displays that a syntactic operation will be applied whenever possible, leading to faster processing of reflexive pronouns in a co-argument structure (168) compared to personal pronouns and pronominal elements in a PP (169) which were processed by a discourse operation.

8.1.3   L2 speakers processing of pronominal elements

Earlier it has been mentioned that the finding that reflexive pronouns in a co-argument structure were processed faster than personal pronouns in a co-argument structure and pronominal elements in a PP, has two important implications. The first implication has already been made clear. The second implication deals with the groups. The contrast in the processing of pronominal elements was not found for the L2 speakers. L2 speakers did not show faster RTs and shorter fixations for reflexive pronouns in a co-argument structure (168) compared to personal pronouns in a co-argument structure and pronominal elements in a PP (169). The difference between the L1 and L2 speakers points into the direction that L2 speakers applied an operation in processing that was different from the one applied by L1 speakers. L1 speakers were argued to apply a syntactic operation in the processing of reflexive pronouns in a co-argument structure and a discourse operation in the processing of personal pronouns and pronominal elements in a PP.

In contrast, L2 speakers applied a discourse operation in the processing of pronominal elements in a co-argument structure and in a PP. The same RTs were found for pronominal elements in a co-argument and PP structure in L2 speakers. This implies that a division of labour between syntax and discourse does not exist. L2 speakers did not apply syntax although in principle, it would have been an option and it would be more economical (Reuland, 2001). This finding is not an argument against *Primitives of Binding* (Reuland, 2001), as this theory does not make any assumptions with regard to learner groups.

The absence of a distinction in processing of pronominal elements in L2 speakers is in line with theories of L2 language processing. Ullman (2001) and Clahsen and Felser (2006) presented theories that argued for differences in processing and representation of language. The DP-model (Ullman, 2001) made a distinction between declarative and procedural knowledge. Procedural memory should be difficult to access for L2 speakers. Procedural knowledge covers grammar and declarative knowledge includes all information that cannot be made up by a rule. Clahsen and Felser (2006) only argued for problems that relate to syntax in L2 speakers, leaving out parts of grammar like morphology. Applying these theories to this study, it means that reflexive pronouns in a co-argument structure are not being processed by a syntactic operation in L2 speakers, even though these pronominal elements could theoretically be processed using syntax. However, due to L2 speakers' inability to process syntax, other processing operations have to be applied. This has actually been shown in this study. L2 speakers did not show a difference in RTs in self-paced reading or differences in fixations in the eyetracking study which suggests, that they processed reflexive and personal

pronouns by the same operation, namely a discourse operation. The access to the application of a syntactic operation is problematic – maybe because these L2 speakers did not start learning the L2 Dutch during the critical period. Newport et al. (2001) defined the critical period as a moment in life when acquiring a language is unproblematic due to plasticity, which is reduced in later ages. The participants started learning Dutch at school (not before the age of 16), or even later at university so that it can be said that the critical period for language acquisition was already finished.

Differences between groups were addressed above as well as the reasons underlying these differences. However, it was also assumed that differences between the L1 and L2 group might decrease, or even disappear if L2 speakers were not considered as a single large group, but instead subdivided according to their proficiency level in the L2 (Ullman, 2001). In the latter case, it could be that highly proficient L2 speakers process reflexive pronouns in a co-argument structure like L1 speakers. L1-like processing has not been predicted for low proficiency L2 speakers. The analyses of the self-paced reading study showed that when the L2 group was divided into highly proficient L2 speakers and low proficiency L2 speakers, both L2 proficiency groups still did not show faster RTs for reflexive pronouns in a co-argument structure than for personal pronouns and pronominal elements in a PP. Neither did the results of the eyetracking study show that highly proficient L2 speakers processed reflexive pronouns in a co-argument structure differently from personal pronouns and pronominal elements in a PP, which could also not be found for the L1 speakers. Thus, in eyetracking, the L2 speaker groups were not different from each other and both L2 groups were not different from the L1 speakers. Regressions to the antecedents did not reveal either that the syntactically legal antecedent was fixated longer than inaccessible antecedents. Only the total times at the antecedents demonstrated that the syntactically legal antecedent (138: de visagist) was fixated more often after the reflexive pronoun in a co-argument structure has been read, which suggests that low and high proficiency L2 speakers and L1 speakers were not different from each other.

However, the self-paced reading study again showed that L1 speakers were different from both high and low proficiency L2 speakers. Thus, although L2 speakers' proficiency level was taken into consideration, it did not change anything. A high proficiency in the L2 did not result in L1-like processing. At least in self-paced reading, highly proficient L2 speakers were comparable to low proficiency L2 speakers and both were not like L1 speakers. This implies that learner groups applied an operation in the processing of reflexive pronouns that is different from L1 speakers. This is, L1 speakers applied syntax in the processing of reflexive

pronouns in a co-argument structure and L2 speakers, independent of proficiency level, applied a discourse operation. Thus, the results of the self-paced reading study cannot be taken to support theories that predict proficiency to be a factor that leads to L1-like processing as is implemented in the DP-model (Ullman, 2001) and Convergence (Green, 2003).

The processing of pronominal elements is subject to the interface of discourse and syntax. Discourse factors like prominence of antecedents or verbs favouring a particular antecedent can influence processing. Structural factors like Principles A and B (Chomsky, 1981) or Condition B (Reinhart and Reuland, 1993) also guide the interpretation process. So, L2 speakers have to learn, recall and consider a lot of factors. Due to the fact that the processing of pronominal elements is located at the interface of discourse and syntax, it could be that especially interfaces are hard to acquire. This has already been argued for by instance Rothman (2009). Interfaces provide more information that needs to be processed than for example syntax alone. This research project conflicts Rothman's (2009) view who found that highly proficient L2 speakers were able to handle interfaces and performed L1-like.

The Convergence hypothesis (Green, 2003) can neither be fully supported nor rejected. The theory assumes that L1 and L2 speakers use the same neural substrates in processing language. This research project does not have a neurolinguistic focus and therefore it cannot be said that L1 and L2 speakers were not using the same neural substrates. However, the finding of the self-paced reading study that L1 and low and high proficiency L2 speakers were dissimilar in their processing could be taken to argue that different neural substrates are being used in L1 and L2 speakers.

Clahsen and Felser (2006) did not incorporate proficiency as a factor that favours L1-like processing. The differences between L1 speakers and low/high proficiency L2 speakers in the self-paced reading study suggest, that proficiency does not give access to the application of syntax, as has been claimed by the SSH (Clahsen and Felser, 2006). The differences in processing point to the existence of strong critical period effects. The L2 speakers all started learning Dutch after the age of 16. Some of them achieved a high proficiency in L2 Dutch. However, a high level of proficiency might not consequently result in L1-like processing. L2 speakers are able to learn grammatical and lexical knowledge, but in a different way from L1 speakers. Thus, L2 speakers succeed in learning a language although they cannot rely on operations that they command in their L1. Finally, the L2 speakers might master learning the L2, but the processing of it is qualitatively different.

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8.1.4 Relatedness of language

The results of the self-paced reading study showed that reflexive pronouns in a co-argument structure were processed faster than personal pronouns and pronominal elements in a PP which is also interesting with regard to the relatedness of languages. German and Dutch are closely related languages and research has shown that relatedness can result in advantages in performance compared to speakers whose L1 is not closely related to the L2 (Sabourin, 2003). For the processing of pronominal elements, the self-paced reading study showed that relatedness or distance between L1 and L2 does not result in L1-like processing. However, the results of the eyetracking data might be interpreted in such a way that the processing of L2 speakers is L1-like, as both groups were not different from each other in the processing of pronominal elements in and across structures. The RTs of the self-paced reading study provided evidence against L1-like processing of L2 speakers. In section 8.1.7.8, an explanation will be provided aiming to explain the differences between eyetracking and self-paced reading.

Although German and Dutch share the same binding behaviour of reflexive pronouns in a co-argument structure, L2 speakers' processing was shown to be different from that of the L1 speakers by the self-paced reading study. On the surface, it might seem that L2 speakers were like L1 speakers. This means that comprehension studies like Sabourin (2003) might find that L2 speakers were like L1 speakers, if the languages have a close typological relationship. However, comprehension is not processing. In the self-paced reading and eyetracking studies the L1 and L2 speakers answered the comprehension questions at least 75 percent correctly, but this does not mean in reverse that processing is the same in L1 and L2 speakers due to relatedness of German and Dutch. I do not want to exclude the possibility that a close typological relationship might promote L1-like processing. However, based on the results of at least the self-paced reading study, this seems not to be the case.

8.1.5 One versus two accessible antecedents

Remember that it has been argued by Ullman (2001) and Green (2003), that proficiency could be a key factor in language processing. When dividing L2 speakers according to their proficiency level, it could be possible to discover that highly proficient L2 speakers were similar in processing to L1 speakers. Highly proficient L2 speakers have had enough practice with the L2 and should have built up an appropriate L2 grammar. Low proficiency L2 speakers' grammatical knowledge might be incomplete in such a way that an appropriate L2 grammar has not been made up yet. A high ability in the L2 could be sufficient to be able to make use of syntax in an L1-like way. Highly proficient L2 speakers will then be comparable

to L1 speakers in their processing of pronominal elements and both groups should be different from low proficiency L2 speakers.

It has been shown by the self-paced reading study, that at least L1 speakers used a syntactic operation in the processing of reflexive pronouns in a co-argument structure. However, do L1 speakers always apply a syntactic operation when it is possible? Further, the self-paced reading study demonstrated that L2 speakers applied a discourse operation in the processing of pronominal elements. The question that needs to be answered, is if the context is manipulated in the sense that it provides two or only one accessible antecedent, would it have an effect on the processing of pronominal elements in L2 speakers? Having only one accessible antecedent – although two antecedents were introduced of which one antecedent does not meet the grammatical features of the pronominal element – might result in longer processing for L2 speakers.

Thus, this research compared the processing of reflexive pronouns in a co-argument structure with two accessible antecedents (170) to the processing of reflexive pronouns with one accessible antecedent (171).

> (170) De kapper en de visagist werkten in de kapsalon. De kapper die graag dingen uitprobeerde schoor zich zodat de nieuwe aftershave kon worden uitgeprobeerd "De hairdresser and the make-up artist were working at the hairdresser's. The hairdresser who liked to try things shaved himself/him so that the new aftershave could be tried"
>
> (171) De kapper en ik werkten in de kapsalon. De kapper die graag dingen uitprobeerde schoor zich zodat de nieuwe aftershave kon worden uitgeprobeerd "De hairdresser and me were working at the hairdresser's. The hairdresser woh liked to try things shaved himself/him so that the new aftershave could be tried"

The question is how the groups dealt with the manipulation of the context. If the participants applied a syntactic operation, meaning that a syntactic chain has been established between the reflexive pronoun and the antecedent, context information should not have an effect on the processing of the reflexive pronoun. For example, L1 speakers are thought to show equally fast RTs for the processing of reflexive pronouns in a co-argument structure with one (171) or two accessible antecedents (170). However, it has been shown with the self-paced reading study that L2 speakers processed pronominal elements with a discourse operation. Anyway, a

discourse operation should be applied in L2 speakers. One study that investigated if the accessibility of antecedents influenced the processing of reflexive pronouns was done by Felser and Cunnings (2012). This study showed that it took L2 speakers longer to process the reflexive pronouns with one accessible antecedent (172) than those with two accessible antecedents (173). This means that the L2 speakers' processing slowed down due to a mismatch in grammatical features. L2 speakers processed the mismatch in gender while L1 speakers did not. Thus, it seems that L1 speakers immediately applied a syntactic operation in the processing of the reflexive pronoun in (172) and (173) with the consequence that a difference in the processing of the reflexive pronoun did not show up. L2 speakers' processing is delayed due to the gender mismatch resulting in longer processing of reflexive pronouns in (172) compared to (173).

(172) Helen has worked at the army hospital for years. The soldier that she treated on the ward wounded himself

(173) James has worked at the army hospital for years. The soldier that he treated on the ward wounded himself

The results of the self-paced reading and eyetracking studies did not show an effect of the inaccessible antecedent on the processing of the reflexive pronoun in L1 and L2 speakers. Reflexive pronouns with one accessible antecedent (171) were not processed differently from reflexive pronouns with two accessible antecedents (170). The regressions and total times to the antecedents did not show a difference between structures either. It was shown in the self-paced reading study that L1 speakers processed reflexive pronouns in a co-argument structure (168) by a syntactic operation and personal pronouns and pronominal elements in a PP (168) by a discourse operation. As the comparison of reflexive pronouns in a co-argument structure with one (171) or two accessible antecedents (170) did not lead to any differences, it can be assumed that the same operation has been applied in the processing of the reflexive pronoun in both structures. This is a syntactic operation.

In contrast to that, in self-paced reading L2 speakers did not applied a syntactic operation in the processing of reflexive pronouns in co-argument structure (168) compared to personal pronouns and pronominal elements in a PP (169). Because of the absence of differences in processing of reflexive pronouns in a co-argument structure with one (171) or two accessible antecedents (170) in L2 speakers, it can be assumed that discourse was applied to process the reflexive pronouns. Thus, this argumentation is not directly based on the findings of reflexive

pronouns with two (170) or one accessible antecedent (171), but it is a combination of these finding with the results of (168) and (169) of the self-paced reading study.

If only the eyetracking data were available, the argumentation would be different. L1 and L2 speakers were not different from each other in the processing of pronominal elements in a co-argument structure (168) and in a PP (169) and they did not differ in the processing of reflexive pronouns in (170) and (171) either, so that L1 and L2 speakers could have been assumed to apply the same operation as L1 speakers. This would be a syntactic operation.

Thus, this research has not found that reflexive pronouns in a co-argument structure with one accessible antecedent (170) were processed slower than with two accessible antecedents (171). This contradicts the results of Felser and Cunnings (2012) who found that the presence of a gender inaccessible antecedent led to longer processing of the reflexive pronoun compared to the processing of reflexive pronouns that matched both antecedents in grammatical features. In the study of Felser and Cunnings (2012), there was a gender inaccessible antecedent that mismatched the reflexive pronoun, whereas this study had a mismatch in number. However, this difference is not sufficient to explain the difference in findings. It could be possible that Felser and Cunnings (2012) found a difference between (172) and (173), because the inaccessible antecedent was closer to the reflexive pronoun than it was in this study (170, 171). This study had the number inaccessible antecedent *ik* in the lead-in sentence. The reflexive pronoun appeared in the next sentence. The gender inaccessible antecedent in the study of Felser and Cunnings (2012) was located in the subordinated clause and the reflexive pronoun in the matrix clause. The reflexive pronoun and the inaccessible antecedent were closer to each other than in this study. The L2 speakers in the study of Felser and Cunnings (2012) processed the next available antecedent and recognised the gender mismatch, whereas in this study the number inaccessible antecedent was too far away from the reflexive pronoun and might therefore not be processed.

The GE-hypothesis (Ferreira et al., 2002) would not expect such a result either. If processing is superficial in L1 speakers, this would imply that all discourse information should be considered by the participants. However, the inaccessible antecedent did not seem to have an effect on the processing system. L1 speakers do seem not to consult a representation that is driven by superficial information, but rather to rely on a syntactic operation even in circumstances where the context is manipulated.

8.1.6 Interference

The main purpose of this research project rests in how pronominal elements were processed in structures where a syntactic or a discourse operation can be applied. Therefore, pronominal

elements were investigated in a co-argument structure and a PP. However, as the languages Dutch and German were investigated, it has to be recognised that cross-linguistic differences exist in the field of pronominal binding. The behaviour of the pronominal elements in a co-argument structure is similar between German and Dutch. Reflexive pronouns refer to the next possible antecedent that is *de kapper* in example (174) and the personal pronoun may not refer to *de kapper* in (174).

(174) De kapper$_i$ die graag dingen uitprobeerde schoor zich$_i$/hem$_{*i}$ zodat de nieuwe aftershave kon worden uitgeprobeerd

"The hairdresser who liked to try things shaved himself/him so that a new aftershave could be tried"

In a PP, binding differences between German and Dutch are present. The reflexive pronoun has to be bound by the subject of the sentence *de kapper, der Friseur* in (175, 176) in both Dutch and German. The personal pronoun may not be bound by *der Friseur* in German (176) but in Dutch reference to the subject *de kapper* is possible (175).

(175) De kapper$_i$ verschoof een grote kapperstoel naast zich$_i$/hem$_i$ zodat er beter kon worden gewerkt

(176) Der Friseur$_i$ verschob einen großen Friseurstuhl neben sich$_i$/ihn$_{*i}$, damit er besser arbeiten konnte

"The hairdresser replaced a big chair next to himself/him so that it could be worked better"

Thus, it is in principle possible that interference between German and Dutch arises in PPs with personal pronouns as the domain of binding differs between the languages. Interference is not expected in the co-argument structure, as both languages do not differ in that respect. The question arises, what the interference in a PP might look like. It should be kept in mind that personal pronouns should be processed with a discourse operation in both languages. Processing in German and Dutch of personal pronouns in PPs should yield the same costs. However, having two languages in mind might affect processing in L2 speakers. L2 speakers command two languages which they need to keep apart in order to avoid interference. When L2 speakers were confronted with a personal pronoun in a PP, they have to supress the German representation otherwise a competition between representations might be the result.

The RTs and eye movements of L1 and L2 speakers showed that L2 speakers did not rest longer on the personal pronoun in a PP compared to the reflexive pronoun, than L1 speakers. Moreover, in eyetracking regressions back to the antecedents did not show either, that in the case of a personal pronoun, the antecedents were fixated longer than for the reflexive pronoun. Generally, reflexive and personal pronouns in a PP (175, 176) have to be processed by a discourse operation. Applying discourse implies that all possible antecedents in the discourse will be considered. Anyway, if all antecedents in the discourse are being evaluated, an effect due to a cross-linguistic difference might be reduced or not apparent, as has been found. Thus, language competition does not take place, as due to discourse, all antecedents were evaluated in both German and Dutch. Thus, the same steps in the processing of pronominal elements will be passed. Interference as proposed in the Competition model (MacWhinney, 2008) would imply that personal pronouns in PPs would be delayed in processing in L2 speakers compared to reflexive pronouns, as the L1 and L2 representations interfere with each other. In German, the attention of the search of the antecedent is directed towards the outside of the sentence, whereas in Dutch speakers should look for the antecedent both the inside and the outside of the sentence. However, this view is not in accordance with the application of a discourse operation, as discourse implies that all antecedents have to be analysed. This has been found by the self-paced reading and eyetracking studies.

Competition of the L1 and L2 representation has not been found either, when the L2 speaker group was divided according to their proficiency level. The analysis that included proficiency did not report a difference between reflexive and personal pronouns in a PP in both self-paced reading and eyetracking. This implies that low proficiency L2 speakers did not only consider their L1 representation in the processing of pronominal elements in a PP, but were like highly proficient L2 speakers and L1 speakers insofar as they all considered all antecedents.

The processing studies showed that the typological distance between German and Dutch with respect to personal pronouns in PPs is negligible for the processing. However, distance can have an effect on how the personal pronoun is interpreted. All antecedents will be evaluated but L2 speakers might be guided by German in their comprehension. Comprehension further might be affected by proficiency. Highly proficient L2 speakers probably have set up two representations. The adequate representation will be recalled and the inappropriate one will be inhibited. Low proficiency L2 speakers have not yet developed two separate systems and interference is possible. In comprehension, L1 speakers and highly proficient L2 speakers might show the same choice of antecedents that is different from the choice by low proficiency L2 speakers. Transfer might show up in low proficiency L2 speakers due to

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insufficient linguistic knowledge. However, the underlying processing of the personal pronouns is comparable in L1 and L2 speakers. This study cannot answer how well L1 and L2 speakers comprehended the pronominal element, as the comprehension questions after each item did not cover pronominal interpretation.

Staying with the issue of personal pronouns in PPs, it is possible that reference in Dutch is affected by regional variation. L1 speakers of Dutch do not all agree that the subject of the sentence *de kapper* can bind the personal pronoun (175). L1 speakers were divided into three groups. The location of participation served as a group separation. The groups were Nijmegen, Amsterdam and Groningen. The self-paced reading and eyetracking studies did not reveal that personal pronouns were processed differently by any of these groups. Therefore, it cannot be argued that possible binding differences lead to differences in RTs and eye movements in a PP. The reason for this is probably the same as for the L2 speakers. Personal pronouns have to be processed in discourse and binding possibilities do not rule out processing of particular antecedents that are inaccessible for some speakers.

8.1.7   Side effects

The analyses of the self-paced reading and eyetracking study showed main effects and interactions that were not directly interesting with regard to the aim of this research project, but that need to be explained to deliver a clear picture of the results. Main effects of *group*, *pronountype* and *structure* as well as two-way interactions have been found.

8.1.7.1   Main effect of group

To begin with the main effect of *group*, this effect points out that L2 speakers were slower than L1 speakers in reading. This outcome is not really surprising because reading in the L2 is in general slowed down compared to reading in the L1, which has already been found in other studies (Juffs, 2004; Patterson et al., 2014). Even when the L2 group was divided according to their proficiency level, highly proficient L2 speakers were still reading slower than L1 speakers. The difference between groups could be explained insofar as L2 speakers were not used to reading in the L2 (Lee and Schallert, 1997). The overall slower reading should not be taken to assume that this is the reason why L2 speakers process pronominal elements exclusively by a discourse operation. Of course, if reading is very slow, automatic processes like the application of a syntactic operation will not guide processing. The graphs show – for both self-paced reading and eyetracking – that L2 speakers were slower than L1 speakers in reading but not extremely slow in reading the sentences. In self-paced reading, for example, L2 speakers were about 100 milliseconds slower than L1 speakers (table 6, table 7). A study (Hoover & Dwivedi, 1998) that investigated L2 reading speed with regard to language

processing showed that the faster the reading speed of L2 speakers became the more their processing resembled that of L1 speakers. The L2 speakers in the study of Hoover and Dwivedi (1998) were also about 100 milliseconds slower than the L1 speakers. Therefore, it is argued that the self-paced reading and eyetracking study do not provide a hint of a relation between slowed reading and the application of a discourse operation.

8.1.7.2 Main effect of pronountype

A main effect of *pronountype* has been found at the critical and post-critical regions in both processing studies. Reflexive pronouns were read faster than personal pronouns. The processing of pronominal elements can be achieved by the application of a syntactic or a discourse operation. A syntactic operation can be applied when the pronominal element is underspecified of phi-features which are person, number and gender and contained in a co-argument relation with the antecedent. This implies that personal pronoun can never be processed by a syntactic operation because personal pronouns are always specified in terms of phi-features. For example, the personal pronoun *hem* is third person, singular and masculine. Reflexive pronouns are underspecified of phi-features. *Zichzelf* and *sich* are third person but do not distinguish between masculine and feminine and singular or plural. Whether reflexive pronouns can enter a syntactic relation with the antecedent depends on the sentence structure. Structure (168) is a co-argument structure where the reflexive pronoun and the antecedent are arguments of the same predicate. Here, the application of a syntactic operation is possible (Reuland, 2001). Structure (169) provides a different syntactic environment to (168). The reflexive pronoun is not an argument of the same predicate as the antecedent. The reflexive pronoun is an argument of the preposition and the prepositional phrase is an argument of the main verb, of which the antecedent is also an argument. Thus, the antecedent and the reflexive pronoun are not co-arguments of the same predicate. The application of a syntactic operation is impossible according to Reuland (2001). A discourse operation can be applied. As this research project investigated the processing of reflexive and personal pronouns in a co-argument structure and in a PP, the main effect of pronominal element cannot be explained by processing operations. An effect of a processing operation can only be found in a co-argument structure with a reflexive pronoun. Thus, an interaction should have been found.

An explanation for the difference in processing between reflexive and personal pronouns could be distance of binding. Reflexive pronouns in a co-argument structure (168) and in a PP (169) have to be bound by the next person, which is the subject. Binding of the reflexive pronoun outside CP is ungrammatical. The personal pronoun in a co-argument structure and in a PP can be bound more freely than the reflexive pronoun. The broader perspective of

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personal pronouns – the higher number of antecedents – could lead to the observed main effect of *pronountype*. Personal pronouns take an antecedent in the broader discourse, whereas reflexive pronouns have a limited scope that is local. Furthermore, the number of possible antecedents is higher for personal pronouns than for reflexive pronouns. The material that was used for this research provided two antecedents in the lead-in sentence, but in the case of the personal pronoun, any person in the discourse is a possible antecedent. In the case of the reflexive pronoun, two antecedents are also available, but the effect of *pronountype* suggests that the binding domain has an impact on discourse. The binding domain restricts the search process. A longer search is the result in the case of personal pronouns compared to reflexive pronouns.

8.1.7.3   Main effect of structure

A main effect of *structure* was also frequently found. The co-argument structure was read slower/fixated longer than the PP at the critical region and the opposite pattern was found at the post-critical regions. The difference between structures at the critical region could be due to differences in the lexical material. The material before the pronominal element was lexically different between the co-argument and PP structure. The co-argument structure contained a verb before the pronominal element (174: schoor zich/hem "shaved himself/him"), whereas the PP always had a preposition before the pronominal element (175: naast zich/hem "next to himself/him"). Verbs contain more information than prepositions. In the case of *scheren* (to shave), it is a transitive verb and it is inflected for past tense. In contrast, prepositions do not carry such features. Prepositions are function words and verbs are content words. Thus, more grammatical and lexical information is contained in verbs than in prepositions. It could therefore be argued that verbs take longer to process, which become apparent in longer reading times or longer fixations as more information has to be processed. This effect can even be delayed one or two regions after that word, as information is still being processed while reading.

At the post-critical region, the PP was read slower/fixated longer than the co-argument structure. Thus, at the post-critical regions, the information of the verb has been processed. However, processing the structures is still different but the other way around. Although co-argument structures initially seem to be more complex than PPs, at the same time the syntactic environment of co-argument structures also have a processing benefit compared to PPs. Elements in the co-argument structures like (174) have a close syntactic relation (Reuland, 2001). The antecedent and the pronominal element are co-arguments of the same predicate. This syntactic relation is not present in PPs like (175). In these cases, a co-

argument relation is absent which implies that the relation between the pronominal element and the antecedent is not narrow (Reuland, 2001). The consequence is that a close syntactic relation facilitates processing compared to when such a close syntactic relations is absent. Thus, it could be argued that although co-argument structures were initially processed slower due to the grammatical and lexical complexity of the verb, this slowdown in processing changes into faster processing due to the close grammatical relation between the pronominal element and the predicate.

8.1.7.4 Main effect of antecedent
Finally, the analyses of the eyetracking data frequently found an effect of antecedent. The number of regressions to the repetition of antecedent 1 (177: underlined) was higher than that to the other antecedents. Moreover, the total times of that antecedent were also significantly different from the other antecedents. This means that the repetition of antecedent 1 was fixated more frequently than the other antecedents. This effect could be explained by the close proximity between the pronominal element and this antecedent. The L1 and L2 speakers check the compatibility of the pronominal element against the features of the repetition of antecedent 1. If the features match, antecedent 1 (177: bold) does not need to be checked, as the antecedents were the same. Thus, this explains the difference between these antecedents. Antecedent 2 (177: italics) is checked because it appears in the discourse. However, if the search already stops at the repetition of antecedent 1, antecedent 2 is not fixated very often. This results in a difference between antecedent 2 and the repetition of antecedent 1.

(177) **De kapper** en *de visagist* werkten in de kapsalon. De kapper$_i$ die graag dingen uitprobeerde schoor zich$_i$/hem$_{*i}$ zodat de nieuwe aftershave kon worden uitgeprobeerd[40]

"De hairdresser and the make-up artist were working at the hairdresser's. The hairdresser who liked to try things shaved himself/him so that the new aftershave could be tried"

8.1.7.5 Interaction of structure and group
Moreover, interactions of *structure* and *group* were found. L2 speakers read the co-argument structure slower than the PP. This interaction could be caused by an overall slower processing in L2 speakers combined with the complexity of the co-argument structures compared to the PP. This result fits well with the assumption by Clahsen and Felser (2006) and Ullman

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[40] De kapper is referred to as antecedent 1, de visagist as antecedent 2 and de kapper (underlined) as the repetition of antecedent 1.

(2001), that syntax is difficult to process for L2 speakers. Above, the difference in lexical material and also in grammatical structure between the co-argument structure and the PP has been explained. A close syntactic relation exists between the pronominal element and the predicate in a co-argument structure which is not the case in a PP (Reuland, 2001). Noticeably, L2 speakers need more time than L1 speakers to process this information.

8.1.7.6 Interaction of structure and pronountype

An interaction of *structure* and *pronountype* also showed up in the self-paced reading study. Personal pronouns in a PP structure were processed slower than reflexive pronouns in a PP and pronominal elements in a co-argument structure at the post-critical region 2. This interaction is also an accumulation of the effect that personal pronouns have a broader perspective (binding domain) and that the co-argument structure constitutes a narrower syntactic environment than a PP which is easier to process.

8.1.7.7 Interaction of pronountype and group

A third interaction of *pronountype* and *group* was found. L1 speakers were faster than L2 speakers in processing reflexive pronouns. L1 speakers were faster anyway in processing and reflexive pronouns were easier to process than personal pronouns. Again, it can be assumed that the limited perspective of reflexive pronouns compared to the broader discourse perspective of personal pronouns led to the differences between pronominal elements. This effect combined with the overall faster processing of L1 speakers resulted in an interaction of group and pronountype.

8.1.7.8 Comparison of self-paced reading and eyetracking

The analyses of the self-paced reading and eyetracking studies delivered differing results. First of all, the material that has been employed was the same. A difference consists in the way it was presented. In self-paced reading, the items were presented in segments on the screen and the participants had to press a button in order to be able to read the sentence. In eyetracking, the items as a whole were presented on the screen. Moreover, participants were not the same in both experiments. A last difference between the processing studies lies in the analyses that were carried out. The analyses for self-paced reading concentrated on the RTs of the pronominal element at the critical and the post-critical regions, whereas in eyetracking these analyses also were conducted and moreover the regressions to the antecedents and the total times of the antecedents were also analysed. This was not possible for self-paced reading, as this method only provides the RTs of the segment that is on the screen at this time. Hence regressions were not measured with self-paced reading. Generally, it can be said that

eyetracking provides more detailed information about how the participants have read the sentence. It should therefore not be surprising that the results between self-paced reading and eyetracking were different. The analyses of the self-paced reading study confirmed the hypothesis that L1 speakers processed reflexive pronouns in a co-argument structure faster than personal pronouns in a co-argument structure and pronominal elements in a PP. This contrast in processing could not be found for L2 speakers. The analyses of the eyetracking study did not replicate the finding of the self-paced reading study, neither at the critical and post-critical region, nor at the antecedents. This outcome might be surprising, as eyetracking is argued to be a more sensitive method than self-paced reading. The underlying idea to make use of eyetracking was that this method should be more sensitive than self-paced reading. A 300Hz eyetracker was used, which means that there were 300 measure points in a second. Thus, in self-paced reading the time (milliseconds) spend reading each segment has been stored, whereas the eyetracker made 300 stores per second. Thus, there is more data that can be analysed.

The outcomes of the analyses of the self-paced reading and eyetracking study were similar insofar as no effects of proficiency were found that revealed that highly proficient L2 speakers but not low proficiency L2 speakers processed reflexive pronouns in a co-argument structure differently from personal pronouns and pronominal elements in a PP. Both studies further did not show that German and Dutch interfered in the processing of personal pronouns in PPs. Finally, neither of the studies showed that L2 speakers took longer to process a reflexive pronoun in a co-argument structure that had only one grammatical matching antecedent compared to a reflexive pronoun in a co-argument structure that had two grammatical matching antecedents.

Thus, it needs to be answered why the eyetracking study did not provide more detailed information, especially with regard to the difference found in self-paced reading between reflexive pronouns in a co-argument structure compared to personal pronouns and pronominal elements in a PP. This question is difficult to answer and will not be answered as it is unclear what might have caused the missing effects in the eyetracking study. A possibility of the absence of effects in eyetracking could be that other information that the eyetracker provides should have been used for analyses. First fixations, first pass times, second pass times and total times as well as regressions have been analysed. Instead, other information like pupillary responses could have been more informative. The pupil reacts in such a way that it changes in size when information is processed. Research has shown that pupillary responses were a reliable measure in language processing (Vogelzang, Hendriks, & Van Rijn, subm.,

Granholm, Asarnow, Sarkin, & Dykes, 1996, Schluroff, Zimmermann, Freeman, Hofmeister, Lorscheid, & Weber, 1986; Kuchinke, Võ, Hofmann, & Jacobs, 2007).

8.2 Discussion part 2: Comprehension study

The scope of this research project lies in the processing of pronominal elements that can be processed by different processing strategies. Especially, the self-paced reading study has shown that when the application of a syntactic operation is possible, L1 speakers of Dutch will apply this operation. A third study had the purpose to investigate how pronominal elements were interpreted in picture NPs. Picture NPs (178, 179, 180) are syntactically different from co-argument structures (174) and PPs (175), as the pronominal element in picture NPs is contained in a complex DP. The similarity between the structures is that in picture NPs, both a syntactic and a discourse operation can be applied to process the pronominal element. Little research has been conducted that concentrated on the binding of reflexive and personal pronouns in picture NPs in English. Studies (e.g. Sturt, 2003; Runner et al. 2002, 2003, 2006) have shown that reflexive and personal pronouns could be bound by syntactically illegal antecedents as well. Thus, there is a distinction between theoretical description and empirical findings. For Dutch and German, empirical evidence is missing. As there is to this date no research on Dutch and German with regard to the binding of pronominal elements in picture NPs, this research seeks to investigate how pronominal elements were interpreted in both languages. Processing of pronominal elements in picture NPs will not be investigated, as first a clear picture needs to be gained that allows making predictions concerning their processing. This research aimed to know how reflexive and personal pronouns in sentences like (178), (179) and (180) were interpreted.

(178) s-PNP: Jan_i confirms that $Frank_j$ will probably publish a new book about $himself_{*i/j}/him_{i/*j}$

(179) p-PNP: Jan_i confirms that $Frank_j$'s new book about $himself_{*i/j}/him_{i/*j}$

(180) PNP: $Frank_i$ confirms that a new book about $himself_i/him_i$

Recall that according to Chomsky (1981), the reflexive pronoun should be bound in its governing category and the personal pronoun should be free of binding. The subordinated clause is the governing category in (178). The reflexive pronoun should be bound by *Frank* and the personal pronoun by *Jan*. In sentence (179), the subordinated clause again is the governing category. The reflexive pronoun should be bound by *Frank* and the personal pronoun by *Jan*. The governing category in (180) is the whole sentence. The reflexive

pronoun has to be bound by *Frank*, whereas the personal pronoun should not be bound by *Frank*. However, this is possible in English and therefore, this binding is a violation of Principle B (Chomsky, 1981).

The comprehension study tested the grammaticality of the items and also how the pronominal elements were interpreted. The grammaticality judgement task revealed for Dutch that pronominal elements in (178), (179) and (180) were acceptable in Dutch. This has also been found for German with the exception of reflexive pronouns in PNPs (180). Only 2 of 24 items were judged as acceptable. Notice that this has been predicted for German and Dutch. Lee-Schoenfeld (2008) argued that reflexive pronouns in German cannot be bound across a CP boundary which would be the case if the reflexive pronoun were bound by *Frank* in (180).

The attention remained on the interpretation of the pronominal elements in the three types of picture NPs (178-180). In German, the personal pronoun in s-PNPs (178), p-PNPs (179) and PNPs (149) was mostly interpreted as the non-local antecedent *Jan*. This is in accordance with Principle B (Chomsky, 1981). However, the personal pronoun in these structures has also been interpreted as the local antecedent *Frank* which is not predicted by Principle B (Chomsky, 1981). The reflexive pronoun in s-PNPs (178) and p-PNP (179) was interpreted as *Frank* that is in accordance with Principle A.

In Dutch, the non-local antecedent *Jan* was also as antecedent for the personal pronoun mainly in s-PNPs (178), p-PNPs (179) and PNPs (180). The local antecedent *Frank* was chosen as antecedent for the personal pronoun as well. The reflexive pronoun in s-PNPs (178), p-PNP (179) and PNPs (180) was interpreted as *Frank*, which is in accordance with Principle A.

Studies (e.g. Sturt, 2003; Runner et al. 2002, 2003, 2006) on English picture NPs have already shown that participants did not choose the antecedents exclusively as predicted by linguistic theory. Here, the comprehension of pronominal elements in German and Dutch resembles that of English. As a consequence, linguistic theory should not be considered as an absolute description of how pronominal elements behave. The behaviour of pronominal elements is subject to regional variation and diachronic changes. Linguistic theory should be considered as more or less as guidance of what pronominal binding could look like.[41] As the results have shown, linguistic theory quite well describes how reflexive pronouns should be bound, whereas the binding of personal pronouns shows more variation. The difference in binding domain between reflexive and personal pronouns for these structures could be explained in

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[41] Reuland (personal communication 2016) argued that „a serious binding theory should be able to capture cross-linguistic variation, including regional variation, or at least strive towards doing so, and provide the ingredients." In other words theories should be revised by considering the results of the comprehension study.

the way that reflexive pronouns need to be bound by the next available antecedent, which is also the antecedent favoured by Principle A (Chomsky, 1981). Personal pronouns in all three structures (178-180) take the local and non-local antecedent, which is only partially consistent with Principle B (Chomsky, 1981). It might be the case that discourse has a greater influence on the interpretation of personal pronouns than a syntactic constraint like Principle B, leading to an interpretation of the personal pronoun towards a syntactically illegal antecedent. Nothing can be said with regard to processing. Here, Principle B might be applied first and at later processing stages discourse might come into play. However, as this study has not investigated the processing of pronominal elements in picture NPs, this is speculative.

Especially the results of the personal pronouns were quite interesting cross-linguistically. Personal pronouns in PNPs (180) and s-PNPs (178) were interpreted non-locally as *Jan* in German, whereas in Dutch, the non-local *Jan* and the local *Frank* antecedents were chosen. Structural and non-structural factors guide interpretation in Dutch. The interpretation of personal pronouns in German picture NPs is more guided by structural constraints. However, there is a more intriguing question: What causes the difference between German and Dutch in the interpretation of personal pronouns? The same structures were tested. Moreover, an equal number of participants took part in both languages. The sentences were lexically not the same as direct translations were not possible. A cross-linguistic difference has already been discussed with regard to personal pronouns in a PP. In Dutch, the personal pronoun may be bound within the sentence by the subject *Jan*. As example (181) shows, that is not acceptable in German. It could be argued that personal pronouns in Dutch can be interpreted more freely than in German. German and Dutch differ with regard to locative PPs like (181) and Dutch is similar to English in this respect. The same holds for personal pronouns in picture NPs (178-180). Here, Dutch and German differ, but English and Dutch show the same coindexation. Hence, there is variation within Germanic languages.

(181) Jan_i legde de pen naast hem_i

"Jan put the pen next to him"

8.2.1 Implications for future research: What needs to be done?

The results of the self-paced reading and eyetracking studies were quite differently from each other. Especially the data of the eyetracking study were not really informative. Main effects were found in both self-paced reading and eyetracking, but interaction at the critical and post-critical regions in eyetracking or the regressions were missing. Eyetracking has been argued to be quite informative or even more informative than the data of the self-paced reading study,

as the measures in eyetracking were thought to be more fine-grained. The differences between the self-paced reading and eyetracking study with regard to the results could be explained by the hugh variation in the eyetracking data which could have led to the absence of more significant effects. Other research analyses pupillary responses instead of first fixations and total times and so forth. It has been argued that pupillary responses were reliable. Hence, a next step could be to analyse the pupillary responses that were also provided by the eyetracker.

Furthermore, it would be interesting to gather more information about how well the participants understood the pronominal element. The comprehension questions of the self-paced reading and eyetracking studies did not examine the interpretation of the pronominal elements, but of the sentences as a whole. This study has provided information about how pronominal elements were processed in L1 and L2 speakers in a co-argument structure and PP. Nevertheless, it would also be interesting to know if comprehension differs from processing. Remember that L1 speakers have been shown to make use of a syntactic operation in the processing of reflexive pronouns in a co-argument structure. This means that a syntactic chain has been established between the reflexive pronoun and the syntactic antecedent. What this research does not tell us is, if the syntactic antecedent would also have been chosen for interpretation. This research thus cannot tell anything about what happens at later processing stages. Does discourse overrule a syntactic operation in the interpretation process?

The comprehension study was a first attempt to get an impression of how reflexive and personal pronouns were interpreted in picture NPs. The interpretation of pronominal elements does not tell anything about the underlying processing. However, it is now clear that structural and non-structural factors influence processing for both reflexive and personal pronouns. Furthermore, cross-linguistic differences have been observed. Having this in mind facilitates the make-up of a processing study and its interpretation as well. Processing will probably also be guided by structural and non-structural strategies in both reflexive and personal pronouns.

9 Conclusion

This research project had the aim to investigate how pronominal elements were processed in a co-argument structure and PP in L1 and L2 speakers and furthermore, how these pronominal elements were interpreted in German and Dutch picture NPs. The methods that were applied were self-paced reading, eyetracking and a questionnaire. It has been shown for self-paced reading that reflexive pronouns in a co-argument structure like (182) were processed by a syntactic operation in L1 speakers, whereas personal pronouns in a co-argument structure and pronominal elements in a PP like (183) were processed by a discourse operation in L1 speakers. Self-paced reading displayed that L2 speakers always applied a discourse operation for the processing of pronominal elements in a co-argument structure and PP. Even highly proficient L2 speakers have been shown to apply a discourse operation in the self-paced reading study.

> (182)   Jan painted himself
>
> (183)   Jan put the pen next to himself/him

The difference in the processing of pronominal elements in L1 speakers shows that their processing depends on the structure in which they appear. It further demonstrates that L2 speakers were different from L1 speakers and that even a high proficiency does not result in L1-like processing of pronominal elements.

The self-paced reading and eyetracking study moreover showed that the L1 German did not interfer with the L2 Dutch in the processing of personal pronouns in a PP. Both processing studies further did not reveal that reflexive pronouns in a co-argument structure were processed slower when only one of two antecedents grammatically matched the features of the reflexive pronoun.

The comprehension study showed that binding of pronominal elements is not exclusively restricted to syntactic factors. The interpretation of reflexive and personal pronouns depends on structural and non-structural factors. Moreover, German and Dutch were different especially in the interpretation of personal pronouns in picture NPs. German and Dutch show cross-linguistic differences with respect to the interpretation of personal pronouns. German and Dutch differed, as Dutch allows syntactically illegal antecedents to bind the personal pronoun, which has not been found for German. Dutch seems to be more like English with regard to the interpretation of pronominal elements in picture NPs and both languages differ from German.

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11 Appendix

Appendix 1

Table 16: averaged first fixation times (ms) per structure and region on interest

L2	mean	sd	skew	kurtosis
Antecedent 1				
CO P	2899.65	2458.36	1.33	3.15
CO R	2879.23	2210.79	0.84	1.03
CO A	3085.82	2635.25	1.4	3.07
PP P	3101.48	2650.69	1.48	5.89
PP R	3051.7	2674.52	2.02	10.96
Antecedent 2				
CO P	2738.31	2577.14	1.59	4.48
CO R	2698.79	2393.39	1.31	2.55
CO A	2664.18	2208.55	0.96	1.22
PP P	3059.29	2801.71	1.54	4.19
PP R	2902.36	2803.21	1.92	6.63
Repetition Antecedent 1				
CO P	2854.73	2204.27	1.62	4.82
CO R	2900.16	2102.79	1.53	6.27
CO A	2848.02	2059.42	0.9	1.35
PP P	3193.46	2506.3	1.74	4.7
PP R	2913.63	2177.71	1.43	4.53
Pre-critical region				
CO P	2074.07	1706.09	1.09	2.2
CO R	2002.14	1707.84	1.08	1.77
CO A	1987.97	1878.46	2.1	11.29
PP P	2719.67	2201.45	1.19	1.97
PP R	2767.53	2311.41	1.37	3.15
Critical region				
CO P	4635.08	4626.08	2.34	10.97
CO R	4396.32	4101.16	1.85	6.96
CO A	4425.71	4209.68	1.24	2.04
PP P	3990.77	3221.27	0.89	0.9
PP R	3978.52	3302.22	0.97	1.55

Post-critical region				
CO P	2291.67	2372.3	1.17	1.35
CO R	2243.74	2459.32	1.39	2.29
CO A	2331.37	2644.47	1.95	7.97
PP P	2865.49	3586.35	2.56	10.55
PP R	2714.07	3002.25	1.77	4.92

• CO P=co-argument structure with a personal pronoun, CO R=co-argument structure with a reflexive pronoun, CO A=co-argument structure with a reflexive pronoun, PP P=PP structure with a personal pronoun, PP R=PP structure with a reflexive pronoun

• The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.

• Antecedent 1: hairdresser, antecedent 2: visagist, repetition of antecedent 1: hairdresser, pre-critical region: shaved, critical region: himself so that, post-critical region: the new aftershave

Table 17: averaged first pass times (ms) per structure and region on interest

L2	mean	sd	skew	kurtosis
Antecedent 1				
CO P	3465.85	2871.44	1.35	3.48
CO R	3637.69	3186.19	1.95	6.95
CO A	3582.03	3029.75	1.49	3.42
PP P	3734.84	3364.8	2.2	10.12
PP R	3651.98	3257.61	1.84	6.5
Antecedent 2				
CO P	3470.09	3321.46	1.74	4.41
CO R	3298.96	2923.1	1.48	4.01
CO A	3520.99	2855.29	1.32	4.19
PP P	3761.7	3414.57	2.24	12.76
PP R	3693.02	3430.94	1.61	4.28
Repetition Antecedent 1				
CO P	3621.25	2807.97	1.47	3.07
CO R	3575.16	2625.54	1.72	5.25
CO A	3633.85	2757.68	1.68	6.17
PP P	3871.48	3023.61	1.7	3.76
PP R	3616.1	2823.96	1.67	4.5
Pre-critical region				

CO P	2209.54	1816.05	1.17	2.53
CO R	2082.03	1746.15	0.99	1.39
CO A	2106.92	1950.89	1.89	9.23
PP P	2914.78	2303.62	1.13	1.7
PP R	2937.25	2415.8	1.33	2.81
Critical region				
CO P	5217.47	5092.27	2.19	8.79
CO R	4981.15	4544.47	1.59	4.49
CO A	4859.51	4528.62	1.22	2.18
PP P	4312.91	3417.29	1.03	2.24
PP R	4193.79	3445.47	0.89	1.03
Post-critical region				
CO P	2569.32	2780.6	1.6	3.8
CO R	2411.37	2681.46	1.49	2.85
CO A	2511.98	2817.27	1.8	6.16
PP P	3032.31	3782.95	2.51	9.67
PP R	3012.53	3334.73	1.71	3.91

• CO P=co-argument structure with a personal pronoun, CO R=co-argument structure with a reflexive pronoun, CO A=co-argument structure with a reflexive pronoun, PP P=PP structure with a personal pronoun, PP R=PP structure with a reflexive pronoun

• The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.

• Antecedent 1: hairdresser, antecedent 2: visagist, repetition of antecedent 1: hairdresser, pre-critical region: shaved, critical region: himself so that, post-critical region: the new aftershave

Table 18: averaged second times (ms) per structure and region on interest

L2	mean	sd	skew	kurtosis
Antecedent 1				
CO P	515.39	1378.14	3.56	14.85
CO R	568.96	1749.69	6.37	59.49
CO A	560.22	1333	3.32	15.72
PP P	384.62	1006.45	3.09	9.87
PP R	457.86	1149.35	3.24	13.28
Antecedent 2				

CO P	811.27	1875.68	3.07	11.21
CO R	860.71	1848.86	2.37	5.73
CO A	817.2	1844.06	2.8	8.97
PP P	801.59	2089.28	3.6	16.13
PP R	761.26	1793.15	3.26	14.27
Repetition Antecedent 1				
CO P	463.16	1171.91	2.93	8.95
CO R	507.25	1421.11	4.66	32.16
CO A	537.09	1409.29	3.59	15.64
PP P	498.74	1319.41	3.57	15.36
PP R	467.31	1364.87	3.87	17.52
Pre-critical region				
CO P	316.35	915.7	3.6	14.33
CO R	246.1	774.29	4.01	19.61
CO A	305.66	1129.96	8.69	116.12
PP P	533.63	1279.96	3.38	14.25
PP R	463.19	1464.55	6.34	60.38
Critical region				
CO P	2132.37	3407.83	2.33	7.76
CO R	1503.74	2702.8	2.29	5.62
CO A	1691.48	3058.1	2.53	8.19
PP P	1460.27	2506.18	2.17	5.65
PP R	1194.78	2202.58	2.41	6.42
Post-critical region				
CO P	342.61	1183.28	4.73	28.01
CO R	303.24	1387.15	7.07	64.14
CO A	382.75	1584.09	7.13	67.51
PP P	520.99	1746.17	4.92	29.9
PP R	479.84	1643.56	4.51	23.08

• CO P=co-argument structure with a personal pronoun, CO R=co-argument structure with a reflexive pronoun, CO A=co-argument structure with a reflexive pronoun, PP P=PP structure with a personal pronoun, PP R=PP structure with a reflexive pronoun

• The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.

• Antecedent 1: hairdresser, antecedent 2: visagist, repetition of antecedent 1: hairdresser, pre-critical region: shaved, critical region: himself so that, post-critical region: the new aftershave

Table 19: averaged first fixation times (ms) per structure and region on interest

L1	mean	sd	skew	kurtosis
Antecedent 1				
CO P	2501.49	1790.55	2.13	11.53
CO R	2450.67	1644.33	1.5	6.41
CO A	2598.71	2179.51	5.02	49.01
PP P	2740.54	2111.53	2.46	12.84
PP R	2699.15	1836.17	1.44	3.85
Antecedent 2				
CO P	2368.7	1533.45	1.16	3.05
CO R	2357.81	1423.22	1.01	2.64
CO A	2473.84	1477.88	1.86	13.18
PP P	2453.17	1557.05	1.16	2.34
PP R	2457.59	1496.22	0.97	1.98
Repetition Antecedent 1				
CO P	2045.86	1501.34	1.85	7.81
CO R	2038.93	1622.6	1.97	7.95
CO A	2062.19	1484.67	1.76	8.4
PP P	2052.01	1571.79	1.9	9.4
PP R	1966.59	1399.97	1.04	2.82
Pre-critical region				
CO P	1217.12	1224.18	0.79	0.12
CO R	1239.55	1194.36	0.62	-0.16
CO A	1250.13	1271.45	0.87	0.48
PP P	1657.23	1410.44	0.95	1.92
PP R	1671.77	1478.29	1.25	4.04
Critical region				
CO P	3548.18	2876.86	1.16	3.18
CO R	3308.66	2514.9	0.66	0.2
CO A	3410.49	2793.34	1.31	4

PP P	3305.58	2450.89	0.9	1.42
PP R	2994.99	2274.22	0.61	0
Post-critical region				
CO P	1935.42	1986	1.5	3.46
CO R	1876.16	1737.37	1.05	1.38
CO A	1847.54	1896.83	2.25	11.14
PP P	2117.86	2090.63	1.68	5.48
PP R	2132.68	2038.75	1.66	5.45

• CO P=co-argument structure with a personal pronoun, CO R=co-argument structure with a reflexive pronoun, CO A=co-argument structure with a reflexive pronoun, PP P=PP structure with a personal pronoun, PP R=PP structure with a reflexive pronoun

• The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.

• Antecedent 1: hairdresser, antecedent 2: visagist, repetition of antecedent 1: hairdresser, pre-critical region: shaved, critical region: himself so that, post-critical region: the new aftershave

Table 20: averaged first pass times (ms) per structure and region on interest

L1	mean	sd	skew	kurtosis
Antecedent 1				
CO P	2768.05	2118.05	2.06	8.04
CO R	2689.6	1943.82	1.65	5.14
CO A	2835.04	2427.4	4.43	37.68
PP P	2983.48	2577.51	3.58	26.54
PP R	2888.76	2190.53	2.82	18.33
Antecedent 2				
CO P	2726.11	2019.28	1.89	6.44
CO R	2672.46	1743.89	1.41	3.93
CO A	2848.66	1866.96	1.82	7.94
PP P	2866.92	2005.23	1.52	3.48
PP R	2860.55	1939.59	1.66	5.84
Repetition Antecedent 1				
CO P	2467.11	2038.29	2.29	8.99
CO R	2307.46	1836.22	2.01	8.6
CO A	2472.19	1926.8	2.05	8.36

PP P	2454.96	1965.73	1.67	5.41
PP R	2270.03	1659.74	1.2	3.21
Pre-critical region				
CO P	1259.51	1278.78	0.84	0.25
CO R	1264.24	1211.23	0.61	-0.2
CO A	1297.95	1337.31	1.06	1.51
PP P	1738.53	1512.63	1.14	2.54
PP R	1735.62	1512.52	1.17	3.52
Critical region				
CO P	3753	2968.67	1.08	2.74
CO R	3507.28	2632.76	0.66	0.29
CO A	3586.52	2924.15	1.29	3.56
PP P	3463.57	2514.62	0.81	1.1
PP R	3155.5	2371.61	0.63	0.17
Post-critical region				
CO P	2136.26	2356.16	2.53	14.32
CO R	1998.84	1889.15	1.07	1.17
CO A	2083.84	2324.92	2.56	12.71
PP P	2304.55	2267.43	1.6	4.62
PP P	2251.39	2140.55	1.56	4.59

• CO P=co-argument structure with a personal pronoun, CO R=co-argument structure with a reflexive pronoun, CO A=co-argument structure with a reflexive pronoun, PP P=PP structure with a personal pronoun, PP R=PP structure with a reflexive pronoun

• The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.

• Antecedent 1: hairdresser, antecedent 2: visagist, repetition of antecedent 1: hairdresser, pre-critical region: shaved, critical region: himself so that, post-critical region: the new aftershave

Table 21: averaged second pass times (ms) per structure and region on interest

L1	mean	sd	skew	kurtosis
Antecedent 1				
CO P	624.46	1338.79	3.93	23.84
CO R	570.67	1213.22	2.96	13.15
CO A	560.09	1488.57	6.5	70.45

PP P	691.74	1326.37	2.74	13.13
PP R	702.16	1298.38	2.26	6.12
Antecedent 2				
CO P	1026.17	1666.02	1.9	3.75
CO R	851.25	1529.26	2.21	5.84
CO A	847.72	1547.75	2.17	5.35
PP P	951.34	1646.34	1.97	3.91
PP R	963.89	1712.98	2.39	7.41
Repetition Antecedent 1				
CO P	569.28	1270.12	2.92	10.81
CO R	516.83	1176.25	2.8	9.66
CO A	480.85	1208.86	4.18	26.8
PP P	560.71	1299.12	3.68	20.39
PP R	598.75	1329.73	2.67	7.82
Pre-critical region				
CO P	168.96	579.94	4.2	20.88
CO R	153.3	515.46	3.72	14.08
CO A	172.9	613.98	4.14	18.29
PP P	296.7	809.09	3.3	12.3
PP R	339.08	948.21	4.1	21.81
Critical region				
CO P	1622.5	2534.13	2.19	5.66
CO R	1192.86	1991.99	2.19	5.79
CO A	1288.12	2181.23	3.13	20.37
PP P	1168.66	1964.62	2.23	5.84
PP R	1006.1	1698.55	1.93	3.75
Post-critical region				
CO P	451.39	1221.05	3.63	15.95
CO R	276.52	911.02	4.09	19.09
CO A	314.15	1130.66	5.18	34.54
PP P	485.45	1391.71	4.56	30.97
PP R	503.03	1804.13	6.63	59.92

• CO P=co-argument structure with a personal pronoun, CO R=co-argument structure with a reflexive pronoun, CO A=co-argument structure with a reflexive pronoun, PP P=PP structure with a personal pronoun, PP R=PP structure with a reflexive pronoun

• The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.

• Antecedent 1: hairdresser, antecedent 2: visagist, repetition of antecedent 1: hairdresser, pre-critical region: shaved, critical region: himself so that, post-critical region: the new aftershave

Table 22: Syntax versus discouse

	Estimate	Std..Error	t.value	p
critical region – first fixation times				
(Intercept)	4.861	0.047	103.26	<0.001
cond_neu_PronountypeR	-0.019	0.027	-0.708	>0.05
cond_neu_COARGPP	-0.053	0.027	-1.946	>0.05
GroupGerman	0.220	0.063	3.518	<0.001
post-critical region – first fixation				
(Intercept)	4.064	0.089	45.6125	<0.001
cond_neu_PronountypeR	0.031	0.060	0.510	>0.05
cond_neu_COARGPP	0.0762	0.060	1.265	>0.05
GroupGerman	0.186	0.113	1.642	>0.05
critical region – first pass times				
(Intercept)	4.928	0.046	107.307	<0.001
cond_neu_PronountypeR	-0.015	0.029	-0.528	>0.05
cond_neu_COARGPP	-0.085	0.029	-2.948	<0.005
GroupGerman	0.266	0.059	4.481	<0.001
post-critical region – first pass times				
(Intercept)	4.144	0.086	47.999	<0.001
cond_neu_PronountypeR	0.012	0.064	0.181	>0.05
cond_neu_COARGPP	0.081	0.064	1.268	>0.05
GroupGerman	0.210	0.104	2.010	<0.05
critical region – second pass times				
(Intercept)	4.936	0.057	86.910	<0.001
cond_neu_PronountypeR	-0.133	0.051	-2.625	>0.05
cond_neu_COARGPP	-0.085	0.050	-1.688	>0.05

GroupGerman	0.156	0.073	2.153	<0.05
post-critical region – second pass times				
(Intercept)	4.059	0.104	38.858	<0.001
cond_neu_PronountypeR	-0.001	0.083	-0.014	>0.05
cond_neu_COARGPP	0.142	0.082	1.735	>0.05
GroupGerman	0.151	0.138	1.098	>0.05

• cond_neu_PronountypeR=reflexive pronoun, cond_neu_COARGPP=PP structure, GroupGerman=L2 speakers

• The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.

• critical region: himself so that, post-critical region: the new aftershave

Table 23: Proficiency

	Estimate	Std..Error	t.value	p
critical region – first fixation times				
(Intercept)	4.864	0.049	100.107	<0.001
cond_neu_PronountypeR	-0.019	0.028	-0.670	>0.05
cond_neu_COARGPP	-0.059	0.028	-2.100	<0.05
LevelL2high	0.142	0.081	1.763	>0.05
LevelL2low	0.286	0.088	3.241	<0.005
post-critical region – first fixation times				
(Intercept)	4.064	0.088	46.079	<0.001
cond_neu_PronountypeR	0.030	0.060	0.499	>0.05
cond_neu_COARGPP	0.077	0.060	1.277	>0.05
LevelL2high	0.064	0.135	0.476	>0.05
LevelL2low	0.343	0.148	2.323	>0.05
critical region – first pass times				
(Intercept)	4.932	0.047	104.547	<0.001
cond_neu_PronountypeR	-0.022	0.030	-0.744	>0.05
cond_neu_COARGPP	-0.083	0.030	-2.770	<0.01
LevelL2high	0.186	0.076	2.453	<0.05
LevelL2low	0.325	0.083	3.911	<0.001
post-critical region – first pass times				
(Intercept)	4.144	0.085	48.554	<0.001
cond_neu_PronountypeR	0.012	0.064	0.183	>0.05

	Estimate	Std..Error	t.value	p
cond_neu_COARGPP	0.081	0.064	1.266	>0.05
LevelL2high	0.090	0.123	0.727	>0.05
LevelL2low	0.364	0.135	2.697	<0.01
critical region – second pass times				
(Intercept)	4.934	0.056	88.462	<0.001
cond_neu_PronountypeR	-0.129	0.050	-2.560	<0.05
cond_neu_COARGPP	-0.082	0.050	-1.652	>0.05
LevelL2high	0.0617	0.085	0.728	>0.05
LevelL2low	0.288	0.095	3.039	0.0024
post-critical region- second pass times				
(Intercept)	4.056	0.106	38.357	<0.001
cond_neu_PronountypeR	-0.002	0.083	-0.020	>0.05
cond_neu_COARGPP	0.143	0.083	1.744	>0.05
LevelL2high	0.159	0.166	0.954	>0.05
LevelL2low	0.139	0.194	0.717	>0.05

• cond_neu_PronountypeR=reflexive pronoun, cond_neu_COARGPP=PP structure, LevelL2high= highly proficient L2 speakers, LevelL2low= low proficiency L2 speakers

• The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.

• critical region: himself so that, post-critical region: the new aftershave

Table 24: Interference

	Estimate	Std..Error	t.value	p
critical region – first fixation times				
(Intercept)	4.830	0.048	101.649	<0.001
cond_neu_PronountypeR	-0.021	0.039	-0.528	>0.05
GroupGerman	0.190	0.064	2.965	<0.005
post-critical region – first fixation times				
(Intercept)	4.147	0.092	45.161	<0.001
cond_neu_PronountypeR	0.056	0.087	0.649	>0.05
GroupGerman	0.178	0.111	1.605	>0.05
critical region – first pass times				
(Intercept)	4.886	0.046	105.105	<0.001
cond_neu_PronountypeR	-0.035	0.037	-0.950	>0.05

GroupGerman	0.203	0.064	3.190	>0.05
post-critical region – first pass times				
(Intercept)	4.206	0.092	45.870	<0.001
cond_neu_PronountypeR	0.044	0.091	0.481	>0.05
GroupGerman	0.226	0.106	2.137	<0.05
critical region – second pass times				
(Intercept)	4.879	0.068	71.346	<0.001
cond_neu_PronountypeR	-0.176	0.077	-2.286	<0.05
GroupGerman	0.151	0.088	1.716	>0.05
post-critical region – second pass times				
(Intercept)	4.184	0.126	33.112	<0.001
cond_neu_PronountypeR	-0.003	0.130	-0.023	>0.05
GroupGerman	0.133	0.165	0.806	>0.05

• cond_neu_PronountypeR=reflexive pronoun, GroupGerman=L2 speakers

• The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.

• critical region: himself so that, post-critical region: the new aftershave

Table 25: Interference and proficiency

	Estimate	Std..Error	t.value	p
critical region – first fixation times				
(Intercept)	4.831	0.047	102.217	<0.001
cond_neu_PronountypeR	-0.021	0.039	-0.544	>0.05
LevelL2high	0.137	0.077	1.784	>0.05
LevelL2low	0.256	0.084	3.052	<0.005
post-critical region – first fixation times				
(Intercept)	4.133	0.093	44.603	<0.001
cond_neu_PronountypeR	0.084	0.094	0.902	>0.05
LevelL2high	0.005	0.144	0.032	>0.05
LevelL2low	0.468	0.155	3.016	<0.005
cond_neu_PronountypeR:LevelL2high	0.082	0.110	0.744	>0.05
cond_neu_PronountypeR:LevelL2low	-0.249	0.116	-2.145	<0.05
critical region – first pass times				
(Intercept)	4.885	0.046	105.551	<0.001

cond_neu_PronountypeR	-0.035	0.037	-0.946	>0.05
LevelL2high	0.154	0.076	2.015	<0.05
LevelL2low	0.266	0.084	3.182	<0.005
post-critical region – first pass times				
(Intercept)	4.205	0.091	46.082	<0.001
cond_neu_PronountypeR	0.044	0.091	0.486	>0.05
LevelL2high	0.122	0.127	0.967	>0.05
LevelL2low	0.358	0.138	2.587	<0.01
critical region – second pass times				
(Intercept)	4.879	0.069	70.474	<0.001
cond_neu_PronountypeR	-0.177	0.078	-2.282	<0.05
LevelL2high	0.165	0.104	1.592	>0.05
LevelL2low	0.127	0.124	1.023	>0.05
post-critical region – second pass times				
(Intercept)	4.172	0.129	32.514	<0.001
cond_neu_PronountypeR	0.005	0.130	0.035	>0.05
LevelL2high	0.268	0.203	1.320	>0.05
LevelL2low	-0.056	0.231	-0.244	>0.05

• cond_neu_PronountypeR=reflexive pronoun, LevelL2high=highly proficient L2 speakers, LevelL2low=low proficiency L2 speakers

• The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.

• critical region: himself so that, post-critical region: the new aftershave

Table 26: Accessible antecedent

	Estimate	Std..Error	t.value	p
critical region – first fixation times				
(Intercept)	4.841	0.050	96.822	<0.001
cond_neu_Asingle	0.033	0.035	0.953	>0.05
GroupGerman	0.227	0.072	3.159	<0.005
post-critical region – first fixation times				
(Intercept)	4.104	0.084	48.742	<0.001
cond_neu_Asingle	0.014	0.076	0.188	>0.05
GroupGerman	0.157	0.105	1.489	>0.05

critical region first pass times				
(Intercept)	4.893	0.051	96.248	<0.001
cond_neu_Asingle	0.018	0.040	0.443	>0.05
GroupGerman	0.282	0.070	4.041	<0.001
post-critical region – first pass times				
(Intercept)	4.160	0.090	46.329	<0.001
cond_neu_Asingle	0.052	0.087	0.602	>0.05
GroupGerman	0.147	0.107	1.373	>0.05
critical region – second pass times				
(Intercept)	4.788	0.071	67.885	<0.001
cond_neu_Asingle	0.061	0.075	0.825	>0.05
GroupGerman	0.246	0.088	2.793	<0.01
post-critical region – second pass times				
(Intercept)	4.153	0.110	37.845	<0.001
cond_neu_Asingle	0.020	0.131	0.152	>0.05
GroupGerman	0.199	0.135	1.475	>0.05

• cond_neu_Asingle=CO R (reflexive pronoun in a co-argument structure with one accessible antecedent), GroupGerman=L2 speakers

• The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.

• critical region: himself so that, post-critical region: the new aftershave

Table 27: Accessible antecedent and proficiency

	Estimate	Std..Error	t.value	p
critical region – first fixation times				
(Intercept)	4.842	0.048	101.350	<0.001
cond_neu_Asingle	0.032	0.034	0.940	>0.05
LevelL2high	0.112	0.082	1.362	>0.05
LevelL2low	0.371	0.090	4.135	<0.001
post-critical region – first fixation times				
(Intercept)	4.106	0.083	49.549	<0.001
cond_neu_Asingle	0.0113	0.076	0.149	>0.05
LevelL2high	0.045	0.125	0.364	>0.05
LevelL2low	0.308	0.136	2.265	<0.05

critical region – first pass times				
(Intercept)	4.896	0.048	101.631	<0.001
cond_neu_Asingle	0.018	0.040	0.442	>0.05
LevelL2high	0.156	0.079	1.979	<0.05
LevelL2low	0.438	0.086	5.117	<0.001
post-critical region – first pass times				
(Intercept)	4.160	0.089	46.834	<0.001
cond_neu_Asingle	0.049	0.087	0.567	>0.05
LevelL2high	0.024	0.127	0.194	>0.05
LevelL2low	0.305	0.138	2.206	<0.05
critical region – second pass times				
(Intercept)	4.785	0.069	69.837	<0.001
cond_neu_Asingle	0.068	0.074	0.912	>0.05
LevelL2high	0.160	0.095	1.683	>0.05
LevelL2high	0.432	0.124	3.472	<0.001
post-critical region – second pass times				
(Intercept)	4.169	0.112	37.205	<0.001
cond_neu_Asingle	-0.018	0.135	-0.130	>0.05
LevelL2high	0.174	0.153	1.134	>0.05
LevelL2low	0.321	0.208	1.543	>0.05

• cond_neu_Asingle=CO R (reflexive pronoun in a co-argument structure with one accessible antecedent), LevelL2high=highly proficient L2 speakers, LevelL2low=low proficiency L2 speakers

• The hairdresser and the visagist were working at the hairdresser's. The hairdresser who liked to try things shaved himself so that the new aftershave could be tested.

• critical region: himself so that, post-critical region: the new aftershave

13 Deutsche Zusammenfassung

13.1 Hintergrund

Reflexiv- und Personalpronomen können verwandt werden, um auf eine Person im Diskurs zu verweisen. Die Pronomen müssen für das Verständnis interpretiert werden. Reflexiv- und Personalpronomen haben mitunter unterschiedliche Antezedenten. Zum Beispiel, in dem Satz, *De kapper en de visagist werkten in de kapsalon. De kapper die graag dingen uitprobeerde schoor zich/hem zodat de nieuwe aftershave kon worden uitgeprobeerd* (Der Friseur und der Visagist arbeiteten im Friseursalon. Der Friseur, der gern Neues ausprobierte, rasierte sich/ihn, damit er das neue Aftershave ausprobieren konnte) bezieht sich das Personalpronomen *hem* auf *de visagist* oder eine Person, die nicht genannt wurde. Dahingegen muss sich das Reflexivpronomen auf *de kapper* beziehen.

Die Verweisung von Reflexiv- und Personalpronomen ist im Niederländischen auch an die Struktur gekoppelt, in der das Pronomen erscheint. Die syntaktische Umgebung beeinflusst auch die Interpretation. Befindet sich das Pronomen in einer Ko-Argument-Beziehung mit dem Antezedenten wie in dem Satz *De kapper die graag dingen uitprobeerde schoor zich/hem*, sind das Pronomen und der Antezedent *de kapper* Argumente desselben Predikates *uitproberen*. Hier verweisen Reflexiv- und Personalpronomen auf unterschiedliche Antezedenten (Reinhart und Reuland, 1993).

Jedoch können sich Pronomen in anderen Strukturen, wie in unter anderem PPs, auf denselben Antezedenten im Niederländischen beziehen. Reflexiv- und Personalpronomen in einem Satz wie *De kapper en de visagist werkten in de kapsalon. De kapper verschoof een grote kapperstoel naast zich/hem zodat er beter kon worden gewerkt* (Der Friseur und der Visagist arbeiteten im Friseursalon. Der Friseur verschob einen Stuhl neben sich/ihn, damit besser gearbeitet werden konnte) dürfen sich auf den Antezedenten *de kapper* beziehen. Das Pronomen in einem PP geht keine Ko-Argument-Beziehung mit dem Antezedenten *de kapper* ein, da das Pronomen ein Argument der Präposition ist und die präpositionale Phrase – die das Pronomen beinhaltet – ist ein Argument des Predikates *verschuiven*. Der Antezedent *de kapper* ist ein Argument des Prädikates *verschuiven*. Somit sind der Antezedent und das Pronomen keine Ko-Argumente (Reinhart und Reuland, 1993).

Bezüglich der Verarbeitung von Reflexiv- und Personalpronomen schlägt Reuland (2011) vor, dass Reflexivpronomen in einer Ko-Argument-Beziehung mit Hilfe einer syntaktischen Operation verarbeitet werden können, während hingegen für die Verarbeitung von Personalpronomen auf eine Diskursoperation zurückgegriffen werden muss. Pronomen in einem PP – einer Nicht-Ko-Argument-Beziehung – müssen immer mit einer Diskursoperation

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verarbeitet werden. Das bedeutet, dass Reflexivpronomen in einem Satz wie *De kapper die graag dingen uitprobeerde schoor zich/hem* mit einer syntaktischen Operation und Personalpronomen mit einer Diskursoperation verarbeitet werden können. Pronomen in einem PP wie in *De kapper verschoof een grote kapperstoel naast zich/hem* können nur durch eine Diskursoperation verarbeitet werden.

Studien, die die Verarbeitung von Pronomen untersucht haben, zeigten, dass Muttersprachler Reflexivpronomen schneller verarbeiteten als Personalpronomen (Nicol and Swinney, 1989; Hendriks, Banga, van Rij and Cannizzaro, 2011). Auf dieser Grundlage wurde angenommen, dass unterschiedliche Operationen für die Verarbeitung von Reflexiv- und Personalpronomen eingesetzt wurden. Darüberhinaus haben Untersuchungen fürs Niederländische dargelegt, dass Reflexivpronomen in einer Ko-Argument-Beziehung schneller verarbeitet wurden als in einer PP (Burkhardt, 2005; Schumacher, Piñango, Ruigendijk and Avrutin, 2010). Die Autoren schlussfolgerten, dass Reflexivpronomen in einer Ko-Argument-Beziehung und einer PP mit verschiedenen Operationen verarbeitet wurden.

Ferner ist die Untersuchung der Pronomen bei Zweitspracherwerbern interessant, da die Verarbeitung in einer Zweitsprache anders ist als in der Muttersprache. Erwachsenen Zweitspracherwerbern ist es nicht möglich, auf syntaktische Operationen zurückzugreifen, wie es Muttersprachler machen (Ullman, 2001). Das hat zur Folge, dass Zweitspracherwerber grundsätzlich auf Diskursoperationen in der Verarbeitung der Pronomen zurückgreifen sollten. Untersuchungen belegten, dass Zweitspracherwerber Reflexivpronomen wie Personalpronomen verarbeiten (Demirci, 2000; Felser, Sato und Bertenshaw, 2009).

Zudem könnte die Verarbeitung in einer Zweitsprache erschwert werden, wenn die Muttersprache und die Zweitsprache sprachübergreifende Unterschiede aufweisen. Zum Beispiel, Personalpronomen in einem PP in einem deutschen Satz wie *Der Friseur verschob einen Stuhl neben ihn* können nicht als *der Friseur* interpretiert werden, was jedoch im Niederländischen möglich ist. Folglich können Unterschiede zwischen der Muttersprache und der Zweitsprache zu Interferenzen führen. Effekte, die durch Interferenzen verursacht wurden, belegte die Studie von Sabourin (2003). Sie fand, dass deutsche Zweitspracherwerber das grammatische Genussystem des Deutschen ins Niederländische transferierten. Dieses führte zu Fehlern in Fällen, in denen das Niederländische und Deutsche keine Übereinstimmung besaßen.

Weiterhin untersuchte dieses Forschungsprojekt, wie Pronomen in picture NPs interpretiert wurden. Ähnlich wie Pronomen in Ko-Argument-Strukturen und PPs, besteht in Sätzen wie

Jan saw that Mike's picture of him/himself has been published eine Ko-Argument-Beziehung zwischen dem Possessor *Mike* und dem Pronomen (Reinhart und Reuland, 1993). Andere Forscher bezweifeln, das der Possessor ein Argument des picture NPs ist (Sturt, 2003; Keller und Asudeh, 2001). Untersuchungen fürs Englische zumindest zeigten, dass Reflexiv- und Personalpronomen als *Mike* und *Jan* interpretiert wurden (Sturt, 2003). Somit beziehen sich Reflexiv-und Personalpronomen in picture NPs mitunter auf die gleichen Antezedenten.

Weitere Einblicke in das Verhalten von Pronomen in picture NPs lieferte dieses Forschungsprojekt für das Deutsche und Niederländische. Die Verarbeitung der Pronomen in picture NPs wurde für diese beiden Sprachen bisher wenig untersucht (Kiss, 2012, Lee-Schoenfeldt, 2008). Deshalb zeigte diese Untersuchung wie Pronomen in Deutsch und Niederländisch interpretiert wurden. Darauf basierend können erste Schlüsse über den Status der Pronomen in picture NPs gezogen werden.

13.2 Fragestellungen

Welche Operationen wenden Zweitspracherwerber des Niederländischen für die Verarbeitung der Reflexiv- und Personalpronomen an?

Verarbeiten Zweitspracherwerber Pronomen anders als Muttersprachler?

Sind Zweitspracherwerber in der Verarbeitung von Personalpronomen in PPs durch die Muttersprache Deutsch beeinflusst?

Wie interpretieren Muttersprachler des Deutschen und Niederländischen Pronomen in picture NPs und bestehen Unterschiede zwischen dem Deutschen und Niederländischen in der Interpretation?

13.3 Ergebnisse

Die eingesetzten Methoden waren *Self-paced reading*, *eyetracking* und ein Fragebogen. Die Ergebnisse der Self-paced reading Studie ergaben, dass Muttersprachler des Niederländischen Reflexivpronomen in einer Ko-Argumentstruktur wie *De kapper die graag dingen uitprobeerde schoor zich/hem* mithilfe einer syntaktischen Operation verarbeiteten, während Pronomen in einer PP-struktur wie *De kapper verschoof een grote kapperstoel naast zich/hem* mit einer Diskursoperation verarbeiten wurden. In Bezug auf die Zweitspracherwerber des Niederländischen zeigte die Self-paced reading Studie, dass sie ausschließlich eine Diskursoperation in der Verarbeitung von Reflexiv-und Personalpronomen in Ko-Argument- und PP-Strukturen verwendeten. Selbst Zweitspracherwerber mit einem hohen Sprachniveau im Niederländischen griffen auf eine Diskursoperation zurück. Die Eytrackingstudie belegte die Ergebnisse der Self-paced reading Studie nicht. Ausgehend von der Self-paced reading

Studie wurde geschlussfolgert, dass Muttersprachler auf verschiedene Operationen zurückgreifen, in Abhängigkeit von der syntaktischen Struktur, in die das Pronomen eingebettet ist. Dagegen zeigt sich, dass die Verarbeitung in einer Zweitsprache (unabhängig vom Sprachniveau) nicht der muttersprachlichen Verarbeitung ähnelt.

Sowohl die Self-paced reading wie auch die Eyetrackingstudien erwiesen, dass die Muttersprache Deutsch nicht mit dem Niederländischen in Bezug auf die Verarbeitung von Personalpronomen in die PP-Struktur interferierte.

Der Fragebogen, der zur Erforschung der Interpretation der Pronomen in picture NPs eingesetzt wurde, belegte, dass die Reflexivpronomen einen eindeutigen Antezedenten zugewiesen bekamen, während die Personalpronomen frei verweisen konnten. Dieses Ergebnis passt zu den Studien, die für das Englische durchgeführt wurden. Desweiteren zeigten sich sprachübergreifende Unterschiede zwischen beiden Sprachen hinsichtlich der Interpretation der Personalpronomen. Im Niederländischen konnten die Personalpronomen in picture NPs freier verweisen als im Deutschen. Das Niederländische ähnelt dem Englischen im Hinblick auf die Interpretation der Pronomen in picture NPs mehr als dem Deutschen.

Lebenslauf

Hendrikje Ziemann, geboren am 5. September 1986 in Schwerin als deutsche Staatsbürgerin, studierte von 2006 bis 2009 an der Universität Oldenburg im Bachelor die Studiengänge Sozialwissenschaften und Niederlandistik. Nach erfolgreichem Abschluss des Bachelorstudiums studierte sie an der Universität Oldenburg den Master Niederlandistik, den sie 2012 ebenfalls erfolgreich abschloss. 2011 studierte Hendrikje Ziemann an der Rijksuniversität Groningen den Master Speech and Language Pathology und schloss diesen im gleichen Jahr sehr gut ab. 2011 begann sie mit der Promotion in der niederländischen Sprachwissenschaft an der Universität Oldenburg.