



Suzanne Kleijn*, Willem M. Mak and Ted J. M. Sanders

Causality, subjectivity and mental spaces: Insights from on-line discourse processing

<https://doi.org/10.1515/cog-2018-0020>

Received June 25, 2020; accepted November 15, 2020;

published online December 21, 2020

Abstract: Research has shown that it requires less time to process information that is part of an objective causal relation describing states of affairs in the world (*She was out of breath because she was running*), than information that is part of a subjective relation (*She must have been in a hurry because she was running*) expressing a claim or conclusion and a supporting argument. Representing subjectivity seems to require extra cognitive operations.

In Mental Spaces Theory (MST; Fauconnier, Gilles. 1994. *Mental spaces: Aspects of meaning construction in natural language*. Cambridge: MIT Press) the difference between these two relation types can be described in terms of an extra mental space in the discourse representation of subjective relations: representing the Subject of Consciousness (SoC). In processing terms, this might imply that the processing difference is not present if this SoC has already been established in the discourse. We tested this prediction in two eye tracking experiments. The results of Experiment 1 showed that signaling the subjectivity of the relation by introducing a subject of consciousness beforehand did not diminish the processing asymmetry compared to a neutral context. However, the relative complexity of subjective relations was diminished in the context of Free Indirect Speech (*No! He was absolutely sure. There was no doubt about it. She was running so she was in hurry*; Experiment 2).

In terms of MST and the representation of subjectivity in general, this implies that not only creating a representation of a thinking subject, but also assigning a claim to this thinking subject requires extra processing effort.

Keywords: causality; connectives; free indirect speech; mental spaces theory; subjectivity

*Corresponding author: **Suzanne Kleijn**, Department of Languages, Literature and Communication, Utrecht University, Trans 10, 3512 JK Utrecht, The Netherlands, E-mail: s.kleijn1@uu.nl. <https://orcid.org/0000-0003-3613-1507>

Willem M. Mak and Ted J. M. Sanders, Department of Languages, Literature and Communication, Utrecht University, Trans 10, 3512 JK Utrecht, The Netherlands, E-mail: w.m.mak@uu.nl (W.M. Mak), t.j.m.sanders@uu.nl (T.J.M. Sanders)

1 Introduction

The notion of *Mental Spaces* (Fauconnier 1994; Sweetser and Fauconnier 1996) has shown to be a fruitful cognitive linguistic contribution to both linguistically and cognitively inspired studies of discourse representation. Mental space configurations are taken to be dynamic and to change from one moment in discourse to the next. During discourse interpretation, various linguistic expressions set up new spaces, reactivate existing spaces and add to already active spaces. These cognitive operations have been used in cognitive linguistic theory to provide explanations for the actual cognitive operations. For instance, the meaning and use of various types of discourse connectives has been explained in terms of mental spaces. Contrastive connectives have been analyzed as elements that block inferences (such as *but*) (Fauconnier 1994; Spooren 1989; Verhagen 2005), conditional constructions like *if ... then*, can function as space-builders that typically establish new mental spaces (Dancygier and Sweetser 2005), and causal connectives can set up epistemic spaces which represent reasoning of a speaker or author (Sanders et al. 2009, 2012; Verhagen 2005). Here, we focus on causal connectives and how they drive cognitive operations. We set out to establish falsifiable claims about how a Mental Spaces account would be reflected in language processing. We investigate whether different cognitive operations that are proposed in Mental Spaces Theory can be observed in online language processing.

We use precise psycholinguistic experiments to investigate the role of causal connectives during on-line discourse processing. This is done against the background of an increasing number of studies showing the on-line function of connectives. Connectives are often regarded as processing instructions, providing information on the coherence relation that connects segments. Eye-tracking and reading time studies have shown how the integration of the segments is sped up in the presence of causal connectives (Cozijn et al. 2011; van Silfhout et al. 2014). Still, this general function of ‘integration’ does hardly do justice to the many systematic differences linguists have identified in the connective lexicons of various languages (Stukker and Sanders 2012; Li et al. 2013). In the case of causal connectives, there is a vast amount of theoretical and corpus work showing that connectives vary in the amount of subjectivity that is expressed. Eye-tracking studies indicate that language users use this information immediately when processing a causal relation (Canestrelli et al. 2013; Wei et al. 2019). Objective and subjective connectives provide different processing instructions, causing readers to slow down when encountering a subjective connective. In the present study we delve deeper in the exact processing instructions these connectives give and how these instructions might translate into different cognitive operations. In two eye-tracking

studies, we compare processing times of Dutch forward causal relations marked with the subjective connective *dus* ‘so’ or the objective connective *daardoor* ‘as a result’. Below, we first discuss the differences between subjective and objective relations and connectives. Then, we relate these differences to Mental Spaces Theory to develop a dynamic account of discourse processing which is tested in two experimental studies.

2 Causality and subjectivity in discourse

According to the subjectivity account, causal relations differ in subjectivity (Pander Maat and Sanders 2001; Pit 2003; Sanders et al. 2009). Objective relations like the *Consequence-Cause* relation in (1) are observable in the real world. Subjective relations like the epistemic *Claim-Argument* relation in (2) are not: they are created by some conscious mind, the *Subject of Consciousness* (SoC) (Pander Maat and Sanders 2001). The SoC is responsible for making the connection between P and Q.¹

- (1) *The temperature rose because the sun was shining.* {Objective; no SoC}
- (2) *The neighbors were out because their car was not in the driveway.*
{Subjective; SoC = speaker; SoC = implicit}

The SoC can be the speaker,² but a speaker may also introduce a different SoC as the person responsible for the relation. The level of subjectivity entrenched in the relation is defined as the degree to which the ‘speaker’ is responsible for connecting the two propositions (‘speaker-involvement’). A sequence is called maximally objective when there is no SoC at all. These relations are observable in the real world. They are not created by some conscious mind (1).

A sequence is maximally subjective when the distance between the SoC and the speaker is nonexistent (speaker = SoC). The relation is not observable but is constructed inside the speaker’s mind (2).

The situation is different when the speaker introduces another person as the SoC for the relation (SoC ≠ speaker). In (3), it is John who is reasoning that the neighbors are not at home based on the fact that their car is not in the driveway. Since John is now the SoC of the relation – and not the speaker – the distance

¹ Other labels that have been used to distinguish these relations are epistemic-content (Sweetser 1990), diagnostic-causal (Traxler et al. 1997a), or semantic-pragmatic (Sanders et al. 1993).

² With ‘speaker’ we refer to the person that relates the story, whether it is in spoken or in written discourse. ‘Speaker’ can also refer to writers or narrators.

between speaker and SoC is larger and therefore the relation is viewed as less subjective than (2). The speaker is reporting the subjective causal relation that is created by the SoC John.

- (3) *John thought that the neighbors were out because their car was not in the driveway.*
 {SoC ≠ speaker, SoC = explicit}

A second aspect of subjectivity concerns the explicit mentioning of the SoC, as in (3). In such cases, the SoC is ‘put on stage’ (Langacker, 1991) and the subjectivity of the relation is more transparent. In contrast, when the SoC is implicit – as in (2) – the interpreter has to infer the involvement of the SoC. Then, subjectivity is not visible: the SoC is left ‘off stage’.

In English, backward objective and subjective causality can be expressed by the same connective: *because*. Interestingly, several languages have causal connectives that are prototypically used to express either objective or subjective relations. Corpus studies have shown that in Dutch (Sanders and Spooren 2015; Verhagen 2005), French (Zufferey 2012), German (Stukker and Sanders 2012), and Mandarin Chinese (Li et al. 2013), language users have systematic preferences for one connective over another. These systematic preferences vary with the subjectivity of the relation. In Dutch, connective use ‘cuts up’ the domain of causal relations: Example (4) – the Dutch version of (1) – would typically be expressed by *doordat* ‘as a result of’ a connective which specializes in non-volitional objective relations. Example (5) – the Dutch version of (2) – on the other hand can only be expressed by *want*, a connective that prefers subjective relations.

- (4) Dutch

De temperatuur steeg, doordat de zon scheen.
 ‘The temperature rose because the sun was shining.’

- (5) Dutch

De buren waren weg, want hun auto stond niet op de oprit.
 ‘The neighbours were out because their car was not in the driveway.’

A third common connective, *omdat* ‘because’, typically expresses the reason for an intentional action, as in (6).

- (6) Dutch

Jan deed het licht aan omdat het donker werd.
 ‘Jan switched on the lights because it was getting dark.’

Although there is no one-to-one relation between these relations and the connectives, these prototypical uses of the Dutch connectives have been shown to be robust (Degand and Pander Maat 2003; Pit 2003; Sanders and Spooren 2009, 2015; Sanders et al. 2009). A similar mechanism accounts for forward causals, in which the direction of the causality goes from cause to consequence (e.g., “*The neighbours’ car is not in the driveway so they are not at home*”) (see Table 1; Pander Maat and Sanders 2001; Stukker et al. 2009). In this paper, we investigate the cognitive representations of these systematic differences.

Table 1: Dutch causal connectives and their semantic-pragmatic profiles (based on corpus studies).

Forward relations (P→Q)	Type of relation expressed	Backward relations (Q←P)
<i>Daardoor</i> ‘as a result’	Objective, non-volitional	<i>Doordat</i> ‘as a result of’
<i>Daarom</i> ‘that’s why’	Objective-volitional (can also express subjective relations)	<i>Omdat</i> ‘because’
<i>Dus</i> ‘so’	Subjective, epistemic	<i>Want</i> ‘because/since’

3 Mental representations of causal relations

According to the subjectivity account, examples (1), (2), and (3) are intrinsically different. These differences can be made apparent by visualizing the mental representations of each of these relations. Figures 1 and 2 are representations of objective and subjective causal relations; the figures are derived from the Basic Communicative Spaces Network (Sanders et al. 2009, 2012). 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: 28).³ It licenses the utterance of a relation.

From the knowledge base, 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, there is a direct connection from the

³ 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 MST framework (Fauconnier 1994; Sweetser and Fauconnier 1996).

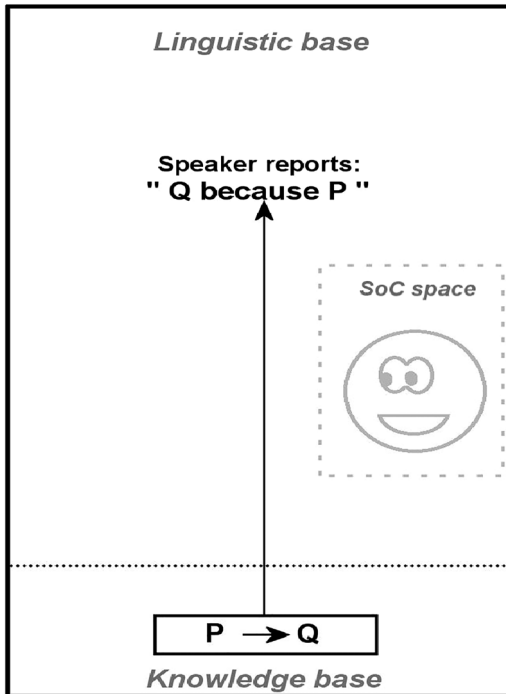


Figure 1: Mental space configuration of an objective causal relation (e.g., *The temperature rose, because the sun was shining*).

knowledge base to the linguistic realization (the solid arrow in Figure 1). The speaker does not intervene, which is represented by the fact that the arrow does not pass through the SoC (the smiley face). The linguistic realization is presented in the linguistic base space and not in the SoC-space which holds the thoughts and beliefs of the SoC.⁴

In subjective relations, the SoC is involved and in Figure 2 the SoC is the speaker. 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 (the lowercase letters). The relation passes through the SoC and comes out slightly altered (the dashed arrow). It must be interpreted as the belief of the SoC

⁴ We differentiate between the presence of an SoC-space and the act of reporting a relation as in 'speaker reports to addressee ...' (see Section 2). While the speaker is necessary for the linguistic realization of the relation, there is no SoC involved in an objective relation. So, there is no reason to assume that there is an open SoC-space: there are no beliefs to represent. We included the SoC-space here in grey only to clarify the position of the SoC with regard to the relation, but we could leave it out entirely.

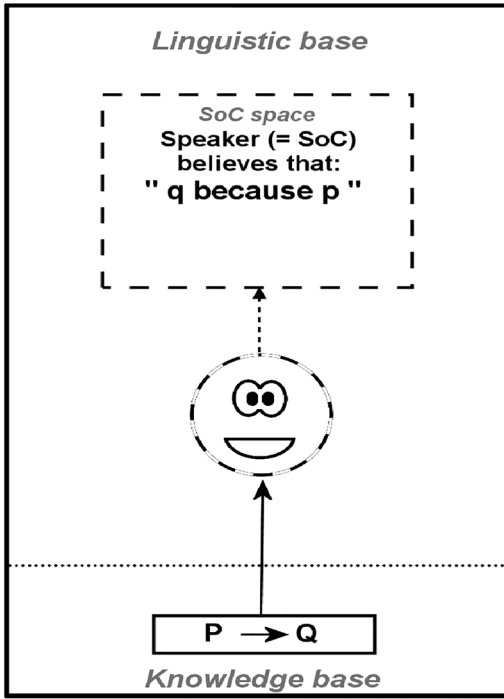


Figure 2: Mental space configuration of an implicit subjective causal relation (e.g., *The neighbours were not at home, because the lights were off*).

and therefore it must be placed inside the SoC-space. Since the SoC is not explicitly mentioned in this example, the SoC-space is represented with dashed lines, indicating that it must be inferred.

When the SoC is explicitly mentioned, no such inference is necessary. The subjectivity of the relation is already marked in such cases. SoC-phrases⁵ like *John thought* in (3), instruct the reader to set up an SoC-space. The influence of such a space builder 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: the smiley face and SoC-space are now represented by solid lines. In addition, *believes that* is 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.

⁵ With SoC-phrase, we 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*.

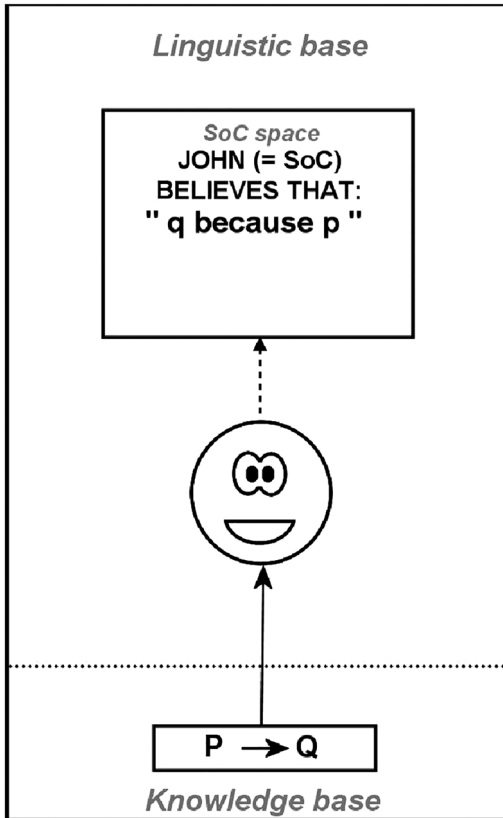


Figure 3: Mental space configuration of an explicit subjective causal relation (e.g., *John thought the neighbours were not at home because the lights were off*).

4 Constructing mental representations on-line

How are such representations constructed on-line? Traxler et al. (1997a, 1997b) found that subjective (in their terms: *diagnostic*) causal relations are processed slower than objective relations. To be precise: readers slow down at the point where an objective interpretation is no longer tenable. In case of the consequence-cause relation in (7) and the claim-argument relation in (8), readers slow down at *stalled* in (8) compared to (7). At this point, readers “make the inference that the assertion is about a possibility or a belief rather than about some straightforward state of the world” (Traxler et al. 1997b: 89). In other words: readers revise their mental representation from an objective to a subjective relation (Figure 1 → Figure 2). Readers must open a space for the SoC and assign the relation to this space. In (8), readers must do this without an explicit signal in the text.

(7) *Tina walked five miles because her engine stalled on the motorway.*
(Traxler et al. 1997a: 497)

(8) *Tina ran out of gas because her engine stalled on the motorway.*
(Traxler et al. 1997a: 497)

If these cognitive operations are in fact responsible for the observed processing asymmetry, the extra processing time that is found should diminish when a subjective mental space configuration is already in place. If the SoC-space is already set up before encountering disambiguating propositional content like *stalled*, then the causal relation can immediately be interpreted within the SoC-space. Consequently, the processing time should diminish.

Traxler et al. (1997b) compared explicit subjective relations with implicit subjective and objective relations. They inserted SoC-phrases into the S_1 of the subjective relations (9). As a result, the subjectivity was already visible before the reader encountered the critical region *stalled* and no revision should be necessary (Figure 3). The insertion had the predicted effect: reading times for explicit subjective relations did not differ from objective relations.

(9) *James thinks Tina ran out of gas because her engine stalled on the motorway.*
(Traxler et al. 1997b: 99)

A similar effect was found for Dutch by Canestrelli et al. (2013). They used Dutch translations of the materials of Traxler and colleagues but changed one critical aspect. Traxler and colleagues used the connective *because* in both subjective and objective relations (see [1] and [2]), but Canestrelli et al. (2013) used the prototypically objective connective *omdat* (10) and the prototypically subjective connective *want* (11). Unlike *because*, these connectives encode information on the subjectivity of the relation.

(10) Objective relation

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.’

(11) Subjective relation

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. (2013) showed that readers use all this information directly online. In line with Traxler et al. (1997a), 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 to determine the type of causal relation. The delay was, therefore, caused by the connective and not by the propositional content. The moment readers encountered the subjective connective *want*, they slowed down. They did not have to wait for disambiguating content to revise their mental representation. Thus, the processing asymmetry showed up earlier, directly following the connective.

To test whether their effect was based on the same principles as the effect found earlier, Canestrelli et al. also included explicit subjective relations in their experiment (12). For Dutch, the processing asymmetry also disappeared when an SoC-phrase was added to the beginning of the sequence. The SoC-phrase signals the presence of an SoC and that the upcoming information is part of the SoC's beliefs. The subjective connective *want* now confirms the subjectivity of the information, rather than introducing the subjectivity of the relation (cf. [11]). At the point of the connective, the SoC-space is already open and the subjectivity of the relation is known.

(12) Explicit subjective relation

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.'

In another experiment, Canestrelli showed that processing asymmetries can also be found in forward relations like (13) and (14) (Canestrelli 2013). Like in backward relations, readers slowed down after reading a subjective connective (*dus*).

(13) Objective (volitional) relation

Tim heeft morgen een tentamen. Daarom zit hij al uren te studeren.

'Tim has a test tomorrow. That's why he has been studying for hours.'

(14) Subjective relation

Tim heeft morgen een tentamen. Dus zit hij al uren te studeren.

'Tim has a test tomorrow. So he has been studying for hours.'

(Canestrelli 2013:100)

Thus, when it comes to introducing an SoC, subjective connectives and SoC-phrases have the same function. Dutch subjective connectives signal the presence of an SoC and cue the reader to open an SoC-space, just like an SoC-phrase does. Finally, in an experiment employing the visual world paradigm, Wei et al. (2019)

have recently shown how subjective connectives make people focus their attention on a responsible person who is the source of the information.

5 The cognitive processes involved in building the mental spaces representation

The results of the processing studies outlined above show that additional processing is required in the interpretation of subjective causal relations. When it becomes apparent that a relation is the belief of an SoC – rather than an observable truth – readers need to revise their mental representation. The presence of an SoC can be cued: before encountering the relation, by a subjective connective or by content. According to Mental Spaces Theory, readers should open an SoC-space representing the relation as part of the thoughts and beliefs of the SoC. However, it is still unclear which specific cognitive operations contribute to processing costs: is it just the opening of an SoC-space? If so, having an open SoC-space should eliminate all extra processing costs. Or does assigning a relation to an open space also contribute to the processing costs? If so, having an open SoC-space will eliminate some but not all extra processing costs.

In the backward causal relations used in previous processing studies, opening and assigning coincide in time. In (11), there is no signal to evoke an SoC-space before encountering the connective *want* and therefore no SoC-space is open at that point in time. When reading *want*, the connective signals the reader to open an SoC-space. In addition, it shows that the previous segment was in fact a belief (a claim). At that point the reader must open an SoC-space and revise the previous representation by assigning the S_1 to the just opened space. Thus, opening and assigning happen at the same moment in time. When we use an SoC-phrase as in (12), the SoC-phrase signals the reader to open an SoC-space and the S_1 is assigned to that space immediately. Opening the space and assigning the claim now happen during the processing of S_1 , instead of during the processing of the connective. Now, when the reader encounters *want*, the SoC-space has already been opened and the claim is already assigned to it. Hence there is no extra processing cost.

To see which operations add to the processing cost of subjective relations, we must separate these operations in time. An SoC-space must be evoked well before encountering the claim. Canestrelli (2013) took the first step by comparing forward causal relations (see Section 4). The difference between forward and backward configurations is how the relation is mapped onto the S_1 and S_2 (Sanders et al. 2012): for a forward subjective relation, the linguistic realization is not “q because p” but “p so q”. As with backward relations, the reader must infer the presence of a

speaker as the SoC and evoke an SoC-space when processing a subjective relation. However, since the presentation order is different, the time course for on-line processing is also different. In forward relations, the claim is presented in the second segment of the relation; it follows the connective. As such, it should be possible to evoke an SoC-space before encountering the claim. By doing so, opening an SoC-space and assigning the claim are separated in time.

The present study uses the different time course of forward causal relations to separate the operations of opening an SoC-space from assigning information to an SoC-space. In two eye-tracking experiments, we will test which operations are costly and which come ‘for free’.

6 Experiment 1: Processing subjectivity in forward causal relations

Based on previous research and theoretical considerations, we expect different processing times when forward causal relations are marked with either a subjective or objective connective. For the four situations outlined below, we predict different time courses.

Situation A: It is raining. The streets are wet. {implicit relation}

Situation B: It is raining. *As a result*, the streets are wet. {objective connective}

Situation C: It is raining. *So*, the streets are wet. {subjective connective}

Situation D: I believe it is raining. *So*, the streets are wet. {SoC-phrase + subjective connective}

In Situation A, the relation is implicit. No cues are given with regards to the coherence relation between the two segments. When a connective is present (Situation B, C and D), we expect the connective to facilitate integration of the upcoming segment. As a result, the words following the connective (i.e., *the streets*) are processed faster in Situation B, C and D compared to A. In Situation B, the objective connective signals an objective relation. No SoC-space needs to be opened and there is no claim to assign to an SoC-space. In Situation C, the subjective connective signals a subjective relation and that a claim is following. It signals the presence of an SoC, which means the reader must open an SoC-space and assign the claim to it. Relative to Situation B, this will cause a delay: the words following the connective will be processed slower in Situation C compared to Situation B. In Situation D, the SoC-phrase “*I believe*” signals the presence of an SoC and at this point, the reader must open an SoC-phrase. Therefore, when the subjective connective is encountered, the SoC-space is already opened. As a result,

the processing asymmetry between subjective and objective relations will disappear, if having an open SoC-space is enough to eliminate all processing difficulty, or diminish, if assigning a claim to an SoC-space also adds to the processing difficulty.

We summarize these hypotheses as follows:

H₁: Implicit > Explicit.

Causal connectives facilitate integration.

H₂: Subjective > Objective.

Processing asymmetry: Subjective relations are processed slower than objective relations, due to the introduction of an SoC.

H_{3a}: Subjective with SoC-phrase = Objective.

If the processing asymmetry disappears: Opening an SoC-space is costly, assigning a claim to it comes for free.

H_{3b}: Subjective > Subjective with SoC-phrase > Objective.

If the processing asymmetry is smaller but still present: Processing costs for assigning a claim to the SoC-space remain.

The hypotheses were tested in an eye-tracking experiment.⁶ Processing times of Dutch forward causal relations marked with subjective and objective connectives were compared with each other and with an implicit version of the relation that functioned as a baseline.

6.1 Method

6.1.1 Participants

Eye movement data of 37 native speakers of Dutch were collected (35 female – two 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.

6.1.2 Materials

The materials consisted of 32 experimental texts which were taken from de Leeuw et al. (2008) and adapted to serve in the present study. The texts were short opinion articles based on existing news articles. Each text contained a forward causal relation that could be given both an objective and subjective interpretation. The

⁶ This experiment has been published originally in Dutch as conference proceedings (Kleijn et al. 2011). The data were reanalyzed using mixed-effect modeling.

texts 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). Introductory 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 with a connective. In the *daardoor*-version, the relation was marked by the connective *daardoor*, which is the prototypical marker for non-volitional objective relations. In the *dus*-version, the subjective connective *dus* was used. By using *dus*, the relation changed to a subjective relation: while the underlying relation – i.e., the implicit relation – lies in the real world, by adding *dus* the relation was portrayed as the reasoning of the speaker (see Langacker 1991; Stukker et al. 2009) and the relation had to be interpreted as such (i.e., as the belief of an SoC).

Finally, in the *SoC-phrase + Dus*-version, an SoC-phrase was inserted at the beginning of the S_1 while the relation was marked with the connective *dus*. Different SoC-phrases were used (e.g., “*I believe that*”; “*I know that*”), but they all put the author of the text on stage and introduced him/her as the SoC.

Table 2: Text versions used in Experiment 1.

Structure	Example
Introduction	<i>An increasing number of people are afraid to get cancer and follow special diets in order to protect themselves. It is uncertain whether these diets have any effect.</i>
$S_1 + S_2$	Implicit: <i>Research has not yet shown whether diets can prevent cancer. Nutrition specialists cannot advise people on the effects of nutrition on cancer.</i> Daardoor/Dus: ⁷ <i>Research has not yet shown whether diets can prevent cancer. <u>Daardoor</u> (<u>‘As a result’</u>)/<u>Dus</u> (<u>‘So’</u>) nutrition specialists cannot advise people on the effects of nutrition on cancer.</i> SoC-phrase + Dus: <i><u>In my opinion</u> research has not yet shown whether diets can prevent cancer. <u>Dus</u> (<u>‘So’</u>) nutrition specialists cannot advise people on the effects of nutrition on cancer.</i>
Concluding statement	<i>Until research has shown that eating healthy prevents cancer, special diets are pointless.</i>

⁷ While *daardoor* requires a subordinate word order (VSO) of the S_2 , *dus* can occur in subordinate as well as coordinated structures (Canestrelli 2013). To avoid confounded effects of word order with connective, the S_2 of both *daardoor* and *dus* were given a subordinate structure.

6.1.3 Design

A repeated measures design was used with one four-level factor *Causality Marking* (*Implicit*, *Daardoor*, *Dus*, and *SoC-phrase + Dus*). The items were divided over four lists, as a Latin-Square. As a result, participants read eight items in each condition and read each text in only one condition. The lists were supplemented with 32 filler items. The items and fillers were evenly distributed throughout three blocks.

6.1.4 Apparatus

The eye movements of the participants were recorded with a head-mounted eye tracker: the SMI EyeLink I, sampling at 250 Hz. Accuracy of the EyeLink I is 0.5–1.0°. The experiment was run using FEP (Veenker 2007). Stimuli were presented on a 19-inch computer screen.

6.1.5 Procedure

Recording took place at the eye tracking laboratory of the Utrecht institute of Linguistics (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. They were asked to make sure that they read and understood the whole text.

The instruction was followed by a nine-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 disappeared and the text appeared. To progress to the next item, participants pressed a button on a button-box.

6.1.6 Data preparation and analysis

The critical sentence (S_2) was divided into five regions. Region 1 contained the connective (if present), Region 2 the finite verb and subject, Regions 3 and 4 were spill over regions containing intermediate material and Region 5 contained the sentence final words. Regions 2–5 were equal in all conditions, although the word order in Region 2 was SV instead of VS for the implicit condition. All regions were analyzed, but only significant effects are reported.

The quality of the fixation recordings was checked with the help of the program Fixation (Cozijn 1994). Two measures were calculated per region. *First pass reading time* (FP) is the summed duration of all fixations within a region before the eyes leave the region either regressively or progressively. This measure was included to measure the immediate effect of the content of a region on processing. *Regression path duration* (RP) is the sum of all fixations from the first fixation in a region until the first fixation on a later region. This measure thus includes rereading of previous regions, and hence can also capture difficulty integrating the present region with the content of earlier regions. Fixation times that were more than two standard deviations above or below both the participant and item mean, as well as times that included blinks, were discarded. Skipped regions were regarded as missing data. Following Baayen (2008), a log-transformation was carried out on the dependent variables before analyzing the data.

The data were analyzed by means of Linear Mixed Effects Regression analyses (LMER) in R (3.5.3; R Core Team 2019) using the packages lme4 (1.1–17; Bates et al. 2015), lmerTest (3.1–2; Kuznetsova et al. 2017) and multcomp (1.4–14; Hothorn et al. 2008). Subjects and items were included as crossed random factors. *Causality Marking* (*Implicit*, *Daardoor*, *Dus*, and *SoC-phrase + Dus*) was included as a four-level fixed factor. Significance was estimated using the Satterthwaite’s approximation combined with a Tukey contrast test.

6.2 Results

Mean first pass reading time and regression path duration are given in Table 3.

Table 3: Means and standard deviations (in ms) of first pass reading time (FP) and regression path duration (RP).

Measure	Condition	Connective	Subject + Finite verb	Region 3	Region 4	Sentence- final
FP	Implicit	–	566 (366)	522 (308)	618 (429)	433 (297)
	Daardoor	302 (188)	445 (284)	519 (289)	554 (362)	483 (362)
	Dus	260 (160)	477 (310)	501 (357)	566 (352)	428 (268)
	SoC-phrase + Dus	273 (192)	536 (332)	494 (304)	576 (358)	473 (343)
RP	Implicit	–	617 (417)	600 (377)	656 (432)	623 (467)
	Daardoor	356 (238)	517 (317)	581 (338)	658 (538)	556 (399)
	Dus	332 (220)	637 (394)	617 (442)	629 (380)	592 (402)
	SoC-phrase + Dus	337 (240)	661 (417)	618 (421)	636 (408)	605 (422)

6.2.1 Implicit versus explicit relations

In the implicit-condition, the words immediately following the connective (consisting of the subject and the finite verb) were read slower than in the *dus*- and *daardoor*-conditions. Compared to the *daardoor*-condition the implicit-condition had a longer first pass reading time and regression path duration (FP: $\beta = -0.10$, $SE = 0.02$, $p(SW) < 0.001$; RP: $\beta = -0.06$, $SE = 0.02$, $p(SW) < 0.001$). Compared to the *dus*-condition the implicit-condition had a longer first pass reading time (FP: $\beta = -0.07$, $SE = 0.02$, $p(SW) < 0.001$). For the *SoC-phrase + dus*-condition there was only an effect for regression path duration, but this effect was in the opposite direction. The regression path duration was shorter for the implicit-condition than for the *SoC-phrase + dus*-condition (RP: $\beta = 0.04$, $SE = 0.02$, $p(SW) = 0.04$).

Effects were also found at the end of the S_2 . For the final words of the S_2 first pass reading time was higher for the *daardoor*- and marginally higher for the *SoC-phrase + dus*-condition compared to the implicit-condition (FP: *daardoor*: $\beta = 0.05$, $SE = 0.02$, $p(SW) = 0.02$; FP: *SoC-phrase + dus*: $\beta = 0.03$, $SE = 0.02$, $p(SW) = 0.10$). For *dus*, effects were found a little later, right after the S_2 . The first words of the next sentence were read a little slower compared to the implicit-condition (FP: $\beta = 0.03$, $SE = 0.02$, $p(SW) = 0.07$; RP: $\beta = 0.04$, $SE = 0.02$, $p(SW) = 0.05$).

6.2.2 Subjective versus objective relations

The analysis of Region 2 showed that reading times for the *daardoor*-condition were shorter compared to the fixation times of the other connective conditions. Compared to the *dus*-condition, the *daardoor*-condition had a shorter regression path duration (RP: $\beta = 0.09$, $SE = 0.02$, $p(\text{Tukey}) = 0.001$). Secondly, first pass reading time and regression path duration were faster for the *daardoor*-condition compared to the *SoC-phrase + dus*-condition (FP: $\beta = 0.08$, $SE = 0.02$, $p(\text{Tukey}) = 0.001$; RP: $\beta = 0.10$, $SE = 0.02$, $p(\text{Tukey}) = 0.001$). Thus, the objective relation was processed faster than both subjective relations. In addition, adding an *SoC-phrase* did not speed up processing of the subjective relations. The only significant effect that was found between the two subjective conditions was in first pass reading time (FP: $\beta = 0.05$, $SE = 0.02$, $p(\text{Tukey}) = 0.04$). However, this effect was in the opposite direction: The first pass reading time was shorter for *dus* without an *SoC-phrase* compared to *dus* with an *SoC-phrase*.

6.3 Discussion

The results of Experiment 1 support H_1 and H_2 . The subjective connective *dus* led to longer reading times than the objective connective *daardoor*. In addition, both conditions facilitated processing of the information directly following the connective as compared to the implicit condition.

The results do not support H_{3a} or H_{3b} . We hypothesized that an SoC-phrase in the S_1 of a forward causal relation would facilitate processing of subjective relations with *dus* since the SoC-phrase opens an SoC-space to which the relation can be assigned. This prediction was not borne out. On the contrary, the reading times for this condition were longer than in the condition without the SoC-phrase. Furthermore, the SoC-phrases eliminated the facilitating effect of the connective *dus* compared to the implicit relation. These results suggest that the SoC-phrases impeded instead of facilitated processing.

One possible explanation of this result is that SoC-phrases tend to have narrow scope (only over S_1). This may have caused readers to interpret S_1 as a claim, rather than a descriptive argument/fact. If so, they would expect the S_2 to contain an argument in support of the claim. However, the forward connective *dus* signals that the S_1 was an argument and the S_2 will contain the claim. Hence, the claim in S_2 may have come as a surprise. This could explain why reading times in the condition with an SoC-phrase were actually longer than in the condition without an SoC-phrase.

Another possibility is that the SoC-phrase did not evoke the right mental space configuration. While the configuration of backward subjective relations marked with an SoC-phrase resembles Figure 3, their forward counterparts may have evoked a configuration like Figure 4. The involvement of the speaker is partially visible, but not completely: for 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 implicit subjective relations). Moreover, Figure 4 is also different from the representation of an implicit subjective relation (see Figure 2), which may indicate why the *dus*-relations with SoC-phrases were processed even slower than implicit relations. The way subjectivity was expressed, may in fact have complicated the process.

Hence, the SoC-phrases used in Experiment 1 may have been unsuccessful in evoking a subjective mental space configuration necessary to interpret subjective relations. 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

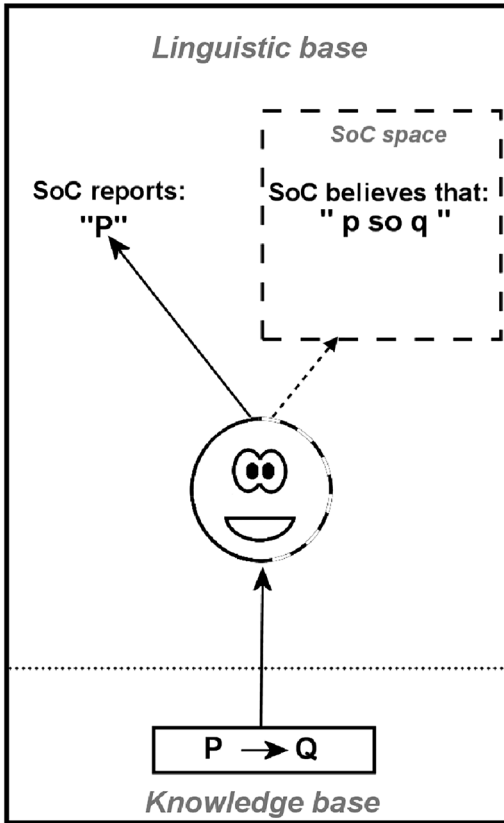


Figure 4: Mental space configuration of a subjective forward causal relation marked by an SoC-phrase (e.g., *I believe that the lights are off, so the neighbours are not at home*).

SoC-phrase + *dus*-condition was not found. Therefore, the results of Experiment 1 are inconclusive.

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 this problem, we must make sure that the entire causal relation is interpreted within the scope of, i.e., ‘the belief’ of, an SoC. It must be clear to readers that the SoC’s thoughts are represented here, and not his observations. One convincing and very natural way to achieve this, is to use *free indirect speech* (FIS) as in (15) (e.g., Bal 1990; Banfield 1982; Chafe 1994; Fludernik 1993; van Krieken et al. 2016; 2017).

(15) *Gosh, he was tired.*

Like in indirect speech – which was used in Experiment 1 – this style evokes a configuration that includes a space for an SoC embedded in the space of the

narrator (Sanders and Redeker 1996). Crucially, however, these representations differ with regard to the allocation of responsibility to the narrator and characters in the discourse.

The subject is responsible for the content, but when it comes to the wording, responsibility is less clear. Rather than a complete deictic shift – to subject or narrator – the deictic center in FIS seems to blend between the two of them ('dual voice theory'; Banfield 1982; Sanders 2010; van Krieken et al. 2017). The result is that the innermost workings of a subject's mind can be portrayed. In longer text fragments, this causes the reader to experience a stream of consciousness which represents the subject's thought flow (16). Therefore, FIS establishes an open SoC-space to which each new proposition can be assigned automatically.

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

7 Experiment 2: Processing subjective causality in free indirect style

The Free Indirect Style evokes a configuration in which an SoC is already opened before encountering a subjective connective. Using eye movement registration, processing times of Dutch forward causal relations are captured. Processing times of sequences marked with subjective and objective connectives are compared with each other in a FIS-context and a neutral context. The following hypotheses are tested:

- H_4 : *Subjective in neutral context > Objective in neutral context*
Processing asymmetry: Subjective relations are processed slower than objective relations, due to the introduction of an SoC.
- H_{5a} : *Subjective in FIS-context = Objective in FIS-context.*
If the processing asymmetry disappears: Opening an SoC-space is costly, assigning a claim to it comes for free.
- H_{5b} : *Subjective in neutral context > Subjective in FIS-context > Objective in FIS-context.*
If the processing asymmetry is smaller but still present: Processing costs for assigning a claim to the SoC-space remain.

As in Experiment 1, we expect that subjective connectives will cause a processing delay compared to objective connectives. We hypothesize that a FIS-context will facilitate processing of a subjective forward causal relation: an SoC-space is kept open, so that the content of S_2 can easily be assigned to it. Like in Experiment 1, we

do not know whether opening a space is enough to alleviate all processing difficulty (H_{5a}). If the processing asymmetry does not disappear but only diminishes, this indicates that only opening a space is not enough and that assigning the utterance to this space also adds to the processing costs (H_{5b}).

7.1 Method

7.1.1 Participants

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

7.1.2 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’. The causal relations were then embedded in a subjective narrative context and a neutral narrative context. The choice of a narrative context was made because in narrative genres the use of the free indirect style is widely accepted and because narratives are usually layered, with references to characters’, narrators’ and sometimes even author’s beliefs, thoughts and feelings (Banfield 1982).

The contexts were thematically the same, only in the subjective context the story was told from the viewpoint of a character (subjective) while in the neutral context the story was told like a factual description given from the viewpoint of a neutral observer/narrator. The texts described common situations in and around the house and workplace (e.g., overflowing the bathtub, public transport delays) and consisted of approximately six sentences. The first sentence (introducing the character) and the second to last sentence (the second segment of the causal relation) were identical in both contexts. In the subjective context the other sentences were written in the free indirect style, and subjectivity was enhanced by including exclamations (e.g., *wow!*, *yes!*), evaluative adjectives and evaluative adverbs (e.g., *beautiful*, *finally*; see Conrad and Biber 2001). In the neutral context, no exclamations were used and the use of evaluative adjectives and adverbs was severely limited.⁸ The S_1 was kept as

⁸ 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.

similar as possible between contexts, but subjectivity was slightly enhanced in the subjective version by including some of the previously mentioned subjectivity indicators. Two versions were created for each context by marking the causal relation with either the (objective) connective *daardoor* or the (subjective) connective *dus*. This resulted in four different versions of each text (see Table 4).

Table 4: Text versions used in Experiment 2.

Context	Example
Subjective	<i>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>Daardoor</u> ('As a result')/ <u>Dus</u> ('So') he saved a lot of money. This was meant to be.</i>
Neutral	<i>Ruben drove to the electronics store. He went to buy a new television set. The store had a sale. <u>Daardoor</u> ('As a result')/ <u>Dus</u> ('So') he saved a lot of money. The LCD-sets were now sharply priced.</i>

All materials were checked by two outside experts. They agreed that both connectives *daardoor* and *dus* led to acceptable sequences in both versions of the stimuli and that in relations marked with *dus*, the character was the SoC of the causal relation.

7.1.3 Design

A 2 (Connective) \times 2 (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. Nine filler items were followed with a verification statement to keep the participants alert. The items and fillers were evenly distributed throughout the blocks.

7.1.4 Apparatus

The eye movements of the participants were recorded with a different eye tracker than in Experiment 1: a SR Research EyeLink 1000 desktop eye tracker. The accuracy of the EyeLink 1000 is comparable to the SMI EyeLink I (0.5°), but it records at a higher frequency of 500 Hz. The eye tracker recorded the position of the

right pupil⁹ via a Logitech QuickCam Pro 5000 webcam. A remote setup with target sticker was used. Stimuli were presented on a 19-inch computer screen.

7.1.5 Procedure

The procedure was identical to Experiment 1 except for two small changes. First, the 9-point calibration procedure was upgraded to a 13-point calibration procedure. Second, Experiment 2 included verification statements for some of the filler items. After reading an 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 and progressed to the next item.

7.1.6 Data preparation and analysis

The critical sentence (S_c) was divided into five regions. Region 1 contained the connective, Region 2 the finite verb and subject, Regions 3 and 4 were spill overs containing intermediate material and Region 5 contained the sentence final words. Regions 2–5 were equal in all conditions. Region 4 was absent for most items, but was sometimes included to ensure that the first spill over region (Region 3) was of similar length for all items. All regions were analyzed, but results are only presented when an effect was observed.

The quality of the fixation recordings was checked with the help of the program Fixation (Cozijn 1994). As in Experiment 1, *first pass reading time* (FP) and *regression path duration* (RP) per region were calculated. 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.

The data were analyzed by means of Linear Mixed Effects Regression analyses (LMER) in R (3.5.3; R Core Team 2019) using the packages lme4 (1.1–17; Bates et al. 2015), lmerTest (3.1–2; Kuznetsova et al. 2017) and multcomp (1.4–14; Hothorn et al. 2008). Subjects and items were included as crossed random factors. Context (subjective/neutral), Connective (*daardoor/dus*) and their interaction were included as fixed factors. Significance was estimated using the Satterthwaite’s approximation. 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-level predictor. The significance of the individual contrasts was tested by a Tukey contrast test

⁹ For three participants a switch was made to the left eye to ensure a more stable registration.

(see Section 6.1.6).¹⁰ As in Experiment 1, a log-transformation was carried out on the dependent variables before analyzing the data.

7.2 Results

Mean first pass reading time and regression path duration are given in Table 5.

Table 5: Means and standard deviations (in ms) of first pass reading time (FP) and regression path duration (RP).

Measure	Context	Connective	Connective region	Subject + Finite verb	Region 3	Region 4	Sentence-final
FP	Subjective	<i>Daardoor</i>	241 (92)	228 (93)	300 (171)	272 (132)	262 (135)
	Subjective	<i>Dus</i>	218 (96)	254 (111)	315 (189)	308 (186)	282 (159)
	Neutral	<i>Daardoor</i>	240 (84)	223 (79)	298 (145)	314 (146)	281 (146)
	Neutral	<i>Dus</i>	229 (91)	271 (145)	321 (191)	288 (144)	281 (151)
RP	Subjective	<i>Daardoor</i>	267 (152)	243 (103)	326 (209)	285 (146)	306 (198)
	Subjective	<i>Dus</i>	244 (112)	276 (155)	375 (287)	345 (234)	353 (251)
	Neutral	<i>Daardoor</i>	254 (125)	245 (149)	333 (185)	367 (240)	336 (212)
	Neutral	<i>Dus</i>	276 (138)	303 (205)	369 (252)	330 (228)	361 (276)

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, $p(\text{SW}) = 0.01$). 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, $p(\text{Tukey}) = 0.04$), while for *daardoor* it did not matter in which context the connective was placed (RP: $\beta = -0.01$, SE = 0.01, $p(\text{Tukey}) = 0.82$). In addition, in a subjective context the regression path duration of *dus* is shorter than that of *daardoor* (RP: $\beta = -0.04$, SE = 0.02, $p(\text{Tukey}) = 0.04$), 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 the first pass reading time, a main effect of Connective was found ($\beta = -0.04$, SE = 0.01, $p(\text{SW}) < 0.001$). First pass reading time was shorter in the *dus*-conditions compared to the *daardoor*-conditions. This effect is likely to be due to the difference in length between the connectives.

10 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.

In region 2 – the region succeeding the connective – there was only an overall main effect of Connective (FP: $\beta = 0.06$, $SE = 0.01$, $p(\text{SW}) < 0.001$; RP: $\beta = 0.06$, $SE = 0.01$, $p(\text{SW}) < 0.001$). Fixation durations on the region were shorter for the *daardoor*-condition compared to the *dus*-condition. No main effects or interaction effects for Context were found to be significant.

Region 3 also showed main effects of *Connective*. First pass reading time and regression path duration were faster in the *daardoor*-conditions than in the *dus*-conditions (FP: $\beta = 0.02$, $SE = 0.01$, $p(\text{SW}) = 0.04$; RP: $\beta = 0.04$, $SE = 0.01$, $p(\text{SW}) = 0.01$).

At the end of the S_2 , an interaction effect for regression path duration was found (RP: $\beta = 0.05$, $SE = 0.05$, $p(\text{SW}) = 0.05$). Additional analyses showed that in a subjective context, the *daardoor*-condition has a shorter regression path duration than the *dus*-condition ($\beta = 0.05$, $SE = 0.02$, $p(\text{Tukey}) = 0.01$), but in a neutral context there was no difference between the *daardoor*- and *dus*-condition ($\beta = 0.00$, $SE = 0.02$, $p(\text{Tukey}) = 1.00$).

7.3 Discussion

The results of Experiment 2 support hypothesis H_4 and H_{5b} . The subjective connective *dus* led to longer reading times than the objective connective *daardoor*. Embedding the relations in subjective FIS-contexts diminished this processing asymmetry but did not resolve it completely. Although opening a salient SoC-space is not enough to alleviate all extra processing costs associated with subjective relations, it does facilitate processing. It seems that opening an SoC-space is at least one of the cognitive processes underlying the processing asymmetry found for subjective relations.

In contrast to Experiment 1, opening the SoC-space beforehand facilitated processing of the subjective connective *dus*. However, this effect seems short-lived given that the words immediately following the connective are read slower in the *dus*-condition independent of the context. Although the means for Region 2 also suggest an interaction as with some facilitation for *dus* in a subjective context, the interaction did not reach statistical significance. We thus see two seemingly opposite motions: an interaction effect at the point of the connective and immediately afterwards an overall facilitating effect of *daardoor* in neutral as well as in subjective contexts. To see whether these effects cancel each other out, additional analyses were run. Regression path durations were aggregated over regions 1 and 2.¹¹

¹¹ Cases for which regression path duration of one of the regions was missing were treated as missing cases.

Means and standard deviations are given in Table 6. The interaction of Connective and Context was significant ($\beta = -0.07$, $SE = 0.02$, $p(\text{SW}) = 0.01$). The *dus*-condition had a longer regression path duration than the *daardoor*-condition but only in a neutral context ($\beta = 0.07$, $SE = 0.02$, $p(\text{Tukey}) = 0.001$) and not in a subjective context ($\beta = -0.00$, $SE = 0.02$, $p(\text{Tukey}) = 1.00$). The interaction-effect was strong enough to survive in the aggregated region and not completely canceled out by the facilitation of *daardoor* in Region 2. This pattern of results (an early advantage in subjective contexts combined with the connective *dus*, followed by a later general processing delay in relations marked by the connective *dus*) is most consistent with the interpretation that the subjective context alleviates the cognitive costs of opening a mental space, but does not affect the cost of assigning a claim to the SoC-space.

Table 6: Means and standard deviations (in ms) of regression path duration (RP) in aggregated region 1 + 2.

Measure	Context	Connective	Region 1 + 2
RP	Neutral	<i>Daardoor</i>	495 (175)
	Subjective	<i>Daardoor</i>	519 (209)
	Neutral	<i>Dus</i>	620 (278)
	Subjective	<i>Dus</i>	540 (203)

8 General discussion and conclusion

Our goal was to gain more insight in subjective mental spaces structures and the construction of causality. Focusing on the processing differences of subjective versus objective causal relations, we hypothesized which processes underlie the construction of the corresponding mental representations and how different cognitive operations that are proposed in MST are reflected in language processing. We started from the finding that backward subjective causal relations, such as (17), are processed slower than objective causal relations. The second segment makes clear that the first segment does not describe an objective fact, but that it is a speaker's claim for which the second segment is the argument. We hypothesized that this processing effect might be an indication of setting up a Mental Space for the speaker. This analysis is in line with experimental results showing that the processing delay for subjective relations disappears when it is clear from the beginning that they should be interpreted as subjective claims or conclusions (18)

because they are part of the SoC-Mental Space: *According to John ... or In my opinion ...* (Canestrelli et al. 2013; Traxler et al. 1997a, 1997b).

- (17) *Nutrition specialists cannot advise people on the effects of nutrition on cancer, because research has not yet shown whether diets can prevent cancer.*
- (18) *In my opinion, nutrition specialists cannot advise people on the effects of nutrition on cancer, because research has not yet shown whether diets can prevent cancer.*

What these studies did not reveal is whether it is only the operation of opening an SoC-space which requires extra processing time or whether other operations, like assigning a claim to such a space, are also costly operations. In order to answer this question, the operation of opening an SoC-space and that of assigning a proposition to it must be separated in time. While in backward relations these two necessarily coincide, in forward relations they do not. In (19), the claim-argument relation of (17) is reversed, to form an argument-claim relation. When the first segment of that relation is marked as subjective (20), it does not automatically imply that the second segment is also subjective. However, since the mental space has been opened, and (in Dutch) the connective *dus* ‘so’ at the start of the second segment marks it as subjective, processing the second segment as subjective may not require extra processing time. Thus, if only opening an SoC-space adds to the processing costs, the processing asymmetry should disappear when an SoC is introduced beforehand. If the asymmetry does not completely disappear, other processes must be at play.

- (19) *Research has not yet shown whether diets can prevent cancer, so nutrition specialists cannot advise people on the effects of nutrition on cancer.*
- (20) *In my opinion, research has not yet shown whether diets can prevent cancer, so nutrition specialists cannot advise people on the effects of nutrition on cancer.*

Experiment 1 explored the possibility that having opened the mental space for the speaker means that new information can be assigned to this space without any extra processing cost. The results showed that having an open SoC-space to which the claim in the second segment can be assigned did not alleviate the processing difficulty of the subjective relation. The relations marked with the subjective connective *dus* led to longer reading times compared to the relations marked with the objective connective *daardoor*, irrespective of the presence of a phrase marking the first segment as a claim. Readers slowed down immediately after the connective. Thus, simply having an already opened SoC-space does not imply that subjective information will be ‘automatically’ assigned to that space. Contrary to expectation, having an SoC-space open did not diminish the processing

asymmetry. We hypothesized that the factual nature of the argument to which the SoC-phrase was added might have interfered with the scope of the SoC-phrase. As a result, the SoC-phrase did not evoke a supportive mental space configuration and integration was not facilitated. In fact, it probably complicated matters by including factual observation and adding a perspective to the information.

For this reason, we conducted Experiment 2 in which we studied the processing of subjective relations in free indirect speech (FIS), which provides a natural opportunity to investigate our main questions, but has never been used to study these and related issues in a processing context – we consider this an innovative aspect of the current study. FIS represents the thoughts and experiences of a character as a continuous stream-of-consciousness and, once this stream is established, the narrative will be naturally interpreted as taking place within the mental space of this character. For that reason, this ‘subjective discourse’ should have an SoC-space open for interpretation, 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 of Experiment 2 confirmed this hypothesis. In a neutral context, subjective relations (again) took longer to process than objective relations. Crucially, this effect was diminished in subjective contexts created by free indirect speech. In FIS, it appeared easier for readers to interpret the causal relation within the mental space of the character. This finding is an important addition to earlier results; it implies that readers are indeed sensitive to this more subtle signal of the presence of a thinking subject, and that this contributes to the processing ease of inherently complex relations. In addition, the results show that complexity in language processing is less determined by number and connections between different spaces, but by having or not having a supportive configuration in place at the right time. Even seemingly complex mental space configurations, like FIS, can facilitate processing of language.

In contrast to earlier results (Canestrelli et al. 2013; Traxler et al. 1997b), the processing asymmetry did not completely disappear. This difference can be explained by the separation of opening an SoC-space from other operations, like assigning a proposition to that space. While these processes coincided in the earlier studies, they did not in our experiment. The SoC-space was opened and established well before the claim was encountered. It seems therefore that while opening an SoC-space is a costly procedure, assigning a proposition to an open space does not come for free and is associated with its own costs. In addition, reactivating an open SoC-space may also come at a cost.

Our results add to the findings of Wei et al. (2019), who showed that subjective connectives immediately activate the awareness of a responsible thinking person. The pattern that emerges is one in which readers constantly keep track of the

Subject of Consciousness, the ‘mind’ that is responsible for the content of the text, updating their mental model according to the (sometimes subtle) signals in the text as to where the responsibility for the content lies. The current results are in line with the idea that readers keep track of a network of mental spaces that is constantly being updated as the discourse unfolds (Fauconnier 1994; Sanders et al. 2009, 2012; Sweetser and Fauconnier 1996; van Krieken et al. 2016). The results also illustrate that various cues influence this network and that some of them may be better space builders than others. Further research should reveal how mental space configurations are affected by various types of space builders, from local cues (such as causal connectives) to more global cues (such as the perspective of the text as a whole).

In general, these results provide further insights in the dynamics of discourse processing, as well as in the cognitive representation of authors, speakers and characters as providing mental spaces. The methodology of combining cognitive theory with precise processing experiments has shown to be fruitful, in that respect. In our view, it is worthwhile to use these and similar methods to make Cognitive Linguistic theories like MST more precise and put them to the test.

Acknowledgments: We extend special thanks to José Sanders and Frank Jansen for their input on the materials of Experiment 2.

References

- Baayen, R. Harald. 2008. *Analyzing linguistic data: A practical introduction to statistics using R*. Cambridge: Cambridge University Press.
- Bal, Mieke. 1990. *De theorie van vertellen en verhalen. Inleiding in de narratologie [Narratology: Introduction to the theory of narrative]*. Muiderberg: Coutinho.
- Banfield, Ann. 1982. *Unspeakable sentences. Narration and representation in the language of fiction*. Boston: Routledge & Kegan House.
- Bates, Douglas, Martin Maechler, Ben Bolker & Steve Walker. 2015. Fitting linear mixed-effects models using lme4. *Journal of Statistical Software* 67(1). 1–48.
- Canestrelli, Anneloes R. 2013. *Small words, big effects? Subjective versus objective causal connectives in discourse processing*. Utrecht: Utrecht University Dissertation.
- Canestrelli, Anneloes R., Willem M. Mak & Ted J. M. Sanders. 2013. Causal connectives in discourse processing: How differences in subjectivity are reflected in eye-movements. *Language and Cognitive Processes* 28(9). 1394–1413.
- Chafe, Wallace. 1994. *Discourse, consciousness, and time. The flow and displacement of conscious experience in speaking and writing*. Chicago: The University of Chicago Press.
- Conrad, Susan & Douglas Biber. 2001. Adverbial marking of stance in speech and writing. In Susan Hunston & Geoffrey Thompson (eds.), *Evaluation in text: Authorial stance and the construction of discourse*, 56–73. Oxford: Oxford University Press.

- Cozijn, Reinier. 1994. *Manual for the interactive analysis program of eye movement recordings: FIXATION*. Nijmegen, The Netherlands: Max Planck Institute for Psycholinguistics.
- Cozijn, Reinier, Leo G. M. Noordman & Wietske Vonk. 2011. Propositional integration and world-knowledge inference: Processes in understanding because sentences. *Discourse Processes* 48(7). 475–500.
- Dancygier, Barbara & Eve E. Sweetser. 2005. *Mental spaces in grammar: Conditional constructions*. Cambridge: Cambridge University Press.
- de Leeuw, Saskia, Pim Mak & Ted Sanders. 2008. Effects of the Dutch causal connectives “dus” and “daardoor” on discourse processing. *Toegepaste Taalwetenschap in Artikelen* 79(1). 53–63.
- Degand, Liesbeth & Henk Pander Maat. 2003. A contrastive study of Dutch and French causal connectives on the speaker involvement scale. In Arie Verhagen & Jeroen van de Weijer (eds.), *Usage-based approaches to Dutch: Lexicon, grammar, discourse (LOT occasional series 1)*, 175–199. Utrecht: Landelijke Onderzoekschool Taalwetenschap.
- Fauconnier, Gilles. 1994. *Mental spaces: Aspects of meaning construction in natural language*. Cambridge: MIT Press.
- Fludernik, Monika. 1993. *The fictions of language and the languages of fiction*. London: Routledge.
- Hothorn, Torsten, Frank Bretz & Peter Westfall. 2008. Simultaneous inference in general parametric models. *Biometrical Journal* 50(3). 346–363.
- Kleijn, Suzanne, Pim Mak & Ted Sanders. 2011. Daardoor dus! Effecten van specificiteit en subjectiviteit op de verwerking van connectieven [Processing the connectives ‘daardoor’ and ‘Dus’. Effects of specificity and subjectivity]. *Toegepaste Taalwetenschap in Artikelen* 85(1). 103–112.
- Kuznetsova, Alexandra, Per B. Brockhoff, Rune H. B. Christensen. 2017. lmerTest package: Tests in linear mixed effects models. *Journal of Statistical Software* 82(13). 1–26.
- Langacker, Ronald W. 1991. *Concept, image, and symbol: The cognitive basis of grammar*. Berlin: Mouton de Gruyter.
- Li, Fang, Jacqueline Evers-Vermeul & Ted J. M. Sanders. 2013. Subjectivity and result marking in Mandarin. *Chinese Language and Discourse* 4(1). 74–119.
- Pander Maat, Henk & Ted Sanders. 2001. Subjectivity in causal connectives: An empirical study of language in use. *Cognitive Linguistics* 12(3). 247–273.
- Pit, Mirna. 2003. *How to express yourself with a causal connective: Subjectivity and causal connectives in Dutch, German and French*. Utrecht: Utrecht University Dissertation.
- R Core Team. 2019. *R: A language and environment for statistical computing*. Vienna, Austria: R Foundation for Statistical Computing. Available at: <https://www.R-project.org/>.
- Sanders, José. 2010. Intertwined voices. Journalists’ representation modes of source information in journalistic subgenres. *English Text Construction* 3(2). 226–249.
- Sanders, José & Gisela Redeker. 1996. Perspective and the representation of speech and thought in narrative discourse. In Gilles Fauconnier & Eve E. Sweetser (eds.), *Spaces, worlds, and grammars*, 290–317. Chicago: Chicago University Press.
- Sanders, Ted & Wilbert P. M. Spooren. 2009. Causal categories in discourse: Converging evidence from language use. In Ted Sanders & Eve Sweetser (eds.), *Causal categories in discourse and cognition*, 205–246. Berlin: Mouton de Gruyter. <https://doi.org/10.1515/9783110224429.205>.
- Sanders, Ted J. M. & Wilbert P. M. Spooren. 2015. Causality and subjectivity in discourse: The meaning and use of causal connectives in spontaneous conversation, chat interactions and written text. *Linguistics* 53(1). 53–92.

- Sanders, Ted J. M., Wilbert P. M. Spooren & Leo G. M. Noordman. 1993. Coherence relations in a cognitive theory of discourse representation. *Cognitive Linguistics* 4(2). 93–133.
- Sanders, Ted, José Sanders & Eve Sweetser. 2009. Causality, cognition and communication: A mental space analysis of subjectivity in causal connectives. In Ted Sanders & Eve Sweetser (eds.), *Causal categories in discourse and cognition*, 21–60. Berlin: Mouton de Gruyter. <https://doi.org/10.1515/9783110224429.19>.
- Sanders, José, Ted Sanders & Eve Sweetser. 2012. Responsible subjects and discourse causality. How mental spaces and perspective help identifying subjectivity in Dutch backward causal connectives. *Journal of Pragmatics* 44(2). 169–190.
- Spooren, Wilbert. 1989. *Some aspects of the form and interpretation of global contrastive coherence relations*. Nijmegen: Radboud University Nijmegen dissertation.
- Stukker, Ninke & Ted Sanders. 2012. Subjectivity and prototype structure in causal connectives: A cross-linguistic perspective. *Journal of Pragmatics* 44(2). 191–231.
- Stukker, Ninke, Ted Sanders & Arie Verhagen. 2009. Categories of subjectivity in Dutch causal connectives: A usage-based analysis. In Ted Sanders & Eve Sweetser (eds.), *Causal categories in discourse and cognition*, 119–171. Berlin: Mouton de Gruyter. <https://doi.org/10.1515/9783110224429.119>.
- Sweetser, Eve E. 1990. *From etymology to pragmatics. Metaphorical and cultural aspects of semantic structure*. Cambridge: Cambridge University Press.
- Sweetser, Eve E. & Gilles Fauconnier. 1996. Cognitive links and domains: Basic aspects of mental space theory. In Gilles Fauconnier & Eve E. Sweetser (eds.), *Spaces, worlds, and grammars*, 1–28. Chicago: Chicago University Press.
- Traxler, Matthew J., Michael D. Bybee & Martin J. Pickering. 1997a. Influences of connectives on language comprehension: Eye-tracking evidence for incremental interpretation. *Quarterly Journal of Experimental Psychology* 50(3). 481–497.
- Traxler, Matthew J., Anthony J. Sanford, Joy P. Aked & Linda M. Moxey. 1997b. Processing causal and diagnostic statements in discourse. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 23(1). 88–101.
- van Krieken, Kobie, José Sanders & Hans Hoeken. 2016. Blended viewpoints, mediated witnesses: A cognitive linguistic approach to news narratives. In Barbara Dancygier, Wei-lun Lu & Arie Verhagen (eds.), *Viewpoint and the fabric of meaning: Form and use of viewpoint tools across languages and modalities*, 145–168. Berlin: Mouton de Gruyter. <https://doi.org/10.1515/9783110365467-007>.
- van Krieken, Kobie, Hans Hoeken & José Sanders. 2017. Evoking and measuring identification with narrative characters: A linguistic cues framework. *Frontiers in Psychology* 8. 1190.
- van Silfhout, Gerdineke, Jacqueline Evers-Vermeul, Willem M. Mak & Ted J. M. Sanders. 2014. Connectives and layout as processing signals: How textual features affect students' processing and text representation. *Journal of Educational Psychology* 106(4). 1036–1048.
- Veenker, Theo. 2007. *Manual flexible experiment program*. Available at: <https://resources.lab.hum.uu.nl/resources/fep/fep.pdf>.
- Verhagen, Arie. 2005. *Constructions of intersubjectivity. Discourse, syntax, and cognition*. Oxford: Oxford University Press.
- Wei, Yipu, Willem M. Mak, Jacqueline Evers-Vermeul & Ted J. M. Sanders. 2019. Causal connectives as indicators of source information: Evidence from the visual world paradigm. *Acta Psychologica* 198. 102866.
- Zufferey, Sandrine. 2012. “Car, parce que, puisque” revisited: Three empirical studies on French causal connectives. *Journal of Pragmatics* 44(2). 138–153.