

# On-line processing of subjective and objective causal connectives

Omdat  
Daardoor  
Dus  
Daarom  
Because  
Thus  
So  
Therefore  
Want  
Doordat

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## Abstract

The English causal connective *because* can mark objective as well as subjective relations. Traxler, Bybee and Pickering (1997) found that subjective causal relations marked with *because* (e.g. “*Susan was careless with money and credit cards because she left her purse at the bus stop.*”) were processed slower than objective causal relations (e.g. “*Susan lost her money and credit cards because she left her purse at the bus stop.*”). Readers slowed down at the point where they had enough semantic information to construct the causal relation (i.e. at “*her purse*”). Drawing from the Mental Space Theory of Fauconnier (1985), this asymmetry was hypothesized to originate from differences in the evoked mental space configurations. Crucially, subjective relations have to be interpreted as the believe of some conscious mind (SoC), rather than an observable truth. This requires the reader to set up a special space representing thoughts that belong to that SoC, which can be observed as a delay in processing.

Contrary to English, Dutch has different connectives for subjective and objective relations (Pander Maat & Sanders, 2000). As such they evoke mental space configurations that in case of the English *because* are evoked only by content. In two eye movement registration studies the influence of subjectivity on the processing of Dutch forward causal relations was investigated. Causal relations marked with an objective causal connective were processed faster than causal relations marked with a subjective causal connective. This asymmetry showed up at the point of the connective, at which point the reader did not have enough semantic information to identify the type of causal relation. The connective signaled to set up a mental space configuration for a subjective relation. It was hypothesized that if this space configuration was evoked before encountering the subjective connective (i.e. by marking the presence of a SoC beforehand), the processing asymmetry should reduce. Indeed, when the relations were embedded in a subjective context, the processing asymmetry diminished. These results indicate that linguistic and cognitive structures are tightly linked.

Keywords: causality, connectives, subjectivity, mental spaces theory, free indirect style

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## 1. Introducing the three C's: coherence, causality and connectives

A text consists of more than a collection of sequential sentences. The relations between these sentences are what make a text a text. Connectives like *and*, *because* and *then* are linguistic elements that make these relations explicit. Not only do they show the reader that two text segments are connected, they also show how they are connected (e.g. Cozijn, 2000; Halliday & Hasan, 1976; Noordman & Vonk, 1997). In on-line processing connectives function as processing instructions: they instruct the reader how to process the upcoming segment and how to relate it to a previous one. Studies on reading times of explicit and implicit relations indeed have shown that connectives make it easier to process relations. Explicit relations are processed quicker than their implicit counterparts. Primarily the words just after the connective are read faster in the explicit condition compared to the same words in the implicit condition (Cozijn, 2000; De Leeuw, Mak & Sanders, 2008; Haberlandt, 1982; Kamalski, 2007; Maury & Teisserenc, 2005; Millis & Just, 1994; Mulder, 2008).

In the present study the focus lies on causal relations and the connectives that mark them. In example (1) the connective *because* shows readers that there is a causal relation between the first segment ( $S_1$ ) '*John needed stitches*' and the second segment ( $S_2$ ) '*He cut his hand*'. Without the connective the reader has to infer this relation (2). We can distinguish between forward ( $P \rightarrow Q$ ) and backward ( $Q \leftarrow P$ ) relations, which refer to how the cause (P) and the consequence (Q) of the relation map onto the  $S_1$  and  $S_2$ .<sup>1</sup> If the cause is given in the  $S_1$  and the consequence is given in the  $S_2$ , the relation is referred to as a 'forward causal relation' (3). On the other hand, if the consequence is given in the  $S_1$  and the cause in the  $S_2$ , it is a 'backward causal relation' (1) – (2).<sup>2</sup>

(1) John needed stitches, because he cut his hand.

(2) John needed stitches. He cut his hand.

(3) John cut his hand. He needed stitches.

Most languages provide their users with multiple causal connectives to choose from. However, language users do not randomly pick an option: "[They] *often systematically prefer one lexical item rather than another (even highly similar) one to express a certain type of causal relationship*" (Sanders & Sweetser, 2009, p.1). Corpus work and experimental studies have shown that these connectives have their prototypical and less-prototypical uses (Degand, 2001; Pander Maat & Sanders, 2000; 2001; Pit, 2007; Stukker, 2005; Stukker & Sanders, 2012; Stukker, Sanders & Verhagen, 2008; 2009). Over the last decade the concept of 'subjectivity' has been adopted to account for this distribution of causal connectives (e.g. Pander Maat & Sanders, 2000, 2001; Pit, 2003; Sanders, Sanders & Sweetser, 2009; Spooren, Sanders, Huiskes, & Degand, 2010). This 'subjectivity account' was partly inspired by a dissatisfaction with previous accounts (e.g. simple causal/diagnostic distinction of Traxler, Bybee et al., 1997; semantic/pragmatic distinction of Sanders, 1997; content/epistemic/speech-act distinction of Sweetser, 1990), which could not fully account for

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<sup>1</sup> See also Sanders, Spooren and Noordman's (1992) discussion of 'basic' and 'nonbasic order'.

<sup>2</sup> Note that in constructions with the English connective *because*, the cause (P) of a relation can be raised (e.g. "*Because he cut his hand, John needed stitches*"). Since in these constructions P maps onto  $S_1$  and Q onto  $S_2$  they are considered to be forward causal relations. However, this classification does not imply that 'Because P, Q'-constructions are processed or understood in the same way as non-raised forward relations.

the use of causal connectives in natural language (Pander Maat & Sanders, 2000; Stukker & Sanders, 2012). Primarily for Dutch – but also for French and German – recent studies show that the distribution of causal connectives indeed ties in with the subjectivity of the causal relation (see Sanders & Stukker (Eds.), 2012).

## 2. Subjectivity

The subjectivity account indexes causal relations by their subjectivity, which is firstly defined as the degree to which the ‘speaker’<sup>3</sup> is responsible for connecting the two propositions (i.e. speaker-involvement).<sup>4</sup> The person that is responsible for making the connection is referred to as the *Subject of Consciousness (SoC)* of the relation (Pander Maat & Sanders, 2000; 2001; Verhagen 1995; 2005). A sequence is called objective when the distance between the speaker and the SoC is at a maximum. That is when there is no SoC at all. These relations are observable in the real world. They are not created by some conscious mind. Sequences that have no SoC can be paraphrased as: “*The fact that P causes the fact that Q.*” (Sanders, 1997). For example, this paraphrase can be used to capture the meaning of (4).

- (4) Heidi felt very proud and happy, because she won first prize at the art show.  
(Traxler, Bybee et al. 1997, p.485)

A sequence is maximally subjective when the distance between the SoC and the speaker is nonexistent (i.e. speaker = SoC). The relation is not observable but is constructed inside the speaker’s head. These sequences can be paraphrased as: “*The fact that P causes the SoC’s claim / advice / conclusion that Q.*” (Sanders, 1997). This paraphrase is suited for example (5).

- (5) Heidi could imagine and create things, because she won first prize at the art show.  
(Traxler, Bybee et al. 1997, p.485)

It is also possible that there is a SoC, but that this SoC is not the speaker (i.e. SoC ≠ speaker). In (6) it is John who is reasoning that Heidi is really creative based on her winning first prize and not the speaker. Since John is now the SoC of the relation – and not the speaker – the distance between speaker and SoC is larger and therefore the relation is viewed as less subjective than (5).

- (6) John thought that Heidi could imagine and create things, because she won first prize at the art show.

A second characteristic of subjectivity is whether the SoC explicitly mentioned or not (i.e. ‘transparency’). Following Langacker (1991), when a SoC is explicitly mentioned – as in (6) – the SoC is ‘put on stage’. In a way, the subjectivity of the relation is then more transparent: the subjectivity is clearly visible for the interpreter. In contrast, when the presence of a SoC is left implicit – as in (5) – this leaves the interpreter to infer the involvement of the SoC. In that case subjectivity is not visible: the SoC is left ‘off stage’.

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<sup>3</sup> With ‘speaker’ I refer to the person that relates the story, whether it is in spoken or in written discourse. In this sense, the term ‘speaker’ refers also to writers and narrators.

<sup>4</sup> For a discussion on the concept of subjectivity see De Smet and Verstraete (2006).

## 2.1 Distribution of Dutch causal connectives

As was shortly mentioned in Section 1, language users do not randomly pick a causal connective. In Dutch there are six connectives that are commonly used: three forward and three backward connectives (see Table 1). The distribution of these causal connectives ties in with the subjectivity of the causal relation.

Table 1: Dutch causal connectives

Forward connectives:	Backward connectives:
1. <i>dus</i> [so]	1. <i>want</i> [because/for]
2. <i>daardoor</i> [as a result]	2. <i>doordat</i> [because]
3. <i>daarom</i> [that is why]	3. <i>omdat</i> [because]

Although these connectives are highly similar in meaning, they cannot always substitute each other (Pander Maat & Sanders, 2000). This is illustrated in examples (7) – (9). The symbol ‘✓’ indicates a perfect fit, the symbol ‘?’ indicates a questionable fit<sup>5</sup> and the symbol ‘#’ indicates an impossible fit (notation taken from Knott & Sanders, 1998).

- (7) Het licht in de woonkamer is uit. # Daardoor / ? Daarom / ✓ Dus zijn de burens niet thuis.  
‘The lights in their living room are out. # As a result / ? That is why / ✓ So the neighbors are not at home.’ (Pander Maat & Sanders, 2000, p.58)
- (8) Er was brand in de energiecentrale. ✓ Daardoor / ? Daarom / # Dus viel de stroom uit.  
‘There was a fire at the power plant. ✓ As a result / ? That is why / # So there was a power outage.’
- (9) Het is warm. # Daardoor / ✓ Daarom / ? Dus gaat Jan zwemmen.  
‘It is hot. # As a result / ✓ That is why / ? So Jan goes swimming.’

Prototypically, the connectives *dus* and *want* are used to mark subjective causality. These connectives can only be used in relations where there is a SoC present. They are perfect to mark epistemic relations like (7), but can also mark volitional relations like (9). On the other hand, the connectives *daardoor* and *doordat* mark objective relations. They can only mark relations without a SoC (8). In the middle are *daarom* and *omdat*. These connectives can mark objective as well as subjective relations, but are mostly used in moderately subjective relations like (9). They are prototypically used when the distance between the SoC and the speaker is large (i.e. SoC ≠ Speaker).

## 3. Processing subjective relations

Subjective relations are considered to be more complex than objective relations. One view is that subjective relations involve a necessary validation. Subjective relations are derived from objective relations in the real world and consequently they have to be judged against that underlying relation: “*An epistemic relation reflects a line of reasoning that is allowed by the co-occurrence of events or situations in the world. The justification of that reasoning is the*

<sup>5</sup> A questionable fit indicates that although the connective may be used in this way, for many language users this seems somewhat odd.



*contingency of events in the world. So, in this sense, an epistemic relation is based on an underlying content relation. In understanding an epistemic relation, the reader has to check the possibility of the underlying content relation in the world. Understanding an epistemic relation implies understanding the underlying content relation.*"(Noordman & De Blijzer, 2000, p.37).

Another view is that subjective relations require the concept of a SoC. There is some person who is reasoning about relations existing in the real world and this person must be represented in the mental representation of the text. In other words: readers have to model the mental state of the SoC using their 'Theory of Mind' abilities (Zufferey, 2010).

If subjective relations are indeed more complex to process than objective relations than this should be reflected in reading times. Studies of Traxler and colleagues (Traxler, Sanford, Aked & Moxey, 1997; Traxler, Bybee et al., 1997) have shown that subjective causal relations do require more processing time than objective causal relations. To be precise: the reader slows down at the point where the concept of an objective causal relation is no longer tenable. For example, while processing (4) and (5) repeated below, readers are slower at 'first prize' in (5) compared to the same region in (4). At this point the reader must "make the inference that the assertion is about a possibility or a belief rather than about some straightforward state of the world." (Traxler, Sanford et al., 1997, p. 89). In other words: readers have to revise their mental representation from an objective relation to a subjective relation.

(4) Heidi felt very proud and happy, because she won first prize at the art show.

(5) Heidi could imagine and create things, because she won first prize at the art show.

The question is then what would these representations look like. Using the principles of Mental Space Theory (from now on MST; Fauconnier, 1985; Sweetser & Fauconnier, 1996) as a starting point, we can hypothesize how the mental representations of objective and subjective relations like (4) and (5) may differ.

### *3.1 Representing subjective and objective mental representations*

The basic idea underlying MST is that: "as we think and talk, mental spaces are set up, structured, and linked under pressure from grammar, context, and culture. The effect is to create a network of spaces through which we move as discourse unfolds." (Sweetser & Fauconnier, 1996, p.11). Drawing from this we can visualize differences between objective and subjective relations as differences between mental space configurations.

Figures 1 and 2 are representations of respectively objective and subjective causal relations. Every causal relation originates from the 'knowledge base', which represents a language user's "encyclopedic knowledge, pragmatic knowledge and human reasoning, as well as the lexicon of the language that is used to express the causal relations" (Sanders et al., 2009, p. 28).<sup>6</sup> It licenses the utterance of a relation. From the knowledge based, the relation is projected into the 'linguistic base', which represents the linguistic realization of the causal relation. Since objective relations are simply reported by the speaker and not constructed like subjective relations, there is a direct connection from the knowledge base to the linguistic realization (represented by a solid arrow in Figure 1). The speaker does not intervene, which

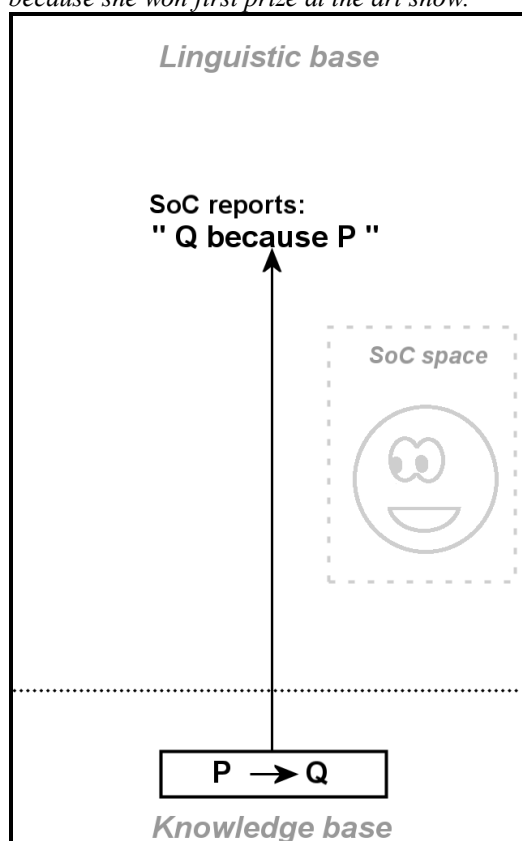
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<sup>6</sup> The concept of a 'knowledge base' is borrowed from the 'Basic Communicative Spaces Network' (BCSN) of Sanders et al. (2009; 2012). It also includes the 'base space' as described by Fauconnier's original framework.

is represented by the SoC – the smiley face ‘☺’ – not crossing the arrow. The linguistic realization is presented in the linguistic base space and not in the SoC space.<sup>7</sup>

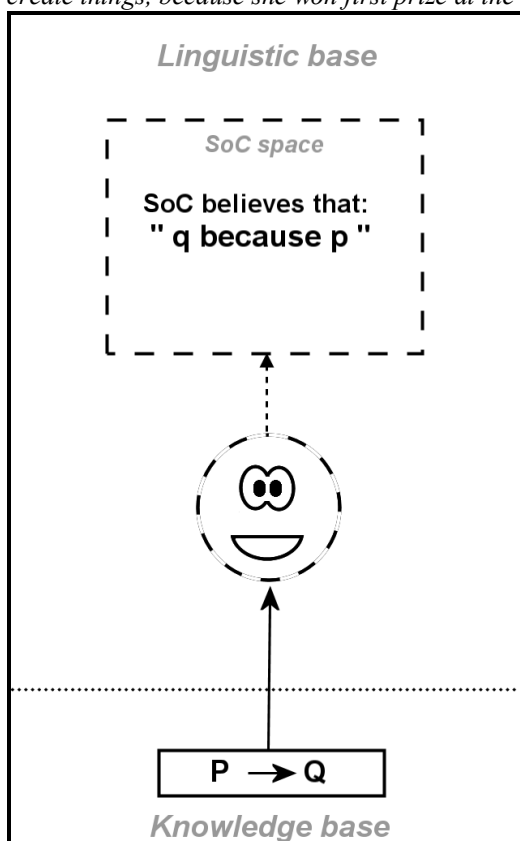
In subjective relations on the other hand, the SoC is involved (see Figure 2). Rather than a direct representation of the relation between P and Q as present in the knowledge base, the linguistic realization is an interpretation of this relation (represented by the lower case letters). The relation passes through the SoC and comes out slightly altered (the dashed arrow). It must be interpreted as the believe of the SoC and therefore it must be placed inside the SoC space. Since the SoC is not explicitly mentioned in this example (i.e. the SoC is ‘off stage’), the smiley face and the SoC space are represented with dashed lines, indicating that they have to be inferred.

Figure 1: Mental space configuration of an objective causal relation (e.g. “Heidi felt very proud and happy, because she won first prize at the art show.”)



<sup>7</sup> The SoC space holds the thoughts and believes of the SoC. In fact, there is no reason to assume that a SoC space is even present in the objective representation, which is why this space is presented in grey. It is included here only to clarify the position of the SoC with regard to the relation.

Figure 2: Mental space configuration of an implicit subjective causal relation (e.g. “Heidi could imagine and create things, because she won first prize at the art show.”)



This inference may be what causes readers to slow down in subjective relations. If so, readers should experience less processing difficulty if the involvement of the SoC does not have to be inferred. Crucially however, this must be done before the relation itself is processed. If a subjective configuration is already set up (i.e. a SoC space is already opened) before encountering disambiguating content like ‘*first prize*’ in (5) above, then the causal relation can immediately be interpreted within the SoC space. Consequently, the needed processing time should diminish.

### 3.2 Subjectivity marking

Theoretically, any direct or indirect reference to a SoC may evoke a mental space configuration that sets up a space for a SoC. Any word that denotes a feeling, thought or judgment, points out that there must be a person responsible for this belief (Conrad & Biber, 2001). Within the MST framework, lexical elements that set up new mental spaces are referred to as ‘mental space builders’ (Fauconnier, 1985). We need mental space builders that evoke a SoC space.

According to Traxler, Sanford et al. (1997) phrases like “*I believe that*” and “*John thought that*”) do just that. These ‘SoC-phrases’<sup>8</sup> mark the fact that a relation is subjective. In a series of experiments Traxler, Sanford et al. (1997) inserted these phrases into the  $S_1$  of the relation (10). As a result, the subjectivity was already visible before reading the critical region ‘*first prize*’. The insertion had the desired effect: when a SoC-phrase was added to the relation, the asymmetry in reading times of objective and subjective relations disappeared.

<sup>8</sup> With SoC-phrase I refer to a family of lexical phrases that include an explicit SoC and a verb or adjective that refers to the mental state of that SoC. This includes constructions with verbs that denote communication, thought or belief (e.g. ‘*I said/think/belief*’), but also constructions like ‘*according to X*’ and ‘*in my opinion*’.

(10) John thought Heidi could imagine and create things, because she won first prize at the art show.

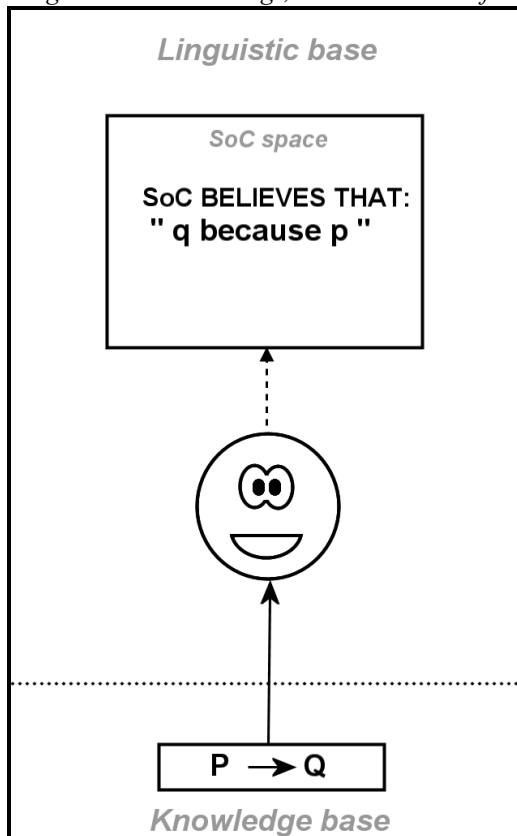
Even an implicit reference to a SoC was enough to reduce processing time. Modals like *perhaps* and *maybe* refer to a person's deliberation process (Langacker, 1991; Nuyts, 2001; Traxler, Sanford et al., 1997). If there is a modal, there must be a SoC who is responsible for it. Traxler, Sanford et al. (1997) confirmed that these modals work in much the same way as SoC-phrases. Sentences like (11) were processed just as fast as their objective counterparts.

(11) Perhaps Heidi could imagine and create things, because she won first prize at the art show.

In terms of Langacker (1991), when the SoC is put on stage, the reader is evoked to build a mental space configuration that already incorporates the subjective nature of the relation. Therefore, readers do not have to revise their mental representation midway – which is what they have to do when the SoC is off stage – and no processing asymmetry is observed.

The influence of the SoC-phrases on the mental space configuration of subjective relations is visualized in Figure 3. Due to the SoC-phrase the involvement of the SoC is now apparent and does not have to be inferred. That is why the smiley face and the SoC space are now represented by solid lines (cf. dashed lines in Figure 2). In addition, *'believes that'* is now capitalized to indicate that this is also linguistically realized. Although the realized relation is still a construal of the SoC (depicted by the dashed arrow), this is now apparent from the start.

Figure 3: Mental space configuration of an explicit subjective causal relation (e.g. *John thought Heidi could imagine and create things, because she won first prize at the art show.*)



### 3.3 Processing causal connectives

Causal connectives can also be seen as mental space builders, and like SoC-phrases and modals they facilitate processing (see Section 1).

Traxler and colleagues (Traxler, Bybee et al., 1997; Traxler, Sanford et al., 1997) used the connective *because* in their experiments. This English connective is able to mark subjective as well as objective backward relations (see (4) – (5); Section 2). As shown in Section 2.1, in Dutch there are different connectives for each type of causal relation. While *because* does not offer the reader any information regarding the subjectivity of the causal relation, Dutch connectives do. Dutch causal connectives are therefore fully specified.<sup>9</sup> As processing instructions they provide the reader with information on three aspects:

1. The fact that there is a causal relation between two segments;
2. The direction of the causal relation (i.e. forward/backward);
3. The degree of subjectivity of the causal relation.

Evidence for this was found by Canestrelli, Mak and Sanders (2012). In a series of eye-tracking experiments they tested whether the results of Traxler, Bybee et al. (1997) and Traxler, Sanford et al. (1997) could be replicated for Dutch. In particular, they tested the effect of the Dutch fully specified connectives. If information concerning the subjectivity of the relation is encoded in the Dutch connectives, the reader knows at the point of the connective how subjective the causal relation will be. The reader does not have to wait for disambiguating content to set up a subjective configuration. If the connective is prototypically used to mark subjective relations, the reader will be signaled to set up a subjective configuration at the point of the connective and not at the point of the disambiguating content. The processing asymmetry will show up earlier: directly following the connective.

Canestrelli et al. (2012) used Dutch backward causal relations (translations of the materials of Traxler, Bybee et al., 1997) like (12) – (13). Objective relations were marked with the prototypical connective *omdat* [because] and subjective relations were marked with the prototypical connective *want* [because/for]. In line with Traxler, Bybee et al. (1997) they found a delay in reading times for subjective relations compared to objective relations. However, this delay transpired immediately after the connective. At this point the readers did not have enough semantic information yet to determine the type of causal relation. The delay was therefore caused by the connective and not by the content.

#### *Objective relation*

- (12) Hanneke was buiten adem, omdat ze vier trappen was afgerend om de post te halen.  
'Hanneke was out of breath, because she ran down four stairs to get the mail.'

#### *Subjective relation*

- (13) Hanneke had haast, want ze was vier trappen afgerend om de post te halen.  
'Hanneke was in a hurry, because she ran down four stairs to get the mail.'

(Canestrelli et al., 2012)

In addition, Canestrelli et al. (2012) replicated Traxler, Sanford et al.'s (1997) effect of SoC-phrases for Dutch. As for English sequences, the processing asymmetry disappeared when a SoC-phrase was added to the beginning of the sequence. Adding a phrase like "*volgens X*"

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<sup>9</sup> While the English *because* is underspecified and does not denote the subjectivity of the relation, other English connectives like *since*, *therefore* and *so* do (Sweetser, 1990).

[according to X] (14), made Dutch subjective relations easier to process compared to unmarked relations. After reading the SoC-phrase the right mental space configuration was already set up to interpret the subjective relation. Hence, no additional processing was necessary.

*Subjective relation marked by SoC-phrase*

(14) Volgens Peter had Hanneke haast, want ze was vier trappen afgerend om de post te halen.

‘According to Peter, Hanneke was in a hurry, because she ran down four stairs to get the mail.’

(Canestrelli et al., 2012)

#### 4. Present study

Canestrelli et al. (2012) used backward relations in their experiments, just like Traxler, Bybee et al. (1997) and Traxler, Sanford et al. (1997). As was discussed in Section 2.1, the Dutch forward causal connectives are also prototypically used in objective or subjective relations. It is therefore likely that forward Dutch connectives can also evoke subjective or objective mental space configurations.

It has been hypothesized that forward and backward causal relations only differ in their order of presentation and not conceptually (Sanders, Sanders & Sweetser, 2012). In regard to the mental space configurations presented in Section 3, this would mean that the configuration does not change. Hypothetically, the only difference between forward and backward configurations is the order in which the relation is expressed. So for a subjective relation the linguistic realization is not “*q because p*” but “*p so q*”. The reader still has to infer the presence of a SoC and evoke a SoC space when processing a forward subjective condition, while in case of a forward objective relation the realization can be interpreted directly in the linguistic base. The processing (a)symmetries found in reading times of backward relations, should be found for forward relations as well. In the present study, these assumptions are investigated.

##### 4.1 ‘Daardoor’ versus ‘dus’

In particular, the focus of this study lies on the forward causal connectives *daardoor* [as a result] and *dus* [so]. These connectives were chosen since sequences connected with *daardoor* can usually also be connected using *dus*. Crucially however, changing the connective changes the meaning of the relation (Pander Maat & Sanders, 2001; Sanders et al., 2009).

The causal relation given in (15) is maximally objective, since there is no SoC present. The relation is paraphrased as: *The fact that the sun is shining caused the fact that the temperature rose*. The prototypical connective for these relations is *daardoor* [as a result] (see Section 2.1). Adding this connective does not alter the underlying relation. (16) can be paraphrased in the same way as (15). Although adding the connective *dus* [so] also leads to an acceptable sequence, this does alter the meaning of the relation.<sup>10</sup> As is shown by the paraphrase in (17), the causality is now interpreted as constructed by a SoC: it is subjective. So while the underlying relation – i.e. the implicit relation as in (15) – lies in the real world, by adding *dus* the relation is portrayed as the reasoning of the speaker (see Langacker, 2002; Stukker, 2005) and this linguistic realization should be interpreted in the SoC space.

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<sup>10</sup> This is why we cannot speak of a valid substitution (see Section 2.1). Following Pander Maat & Sanders (2000) substitution is only allowed when the interpretation remains the same.

(15) De zon scheen. De temperatuur steeg.

The sun was shining. The temperature rose.

PARAPHRASE: ‘The fact that the sun was shining caused the fact that the temperature rose.’

(16) De zon scheen. Daardoor steeg de temperatuur.

The sun was shining. As a result the temperature rose.

PARAPHRASE: ‘The fact that the sun was shining caused the fact that the temperature rose.’

(17) De zon scheen. Dus steeg de temperatuur.

The sun was shining. So the temperature rose.

PARAPHRASE: ‘The fact that the sun was shining, caused the SoC’s (= speaker) conclusion that the temperature rose.’

(Adapted from Sanders et al., 2009, p.50)

By changing *daardoor* into *dus* we can create ‘minimal pairs’. The sequences only differ semantically with regard to their subjectivity. The  $S_1$  and  $S_2$  of the sequences are kept constant.<sup>11</sup> This property gives us the opportunity to make a very direct comparison between objective and subjective causal relations. Since *daardoor* is the prototypical marker of objective relations and *dus* is the prototypical marker of subjective relations, it is hypothesized that *daardoor* will signal the reader that the linguistic realization should be interpreted in the linguistic base, while *dus* signals the reader to interpret it in the SoC space. Hence, the mental space configuration of (16) would resemble Figure 1 and (17) would resemble Figure 2 (see Section 3.1). Consequently, the processing delay found in (unmarked) backward subjective relations – compared to objective relations – should also be found for (17). In two experiments – to be discussed in the upcoming sections – minimal pairs of *daardoor* and *dus* causal relations will be used to see how these forward causal connectives influence processing times and whether the assumptions presented above can be substantiated for forward causal relations.

## 5. Experiment 1<sup>12</sup>

In this experiment eye movement registration was used to capture processing times of Dutch forward causal relations. Fixation times of sequences marked with *dus* and *daardoor* are compared with each other and with an implicit version of the relation that functions as a baseline.

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<sup>11</sup> Cf. Traxler’s and Canestrelli’s materials, in which the  $S_2$  was kept constant but the  $S_1$  differed per condition.

<sup>12</sup> This experiment has originally been published in Dutch as Kleijn, Mak & Sanders (2011). For the present study, the data will be reanalyzed using mixed-effect modeling (see Section 5.3). Originally, the data were analyzed using repeated measures ANOVAs.

## 5.1 Hypotheses

The following hypotheses are tested:<sup>13</sup>

- H1: Connectives facilitate processing, leading to shorter fixation times at the beginning of the  $S_2$  when a connective is present compared to when a connective is not present.
- H2: Relations marked with a prototypical marker for objective relations (i.e. *daardoor*) will be processed faster than relations marked with a prototypical marker for subjective relations (i.e. *dus*). This processing asymmetry will be found immediately following the connective.
- H3: If a SoC-phrase is inserted at the beginning of a subjective relation, the asymmetry presented in H2 will diminish or even disappear.

## 5.2 Method

### 5.2.1 Participants

Eye movement data of 37 native speakers of Dutch were collected (35 female – 2 male). Most participants were students at Utrecht University. Mean age was 22 years (range: 14 – 45). The participants had normal or corrected to normal vision and were paid for their participation.

### 5.2.2 Materials

The materials consisted of 32 experimental texts which were taken from De Leeuw, Mak and Sanders (2008) and adapted to serve in the present study (see Appendix A). The texts were short newspaper articles that each contained an objective forward causal relation. Each text started off with two introductory sentences followed by the  $S_1$  and  $S_2$  of the causal relation, and a concluding statement.

The texts were manipulated to provide four different versions (see Table 2). Introduction sentences and concluding statements were kept constant over all versions. In the implicit version the relation between the  $S_1$  and  $S_2$  was not marked. No connective was used. In the second and third version the relation was marked by either the connective *daardoor* or the connective *dus*.<sup>14</sup> Finally, in the fourth version again the connective *dus* was used, but now combined with a SoC-phrase inserted at the beginning of the  $S_1$ . The SoC-phrases all put the author of the text on stage and introduce him/her as the SoC. This was done with the help of SoC-phrases like ‘*Ik ben er van overtuigd dat*’ [I am convinced that], ‘*Naar mijn mening*’ [In my opinion], and ‘*Ik weet dat*’ [I know that].

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<sup>13</sup> Although no hypotheses are formulated regarding processing times at the end of the  $S_2$ , some additional attention will be paid to this region. The reason for this is that in previous work concerning implicit and explicit relations effects have been found for this part of the sentence (e.g. Cozijn, 2000).

<sup>14</sup> Note that while *daardoor* requires a subordinate word order (VSO) of the  $S_2$ , *dus* can occur in subordinate as well as coordinated structures (see also Evers-Vermeul, 2010). To avoid confounded effects of syntactic structure with connective, the  $S_2$  of both *daardoor* and *dus* were given a subordinate structure.



Table 2: Text versions

Structure	Example
<i>Introduction:</i>	De afgelopen tijd is er veel aandacht geweest voor het vermeerderen van het aantal huurwoningen in Nederland. Sinds dit jaar is er meer keuze op de markt en is er meer variatie in het soort huis dat aangeboden wordt. ‘Over the last period there has been much attention for increasing the number of rented houses in the Netherlands. For this year, there is more choice on the market and there is more variation in the kind of house that is offered.’
$S_1 + S_2$ :	<p><i>Implicit:</i> Koopwoningen gaan de komende jaren verder dalen in waarde. Huiseigenaren zullen in bijna alle gevallen slechter af zijn dan mensen die huren. ‘The value of owner-occupied houses will decrease within the next few years. House owners live more expensively in comparison to people who rent a house.’</p> <p><i>Daardoor:</i> Koopwoningen gaan de komende jaren verder dalen in waarde. <u>Daardoor</u> zullen huiseigenaren in bijna alle gevallen slechter af zijn dan mensen die huren. ‘The value of owner-occupied houses will decrease within the next few years. <u>As a result</u> house owners live more expensively in comparison to people who rent a house.’</p> <p><i>Dus:</i> Koopwoningen gaan de komende jaren verder dalen in waarde. <u>Dus</u> zullen huiseigenaren in bijna alle gevallen slechter af zijn dan mensen die huren. ‘The value of owner-occupied houses will decrease within the next few years. <u>So</u> house owners live more expensively in comparison to people who rent a house.’</p> <p><i>Dus + SoC-phrase:</i> <u>Ik ben er van overtuigd dat</u> koopwoningen de komende jaren verder gaan dalen in waarde. <u>Dus</u> zullen huiseigenaren in bijna alle gevallen slechter af zijn dan mensen die huren. ‘<u>I am convinced that</u> the value of owner-occupied houses will decrease within the next few years. <u>So</u> house owners live more expensively in comparison to people who rent a house.’</p>
<i>Concluding statement:</i>	Een huis huren is een beter idee dan een huis kopen. ‘Renting a house is a better idea than buying a house.’

### 5.2.3 Design

A repeated measures design was used with one four-leveled factor (i.e. *Condition*). The items were divided over four lists, as a Latin-Square. As a result, participants read every item but only in one condition. The lists were supplemented with 32 filler items. The items and fillers were evenly distributed throughout three blocks (i.e.  $\pm 21$  stimuli per block).

### 5.2.4 Apparatus

The eye movements of the participants were recorded with a head-mounted eye tracker: the SMI EyeLink I. By default this eye tracker recorded the position of both eyes at a frequency of 250Hz.<sup>15</sup> Neither a bite bar nor a chin rest was used, allowing participants to move their head slightly. Accuracy of this eye tracker is 0.5 – 1.0 degrees. Stimuli were presented on a 19 inch computer screen.

### 5.2.5 Procedure

Recording took place at the eye tracking laboratory of the Utrecht institute of Linguistics OTS (UiL OTS). Each participant received an oral instruction during which the equipment and procedure were explained. The participants were instructed to read each item at their own pace, but to make sure that they read and understood the whole text.

<sup>15</sup> For 7 participants only the position of one pupil was recorded since this resulted in a more stable calibration.

The instruction was followed by a 9-point calibration and validation procedure. Participants fixated on a sequence of dots which appeared on various locations on the computer screen. After a successful calibration and validation sequence the testing started with three practice items to familiarize the participant with the procedure. The calibration procedure was repeated after every block.

Each item started with a single dot on the screen, which indicated the location of the first word of the item. When the participant fixated on the dot, the dot vanished and the text appeared. To progress to the next item participants pressed a button on a button-box.

### 5.2.6 Data preparation and clean-up

Each item was divided into 8 regions (18). The first three sentences – including the  $S_1$  – formed region 0. If a connective was present, this formed region 1 (i.e. this region was absent for the implicit version, see (19)). Region 2 consisted of the verb and subject of the  $S_2$ . Regions 3 and 4 contained the rest of the  $S_2$ , except for the last words which were coded as region 5. The final sentence was split up in region 6 (a spill over region containing the first two words) and region 7 (residual words).

Special attention was paid to the presentations of regions 2 and 5 (see Section 5.1). These regions did not include line breaks and were never presented at the beginning or at the end of a line. These measures were taken to circumvent the effect of return sweeps in these critical regions.

#### *Text regions for conditions with a connective*

(18)<sup>0</sup>[De afgelopen tijd is er veel aandacht geweest voor het vermeerderen van het aantal huurwoningen in Nederland. Sinds dit jaar is er meer keuze op de markt en is er meer variatie in het soort huis dat aangeboden wordt. <sup>1</sup>[Daardoor] <sup>2</sup>[zullen huiseigenaren] <sup>3</sup>[in bijna alle] <sup>4</sup>[gevallen slechter af zijn] <sup>5</sup>[dan mensen die huren.] <sup>6</sup>[Huren is] <sup>7</sup>[een beter idee dan een huis kopen.]

#### *Text regions for implicit condition*

(19)<sup>0</sup>[De afgelopen tijd ... in waarde.] <sup>2</sup>[Huiseigenaren zullen] <sup>3</sup>[in bijna alle] <sup>4</sup>[gevallen slechter af zijn] <sup>5</sup>[dan mensen die huren.]

Fixations were checked and assigned to their corresponding regions with the help of a computer program named ‘Fixation’ (Cozijn, 1994). *First fixation duration* (FF), *first pass reading time* (FP), *first pass total reading time* (FPT), *regression path duration* (RP) and *regression probability* (RPP) per region were calculated (see Table 3). Fixation times that were either two standard deviations above or below a person’s or item’s mean, as well as times that included blinks, were discarded. Skipped regions were regarded as missing data.

Table 3: Description of measures

Name (abbreviation)	Description
<i>First fixation duration</i> (FF)	Duration of the first fixation on a region in first pass
<i>First pass reading time</i> (FP)	Summed duration of all fixations within a region before the eyes leave the region either regressively or progressively.
<i>First pass total reading time</i> (FPT)	Total length of all fixations within a region before the eyes move to an upcoming region (progressive).
<i>Regression path duration</i> (RP)	Summed duration of all fixations within a region plus all fixations on previous regions before the eyes move to an upcoming region.
<i>Regression probability</i> (RPP)	Probability that readers regress to a previous region after fixating on the present region in first pass.

### 5.3 Results

Effects on *first fixation duration*, *first pass reading time*, *regression path duration* and *first pass total reading time* were analyzed with Linear Mixed Effects Regression analyses (LMER) using the restricted maximum likelihood method. Effects on *regression probability* were analyzed with Generalized Linear Mixed Model analyses (GLMM) using the Laplace approximation.<sup>16</sup> *Subjects* and *items* were included as crossed random factors. *Condition* (implicit, daardoor, dus, dus + SoC-phrase) was included as a four-leveled fixed factor. Following Baayen (2008), a log-transformation was carried out before analyzing the data. Significance was estimated using Markov Chain Monte Carlo (MCMC) sampling combined with a Tukey contrast test.<sup>17</sup>

Mean *first fixation duration*, *first pass reading time*, *regression path duration* and *first pass total reading time* are given in Table 4 and mean *regression probability* is given in Table 5.

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<sup>16</sup> These analyses were performed using R version 2.15.0 (R Development Core Team, 2012).

<sup>17</sup> *Condition* is a four-level factor. However, MCMC sampling only compares each level within a predictor with a reference level, so other possible comparisons are not calculated using this method. Since comparisons of all levels are needed (see Section 5.1), a multiple comparison of means test was used to estimate the significance level for the additional comparisons. P-values from MCMC sampling are marked as p(MCMC) and p-values from the Tukey test are marked as p(Tukey).

Table 4: Means and standard deviations in ms of first fixation duration (FF), first pass reading time (FP), regression path duration (RP) and first pass total reading time (FPT)

Measure	Condition	Region 0	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6	Region 7
<b>FF</b>	<i>Implicit</i>	227 (65)	-	231 (98)	204 (69)	205 (98)	209 (75)	233 (115)	202 (81)
	<i>Daardoor</i>	232 (73)	226 (91)	211 (70)	202 (70)	199 (81)	219 (75)	221 (84)	201 (76)
	<i>Dus</i>	231 (66)	237 (128)	213 (76)	209 (83)	198 (78)	209 (71)	233 (111)	204 (80)
	<i>Dus + SoC-phrase</i>	234 (66)	249 (170)	227 (99)	217 (82)	204 (77)	220 (77)	221 (80)	198 (71)
<b>FP</b>	<i>Implicit</i>	9111 (2956)	-	566 (366)	522 (308)	618 (429)	433 (297)	364 (246)	2054 (1272)
	<i>Daardoor</i>	8930 (3089)	302 (188)	445 (284)	519 (289)	554 (362)	483 (362)	367 (276)	2059 (1122)
	<i>Dus</i>	9175 (3027)	260 (160)	477 (310)	501 (357)	566 (352)	428 (268)	394 (287)	2070 (1104)
	<i>Dus + SoC-phrase</i>	9614 (2945)	273 (192)	536 (332)	494 (304)	576 (358)	473 (343)	372 (257)	2065 (1156)
<b>RP</b>	<i>Implicit</i>	9111 (2956)	-	617 (417)	600 (377)	656 (432)	623 (467)	398 (300)	2469 (1176)
	<i>Daardoor</i>	8930 (3089)	356 (238)	517 (317)	581 (338)	658 (538)	556 (399)	432 (418)	2346 (1111)
	<i>Dus</i>	9175 (3027)	332 (220)	637 (394)	617 (442)	629 (380)	592 (402)	432 (316)	2393 (1062)
	<i>Dus + SoC-phrase</i>	9614 (2945)	337 (240)	661 (417)	618 (421)	636 (408)	605 (422)	412 (323)	2349 (1027)
<b>FPT</b>	<i>Implicit</i>	9111 (2956)	-	590 (363)	571 (337)	636 (421)	525 (347)	382 (265)	2406 (1132)
	<i>Daardoor</i>	8930 (3089)	318 (187)	488 (289)	561 (329)	601 (382)	522 (371)	397 (302)	2274 (1032)
	<i>Dus</i>	9175 (3027)	275 (165)	576 (340)	562 (373)	596 (346)	508 (312)	411 (290)	2318 (986)
	<i>Dus + SoC-phrase</i>	9614 (2945)	287 (199)	617 (356)	570 (348)	611 (364)	535 (346)	391 (272)	2310 (1005)

Table 5: Mean regression probability (RPP)

Measure	Condition	Region 0	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6	Region 7
<b>RPP</b>	<i>Implicit</i>	-	-	0.05	0.09	0.04	0.20	0.05	0.19
	<i>Daardoor</i>	-	0.09	0.12	0.07	0.11	0.11	0.05	0.13
	<i>Dus</i>	-	0.18	0.22	0.13	0.09	0.22	0.05	0.16
	<i>Dus + SoC-phrase</i>	-	0.22	0.15	0.13	0.06	0.17	0.04	0.14

### 5.3.1 Implicit versus explicit relations

The results are partially in line with the first hypothesis (H1). In the implicit-condition, the words immediately following the connective – region 2 – were read slower than in the *dus*- and *daardoor*-conditions. Compared to the *daardoor*-condition the implicit-condition had a longer *first fixation duration*, *first pass reading time*, *regression path duration* and *first pass total reading time* (FF:  $\beta = -0.03$ , SE= 0.01,  $p(\text{MCMC})=0.05$ ; FP:  $\beta = -0.10$ , SE= 0.02,  $p(\text{MCMC})<0.001$ ; RP:  $\beta = -0.06$ , SE= 0.02,  $p(\text{MCMC})<0.001$ ; FPT:  $\beta = -0.07$ , SE= 0.02,  $p(\text{MCMC})<0.001$ ). Compared to *dus* the implicit-condition had a longer *first pass reading time* and (marginally) a longer *first fixation duration* (FP  $\beta = -0.07$ , SE= 0.02,  $p(\text{MCMC})<0.01$ ; FF:  $\beta = -0.02$ , SE= 0.01,  $p(\text{MCMC})=0.08$ ). Not in line with H1 was the finding that no significant effects were found for the *dus+SoC-phrase*-condition. In fact, compared with the implicit-condition there was only an effect for *regression path duration*, but this effect was in the opposite direction. RP was shorter for the implicit-condition (RP:  $\beta = 0.04$ , SE= 0.02,  $p(\text{MCMC})<0.05$ ). Finally, for *regression probability*, the chance of a regression was much lower in the implicit-condition than in all other conditions (RPP *daardoor*:  $\beta = 1.03$ , SE= 0.36,  $p(\text{MCMC})<0.001$ ,  $\exp\beta = 2.80$ ; *dus*:  $\beta = 1.80$ , SE= 0.34,  $p(\text{MCMC})<0.005$ ,  $\exp\beta = 6.07$ ; *dus+SoC-phrase*:  $\beta = 1.23$ , SE= 0.35,  $p(\text{MCMC})<0.001$ ,  $\exp\beta = 3.42$ ). This was to be expected. In the implicit-condition, there is not much semantic information available at that point to warrant any semantically triggered regression.

Some additional, (marginal) effects concerning implicit and explicit comparisons were found in regions 5 (i.e. the last words of the  $S_2$ ) and 6 (i.e. the first words after the  $S_2$ ). In region 5 *first fixation duration* and *first pass reading time* were higher for the *daardoor*- and *dus+SoC-phrase*-condition (FF *daardoor*:  $\beta = 0.02$ , SE= 0.01,  $p(\text{MCMC})=0.08$ ; FF *dus+SoC-phrase*:  $\beta = 0.02$ , SE= 0.01,  $p(\text{MCMC})=0.08$ ; FP *daardoor*:  $\beta = 0.05$ , SE= 0.02,  $p(\text{MCMC})<0.05$ ; FP *dus+SoC-phrase*:  $\beta = 0.03$ , SE= 0.02,  $p(\text{MCMC})=0.09$ ). Also, the *regression probability* for the *daardoor*-condition was lower than for the implicit-condition (RPP:  $\beta = -0.79$ , SE= 0.28,  $p(\text{MCMC})<0.005$ ,  $\exp\beta = 0.45$ ). For *dus* effects were found a little later, namely in region 6. In this region the *dus*-condition had longer *first pass reading time*, *regression path duration* and *first pass total reading time* compared to the implicit condition (FP:  $\beta = 0.03$ , SE= 0.02,  $p(\text{MCMC})=0.07$ ; RP:  $\beta = 0.04$ , SE= 0.02,  $p(\text{MCMC})=0.05$ ; FPT:  $\beta = 0.04$ , SE= 0.02,  $p(\text{MCMC})<0.05$ ).

### 5.3.2 Subjective versus objective relations

As was to be expected due to differences in word length, at the point of the connective – region 1 – there was an overall effect for *daardoor* leading to longer *first pass reading time*, *regression path duration* and *first pass total reading time* (FP *dus*:  $\beta = -0.09$ , SE= 0.02,  $p(\text{MCMC})<0.001$ ; FP *dus+SoC-phrase*:  $\beta = -0.11$ , SE= 0.02,  $p(\text{MCMC})<0.001$ ; RP *dus*:  $\beta = -0.05$ , SE= 0.03,  $p(\text{MCMC})=0.10$ ; RP *dus+SoC-phrase*:  $\beta = -0.06$ , SE= 0.03,  $p(\text{MCMC})<0.05$ ; FPT *dus*:  $\beta = -0.09$ , SE= 0.02,  $p(\text{MCMC})<0.001$ ; FPT *dus+SoC-phrase*:  $\beta = -0.11$ , SE= 0.02,  $p(\text{MCMC})<0.001$ ). On the other hand, *regression probability* was significantly lower for *daardoor* compared to the other conditions (RPP *dus*:  $\beta = 0.88$ , SE= 0.40,  $p(\text{MCMC})<0.05$ ,  $\exp\beta = 2.42$ ; RPP *dus+SoC-phrase*:  $\beta = 1.24$ , SE= 0.39,  $p(\text{MCMC})<0.01$ ,  $\exp\beta = 3.44$ ). No significant differences were found between the two *dus*-conditions.

Analysis of region 2 showed that reading times for the *daardoor*-condition were shorter compared to the fixation times of the other conditions. Compared to the *dus*-condition *daardoor* had a shorter *regression path duration* and *first pass total reading time* (RP:  $\beta = 0.09$ , SE= 0.02,  $p(\text{Tukey})<0.001$ ; FPT:  $\beta = 0.08$ , SE= 0.02,  $p(\text{Tukey})<0.001$ ), and chances of a regression were lower for *daardoor* (RPP:  $\beta = 0.77$ , SE= 0.26,  $p(\text{Tukey})<0.05$ ,  $\exp\beta = 2.16$ ). Secondly, *first pass reading time*, *regression path duration* and *first pass total reading time* were faster for *daardoor* compared to the *dus+SoC-phrase*-condition (FP:  $\beta = 0.08$ , SE= 0.02,

$p(\text{Tukey}) < 0.001$ ; RP:  $\beta = 0.10$ ,  $\text{SE} = 0.02$ ,  $p(\text{Tukey}) < 0.001$ ; FPT:  $\beta = 0.10$ ,  $\text{SE} = 0.02$ ,  $p(\text{Tukey}) < 0.01$ ). These findings are in line with H2: the objective relations (with *daardoor*) are processed faster than subjective relations (with *dus*). However, according to H3 this difference should have diminished when a SoC-phrase was added. This hypothesis did not bear out. Only for one of the fixation time measures – *first pass reading time* – a significant effect was found (FP  $\beta = 0.05$ ,  $\text{SE} = 0.02$ ,  $p(\text{Tukey}) < 0.05$ ). However, this effect was in the opposite direction: FP was shorter for *dus* without a SoC-phrase compared to *dus* with a SoC-phrase. On the other hand, *regression probability* did show a marginal effect in the expected direction (RPP:  $\beta = -0.57$ ,  $\text{SE} = 0.25$ ,  $p(\text{Tukey}) = 0.10$ ,  $\exp\beta = 0.56$ ). Chance of a regression decreased when a SoC-phrase was used and no difference in *regression probability* was found between the *daardoor*-condition and the *dus+SoC-phrase*-condition (RPP:  $\beta = 0.20$ ,  $\text{SE} = 0.28$ ,  $p(\text{Tukey}) = 0.89$ ).

To conclude, in region 5 an effect on *regression probability* was found between the *dus*- and *daardoor*-condition (RPP:  $\beta = 0.93$ ,  $\text{SE} = 0.27$ ,  $p(\text{Tukey}) < 0.005$ ,  $\exp\beta = 2.53$ ). The chance of a regression was higher for *dus* than for *daardoor*. Although the difference with *daardoor* disappeared when a SoC-phrase was used, there was no significant difference between the *dus*- and the *dus+SoC-phrase*-condition.

#### 5.4 Conclusion and discussion

The results of Experiment 1 partially confirm the H1. The connectives *daardoor* and *dus* speed up processing at the beginning of the second segment of a forward causal relation, but only if they are not preceded by a SoC-phrase. The second hypothesis was completely confirmed: subjective relations are read slower than objective relations. In contrast with findings of Canestrelli et al. (2012) and Traxler, Sanford et al. (1997) the third hypothesis could not be confirmed. Introducing the SoC beforehand – with the help of a SoC-phrase – did not diminish the effect of subjectivity. Although most comparisons were not significant, the fixation means given in Table 4 show that even if an effect would have been found this would be in the opposite direction. This – together with the finding that SoC-phrases eliminated the facilitating effect of the connective *dus* compared to the implicit function – suggest that the SoC-phrases seem to have caused problems, rather than to ‘solve’ them. A closer inspection of the used items brought to light a possible explanation for the found results.

##### 5.4.1 Complication of order

The difference between the studies of Canestrelli et al. (2012), Traxler, Sanford et al. (1997) and the present study is the studied direction of the causal relation. In contrast to the present study, Canestrelli and Traxler both used backward relations (see Sections 2 and 3). While subjective backward relations start with a claim (20), forward relations start with an argument (21). As I will show below, this difference has complications for the scope of the SoC-phrase. This is what I will refer to as the ‘scope-problem’.

- (20)a. [De buren zijn niet thuis.]<sup>Claim</sup>, want [De lichten zijn uit]<sup>Argument</sup>  
 ‘The neighbors are not at home, because the lights are off.’  
 b. Volgens Peter [zijn de buren niet thuis]<sup>Claim</sup>, want [De lichten zijn uit]<sup>Argument</sup>  
 ‘According to Peter the neighbors are not at home, because the lights are off.’

- (21)a. [De lichten zijn uit]<sup>Argument</sup>, dus [de buren zijn niet thuis.]<sup>Claim</sup>  
 ‘The lights are off, so the neighbors are not at home.’
- b. Volgens Peter [zijn de lichten uit]<sup>Argument</sup>, dus [de buren zijn niet thuis.]<sup>Claim</sup>  
 ‘According to Peter the lights are off, so the neighbors are not at home.’

In all three studies a short lexical phrase was added to make the SoC explicit (e.g. in (20b) and (21b) ‘*volgens Peter*’ [according to Peter]). This SoC-phrase was part of the S<sub>1</sub>, so that the subjectivity of the relation would already be known to the reader before (s)he encountered the subjective connective. Consequently, in backward relations the SoC-phrase was added to the claim-proposition while in forward linear sequences it was added to the argument-proposition. The problem that may have risen, is that inserting a SoC-phrase in an argument-proposition – as in (21b) – does not automatically make the whole relation subjective, but only makes the argument itself subjective. As a result, the configuration evoked by the SoC-phrase was not suited to interpret the relation and a revision was still needed.

Unless marked otherwise the argument is regarded as a fact (i.e. observable in the real world) and the claim is presented as a possible or probable outcome (from the perspective of the SoC). So, conceptually there is a difference in the status of the propositions: one is a fact and the other is a derivation based on that fact. This can best be captured by the paraphrase: “*The fact that P causes the SoC’s claim / advice / conclusion that Q.*” In other words: the argument (P) is not considered to be subjective.

Adding a SoC-phrase to a claim-proposition – like Canestrelli et al. (2012) and Traxler, Sanford et al. (1997) did – does not result in a scope-problem, because the SoC is added to the derived information (the claim). It makes the SoC responsible for the derived information and thereby automatically for the formation of the relation between P and Q. By adding a SoC-phrase to an argument-proposition the observation described in the argument is assigned to a SoC. However, this SoC may only be responsible for the observation, but not necessarily for the construction of the relation between P and Q. For instance, (21b) may describe the situation that Peter saw that the lights were off and that he shared this information with the speaker. The speaker used that information (instead of his own observation) to draw his own conclusion.

There is also another way to illustrate this scope-problem in forward relations. In Section 3.1 it was discussed that modals can also introduce SoC’s. So instead of adding ‘*according to Peter*’, adding a modal to the S<sub>1</sub> should also put the SoC on stage and evoke a subjective configuration. However, while adding a modal like *misschien* [perhaps] to a backward relation results in an acceptable sequence (20c), adding it to a forward relation does not (21c). A claim cannot be derived on the basis of a questioned observation.<sup>18</sup> The unacceptability of (21c) shows that the modal has no scope over the relation; it only has scope over the argument.

- (21)c. Misschien [zijn de buren niet thuis]<sup>Claim</sup>, want [De lichten zijn uit]<sup>Argument</sup>  
 ‘Perhaps the neighbors are not at home, because the lights are off.’

- (22)c. # Misschien [zijn de lichten uit]<sup>Argument</sup>, dus [de buren zijn niet thuis.]<sup>Claim</sup>  
 ‘Perhaps the lights are off, so the neighbors are not at home.’

If indeed the SoC-phrase did not have scope over the relation, this has consequences for the mental space configuration. While the mental space configuration of backward subjective

<sup>18</sup> It seems that the relation must be conditional for a modal to be used in this way: “*Perhaps the lights are off, if so the neighbors are not at home.*”

relations marked with a SoC-phrase resemble Figure 3 (repeated below), their forward counterparts may have evoked a configuration more like Figure 4 below. The involvement of the speaker is partially visible, but not completely. With regard to the realization of ‘P’ the involvement is visible. The SoC is responsible for the observation of ‘P’, which is a representation of a cause observable in the real world. In contrast, the involvement of the SoC in the construction of the causal relation is still concealed. As a result, the SoC space still has to be inferred (as in unmarked subjective relations). Moreover, Figure 4 is also different from the representation of an unmarked subjective relation (see Figure 2, Section 3.1), which may indicate why the *dus* relations with SoC-phrases were processed even slower than implicit relations. The way subjectivity was marked, may in fact have complicated the process.

Figure 3: Mental space configuration of an explicit subjective causal relation (e.g. *John thought Heidi could imagine and create things, because she won first prize at the art show.*)

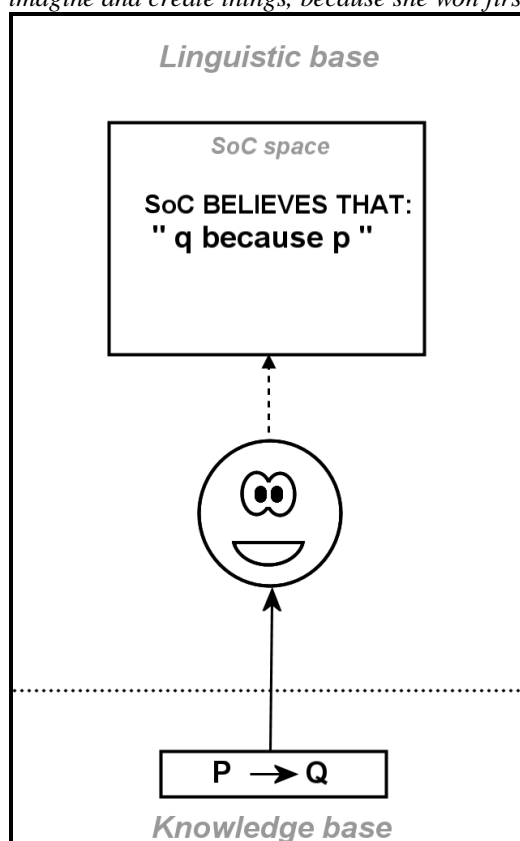
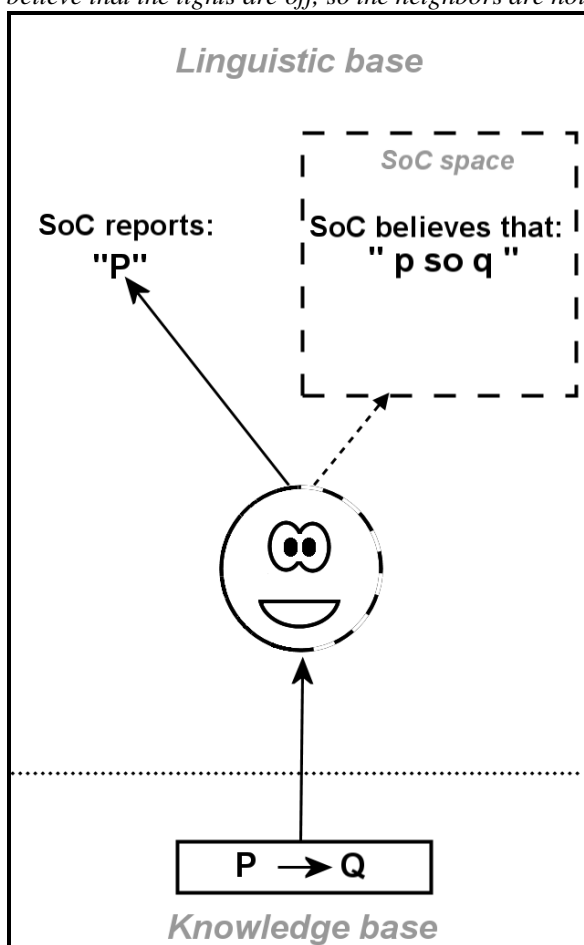




Figure 4: Mental space configuration of a subjective forward causal relation marked by a SoC-phrase (e.g. *I believe that the lights are off, so the neighbors are not at home.*)



Hence, it is possible that the SoC-phrases used in Experiment 1 were unsuccessful in evoking a subjective mental space configuration necessary to interpret subjective relations effortlessly. As a result, the readers may not have been prepared for a subjective relation, which would explain why the expected difference between the *dus-* and *dus+SoC-phrase-* condition was not found. Consequently, at present H3 cannot be discarded. The scope-problem should be solved before ruling out this hypothesis.

## 6. Marking subjectivity in forward causal relations

As was discussed in Section 5.4.1, the SoC-phrases may have evoked a configuration in which the SoC was presented as the observer responsible for the argument and not as a reasoning entity responsible for the causal relation. To solve the scope-problem, we must make sure that the entire causal relation is interpreted as ‘the believe’ of a SoC. It must be clear to the reader that the SoC’s thoughts are represented here and not his observations.

In literary science, the representation of thought and speech has been a subject of interest for many decades. There are thought to be three (main) ways to present thought and speech: using the direct style (22), the indirect style (23) or the free indirect style (24) (e.g. Bal, 1990; Banfield, 1982; Chafe, 1994; Fludernik, 1993).<sup>19</sup> All three styles evoke a mental

<sup>19</sup> Within these styles further subcategorizations can be made (for instance differentiating between speech and thought), see for example Chafe (1994).

space configuration that includes a space for a SoC embedded in the space of the narrator: “Each time the narrator lets characters speak or present their thoughts, an embedded mental space (*M*) is created within the base space (*B*).” (Sanders & Redeker, 1996, p.295). Crucially however, these representations differ in regard to the allocation of responsibility to the narrator and characters in the discourse. In this may lie the answer to the scope-problem. If the allocation of responsibility depends on the style in which the thought is presented, adapting the right style might ‘circumvent’ the scope-problem entirely.

*Direct*

(22) Tom said/thought: “Gosh, I am tired.”

*Indirect*

(23) Tom said/thought that he was tired.

*Free indirect*

(24) Gosh, he was tired, Tom said/thought.

(adapted from Fludernik, 1993, p.74)

### 6.1 The direct style<sup>20</sup>

Expressions in the direct style are verbatim representations of what is said or thought. The direct style causes a complete deictic shift from the narrator to the quoted subject (e.g. ‘*Tom*’ in (22); Banfield, 1982; Fludernik, 1993; Sanders & Redeker, 1996). The subject is responsible for not only the content of the expression, but also for the wording (Sanders & Redeker, 1996). Due to the deictic shift, the subject is referred to in first-person. Beside the deictic shift, the direct style characterizes itself by the use of: emotive elements, exclamations (e.g. ‘*Gosh*’ in (22)), incomplete sentences (e.g. ‘*There!*’) and an expressive use of punctuation marks (e.g. exclamation and question marks; Banfield, 1982).

Although direct expressions are often placed in quotation marks, it is not a prerequisite (Fludernik, 1993). Nonetheless, these quotation marks make it very clear for which utterances the subject is completely responsible and for which the narrator is (partially) responsible. With regard to the interpretation of subjective causal relations, this means that if the whole sequence is placed between quotation marks, the whole sequence belongs to the same SoC (i.e. the subject). In (25) the introducing phrase ‘*Tom said*’ belongs to the base space of the narrator. In combination with the first quotation mark this opens up an embedded space for Tom’s thoughts. Viewpoint shifts to this embedded space (Sanders & Redeker, 1996), making the subject responsible for content and wording. Until the closing quotation mark has been encountered, viewpoint remains at this space. Thus, in (25) the entire causal relation is interpreted as the thoughts of the subject. As a result Tom is the SoC of the relation.<sup>21</sup>

(25) Tom said: “The lights are off, so the neighbors are not at home.”

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<sup>20</sup> I will only highlight some characteristics, for detailed accounts of these styles see Banfield (1982) and Fludernik (1993).

<sup>21</sup> Note that in sequences like ‘*Tom said: “According to Peter the lights are off, so the neighbors are not at home.”*’ – in which an indirect expression is presented embedded in a direct expression – *so* will refer to the speaker Tom and not to Peter or to the narrator/writer. More importantly, these sequences fall prey to the same scope-problem as ‘normal’ indirect sequences.

Thus, forward causal relations presented in the direct style do not suffer from the same scope-problem as relations presented in the indirect style. However, caution is advised when using the direct style in processing studies. Not much is known about the processing of direct expressions while reading. Recent studies of Yao, Belin and Scheepers (2011)<sup>22</sup> and Bohan, Sanford, Cochrane and Sanford (2008) indicate that the direct style is processed differently than the indirect style.

### 6.1.1 Processing the direct style

Yao et al. (2011) found that certain areas in the auditory cortex are more active while reading direct style texts compared to when reading indirect style texts. These areas were ‘voice-selective areas’ meaning they become active when hearing vocalized sounds. “*Even during silent reading of text, direct speech may be more likely to activate ‘audible speech’-like representations than indirect speech*” (Yao et al., 2011, p.3146). Processing differences are also observed in offline measures. Bohan et al. (2008) found that the surface base representation was coded more thoroughly in direct speech situations compared to indirect speech situations.

Results of both studies indicate that processing resources are allocated differently when reading direct style text fragments compared to when reading indirect style text fragments. If the direct style were to be used in an eye movement registration study, this would mean that subjectivity marking processing and direct style processing would be confounded.

### 6.2 The indirect style

In contrast to expressions in the direct style, expressions in the indirect style are not literal representations of what is said or thought. For example, (26) could be based on the speech event of the subject ‘Tom’ actually saying ‘*I am tired*’, but also on utterances that have the same general meaning or intent, like Tom saying ‘*I can’t see straight anymore*’ (Fludernik, 1993). The narrator is responsible for the wording of the sentence (Sanders & Redeker, 1996). Yet, the subject remains responsible for the content of the expression. The narrator may change the subject’s exact words, but not their intention.

The viewpoint lies with the narrator. This requires a deictic reorientation (Fludernik, 1993), which means that references to times, spaces and persons are reoriented as if they are observed from the narrator’s point of view. The subject is referred to in third-person and most of the time the tense shifts to past tense (26).<sup>23</sup> In addition, direct references to the ‘original’ wording of the subject – e.g. exclamations, incomplete sentences, question marks and exclamation points – are not present (Banfield, 1982).

(26) Tom said that he was tired.

As a matter of fact, SoC-phrases – like those that were used in Experiment 1<sup>24</sup> – are instances of the indirect style. Phrases like ‘*according to Tom*’ refer to the mental state of Tom without

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<sup>22</sup> See also Yao’s dissertation on mental simulation when processing direct and indirect speech (Yao, 2011).

<sup>23</sup> Usually, but not necessarily: “*He says that he is tired.*” is acceptable though this is usually constrained by context (e.g. in spoken discourse: “*What is he saying?*” “*He says that he is tired.*”).

<sup>24</sup> Although the SoC-phrases of Canestrelli et al. (2012) and Traxler, Sanford et al. (1997) can also be characterized as instances of indirect speech. Note that the conditions with modals used by Traxler, Sanford et al. are instances of the direct style (e.g. “*Perhaps the neighbors are not at home, because the lights are off.*”

giving a literal representation of what Tom is thinking. In (27) it is Tom who knows that the lights are off. In addition, just like in (26) he could have thought or said ‘*the lights are off*’ or something similar ‘*the whole house is dark*’. Therefore, (27) is an indirect presentation of Tom’s speech/thought act. However, as was discussed in Section 5.4.1 these indirect utterances may suffer from a scope-problem. When used in forward causal relations, the character whose thoughts are represented in the  $S_1$  does not have to be responsible for the content of the  $S_2$ . As can be seen in (28), the more classical form of the indirect style (‘*X said that ...*’) suffers from the same scope-problem as (27). The indirect style is not suited to mark subjectivity in forward causal relations, because it leaves in doubt where the responsibility of the subject ends and where the responsibility of the narrator begins.

(27) According to Tom the lights are off, so the neighbors are not at home.

(28) Tom said that the lights are off, so the neighbors are not at home.

PARAPHRASE: ‘Based on Tom stating that the lights are off, I conclude that the neighbors are not at home.’

### 6.3 The free indirect style

The free indirect style (FIS) is generally considered to be a mixture of the direct and the indirect style, since it has characteristics of both. It displays emotive language, exclamations and punctuation as in the direct style, but the subject is referred to in third-person and the tense shifts to past tense as in the indirect style (see (24) repeated below; Fludernik, 1993).

(24) Gosh, he was tired, Tom said/thought.

Rather than a complete deictic shift – to subject or narrator – the deictic center in FIS seems to blend between the two of them (see also ‘dual voice theory’; e.g. Banfield, 1982; Bray, 2007, Pascal, 1977). The subject is responsible for the content, but when it comes to the wording, responsibility is less clear. As a result, the viewpoint is theoretically ambiguous between subject and narrator. However, according to Sanders and Redeker (1996) by default the ‘subject interpretation’ is stronger than the ‘narrator interpretation’.

This assumption is in line with results of Bray (2007). In a very simple off-line study he asked students to identify the viewpoint of a FIS text fragment. Only 4 out of the 32 students identified the narrator as the voice of the fragment. The others were equally divided between ‘the subject’ and ‘both subject and narrator’. When asked to explain, the participants noted that it were the thoughts of the subject that were presented here, but that the narrator was involved as well (indicated by third-person). These results show that the participants were aware of the blend between subject and narrator.

#### 6.3.1 Implications of FIS

Mainly due to the blend, FIS is interpreted quite differently than the indirect and the direct style. Firstly, in the direct style the narrator is not responsible for content or wording (see Section 6.1). The narrator almost does not play a role. However, narrators have an important role in structuring the discourse (Banfield, 1982; Pascal, 1977). In a way, it is the narrator who decides how to tell the story, what is focused on, and which thoughts and descriptions to reveal. With the help of a narrator, the thoughts of a character can be presented coherently and overall the text unity is increased (e.g. Banfield, 1982; Pascal, 1977). While the indirect style gives free reign to the narrator, FIS minimizes the influence of the narrator when it comes to responsibility for wording without compromising the organizational function of the narrator.

Secondly, FIS has the ability to capture the inner most workings of a character's mind, without having to result to a verbatim account of events. As expressed by Fludernik (1993): "*free indirect discourse can effectually outline a character's mental situation, his or her emotional upheaval, and follow the train of thoughts and emotions through their turmoil to possible resolution*" (p.79-80) and by Banfield (1982): "*This style captures something about the nature of consciousness which cannot be represented either by casting it into a form with a new referent of the first person or by paraphrasing it in a propositional form. It articulates the movements of the mind, the 'stream of consciousness', in a way which avoids suggesting that the processes of reflection occur as inner speech or that consciousness can be reduced to the logical content of any propositions it contains.*" (p.138). This ability of FIS is very apparent when reading slightly longer FIS text fragments, like (29). This fragment seems to be a step-by-step account of the thoughts that go through someone's head. This causes the reader to experience a continuous stream of consciousness.<sup>25</sup>

(29)No. No. No. This could not be happening. Not now, not ever! He had worked to damn hard to lose it all now.

By creating such a stream of consciousness, every utterance will be regarded from the viewpoint of the subject. "*Perspective-neutral sentences, then, can fall within the scope of a perspective marker (...) The mental space model of perspective offers a description of perspective not only at local-sentence or main-clause level, but also at a more global level. Embedded perspective spaces may span several sequentially narrative events.*" (Sanders & Redeker, 1996, p.310). In other words, provided that the utterance does not break with the style or contains a marker that indicates a stop or shift of viewpoint, the utterance will be interpreted according to the lastly indicated perspective. As long as the free indirect perspective is well established, we can include causal relations and those will be interpreted from the subject's point of view (30). The reader is 'absorbed' into the stream of consciousness of the subject and this – combined with the fact that the role of the narrator has been brought back to the bare minimum – leads to the only possible interpretation with the subject as the SoC of the relation. Therefore – when performed adequately – expressions in the free indirect style do not suffer from a scope-problem.

(30)Look at the state of him! He looked a complete fright. He desperately hoped that no one would see him walking up to the house. Definitely not his nosy neighbors Mr. and Mrs. Smith.. Oh thank God! Their lights were off. So they were out. At last a bit of luck!

#### 6.4 Text types

Using FIS seems to be a very promising solution for marking subjectivity in forward causal relations. However, a 'simple' rewrite of the texts used in Experiment 1 into FIS will be unsatisfactory. The free indirect style is not very common in newspaper articles (Sanders & Redeker, 1996). A quick glance at the materials of Experiment 1 (see Appendix A) confirms the idea that a transformation of these materials is out of the question. As was discussed in Section 6.3.1, the FIS perspective must be well established before introducing a causal sequence. To accomplish this, almost the entire text must be written in FIS to create the feeling of a stream-of-consciousness. Even if this is possible, it would be hard to consider the

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<sup>25</sup> See Chafe (1994), but see also discussions surrounding the 'stream-of-consciousness' technique and 'monologue intérieur' (e.g. Bowling, 1950; Chatman, 1980).

outcome as an instance of a typical newspaper article. These texts might threaten the ecological validity of the experiment.

In contrast, in narrative genres the use of FIS is widely accepted. Narratives are usually layered, with references to characters', narrators' and sometimes even author's beliefs, thoughts and feelings (Banfield, 1982). FIS is used here to represent the thoughts and beliefs of these SoCs. Thus, we should stay true to the way in which FIS is naturally used and embed forward causal relations in short narratives, rather than in news articles.

## 7. Experiment 2

Forty new experimental texts were created.<sup>26</sup> Of each text a neutral and a subjective version was made. Before using these materials in a second eye movement registration study, the materials were evaluated to see if they satisfied the following conditions:

1. The connective *daardoor* as well as the connective *dus* lead to an acceptable sequence in both versions of the text.
2. In relations marked with *dus*, the character is designated as the SoC of the causal relation.

All materials were checked and approved by two outside experts.<sup>27</sup> However, during this evaluation one of the experts remarked that a connective like *nu* [now] may be a better fit in the subjective contexts than a causal connective. *Nu* is a temporal connective that directly refers to the deictic centre. It is more inherently bound to the present action than the causal connectives. As such, *nu* might fit better within the continuous stream of consciousness which is created by the use of FIS.

Although the experts agreed that both connectives were possible in the texts, there was some concern whether the suitability of the connectives depended on the style of the text. The connective *dus* marks a reasoning process of a SoC. As was shown in Section 6.3, FIS is often used to reflect deliberations. Therefore, *dus* might be more fitting in a FIS text than in a neutral text. If so, any difference in processing times could be due to the effect of the style and not due to the marking of the subjectivity of the relation. To see whether these critiques are valid, a preliminary off-line experiment was carried out. This multiple choice cloze experiment is described below.

### 7.1 Hypotheses

The following hypotheses are tested:

- H4: Participants will prefer the connective *daardoor* above the connective *dus*, independent of the context. They will recognize the underlying relation as an objective relation and will choose the prototypical marker which is *daardoor* (see Section 2.1).

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<sup>26</sup> These materials were created by me in tandem with my supervisors prof. dr. Ted Sanders and dr. Pim Mak.

<sup>27</sup> Special thanks to dr. José Sanders (Radboud University Nijmegen) and dr. Frank Jansen (Utrecht University) for their time and input.

H5: The odds ratio of *daardoor* versus *dus* will not differ between contexts. That is the style will not influence the acceptability of the connective.

H6: The choice for *daardoor* and *dus* will overall be lower in the subjective context compared to the neutral context due to the fact that *nu* is a likely competitor in that context.

## 7.2 Method

### 7.2.1 Participants

Responses of 28 Dutch students at Utrecht University were collected (23 female – 5 male). Mean age was 22 years (range: 17 – 29). They participated as part of a course requirement.

### 7.2.2 Materials

A total of 40 Dutch forward causal relations were created, that could be marked by the connective *daardoor* [as a result] as well as the connective *dus* [so].<sup>28</sup> The causal relations were then embedded in a subjective narrative context (31) and a neutral narrative context (32). The contexts were thematically the same. Both described the same events but either from the viewpoint of the character (subjective) or as a factual description given from the viewpoint of a neutral observer/narrator (neutral).

#### *Subjective context*

(31) Ruben reed naar de elektronicazaak. Asjemenou! Die vorm, die kleur, dat beeld, dat was het helemaal! Daar stond de televisie van zijn dromen. En wat een geluk: de winkel hield een geweldige kortingsactie. [.....] was hij veel goedkoper uit dan normaal. Dat moest voorbestemd zijn!

‘Ruben drove to the electronics store. Wow! That shape, that color, that screen, that was it! There stood the television set of his dreams. And how lucky, the store had an incredible sale. [.....] he saved a lot of money. This was mend to be.’

#### *Neutral context*

(32) Ruben reed naar de elektronica zaak. Hij ging een nieuwe televisie aanschaffen. De winkel hield een kortingsactie. [.....] was hij veel goedkoper uit dan normaal. De LCD-televisies waren sterk afgeprijsd.

‘Ruben drove to the electronics store. He went to buy a new television set. The store had a sale. [.....] he saved a lot of money. The LCD-sets were now sharply priced.’

The texts described common situations in and around the house and workplace (e.g. overflowing the bathtub, public transport delays, failing network connections) and consisted of approximately 6 sentences (see Appendix B). The first sentence (introducing the character) and the second to last sentence (the S<sub>2</sub>) were identical in both contexts. In the subjective context the other sentences were written in the free indirect style (see Section 6.3) and subjectivity was enhanced by including exclamations (e.g. “o”, “wow” and “yes”), evaluative adjectives and evaluative adverbs (e.g. “beautiful”, “finally” and “really”; see Conrad & Biber, 2001). In the neutral context no exclamations were used and the use of evaluative

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<sup>28</sup> Depending on the connective the type of relation changes (see Section 4.1).

adjectives and adverbs was severely limited.<sup>29</sup> The S<sub>1</sub> was kept as similar as possible between contexts, but subjectivity was slightly enhanced in the subjective version by including some of the previously mentioned subjectivity indicators.

In this experiment the texts were adapted to serve in a multiple choice cloze test (see Appendix C). The causal connectives were replaced with a gap.

### 7.2.3 Design

A repeated measures design was used with one two-leveled factor (i.e. *Context*). The items were divided over two lists as in a Latin-Square design. As a result, participants read every item: 20 of them in a subjective context, the other 20 in a neutral context. Every list was presented in two different orders and supplemented with 32 filler items.

### 7.2.4 Procedure

The cloze test was administered for all participants simultaneously in a classroom at Utrecht University. Participants were instructed to choose the connective that – in their opinion – fitted the best in the gap. They were given four possibilities: *zo* [that way/directly], *daardoor* [as a result], *nu* [now] and *dus* [so]. They were asked to not overthink their answer and to give their first impression.

### 7.3 Results

A Multinomial Logistic Regression (MLR) analysis was performed.<sup>30</sup> *Context* (subjective/neutral) was included as a fixed factor. In addition, for each participant it was calculated how often (s)he chose a specific connective. This probability was entered into the model to simulate random effects of personal preference. The same was done for each item. This procedure resulted in eight additional fixed factors (from now on the *participant* and *item characteristic factors*).

#### 7.3.1 Responses

Table 6 shows the number of times each connective was chosen, given a certain context. All hypotheses bore out. There was a clear preference for the connective *daardoor* in both contexts (H4). Overall participants recognized the underlying objective causal relation and choose accordingly. Only in a fifth of the cases the subjective connective *dus* was picked.

As H6 predicted the percentage of *daardoor* was severely lower when the relation was embedded in a subjective context than in an objective context and *nu* was in fact the second most preferred connective in that context.

Table 6: Count and percentage of the responses per context

	Daardoor		Dus		Nu		Zo	
	Count	Perc.	Count	Perc.	Count	Perc.	Count	Perc.
<b>Subjective context</b>	250	44,6%	86	15,4%	161	28,8%	63	11,2%
<b>Neutral context</b>	353	63,0%	118	21,1%	62	11,1%	27	4,8%

<sup>29</sup> Not all evaluative words could be omitted. Certain ‘low level’ evaluative words like “*long*” were used in the neutral context. However, ‘high level’ evaluative words (e.g. “*terrible*”) were never used in this context.

<sup>30</sup> Originally a Multinomial Logistic Mixed Model (MLMM) with *subjects* and *items* as crossed random effects and *context* as a fixed factor was used to model the responses. However, results of this analysis were found to be unreliable due to a Hessian Matrix error. Efforts to resolve this error were unsuccessful. To mimic the random effects to some degree, subjects’ and items’ characteristics were calculated and added to the model.



The MLR confirmed that *Context* was a significant factor for predicting differences between *daardoor* and *nu* ( $\beta = -1.77$ ,  $SE = 0.20$ ,  $p < 0.001$ ,  $Exp\beta = 0.17$ ), as well as for *daardoor* and *zo* ( $\beta = -1.62$ ,  $SE = 0.29$ ,  $p < 0.001$ ,  $Exp\beta = 0.20$ ). In both cases, the probability of *nu* and *zo* decreased if the item was presented in a neutral context. As predicted by H5, no effect of *Context* was found for *dus* ( $\beta = 0.04$ ,  $SE = 0.20$ ,  $p = 0.83$ ,  $Exp\beta = 1.04$ ). The odds ratio was the same in subjective and neutral contexts.

Inclusion of *participant* and *item characteristic factors* resulted in a model that accounted for 50,2% of the variance<sup>31</sup> and predicted outcomes correctly in 66,9% of the cases (see Table 7). Without these characteristics, only 7% of the variance was explained and only 53,8% of the outcomes were predicted correctly. The final model can be found in Appendix D.

Table 7: Model's prediction

Observed	Predicted				Percent Correct
	<i>zo</i>	<i>daardoor</i>	<i>Nu</i>	<i>dus</i>	
<i>zo</i>	31	39	16	4	34,4%
<i>daardoor</i>	10	507	44	42	84,1%
<i>nu</i>	9	85	119	10	53,4%
<i>dus</i>	7	98	7	92	45,1%
Overall Percentage	5,1%	65,1%	16,6%	13,2%	66,9%

#### 7.4 Conclusion and discussion

The fact that participants chose *nu* [now] more often in the subjective context than in the objective context shows that style does influence the choice of a connective. In the free indirect style certain underspecified connectives with a strong connection to the deictic centre can be preferred above fully specified connectives. Although *nu* is a significant competitor in subjective contexts, it is still easily surpassed by the choice for *daardoor*. In addition, summing the counts for *daardoor* and *dus* shows that still in 60% of the cases a causal connective was chosen, which is the doubled amount compared to *nu*. So even though *nu* is a good fit in these sequences, it is not necessarily a better fit. More importantly, since the odds ratio between the two causal connectives did not differ between contexts, any processing advantage for *daardoor* due to the higher preference compared to *dus* should be equal for both context. In conclusion, the overall preference for *daardoor* is in line with corpus and prior experimental research (see Section 2.1), which have found that *daardoor* is the prototypical connective to mark objective causal relations. The results provide further evidence for the view that causal connectives are not randomly selected, but used in prototypical ways to denote a certain type of causal relation (see Sections 1 and 2).

## 8. Experiment 3

The materials used in Experiment 2 were used in another experiment. In this eye movement registration study the effects of two factors (*Connective* and *Context*) on fixation times of forward causal relations were investigated.

### 8.1 Hypotheses

The subjective context was hypothesized to work in the same way as SoC-phrases in experiments of Traxler, Sanford et al. (1997) and Canestrelli et al. (2012). Thus, an interaction between the connective and the context is expected:

<sup>31</sup> Cox & Snell's  $R^2$ , see Field (2009)

H7: In a neutral context, the connective *daardoor* will lead to faster processing of the region just after the connective compared to *dus*.

H8: In a subjective context, the difference in processing times described in H7, will diminish or even completely disappear.

## 8.2 Method

### 8.2.1 Participants

Eye movement data of 40 native speakers of Dutch were collected (32 female – 8 male). All participants were students at Utrecht University. Mean age was 21 years (range: 19 – 31). The participants had normal or corrected to normal vision. They received course credit for their participation.

### 8.2.2 Materials

The same texts as in Experiment 2 were used only now the gap was replaced by either the connective *dus* or *daardoor*. This resulted in four different versions for each text (see Table 8).

Table 8: Text versions used in Experiment 3

Context	Connective	Example
<b>Subjective</b>	<i>Daardoor</i>	Ruben reed naar de elektronicazaak. Asjemenou! Die vorm, die kleur, dat beeld, dat was het helemaal! Daar stond de televisie van zijn dromen. En wat een geluk: de winkel hield een geweldige kortingsactie. <u>Daardoor</u> was hij veel goedkoper uit dan normaal. Dat moest voorbestemd zijn! ‘Ruben drove to the electronics store. Wow! That shape, that color, that screen, that was it! There stood the television set of his dreams. And how lucky, the store had an incredible sale. <u>As a result</u> he saved a lot of money. This was mend to be.’
	<i>Dus</i>	Ruben reed naar de elektronicazaak. Asjemenou! Die vorm, die kleur, dat beeld, dat was het helemaal! Daar stond de televisie van zijn dromen. En wat een geluk: de winkel hield een geweldige kortingsactie. <u>Dus</u> was hij veel goedkoper uit dan normaal. Dat moest voorbestemd zijn! ‘Ruben drove to the electronics store. Wow! That shape, that color, that screen, that was it! There stood the television set of his dreams. And how lucky, the store had an incredible sale. <u>So</u> he saved a lot of money. This was mend to be.’
<b>Neutral</b>	<i>Daardoor</i>	Ruben reed naar de elektronica zaak. Hij ging een nieuwe televisie aanschaffen. De winkel hield een kortingsactie. <u>Daardoor</u> was hij veel goedkoper uit dan normaal. De LCD-televisies waren sterk afgeprijsd. ‘Ruben drove to the electronics store. He went to buy a new television set. The store had a sale. <u>As a result</u> he saved a lot of money. The LCD-sets were now sharply priced.’
	<i>Dus</i>	Ruben reed naar de elektronica zaak. Hij ging een nieuwe televisie aanschaffen. De winkel hield een kortingsactie. <u>Dus</u> was hij veel goedkoper uit dan normaal. De LCD-televisies waren sterk afgeprijsd. ‘Ruben drove to the electronics store. He went to buy a new television set. The store had a sale. <u>So</u> he saved a lot of money. The LCD-sets were now sharply priced.’

### 8.2.3 Design

A 2(Connective)x2(Context)-factorial design was used. The items were divided over four lists, as a Latin-Square. As a result, participants read every item but only in one condition. Every list was presented in two different orders and divided into four blocks. The lists were supplemented with 36 filler items. 9 filler items were followed with a verification statement to keep the participants alert. The items and fillers were evenly distributed throughout the blocks (i.e. 19 stimuli per block).

### 8.2.4 Apparatus

The eye movements of the participants were recorded with a desktop eye tracker: a SR Research EyeLink 1000. The eye tracker recorded the position of the right pupil<sup>32</sup> via a Logitech QuickCam Pro 5000 webcam at a rate of 500Hz. A remote setup with target sticker was used. Neither a bite bar nor a chin rest was used, so participants could move their head. Accuracy of this eye tracker is 0,5 degrees. Stimuli were presented on a 19 inch computer screen.

### 8.2.5 Procedure

Recording took place at the eye tracking laboratory of the Utrecht institute of Linguistics OTS (UiL OTS). Each participant received an oral instruction during which the equipment and procedure were explained. The participants were instructed to read each item at their own pace, but to make sure that they could verify statements concerning the content of the item.

The instruction was followed by a 13-point calibration and validation procedure. Participants fixated on a sequence of dots which appeared on various locations on the computer screen. After a successful calibration and validation sequence the testing started with four practice items to familiarize the participant with the procedure. The calibration procedure was repeated after every block.

Each item started with a single dot on the screen, which indicated the location of the first word of the item. When the participant fixated on the dot, the dot vanished and the text appeared. To progress to the next item participants pressed the ‘next’ button on the button-box. To verify statements participants pressed either the ‘yes’ or the ‘no’ button on the button box.

### 8.2.6 Data preparation and clean-up

Each item was divided into 8 regions (33). Regions 2 to 5 are equal in all conditions (see 9.2.2 materials). Region 4 was absent for most items (see (36)), but was sometimes included to ensure that the spill over region (region 3) was of similar length for all items. Effects were expected in region 2 only (see Section 8.1). All other regions will be analyzed, but results will only be given if an effect was observed.

Region 2 contained the first two words after the connective (usually a verb and a pronoun). In case of a verb longer than 4 letters, only the verb was included in this region.<sup>33</sup> The region was presented neither at the beginning nor at the end of a line and did not include line breaks.<sup>34</sup>

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<sup>32</sup> For 3 participants a switch was made to the left eye to insure a more stable registration.

<sup>33</sup> Note that this region is much smaller compared to the same region in Experiment 1.

<sup>34</sup> As in Experiment 1, the same was done for region 5.

(33)<sup>0</sup>[Ruben reed naar de elektronicazaak. Asjemenou! Die vorm, die kleur, dat beeld, dat was het helemaal! Daar stond de televisie van zijn dromen. En wat een geluk: de winkel hield een geweldige kortingsactie.] <sup>1</sup>[Daardoor] <sup>2</sup>[was hij] <sup>3</sup>[veel goedkoper] <sup>4</sup>[uit dan] <sup>5</sup>[normaal.] <sup>6</sup>[Dat moest] <sup>7</sup>[voorbested zijn!]

Fixations were checked and assigned to their corresponding regions with the help of a computer program named *Fixation* (version 0.1.0.15). *First fixation duration* (FF), *First pass reading time* (FP), *First pass total reading time* (FPT), *Regression path duration* (RP) and *Regression probability* (RPP) per region were calculated (see Table 3; Section 5.2.6). Fixation times that were either two standard deviations above or below a person's or item's mean, as well as times that included blinks, were discarded. Skipped regions were regarded as missing data.

### 8.3 Results

Effects on *first fixation duration*, *first pass reading time*, *regression path duration* and *first pass total reading time* were analyzed with Linear Mixed Effects Regression analyses (LMER) using the restricted maximum likelihood method. Effects on *regression probability* were analyzed with Generalized Linear Mixed Model analyses (GLMM) using the Laplace approximation. *Subjects* and *items* were included as crossed random factors. *Context* (subjective/neutral), *Connective* (daardoor/dus) and their interaction were included as fixed factors. As in Experiment 1, a log-transformation was carried out before analyzing the data. Significance was estimated using Markov Chain Monte Carlo (MCMC) sampling. Directions of significant interactions were determined by running additional analyses. During these analyses new models were created. In these models the predictors *Context* and *Connective* were replaced by a new predictor called 'Condition'. This predictor combined *Context* and *Connective* into a single four-leveled predictor. The significance of the individual contrasts was tested by a Tukey-test (see Section 5.3).<sup>35</sup>

Mean *first fixation duration*, *first pass reading time*, *regression path duration* and *first pass total reading time* are given in Table 9 and mean *regression probability* is given in Table 10.

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<sup>35</sup> Note: Only contrast pairs in which the elements share the same context or connective are given (i.e. *daardoor* in subjective context will not be compared to *dus* in neutral context).

Secondly, since these models do not include main effect predictors (i.e. *Context* and *Connective*) estimates should not be interpreted together with estimates from the initial model.

Table 9: Means and standard deviations in ms of first fixation duration (FF), first pass reading time (FP), regression path duration (RP) and first pass total reading time (FPT)

Measure	Context	Connective	Region 0	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6	Region 7
<b>FF</b>	Subjective	Daardoor	372 (89)	212 (67)	208 (62)	207 (56)	210 (46)	215 (90)	211 (58)	213 (90)
	Subjective	Dus	376 (98)	212 (79)	213 (71)	205 (55)	222 (62)	217 (78)	226 (83)	212 (85)
	Neutral	Daardoor	375 (92)	208 (47)	203 (50)	204 (54)	244 (115)	224 (83)	226 (85)	210 (79)
	Neutral	Dus	369 (94)	221 (88)	215 (60)	216 (74)	226 (67)	220 (85)	230 (84)	210 (73)
<b>FP</b>	Subjective	Daardoor	6737 (2357)	241 (92)	228 (93)	300 (171)	272 (132)	262 (135)	265 (124)	1368 (763)
	Subjective	Dus	6537 (2250)	218 (96)	254 (111)	315 (189)	308 (186)	282 (159)	266 (122)	1385 (820)
	Neutral	Daardoor	5097 (1951)	240 (84)	223 (79)	298 (145)	314 (146)	281 (146)	273 (122)	1258 (622)
	Neutral	Dus	4736 (1820)	229 (91)	271 (145)	321 (191)	288 (144)	281 (151)	284 (158)	1264 (651)
<b>RP</b>	Subjective	Daardoor	6737 (2357)	267 (152)	243 (103)	326 (209)	285 (146)	306 (198)	264 (129)	1665 (975)
	Subjective	Dus	6537 (2250)	244 (112)	276 (155)	375 (287)	345 (234)	353 (251)	273 (151)	1686 (972)
	Neutral	Daardoor	5097 (1951)	254 (125)	245 (149)	333 (185)	367 (240)	336 (212)	274 (132)	1593 (873)
	Neutral	Dus	4736 (1820)	276 (138)	303 (205)	369 (252)	330 (228)	361 (276)	292 (176)	1608 (834)
<b>FPT</b>	Subjective	Daardoor	6737 (2357)	227 (81)	225 (90)	288 (165)	262 (131)	248 (120)	257 (114)	1273 (779)
	Subjective	Dus	6537 (2250)	216 (95)	240 (97)	278 (157)	301 (188)	250 (118)	259 (109)	1313 (834)
	Neutral	Daardoor	5097 (1951)	228 (77)	217 (70)	287 (140)	299 (139)	265 (136)	266 (115)	1162 (615)
	Neutral	Dus	4736 (1820)	221 (88)	257 (128)	301 (176)	267 (127)	258 (137)	282 (157)	1182 (681)

Table 10: Mean regression probability (RPP)

Measure	Context	Connective	Region 0	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6	Region 7
<b>RPP</b>	Subjective	Daardoor	-	0.07	0.09	0.08	0.06	0.14	0.01	0.54
	Subjective	Dus	-	0.11	0.09	0.19	0.10	0.22	0.01	0.52
	Neutral	Daardoor	-	0.05	0.10	0.13	0.14	0.18	0.02	0.58
	Neutral	Dus	-	0.18	0.12	0.16	0.12	0.22	0.01	0.57

### 8.3.1 Effects of 'Context' and 'Connective'

The fixation means depicted in Table 9 seem to indicate an interaction effect between *Context* and *Connective* in regions 1 and 2. However, closer inspection revealed that only in region 1 this interaction was significant.

In region 1 – the region containing the connective – a significant interaction effect was found for *regression path duration* (RP:  $\beta = -0.06$ , SE= 0.02,  $p(\text{MCMC}) < 0.01$ ) as well as a marginally significant interaction effect for *regression probability* ( $\beta = -1.15$ , SE= 0.64,  $p = 0.07$ ,  $\text{Exp}\beta = 0.32$ ). Additional analyses showed that *dus* had a shorter *regression path duration* in a subjective context compared to a neutral context (RP:  $\beta = 0.05$ , SE= 0.02,  $p(\text{Tukey}) < 0.05$ ), while for *daardoor* it did not matter in which context the connective was placed ( $\beta = -0.01$ , SE= 0.01,  $p(\text{Tukey}) = 0.82$ ). In addition, in a subjective context *dus*'s RP is faster than that of *daardoor* (RP:  $\beta = -0.04$ , SE= 0.02,  $p(\text{Tukey}) < 0.05$ ), but in a neutral context there is no difference between the connectives (RP:  $\beta = 0.02$ , SE= 0.02,  $p(\text{Tukey}) = 0.72$ ). For *regression probability* the analyses showed that in a neutral context RPP was higher for *dus* than for *daardoor* (RPP:  $\beta = 1.71$ , SE= 0.45,  $p(\text{Tukey}) < 0.001$ ,  $\text{Exp}\beta = 5.53$ ), while in a subjective context there was no difference between the connectives (RPP:  $\beta = 0.65$ , SE= 0.46,  $p(\text{Tukey}) = 0.61$ ).

In region 2 – the region succeeding the connective – there was only an overall main effect of *Connective* (FF:  $\beta = 0.02$ , SE= 0.01,  $p(\text{MCMC}) < 0.005$ ; FP:  $\beta = 0.06$ , SE= 0.01,  $p(\text{MCMC}) < 0.001$ ; RP:  $\beta = 0.06$ , SE= 0.01,  $p(\text{MCMC}) < 0.001$ ; FPT:  $\beta = 0.05$ , SE= 0.01,  $p(\text{MCMC}) < 0.001$ ).<sup>36</sup> Fixation durations on the region were shorter for the connective *daardoor* compared to the connective *dus*. No main effects or interaction effects for *Context* were found to be significant. These results are in line with H7 but not with H8.

Some additional effects were found in regions 3 and 5. In region 3 analyses of the *first fixation duration* showed an interaction of *Connective* and *Context* (FF:  $\beta = -0.03$ , SE= 0.01,  $p(\text{MCMC}) < 0.05$ ). *First fixation duration* was marginally higher for *dus* in a neutral context compared to a subjective context ( $\beta = 0.02$ , SE= 0.01,  $p(\text{Tukey}) = 0.07$ ), but for *daardoor* FF did not differ between contexts ( $\beta = -0.00$ , SE= 0.01,  $p(\text{Tukey}) = 0.97$ ). Secondly, while in a neutral context *dus* was marginally slower than *daardoor* ( $\beta = 0.02$ , SE= 0.01,  $p(\text{Tukey}) = 0.06$ ), no difference was found between the connectives in a subjective context ( $\beta = -0.00$ , SE= 0.01,  $p(\text{Tukey}) = 0.98$ ). In addition, for *first pass reading time*, *regression path duration* and *regression probability* main effects of *Connective* were found. FP and RP were faster in the *daardoor*-conditions (FP:  $\beta = 0.02$ , SE= 0.01,  $p(\text{MCMC}) < 0.05$ ; RP:  $\beta = 0.04$ , SE= 0.01,  $p(\text{MCMC}) < 0.01$ ) and the chance of a fixation was lower in this condition (RPP:  $\beta = 0.62$ , SE= 0.20,  $p < 0.05$ ,  $\text{Exp}\beta = 1.85$ ).

In region 5, an interaction effect for *regression path duration* was found (RP:  $\beta = 0.05$ , SE= 0.05,  $p(\text{MCMC}) < 0.05$ ). Additional analyses showed that in a subjective context, *daardoor* has a shorter *regression path duration* than *dus* ( $\beta = 0.05$ , SE= 0.02,  $p(\text{Tukey}) < 0.05$ ), but in a neutral context there was no difference between the connectives ( $\beta = 0.00$ , SE= 0.02,  $p(\text{Tukey}) = 1.00$ ). A main effect for *Connective* was found for *Regression probability* ( $\beta = 0.43$ , SE= 0.15,  $p < 0.005$ ,  $\text{Exp}\beta = 1.54$ ). Readers regressed less in the *daardoor*-conditions than in the *dus*-conditions.

### 8.4 Conclusion and discussion

The results of Experiment 3 show two opposite motions. On the one hand we find interaction effects that indicate that subjective contexts help processing relations marked with the connective *dus*. On the other hand we find that relations with *daardoor* are processed faster than *dus* relations, regardless of the context.

<sup>36</sup> Only for RPP there was no main effect of *Connective* in this region (RPP:  $\beta = 0.15$ , SE= 0.22,  $p = 0.49$ ).

We find an interaction effect at the point of the connective, which confirms that subjective contexts speed up processing of *dus* relations. Yet, immediately afterwards we find an overall facilitating effect of *daardoor* in objective as well as in subjective contexts.

A possible explanation for this latter effect is that as a processing instruction, *daardoor* offers a more specific instruction than *dus*. *Daardoor* can only signal objective cause-effect relations (i.e. non-volitional content relations; e.g. Pander Maat & Sanders, 2000). Conversely, *dus* can mark a number of subjective relations, among which are argument-claim relations, paraphrases and summarizations (Evers-Vermeul, 2010; Pander Maat & Sanders, 2000). Although all of these latter relations require a subjective configuration, *dus* does not pick out one specific relation like *daardoor* does. According to Sanders's (2005) 'Specific Connective hypothesis': "*the more specific the connective is, the easier it is to process the following information.*". This means that while the subjective context did evoke a subjective mental space configuration, this configuration was not fine-grained enough to fit only the argument-claim relation we were aiming for.

To see whether these effects cancel each other out, additional analyses were run. The question was whether the interaction effect for *regression path duration* in region 1 survives when fixation times of region 1 and 2 are aggregated.<sup>37</sup> The interaction of *Connective* with *Context* was significant ( $\beta = -0.07$ ,  $SE = 0.02$ ,  $p(\text{MCMC}) < 0.01$ ). The effect was strong enough to survive in the aggregated region. *Dus* only had a longer *regression path duration* in a neutral context ( $\beta = 0.07$ ,  $SE = 0.02$ ,  $p(\text{Tukey}) < 0.005$ ) and not in a subjective context ( $\beta = -0.00$ ,  $SE = 0.02$ ,  $p(\text{Tukey}) = 1.00$ ). This finding is in line with H7 and H8; the subjective context diminished the processing delay between subjective and objective relations found in neutral contexts.

## 9. General discussion

The purpose of the present study was to replicate and provide additional evidence for the processing asymmetry between subjective and objective causal relations as described by Canestrelli et al. (2012), Traxler, Bybee et al. (1997) and Traxler, Sanford et al. (1997). They found that backward subjective causal relations are processed slower than objective causal relations, but when the subjectivity is marked beforehand the processing asymmetry disappears. Drawing from the Mental Space Theory of Fauconnier (1985), this asymmetry was hypothesized to originate from differences in the evoked mental space configurations. In contrast with previous studies, the present focused on forward causal relations. It was assumed that forward causal relations are conceptually the same as backward relations and that only the linguistic realization is altered. As in backward relations, the reader has to infer the presence of a SoC and evoke a SoC space when processing a forward subjective condition, while in case of a forward objective relation the realization can be interpreted directly in the linguistic base. If correct, we should be able to replicate the findings for backward relations for forward relations.

In addition, a causal relation can be explicitly marked by a connective. These connectives serve as processing instructions, telling the reader exactly what to expect from the upcoming text segment. In Dutch there are different connectives to mark objective and subjective relations. It was proposed that this information is encoded in the connectives and that it is used directly while processing causal relations (Canestrelli et al., 2012). As a result,

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<sup>37</sup> Cases for which RP of one of the regions was missing were treated as missing cases.

in Dutch the processing asymmetry shows up at the point of the connective, since this signals the set up of either a subjective or an objective mental space configuration. In forward relations the connective *daardoor* is the prototypical marker for objective relations, while *dus* is the prototypical marker of highly subjective relations. It was hypothesized that substituting *daardoor* by *dus* would cause readers to slow down right after the connective was read.

In two eye movement registration studies reported here, evidence was collected to verify the assumptions presented above. The first experiment replicated the findings of Canestrelli et al. (1997), Traxler, Bybee et al. (1997) and Traxler, Sanford et al. (1997) with regard to the processing asymmetry between subjective and objective relations. Subjective relations were read slower than objective relations. Readers slowed down immediately after the connective. In addition, the experiment corroborates findings of corpus studies and substitution tests that Dutch causal connectives mark different types of causality. Substitution of the causal connective *daardoor* by the causal connective *dus*, results in the sequence being processed differently. This supports the view that causal connectives differ in their exact meaning and processing instruction. The results of Experiment 1 were inconclusive with regard to the effect of subjectivity marking on the processing of causal relations. Using Mental Space Theory as a descriptive and explanatory framework, this could be related to issues of multi-layered responsibility in (narrative) discourse. Responsibility is often blended between narrator and character, giving rise to different interpretations. The SoC-phrases used in Experiment 1 may have led to a different allocation of responsibility than originally predicted.

Drawing further from insights of literary science, a second experiment was set up which used the free indirect style (FIS) to create a continuous stream-of-consciousness in which the causal relation was embedded. Hypothetically, this ‘subjective context’ should open up a SoC space within the mental representation that is stable (and foregrounded) enough so that the entire causal relation can be seamlessly interpreted within the SoC space. As such, it should diminish the processing delay found for subjective relations. The results showed that in a neutral context, objective relations were again processed faster than subjective relations. However, in subjective contexts this effect diminished. In contrast to Canestrelli et al. (2012) and Traxler, Sanford et al. (1997), the asymmetry did not completely disappear. It may be that *daardoor* as a processing instruction gives a more specific instruction than *dus*. Since Traxler et al. only used the underspecified connective *because*, this was not an issue in their studies. In addition, Canestrelli et al. used *omdat* and *want* as indicators of objective and subjective relations respectively. *Omdat* is less specific than *want*, since it can mark slightly subjective as well as objective relations (Pander Maat & Sanders, 2000; 2001; Sanders, 2005). Because of this, if specificity interacted with the results, it would have caused the processing asymmetry in Canestrelli’s et al. experiment to be smaller in the first place; making it more likely that the effect would completely disappear.<sup>38</sup>

Nevertheless, marking the subjectivity of a relation by placing the relations in a FIS context seems to generate the same kind of effect as placing SoC-phrases or modals in the  $S_1$  of a causal relation. All these markings reduce the processing asymmetry between objective and subjective causal relations. This provides additional support for the subjectivity account. If the processing delay was not caused by the introduction of a Subject of Consciousness, than these markings should not have had an effect. Language users distinguish different types of causality based on their subjectivity and specifically choose a connective that is associated

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<sup>38</sup> When comparing *omdat* and *want*, subjectivity and specificity work in different directions. *Omdat* is advantaged because it signals mainly objective relations, but disadvantaged because it loses in specificity. *Want* is disadvantaged because it signals a subjective relation, but advantage because it is specific. For *daardoor* and *dus* this is different. Subjectivity and specificity work in the same direction: against *dus*.



this level of subjectivity. This demonstrates that cognitive and linguistic structures are tightly linked.

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