German Demonstrative Pronouns in Contrast

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Abstract

German has two demonstrative pronouns: the *der*, *die*, *das* paradigm and the *dieser*, *diese*, *dies(es)* paradigm. Previous studies mainly compared the anaphoric use of *der* with the personal pronoun *er* and observed that *der* refers to less prominent antecedents, but there are only very few studies that investigate the differences between these two demonstrative pronouns. We hypothesize that they differ in signaling topic persistence and in accessing contrastive antecedents. We tested these hypotheses in short texts that manipulated the contrast of the antecedent by inducing the expression 'in contrast to' vs. 'together with' (e.g., *the cellist in contrast to the flutist* vs. *the cellist together with the flutist*). Results from our eye-tracking reading Experiment (Experiment 1), in which participants' eye-movements were monitored while reading sentences, show that (i) readers preferred *dieser* when referring to the topic of a sentence, (ii) *dieser* caused less processing difficulties than *der* in both contrast and no-contrast contexts, and (iii) the processing of *der* in a contrastive context is faster than in a no-contrast context. Our sentence completion Experiment (Experiment 2) also confirmed that *der* and *dieser* are both used for anaphoric reference to a topical antecedent. Collectively, our experiments provide evidence that *dieser* functions as inducing topic persistence, and that contrast in the previous discourse influences the online processing of the German demonstrative *der*. These results suggest that there is a need for further experimental investigation into the semantic factors and informational structures influencing the usage of demonstrative pronouns in German.
Keywords: demonstratives, anaphora, online reading, contrast, prominence.

1. Introduction

Discourse management encompasses the organization and flow of information in a conversation or written text, and so plays a crucial role in effective communication. Effective discourse management relies on establishing and maintaining clear referential structures to avoid ambiguity. Referential structures deal with how referential expressions refer to entities in discourse. We can refer to entities/individuals in discourse by personal or demonstrative pronouns. In particular, German includes various types of demonstratives that can be utilized anaphorically. The most prevalent ones are the demonstratives from the *der* paradigm (i.e., *der*, *die*, *das*), also termed as 'd-pronouns' and those from the *dieser* paradigm (i.e., *dieser*, *diese*, *dieses*), which are termed as 'dem-pronouns'.
For example, in (1) a speaker can say:

(1a) Ich habe einen Perkussionisten und einen Gitarristen auf der Bühne gesehen.
I saw a percussionist and a guitarist on the stage.

(1b) *Der*+ Perkussionist / er / *der* / *dieser*/ hat sehr fleißig gearbeitet.
The percussionist / he / that one / this one worked very diligently.

When referring to the percussionist or guitarist introduced in (1a), one has the option to use a definite noun phrase (*der Perkussionist*) a personal pronoun (*er*), one of the two d-pronouns (e.g., *der* vs. *dieser*)[1].

With respect to (1b), scholars have been trying to determine which anaphoric form is selected and what factors play a role in the selection process. The most studied factors are *structural elements* such as grammatical role (subject vs. object vs. other arguments), linear position of antecedents (first vs. last), topichood (topic vs. non-topic) and *thematic role* (agent vs. patient) – (see the section on structural factors below). In addition, *der* has been extensively investigated and specifically compared to the personal pronoun *er* using acceptability judgment tasks, sentence completion experiments, or forced-choice tasks (e.g., Bader & Portele, 2019; Bouma & Hopp, 2007; Schumacher et al., 2016), as well as corpus data (Bosch et al., 2003), self-paced reading, (Bosch & Umbach, 2007), visual world paradigm studies (Ellert, 2013; Schumacher et al., 2017; Wilson, 2009), ERP studies (Schumacher et al., 2015; Repp & Schumacher, 2023), and an eye-tracking reading study (Patterson & Schumacher, 2020). A common result across these studies is that while *der* refers to less prominent antecedents, *er* refers to more prominent antecedents (e.g., potential antecedents of *der*: object in Kaiser, 2011, or recent/last-mentioned entities, anti-topic bias in Bosch & Hinterwimmer, 2016; Bosch & Umbach, 2007; Wilson, 2009; and potential antecedents of *er*: topic, subject, first-mentioned entity in Bosch et al., 2003; Bouma & Hopp, 2007). Furthermore, while the antecedent choice of *er* was flexible, the antecedent of *der* was not (Bader & Portele, 2019; Kaiser, 2011; Schumacher et al., 2015; 2016; 2017).

It is worth noting that the comparison of the demonstrative pronouns *der* and *dieser* has received far less attention with online processing methods (e.g., eye-tracking reading or ERP experiments). *Dieser* was primarily investigated using offline studies: (i.e., Abraham 2002 (Centering Theory); Ahrenholz, 2007; Weinert 2007 (corpus studies); Fuchs & Schumacher, 2020 (sentence completion task); Patil et al. 2020; 2023 (forced-choice and acceptability judgement tasks); Patterson & Schumacher, 2021 (acceptability judgement tasks); and Patterson & Schumacher, 2023 (story completion tasks); Zifonun et al., 1997; Wöllstein et al., 2022 (in grammars); as well as Diessel 1999; Himmelmann, 1997 (more typological research)). When discussed in sentences with two arguments (e.g. subject vs. object), the pronominal use of *der* and *dieser* is assumed to signal a topic shift. They refer to a non-topic antecedent that introduced a referent that is taken up by the demonstrative as a topic in the current sentence, typically in the first position of the sentence (Zifonun et al. 1997, Abraham, 2002; Bosch et al., 2007). However, there is no explicit research on the contrastive or topic persistent functions of demonstrative pronouns in German. To fill this gap, we focus on the pronominal use of *der* and *dieser*, rather than on their determiner uses (i.e., prenominal use). We specifically focus on the masculine singular forms *der*/*dieser*, since these forms are fully specified for number and case, while the feminine forms *die*/*diese* are underspecified for case and number, which is not within the scope of the current study.

Moreover, to the best of our knowledge, there are still no studies that have examined the online reading processing of *der* and *dieser* in contrast and no-contrast contexts. By using both online and offline methods (i.e., eye-tracking reading and sentence completion experiments), the current study fills this gap and makes several novel contributions. Firstly, we employ eye-movement recording during reading to examine the processing of *der* and *dieser* in contrast and no-contrast contexts. Secondly, since previous studies have explored the thematic roles of verbs (i.e., agent vs. patient) in the antecedent selection of

[1] Note that the use of *der* as in *der* Perkussionist can be either the definite article *der, die, das* or the demonstrative determiner *der, die, das*. Both paradigms partly overlap, but show different forms for the genitive singular, genitive plural and dative plural (see Wöllstein et al., 2022: 744, §1297).

demonstratives and personal pronouns, we contribute new results with respect to *der* and *dieser*. Our study explores antecedent preferences of *der* and *dieser* when all parameters (e.g., thematic roles, recency, and animacy) are kept the same but the contrastiveness of the subject and topic of the previous sentence are controlled. Such investigation provides a deeper understanding of the discourse and referential functions of demonstratives and how prominence – boosted by contrast – affects the selection of antecedents of *der* and *dieser*.

2. Review of Literature

Before delving into our experimental results, we give a brief review of previous studies that investigated the status of noun phrases in anaphora processing and production, including concepts such as the first-mentioned entity and the recency effect. Following this, we discuss the outcomes of studies focusing specifically on d-pronouns *der* and *dieser.*

2.1 Structural factors in anaphora processing.

Researchers have determined the factors that play a role in anaphora processing, including structural factors (e.g., first-mention advantage, subjecthood, parallelism, last-mentioned entity: Arnold et al., 2000; Gordon, et al., 1993; Stevenson et al., 1994; 1995; 2000) and semantic factors (e.g., implicit causality, animacy: Järvikivi et al., 2017; Pyykkönen & Järvikivi, 2010; van den Hoven & Ferstl, 2018). It has long been recognized that a *recency* effect results in 'more recently introduced' entities being more likely antecedents of referential expression (Hobbs, 1979). However, choosing the most recent mention is not necessarily the most effective strategy in anaphora resolution. Previous studies also show *a first-mention advantage,* indicating the first-mentioned noun phrase is the preferred antecedent of an ambiguous pronoun (e.g., Arnold et al., 2000; Gordon, et al., 1993). In addition, while the results of Kaiser and Trueswell's (2004) eye-tracking study that examined the temporal progression of the first-mention effect initially revealed an inclination towards recency, this preference later shifted to the first-mentioned character. In a subsequent eye-tracking reading study, Fukumura and van Gompel (2015) demonstrated that the influence of mention order on pronoun comprehension could depend on *the type of referential expression*. For instance, the personal pronoun *er* in German has been shown to refer to the subject (e.g., Bouma & Hopp, 2007; Schumacher et al., 2016), whereas *der* refers to the object (Schumacher et al., 2015; 2016).

Another hypothesis, supported by numerous researchers, suggests that an entity's prominence is influenced by its *syntactic function* rather than its *sentence position*. According to the *subject preference account*, prominence derives from grammatical role, with entities in a *subject position* being more salient than those in other grammatical roles (Arnold et al., 2000; Crawley et al., 1990; Gordon et al., 1993; Grosz et al., 1995).[2] While providing an extensive characterization of topicality or subject matter is not within the scope of this paper, it is important to acknowledge that numerous researchers have pointed out that subject position often hosts topical entities (e.g., Chafe, 1976; Gundel, 1988; Lambrecht, 1994; Reinhart, 1981). The topic is what the sentence is about (Reinhart, 198). A relationship between topicality and givenness/pronominalization has been proposed (e.g., Ariel, 1990; Beaver, 2004). This implies a link between being a suitable antecedent for a subsequent pronoun and being topical. For instance, in following constructions 'Peter in contrast to Paul came early' or 'Peter together with Paul came early', *Peter* is in the subject and topic position whereas the second argument *Paul* is in a prepositional phrase. *Paul* holds a lower position in terms of grammatical role hierarchies compared to Peter. Additionally, the use of contrastive construction further contributes to a higher prominence level for *Peter* than *Paul*. *Peter* rather than *Paul* is likely to be a more prominent to be antecedent for referential expressions. As a result, one could deduce that topicality functions as the overarching influence that shapes the prominence of a referent

[2] We use the term saliency and prominence in the same way (cf, von Heusinger & Schumacher 2019 for further discussion).

and steers pronoun interpretation by narrowing possible antecedent options.[3] Within this in mind, to the best of our knowledge, there is still a lack of understanding of how contrastive structure (*in contrast to*) and topic persistence affect the online processing and production of *der* and *dieser*. Below, we will discuss the existing theories and accounts concerning the pronominal use of *der* and *dieser*.

2.2 Existing work on pronominal use of two demonstratives in German

In addition to several studies that have focused on English demonstratives (Çokal et al., 2014; 2016; Fossard et al., 2012; Maes et al., 2022a; 2022b), there has been behavioural research on demonstrative determiners (*der* and *dieser* +NP) in written discourse in German (Bader et al., 2022; Fuchs & Schumacher, 2020; Patil et al., 2020). It has been claimed that *dieser* is conventionally limited to selecting a noun phrase positioned at the end of a clause as its antecedent because demonstratives generally avoid the most prominent discourse referents as antecedents (Hinterwimmer & Bosch, 2018; Patterson & Schumacher 2021; Zifonun et al., 1997). Specifically, Patil et al. (2020) focused on transitive or ditransitive sentences with distinct grammatical and thematic roles and used a forced-choice task with a drop-down menu to select *der*, *dieser*, and *er*. They demonstrated that *dieser* can refer to NPs appearing at the beginning of sentences. However, this occurs particularly when the object comes before the subject in the preceding context sentence. Consequently, Patil et al. (2020) proposed that *dieser* exhibits a preference for an object reference.
Similarly, in a sentence completion experiment, Fuchs and Schumacher (2020) investigated whether *er*, *der,* and *dieser* bring arguments in different grammatical or thematic roles in a preceding discourse into focus. To test this, they provided a sentence with two arguments (i.e., proto-agents and proto-patient) for two verb types: active accusative verbs (subject/ proto-agent and direct object/proto-patient) and dative experiencer (i.e., indirect object/proto-agent and subject/proto-patient) as in (2a) and (2b).

(2a) example for an active accusative verb

Jeden Morgen hat der Pfleger den Heimbewohner gekämmt. Dabei hat *er*/*der*/*dieser* oft...
Every morning, the$_{nom}$ (male) nurse combed the$_{acc}$ (male) resident. During this process, *he*/*he.DEM* /*he.DEM* often...

(2b) example for a dative experiencer verb

Im Hafen ist dem Segler der Urlauber aufgefallen. Wenig später hat *er*/*der*/*dieser* dann...
At the harbour, the$_{dat}$ (male) sailor noticed the$_{nom}$ (male) tourist. Shortly afterwards, *he*/*he.DEM*/*he.DEM* then....

They observed that in 65% of cases, the personal pronoun *er* prefers the first-mentioned referent, while both demonstrative pronouns tend toward the second-mentioned referent (73% for *der* and 74% for *dieser*). It should be noted that in both types of sentences, the first-mentioned entity exhibits a high level of agentivity involving either an agent or experiencer as opposed to a proto-patient. In addition, in Fuchs and Schumacher's (2020) study, the second mentioned entity came immediately before anaphoric expressions. This suggests that the proximity of the second entity (i.e., recency effect) to the demonstrative pronouns could have an impact. However, the preference of a second-mentioned referent for demonstrative pronouns may not always be observed. For instance, in an online electroencephalogram (EEG) experiment, Repp and Schumacher (2023) investigated the processing of d-pronoun *der* and personal pronouns in naturalistic

[3] It is also worth mentioning that antecedents joined by *with* showed no plural and a singular entity preference in a sentence completion experiment (Hielscher & Musseler, 1990). Similarly, Moxey et. al (2004) observed that the context 'X with Y' allows individuals to be focused upon entities separately, and thus resulted in few plural continuations in the with condition.

discourse contexts (specifically during story listening). Their analysis of the Tschick corpus highlighted the unexpected characteristics of the antecedents of *der* (such as their occurrence as subjects and agents), suggesting the prominent role of the perspectival center in their corpus. Consequently, like personal pronoun (e.g., *er*) *der* can also refer to subjects/agent antecedents. Repp and Schumacher pointed out that their findings on *der* dramatically deviate from the observations in previous studies (e.g., object antecedent preference in Bosch et al., 2003; 2007; proto-patient antecedents in Schumacher et al., 2016). Moreover, in the EEG experiment, where participants listened to audiobooks, Repp and Schumacher (2023) also found that a biphasic N400-Late Positivity pattern at posterior electrodes emerged in response to d-pronouns compared to personal pronouns. Due to its relative unexpectedness in the context of stories when compared to a personal pronoun, they interpreted that the observed N400 associated with *der* was indicative of higher processing costs.

On the other hand, Bader et al. (2022) extended earlier findings. In a sentence completion experiment, with a subject-experiencer verb (e.g., 'Bernhard fears the real-estate agent because *dieser/der* has a bad reputation'), both *dieser* and *der* referred to the object referent. In contrast, with an object-experiencer verb (e.g., 'The real-estate agent frightens Bernhard because *dieser/der* makes a fraudulent impression'), a majority of references with *dieser* and *der* were to the subject referent. Additionally, the two demonstratives predominantly referred to the subject in the case of object-experiencer verbs (Hinterwimmer & Bosch, 2018; Patterson & Schumacher, 2021; Zifonun et al., 1997). Given the research indicating that *dieser* is conventionally associated with selecting a noun phrase positioned at the end of a clause – especially when the object precedes the subject in the preceding context sentence (Patil et al., 2020) – *dieser* was observed to refer to the subject in the case of object-experiencer verbs (Bader et al., 2020). These findings provide a nuanced understanding of how these two demonstratives are used in different situations (e.g., verb semantics).

Extending the brief summary of the recent research of demonstrative pronouns to demonstrative determiners in complex demonstratives (e.g., *that book*), we can state that complex demonstratives are distinguished from definite noun phrases (e.g., *the book*) in their anaphoric use by the following properties: First, they express contrast to other referents of the same type. From this, it follows that they also express an anti-uniqueness/contrast condition, evidenced by the ungrammaticality of *this sun, this pope* in a neutral context (Ahn, 2019; Bisle-Müller, 1991; Bosch & Umbach, 2007; King, 2001; Wolter, 2006). Second, demonstrative determiners are topic shifters (i.e., they refer to a non-topical antecedent and promote it to the topic of the current clause (Bosch & Umbach, 2007; Diessel, 1999; van Kampen, 2007; Zifonun et al., 1997)). Third, they signal topic persistence, which is understood as a primitive of Givón's (1983) concept of topic continuity. Topic persistence means the cataphoric or forward-looking function (Fuchs & Schumacher, 2020) of demonstratives, best investigated for indefinite demonstratives (Deichsel & von Heusinger, 2011, Gernsbacher & Shroyer, 1989, Prince, 1981). These patterns are observed more frequently with complex demonstratives with the pronominal *dieser* than with definite noun phrases with the prenominal *der*, which is in most cases understood as being the definite article. From the observations on demonstrative determiners in complex demonstratives, we assume that some functions are similar for demonstrative determiners and demonstrative pronouns – perhaps in a different distribution. Therefore, we assume that pronominal *dieser* for topic persistence and thus signals that the referent is used in the subsequent discourse as topic, as well.

The semantics of the German demonstratives also involves a *contrast function*. Contrast function, as discussed by Diessel (1999), refers to the capability of demonstratives to distinguish a specific object or person from a group of similar entities (cf. further discussion, Ahrenholz, 2007). This is described as "…pointing out one member of a group" (Anderson & Keenan, 1985, p. 289). Bisle-Müller (1991) also emphasized the contrast and delimitation functions of demonstrative noun phrases with *dieser*. *Dieser* implies a distinction from other referents, suggesting a sense of "only this one matters, forget about the others." This distinction goes beyond just spatial functions of demonstratives and signifies a fundamental differentiation. Bisle-Müller's (1991) perspective on the meaning of *dieser* is that it serves to address differentiation from other possible referents. All these accounts describe the demonstrative determiner

dieser (*dieser NP*), since a complex demonstrative *der NP* cannot easily distinguished from a definite noun phrase *der NP*.

Other researchers have posited that the demonstrative pronoun *der* is used if there is a contrast in alternation with non-accented personal pronoun *er* (Bosch, 1988; Zifonun et al., 1997). Additionally, Bader et al. (2022) propose that both *dieser* and *der* demonstratives are capable of indicating contrast. While these studies focused on German pronouns, van Kampen (2007) also examined how referent preferences can also be modulated by contrast in Dutch, German and Swedish. Van Kampen (2007) suggests that demonstratives can only shift a topic referent if that referent holds a contrastive position in the previous sentence. While van Kampen (2007) investigated antecedents in the focus position, one could also test accented antecedents or antecedents that are contrastively marked by explicit expressions. However, it remains uncertain how sensitive *der* and *dieser* are to *topic contrast* context. Consequently, we investigated their usage in both contrast and non-contrast contexts (see current study & design sections below).

3. The current study

Examining demonstratives in such a contrast context will provide new results with respect to how *der* and *dieser* are processed in context and how they are integrated into a discourse model. Overall, there is a lack of comprehensive characterization for *dieser*, and no systematic distinction has been established between *der* and *dieser* in terms of their interpretive preferences. Therefore, the current study aims to answer the un-investigated questions: (1) Do we observe any distinction between these two demonstrative pronouns uses? and (2) How does contrast affect the function of *der* and *dieser* to find an antecedent and their integration into discourse model? Above, we argued that previous studies leave open questions of how contrast influences real-time processing of *der* and *dieser*. We predict that the functions are not equally distributed over the two demonstrative pronouns: (1) *dieser* signals topic persistence (2) *der* signals that the antecedent argument is contrastive. In order to test these two hypotheses, we construct short texts that allow us (i) to neutralize the parameter of distinct grammatical and thematic roles; (ii) allow us to manipulate the contrast of one argument; (iii) neutralized immediate recency; (iv) allow us to see whether demonstrative pronouns can access topics and whether they also continue the previous topic (i.e., topic persistence). We, therefore, designed short texts of the following type:

(3)

S1: I listened to a cellist and a flautist at a Munich classical music festival.
S2: The cellist, in contrast to the flautist /together with the flautist, played a few wrong notes.
S3: A few minutes before the opening concert of the event, *dieser*/*der* changed the strings skillfully and tuned his instrument.

The first sentence (S1) introduces two indefinite noun phrases in direct object position. In the second sentence (S2), the first indefinite noun phrase introduced in S1 is taken up as a definite noun phrase in subject/topic position. The second noun phrase is taken up as a prepositional phrase, either expressing a contrast (NP1 in contrast to NP2) or as a comitative phrase (NP1 together with NP2). On the one hand, the syntactic role of NP2 is clearly degraded in comparison to the NP1, which functions as the subject/topic. On the other hand, NP2 has the same thematic role as it refers to an alternative or comitative expression to NP1. This design enables us to investigate the subtle difference between *der* and *dieser* keeping the thematic role stable. The third sentence (S3) starts with the demonstrative pronoun in the subject (and topic) position and then predicates a property that is only coherent with NP1. In other words, we have an ambiguous pronoun that is disambiguated after the verb phrase.

To examine subtle differences between the functions of *der* and *dieser*, in Experiment 1 (reported below), we used eye-movement recording during reading to examine how *der*/*dieser* are processed in German, using contrast (e.g., NP1 in contrast to NP2) and no-contrast contexts (e.g., NP1 together with NP2). Additionally, we ran a sentence-completion experiment (Experiment 2 reported below) to examine

participants' antecedent preferences regarding information structure without time pressure (i.e., *der*/*dieser* references to NP1 or NP2 in contrast and no-contrast contexts).

4. Experiment 1

Experiment 1 was an eye-tracking study using a 2 × 2 within-subject, within-item design, crossing contrast type (*contrast and no-contrast)* with anaphora type (*dieser* and *der*) as seen in Example (4) below.

(4a) *Dieser* in contrast context

Bei einem Münchener Klassikfestival habe ich einem Cellisten und einem Flötisten zugehört. Der Cellist **im Gegensatz** zum Flötisten hat ein paar schiefe Töne gespielt. Einige Minuten vor dem Eröffnungskonzert der Veranstaltung hat *dieser* die Saiten routiniert ausgewechselt und sein Instrument gestimmt.

(4b) *Der* in contrast context

Bei einem Münchener Klassikfestival habe ich einem Cellisten und einem Flötisten zugehört. Der Cellist **im Gegensatz** zum Flötisten hat ein paar schiefe Töne gespielt. Einige Minuten vor dem Eröffnungskonzert der Veranstaltung hat *der* die Saiten routiniert ausgewechselt und sein Instrument gestimmt.

(Translations of 4a/4b: At a classical music festival in Munich, I listened to a cellist and a flautist at a Munich classical music festival. The cellist, in contrast to the flautist, played a few wrong notes. A few minutes before the opening concert of the event, *dieser/der* changed the strings skillfully and tuned his instrument.)

(4c) *Dieser* in no-contrast context

Bei einem Münchener Klassikfestival habe ich einem Cellisten und einem Flötisten zugehört. Der Cellist **zusammen mit** dem Flötisten hat ein paar schiefe Töne gespielt. Einige Minuten vor dem Eröffnungskonzert der Veranstaltung hat *dieser* die Saiten routiniert ausgewechselt und sein Instrument gestimmt.

(4d) *Der* in no-contrast context

Bei einem Münchener Klassikfestival habe ich einem Cellisten und einem Flötisten zugehört. Der Cellist **zusammen mit** dem Flötisten hat ein paar schiefe Töne gespielt. Einige Minuten vor dem Eröffnungskonzert der Veranstaltung hat *der* die Saiten routiniert ausgewechselt und sein Instrument gestimmt.

(Translations of 4c/4d: At a classical music festival in Munich, I listened to a cellist and a flautist. The cellist, together with the flautist, played a few wrong notes. A few minutes before the opening concert of the event, dieser/*der* changed the strings skillfully and tuned his instrument.)

4.1 Predictions

Our first prediction is that *dieser* is a marker for topic persistence (Deichsel & von Heusinger 2011, Gernsbacher & Shroyer, 1989, Prince, 1981). If this principle does play a role, then *dieser* in (4a/4c) would likely lead to less processing difficulties, resulting in lower odd ratios of regressions-out as well as shorter total times in the disambiguation[4] and/or spill-over regions. Both conditions suggest that we talk more about "the cellist" and therefore allow *dieser* to be processed easily.

Our second prediction is that *der* has a congruent feature of contrast and therefore it can be anaphorically linked to a contrasted item in the previous context. If that is the case, in (4b) *der* would be preferred to *d*er in (4d) because in (4b) a contrast with respect to a competitive referent is made (i.e., the cellist in contrast

[4] In the disambiguation region, we disambiguated the antecedents of *der* and *dieser* by employing a referential expression closely related to NP1 (strings related to *cellist*).

to the flautist). Consequently, we expected to observe processing difficulty (i.e., high proportions of regressions-out and longer total times) in (4d) immediately after *der,* (the disambiguation region), in comparison to *der* in (4b). Given this experimental design, the presence or absence of topic contrast in the previous context would lead to an interaction (all other things being equal) between *contrast type* and *anaphora type*, due to the prediction of a difference between (4b) and (4d) and the absence of a contrast effect in (4a) and (4c). It should be noted that this prediction assumes that *der* and *dieser* have a difference in meaning and function.

4.2 Method

4.2.1 Participants

Fifty-two paid, native German-speakers aged 21-24 from the University of Cologne participated in the experiment. They were not exposed to another language before they were three years old. All were unaware of the study's purpose. The experiment involving human participants was reviewed and approved by the Ethics Board of the German Linguistic Society. The participants provided written informed consent to participate in this study.

4.2.2 Apparatus

We used an Eyelink 1000 eye-tracker (SR Research Ltd, Ottawa, Canada) in tower-mounted mode, with a chin rest to stabilize each participant's head.

4.2.3 Materials

Forty items were created based on Example 4 above. Each item appeared in four conditions, which crossed contrast type (contrast vs. no-contrast) with anaphora type (*der* vs. *dieser*). The explicit topic contrast was manipulated using im Gegensatz zu ('in contrast to') in the contrast condition and *zusammen mit* ('together with') in the no-contrast condition. Anaphora type was manipulated by including either *der* or *dieser*.

We disambiguated the antecedents of *der* and *dieser* by using referential expressions/noun phrases (e.g., strings) coming after them thereby disambiguating the demonstrative pronouns (e.g., *der*/*dieser* changed the strings – referring to a cellist in example 4). Throughout the experiment, *der* and *dieser* were disambiguated to NP1, i.e. the subject and topic of the antecedent sentence (i.e. *cellist* in the example above. While both referents (i.e., cellist and flautist) were congruent in gender and number with the pronoun, reference to the subject/topic was ensured via the plausibility of the critical sentence (e.g., in example x it is only plausible that a cellist would check the strings, not the flautist because a flute does not have strings). References to the subject/topic was done to avoid the recency/last-mentioned entity as a confounding factor for demonstrative reference (Bosch & Hinterwimmer, 2016; Bosch & Umbach, 2007; Kaiser, 2011; Wilson, 2009; Zifonun et al., 1997). In addition, to reduce the recency effect (i.e., the second NP as an alternative antecedent), temporal phrases were also used after the critical sentence (e.g., *Einige Minuten vor dem Eröffnungskonzert der Veranstaltung* 'A few minutes before the opening concert of the event') to put a distance between *der*/*dieser* and their possible antecedent options. Except for our manipulations (the cellist & the flautist), there were no alternative antecedents for *der* or *dieser* in the previous context. In the spillover region, the length of adverb (*routiniert* 'skillfully') in each item was matching across four conditions.

The forty stimuli were distributed into four lists, following a Latin Square procedure. In each list, every item appeared in only one condition, and each condition appeared an equal number of times. Each list was assigned to 10 participants. Additionally, there were 73 fillers with plural pronouns but not personal or demonstrative pronouns in the singular. In addition, there were three practice items, all of which were similar in length to the experimental sentences. Here is an example of a filler item:

(5) Es war in einem Operationssaal eines Krankenhauses in Köln Lindenthal. Die Ärzte standen am Operationstisch. Die Anästhesisten standen daneben. Es war ein typischer arbeitsreicher und produktiver Tag. *Sie* checkten sorgfältig ihre Aufgaben und erledigten die Arbeit.
(It was in an operating room of a hospital in Cologne Lindenthal. The doctors were standing at the operating table. The anesthesiologists stood by. It was a typical busy and productive day. *They* carefully checked their assignments and got the job done.)

4.2.4 Pre-testing items

We pre-tested our stimuli using Qualtrics with 120 native speakers of German. We provided the initial text and asked them to choose "who would do the action". A sample pre-test item is as follows:

(6) Es gab einen Cellisten und einen Flötisten. Der hat die Saiten routiniert ausgewechselt.
Wer hat die Saiten ausgewechselt? (Who changed the strings?)
(a) Cellist (b) Flötist

Our results showed that 75% of referents were selected as NP1, whereas 25% of cases were selected as NP2.

Using Qualtrics, we also ran an acceptability judgment task to check that the items and conditions did not differ in their acceptability. The participants did not take part in the previous pre-testing session (n = 46). They rated 40 experimental stimuli and 40 filler items from 1 to 5. We ran a linear mixed-effects model including random intercept for participants and items, β = 1.028, SE = 0.144, t = 7.084. While the interaction between anaphora type and contrast type was not significant, there were main effects of anaphora and contrast types, anaphora: β = 0.064, SE = 0.27, t = 2.369; contrast: β = -0.092, SE = 0.27, t = -3.337. In both contexts, the use of *dieser* was significantly preferred to *der*. In addition, irrespective of anaphora type, no-contrast context was slightly less preferred than contrast context, *der* with explicit contrast context with M = 3.22, SE = 1.40; *dieser* with explicit contrast M = 3.36, SE = 1.39; *der* with no-contrast context M = 2.91, SE = 1.38; *Dieser* with no-contrast M = 3.33, SE = 1.40. In addition, to a significant degree participants had less of a preference for the use of *der* with a no-contrast context to *der* with a contrast context: β = -0.325, SE = 0.111, t = -2.969. Overall, our results indicate that sentences are not considered ungrammatical on a 3 out of 5 scale. However, raters had slight preferences for *dieser* and the contrast context compared to *der* and the no-contrast context. This was expected given that the demonstrative *dieser* is often preferred in formal and /or written discourse, while the demonstrative *der* is preferred in informal or oral discourse (Patil et al., 2023, for further discussion). Moreover, participants might have learned that the use of *der* is impolite for human referents. Both assumptions would predict a certain preference of *dieser* over *der* in our written test items.

4.2.5 Procedures

We presented 116 texts in Times New Roman 18 font, in a fixed random order, with no experimental items adjacent to each other. The texts were presented on six or seven written lines, with each line containing between 76 and 85 characters. The critical regions including *der/dieser* and their referents (i.e., die Saiten/the strings) always appeared near the middle of a line and were not the last sentence on the screen.
To familiarize participants with the experimental procedure, the experiment began with three fillers. While viewing was binocular, only the right eye was tracked. The items appeared on a 19" monitor, approximately 70 cm away from the participants' eyes. In order for the experimenter to check the calibration of each participant, the participant fixated on a black square before each item, indicating the position of the first character of the text. The black square was automatically replaced with text once a stable fixation was detected. After reading each item, the participant pressed a button to indicate the end of the sentence. For 37% of the items, a comprehension question then appeared, which the participant answered by pressing a

button on the left or right side of the button box. The comprehension questions never probed an anaphora and the antecedent ('cellist'; or 'flautist').

4.2.6 Data analysis

Texts were divided into three regions (see Table 1). Below, we report data for the following regions: anaphora, disambiguation, and spillover. It should be noted there is a length difference in the anaphora region between *der* (i.e., 3 characters) and *dieser* (i.e., 6 characters) rendering this main effect in the anaphora region uninterpretable. Additionally, due to the skipping rate of functional words in previous studies (Rayner, 2011), we have typically not found early effects of syntactic or referential processing difficulty in anaphora region. We predicted that we would observe an interaction between two factors (i.e., anaphora type and type of contrast) in the disambiguation and spill-over regions, which immediately follow the anaphora region. These regions were matched for length in all conditions.

Region 1	Region 2	Region 3
Anaphora	Disambiguation	Spillover
der/dieser	die Saiten	Routiniert
der/dieser	the strings	skillfully

Table 1. Regions (R) in Experiment 1

Fixations of less than 80, or more than 1200 ms, were excluded from analysis. All participants correctly answered at least 90% of comprehension questions. Since reporting a large number of eye-movement measures might result in false positives due to family-wise errors (von der Malsburg & Angele, 2017), we selected only two eye-movement measures: regression out and total time: We selected regressions-out, which is the proportion of trials where readers looked back from the region to an earlier piece of the text between the time when the region was first entered from the left to the time when the region was first exited to the right. This measure indicates that lexical semantic information is processed during regressions-out and used in recovery from processing difficulty from the previous text where the current word/text does not meet the expectation of readers (cf. further discussion on regressions in reading Sturt & Kwon, 2018). For completeness, we also report total time (i.e., the sum of all fixations in the region) as a general measure of processing, even though this does not provide information about initial processing. In cases where the region received no fixations (total time), the trial was treated as missing data and excluded from analysis.

We used the following packages: lme4 to run logistic mixed effects regressions models for the analysis of regressions-out. We used Sjplot to calculate odds ratios, random effects; library (emmeans) to calculate standard errors and confidence Intervals; ggplot2 to graph estimate proportions of each condition.

The analysis was based on whether or not participants had regressions-out in the region. Therefore, trials without regressions-out were retained in the analysis. Trials that had no regressions-out were included and coded as 0. We used logistic-mixed effect regression (GLMER). Factor labels were also transformed into numerical values and centered prior to analysis, with a mean of 0 and a range of 1. Random slope parameters corresponding to the two experimental factors and their interactions were included in the maximal model for both participants and items. Below we report odd ratios for the analysis of regressions-out. To aid convergence, and to avoid spurious over-estimates of correlations, random correlation parameters were excluded from the model. In anaphora and disambiguation regions for regressions-out, the model failed to converge, and random slope parameters with the least variance were removed until convergence was achieved. To decide which factors needed to be removed first to achieve convergence, we assessed the variability at each level in our data. It should be noted that when there is little variability between the levels of a particular random effect, it may not be necessary to include it in our model.
The following models converged for the regressions-out:

- Anaphora region: (anaphora type * contrast type +1||subject) + (anaphora type +1|item) + anaphora type * contrast type

- Disambiguation region: (anaphora type +1|subject) + (anaphora type +1|item) + anaphora type * contrast type
- Spillover region: (contrast type +1|subject) + (anaphora type + contrast type +1|item) + anaphora type * contrast type

For each region and total time, linear mixed effects regression (LMER) models using lme4 R packages were constructed, incorporating all fixed effects and interactions in a single step. An additional package (plyr) was used to compute mean values. Factor labels were transformed into numerical values and centered prior to analysis, with a mean of 0 and a range of 1. We performed analyses on log-transformed reading times, and all analyses reported below incorporated crossed random intercepts for participants and items.

The model did not converge in the anaphora and disambiguation regions for total time. To achieve convergence, random slope parameters with the lowest variance were eliminated. Converged models for each region are as follow:

- Anaphora region: (1|subject) + (1|item) + anaphora type * contrast type
- Disambiguation region: (contrast type +1|subject) + (1|item) + anaphora type * contrast type
- Spillover region: (anaphora type + contrast type +1|subject) + (anaphora type + contrast type +1|item) + anaphora type * contrast type

While regressions-out are reported with odds ratios, standard errors, and p-values, the results for total times also include coefficients, standard errors, and t-values for each fixed effect and interaction. A given co-efficient was judged to be significant at $\alpha = 0.05$ if the absolute t-value exceeded 2 (Baayen et al., 2008). Data, scripts, and stimuli for all experiments are available at https://osf.io/ubxkr/?view_only=01bc62fb4fd0460f9e7831b0eedfbe4e

4.3 Results and discussion

4.3.1 Anaphora region

Regressions-out did not show main effects of anaphora and contrast types (see Tables 2 & 3), anaphora: *OR* = 0.77, *SE* = 0.16, *p* = 0.873, contrast type: *OR* = 0.77, *SE* = 0.14, *p* = 0.167. Total time showed a main effect of anaphora type, with longer reading times for *dieser* than *der*, β = -0.052, *SE* = 0.023, *t* = -2.249, *Dieser*: *M* = 298, *SE* = 11.20, *Der*: *M* = 272, *SE* = 13.74. This effect is likely due to the length differences between *dieser* and *der*, as discussed above. Therefore, this effect is not interpretable. The interaction between anaphora and context in total times was not significant, *Der*-contrast: *M* = 252, *SE*= 17.16; *Der*-no-contrast: *M*= 292, *SE* = 21.29; *Dieser*-contrast: *M* = 293, *SE* = 15.21; *Dieser*-no-contrast: *M* = 302, *SE* = 16.57 (see Table 2 below).

Regions/parameters	Regressions-out			Total Time		
	Odds Ratio	SE	p-value	β	SE	t
Anaphora						
Intercept	0.17 (0.12-0.23)	0.03	0.001*	5.72	0.041	136.395
Contrast	0.97 (0.70-1.35)	0.16	0.873	-0.029	0.034	-0.852
Anaphora	0.77 (0.54- 1.11)	0.14	0.167	-0.052	0.023	-2.249*
Contrast* Anaphora	0.101 (0.53-1.92)	0.33	0.975	0.011	0.046	0.244
Disambiguation						
Intercept	0.22 (0.16-0.30)	0.04	0.001*	6.065	0.067	89.791
Contrast	0.78 (0.61-0.99)	0.09	0.039*	-0.027	0.026	-1.025
Anaphora	0.37 (0.27-0.51)	0.06	0.001*	-0.054	0.021	-2.548*
Contrast *Anaphora	1.15 (0.72-185)	0.28	0.561	0.026	0.042	0.617
Spillover						
Intercept	0.10	0.02	0.001*	5.755	0.041	138
Contrast	1.53	0.27	0.017*	0.022	0.029	0.758
Anaphora	0.79	0.12	0.116	0.008	0.019	0.042
Contrast* Anaphora	1.38	0.40	0.270	-0.055	0.039	-1.421

Table 2. Results of mixed-effects analysis for the eye-movement measures for Experiment 1

4.3.2 Disambiguation region

Regressions-out showed main effects of anaphora and contrast types but not a two-way interaction (i.e., anaphora * contrast context): anaphora: *OR* = 0.36, *SE* = 0.06, *p* = 0.001; contrast: *OR* = -0.78, *SE* = 0.09, *p* = 0.039; anaphora * contrast: *OR* = 0.72, *SE* = 0.28, *p* = 0.561 The odds ratios with *der* were higher than those with *dieser,* which indicates that irrespective of contrast type (i.e., contrast or no-contrast), conditions with *der* led to more processing difficulties compared to *dieser* (see Figure 1 & Table 2). In addition, irrespective of anaphora types, no-contrast context led to more regressions-out than the contrast context.

In the no-contrast context, *der* led to more regressions-out than *der* in a contrast context, which was also significant in the pairwise comparison, *β* = -0.334, *SE* = 0.155, *z* = -2.150, *OR = 0.72, SE* = 0.11, *p* = 0.032. The pairwise comparison showed that there were significantly fewer regressions-out in both contrast and no-contrast contexts with *dieser* than *der*, indicating that references to a topic with *dieser* led to less processing difficulties than for *der*, irrespective of contrast type: pairwise comparison of *dieser* and *der*:

contrast context: β = -1.028, *SE* = 0.173, *z* = -5.921, *OR = 0.46, SE* = 0.10, *p* = 0.001. no-contrast context: β = -1.284, *SE* = 0.237, *z* = -5.408.

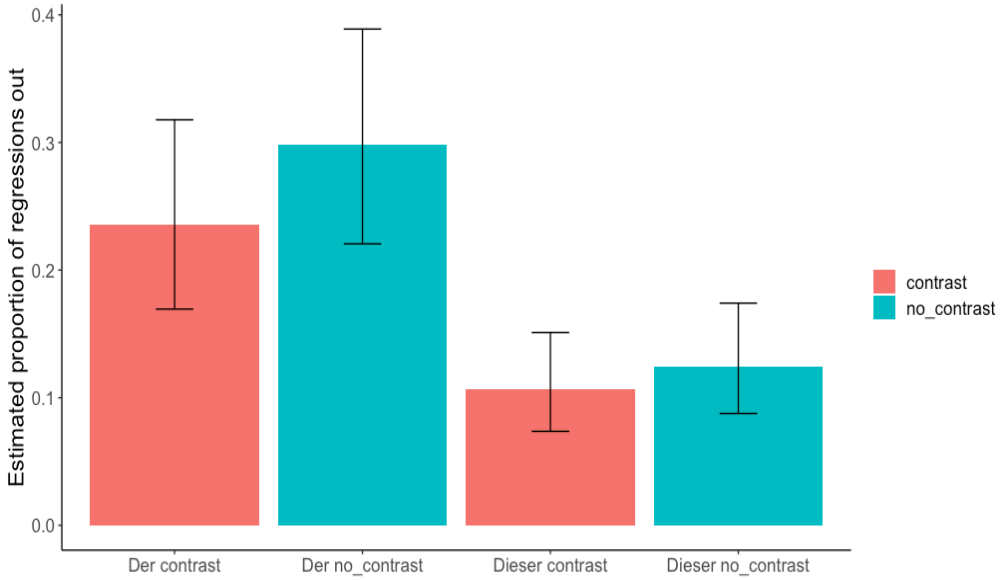

Figure 1. Estimated proportion of regressions-out in the disambiguation region

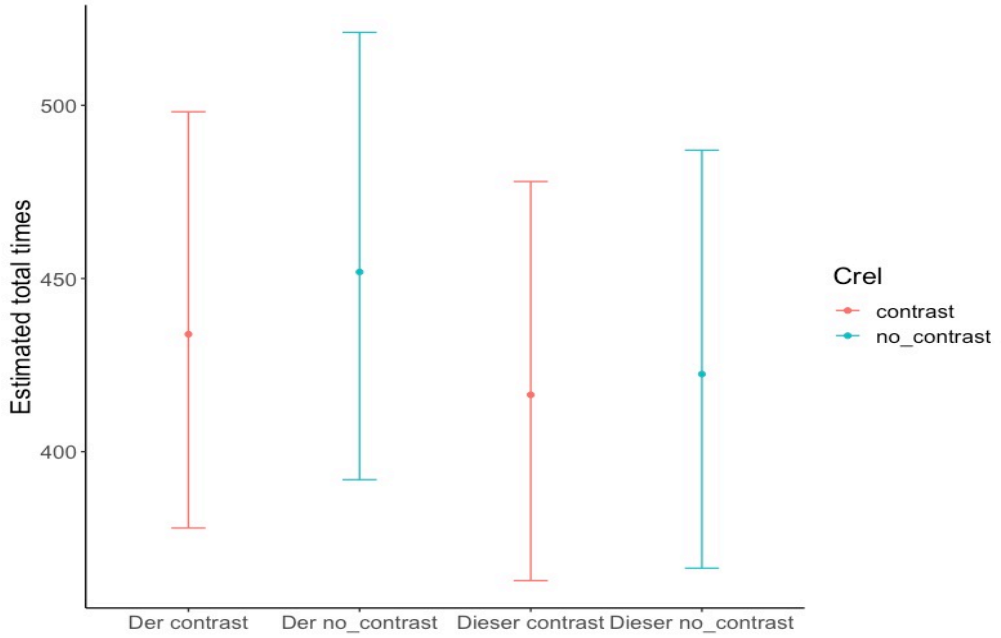

Figure 2. Estimated total times in the disambiguation region.

In the disambiguation region, total time did not show a significant interaction between the two variables (contrast * anaphora), *Der*-contrast: M = 434, SE = 30.1; *Der*-no-contrast: M = 452, SE = 32.4; *Dieser*-contrast: M = 416, SE = 28.9; *Dieser*-no-contrast: M = 422, SE = 30.3 (see Table 2 and Figure 2). While *der* in the contrast context led to shorter total times compared to its use in the no-contrast context, the pairwise comparisons were not significant, β = -0.043, SE = 0.030, t = -1.413. There was a main effect of anaphora, with longer total times with *der* than *dieser*. Overall, the processing of *der* took longer than that of *dieser,* β = -0.054, SE = 0.021, t = -2.548.

4.3.3 Spillover region

Regressions-out showed a main effect of contrast context but no main effect of anaphora type or an interaction between the factors (see Table 2), $OR = 0.53$, SE = 0.27, p = 0.017. Compared to the no-contrast context, the contrast context led to more regressions-out, showing that contrast contexts were difficult to process irrespective of anaphora type in the spillover region, *Der*-contrast: 0.115, SE = 0.019, *Dieser*-contrast: 0.108, SE = 0.018; *Der*-no-contrast: 0.091, SE = 0.016; *Dieser*-no contrast: 0.063, SE = 0.013.

Total time for the spillover region did not show a two-way interaction (i.e., anaphora and context type), β = -0.055, SE = 0.039, t = -1.421, or main effects of anaphora and contrast types, anaphora: β = 0.008, SE = 0.019, t = 0.042; contrast: β = 0.022, SE = 0.029, t = 0.758 (See Table 2).

In summary, in the disambiguation region, the main effect of anaphora in regressions-out indicates that overall, readers had less processing difficulties with *dieser*. In the initial processing, participants preferred *dieser* over *der*. Processing of *der* took longer (reflected in total reading times) compared to *dieser,* which also suggests that participants' preferences for *dieser* did not change in later processing. In other words, regardless of contrast type*, dieser* was preferred to *der.* The less processing difficulty observed for *dieser* might be attributed to its topic persistence function in both contrast and no-contrast contexts. This finding appears to support our initial prediction that *dieser* serves as a marker for topic persistence.

Our second prediction was that in the disambiguation region, *der* in the contrast context would lead to less processing difficulty than *der* in the no-contrast context, due to the presence of a contrastive antecedent. This assumption is supported by the findings in the disambiguation region of regressions-out: *der* with the contrast context led to significantly lower regressions-out than *der* with the no-contrast context. While the same pattern for *der* was observed in the same region of total times, the pairwise comparison was not significant. However, the results from regressions-out suggest that with a contrast context *der* was preferred because its referent (i.e., 'the cellist') was the topic of the sentence, which was also emphasized with the contrast construction 'in contrast to', making it more prominent than 'the flautist'.

In addition, the presence of a contrast context influenced regressions-out in both disambiguation and spillover regions. Initially, readers experienced processing difficulties in the disambiguation region when presented with a no-contrast context. However, in the subsequent spillover region, this preference shifted. Regardless of anaphora type, processing a contrast context resulted in higher regressions-out compared to a no-contrast context in the spillover region. Initially, due to the presence of two alternatives, readers in the disambiguation region might find no-contrast contexts demanding. While these alternatives are bundled with the use of such phrases as 'together with', in the disambiguation region they need to 'unbundle' them. After accomplishing this, in the spillover region readers may find no-contrast contexts less taxing than contrast contexts, since contrastive information in online processing, emphasizing a particular element or concept in a sentence or discourse, creates a mental 'placeholder' for related alternatives (Repp & Spalek, 2021). This placeholder can be connected to likely candidates or alternatives presented after the initial focus. Our results indicate that these alternatives can be generated or considered as the discourse unfolds.

While Experiment 1 focused on participants' online processing of *der* and *dieser* in contrast and no-contrast contexts, in Experiment 2 we explored participants' offline antecedent preferences for these anaphoric expressions. In this way, we were able to examine which individuals (NP1) and (NP2) were selected as antecedents using these expressions. Experiment 2 also provided further information on whether participants preferred topic references (NP1) with *der* and *dieser.*

5 Experiment 2

Experiment 2 tested participants' antecedent preferences using a sentence completion method approved by the Ethics of Research Committee at University of Cologne.

5.1 Method

In this section, we will describe our participants, materials, and data analysis.

5.1.1 Participants

Experiment participants (n =32) were native German-speakers aged 21-24 from Cologne University, and they were compensated for their participation. All were unaware of the study's purpose, and none had participated in Experiment 1. To recruit participants, we posted fliers to the Faculty of Philosophy at University of Cologne. Our main selection criteria were being a native speaker of German and not being bilingual (defined as not growing up in an environment where more than one language was spoken).

5.1.2 Materials

We used the same sentences as in Experiment 1, but we made a slight change to avoid the demonstrative determiner uses of *der* and *dieser* in their completions (e.g*., der Cellist, der Flötist*). While in Experiment 1, the auxiliary *hat* 'has' came before *der* and *dieser (i.e.,* hat *der*/*dieser ...),* in Experiment 2, *hat* (i.e., *der*/*dieser hat*) followed *der* and *dieser* (please see below). This forced a demonstrative pronoun usage and disallowed a demonstrative determiner usage.

Each participant was provided with an initial context and asked to provide a completion answer for the sentence fragment ending with *der hat* or *dieser hat* in a manner consistent with the previous text. In each condition, participants could refer to either the first NP (NP1) (e.g., the cellist) or the second NP (NP2) (e.g., the flautist). One experimental item with its conditions is given below:

(7a)/(7b) *Dieser/Der* in the contrast context

> Bei einem Münchener Klassikfestival habe ich einem Cellisten und einem Flötisten zugehört. Der Cellist **im Gegensatz** zum Flötisten hat ein paar schiefe Töne gespielt. Es waren einige Minuten vor dem Eröffnungskonzert. *Dieser / Der* hat ...
>
> (I listened to a cellist and a flautist at a Munich classical music festival. The cellist, in contrast to the flautist, played a few wrong notes. It was a few minutes before the opening concert of the event. *Dieser / Der* has …)

(7c)/(7d) *Dieser/Der* in the no-contrast context

> Bei einem Münchener Klassikfestival habe ich einem Cellisten und einem Flötisten zugehört. Der Cellist zusammen mit dem Flötisten hat ein paar schiefe Töne gespielt. Es waren einige Minuten vor dem Eröffnungskonzert. *Dieser / Der* hat ...
>
> (At a classical music festival in Munich, I listened to a cellist and a flautist. The cellist, together with the flautist, played a few wrong notes. It was a few minutes before the opening concert of the event. *Dieser / Der* has …)

There were 40 experimental and 60 filler sentences. There were four experimental conditions as per Experiment 1. Four lists were constructed, using Latin Square counterbalancing. In each list, each sentence appeared in only one condition, with an equal number of items from each condition. Sentences were presented in a Word document in fixed random order. All filler sentences had referential expressions (See a sample filler with a personal pronoun below.).

(8) Es war in einem Operationssaal eines Krankenhauses in Köln Lindenthal. Die Ärzte standen am Operationstisch. Die Anästhesisten standen daneben. Es war ein typischer arbeitsreicher und produktiver Tag. *Sie* hatten …
(It was in an operating room of a hospital in Cologne Lindenthal. The doctors were standing at the operating table. The anesthesiologists stood by. It was a typical busy and productive day. *They* had …)

5.1.3 Procedure

Each participant made an appointment for a sentence completion experiment session. We conducted a two-block data collection process, which has been previously used in studies of plural and singular anaphors (Çokal et al., 2023; Çokal & Sturt, 2017; Koh & Clifton, 2002). In the first-block, participants finished all sentence completions, and we saved their completions to a different folder. In the second-block, immediately after saving their document, participants were asked to review their completions and underline to what the referential expressions (e.g., *der*, *dieser*) referred. Since filler sentences included other referential expressions (e.g., *sie* 'she', 'they', *das* 'that'*, er* 'he'), participants also underlined their referents. No feedback was given to participants.

5.1.4 Data analysis

We used the following continuation codings and samples for *der* and *dieser*. The data analysis below was based on participants' underlined interpretations.

If *der* or *dieser* referred to the protagonist introduced first, then its referent was coded as the first NP (NP1), as in (9) and (10) below:

(9) In meiner Stammkneipe habe ich mit einem Koch und einem Barmixer geredet. Der Koch *im Gegensatz zu* dem Barmixer war durchgehend sehr freundlich. Es gab ein unterhaltsames Gespräch. *Der* hat den anderen viele Tipps und Ratschläge zum Kochen gegeben.
(In my regular pub, I had a conversation with a chef and a bartender. The chef, unlike the bartender, was consistently very friendly. It was an entertaining conversation. *Der* gave the bartender many tips and pieces of advice about cooking.

(10) Auf einem Jazzfestival in dem berühmtesten Kölner Konzerthaus habe ich einen Sänger und einen Saxophonisten gemeinsam auftreten sehen. Der Sänger *zusammen mit* dem Saxophonisten hat stehende Ovationen bekommen. Es herrschte eine angenehme Stimmung in der schönen Kölner Philharmonie. *Dieser* hat den Saxophonisten umarmt, weil er so glücklich über die tolle Performance war.
(At a jazz festival in the most famous concert hall in Cologne, I saw a singer and a saxophonist perform together. The singer, along with the saxophonist, received a standing ovation. There was a pleasant atmosphere in the beautiful Cologne Philharmonic Hall. *Dieser* hugged the saxophonist because he was so delighted with the fantastic performance.)

If *der* or *dieser* referred to the protagonist introduced as the second noun, then its referent was coded as the second NP (NP2), as in (11) below:

(11) In meiner Stammkneipe habe ich mit einem Koch und einem Barmixer geredet. Der Koch zusammen mit dem Barmixer war durchgehend sehr freundlich. Es gab ein unterhaltsames Gespräch. *Dieser* hat schon mit 16 seine ersten Cocktails gemixt.
(In my regular pub, I talked with a chef and a bartender. The chef, along with the bartender, was consistently very friendly. There was an entertaining conversation. *Dieser* started mixing cocktails at the age of 16.)

Ungrammatical or incoherent sentence completions were excluded from the logistic mixed effects regression analysis. For instance, while *der*/*dieser* is used for masculine nouns in nominative singular, they can also be used for feminine nouns in the genitive or dative singular form (see supplementary materials for other cases).

5.2 Results

We ran logistic mixed effects regressions, taking pronouns (*der* vs. *dieser*) and type of contrast (contrast vs. no-contrast) as the fixed effects, and including crossed random intercepts and slopes for participants and items. When participants had ungrammatical or incoherent sentence completions, these cases were coded as 'other cases' using 2 and excluded from the main analysis (as illustrated above). The percentage of other cases was 3.59 (n = 23 cases out of 1280. In the logistic mixed-effects regression, we coded references to the first protagonist (NP1/ *der Cellist*) as 1 and to the second protagonist (NP2/ *der Flötist*) as 0. Factor labels were transformed into numerical values and centered prior to analysis, with a mean of 0 and a range of 1. However, since the full model did not converge, we reduced the fixed random effect for items and ran the following model instead:

Response ~ (1 | subject) + (contrast type *anaphora type+1||item) + contrast type * anaphora type

The analysis revealed main effects of anaphora and contrast type: more NP1 references with *der* than *dieser*, and more NP1 references in no contrast than contrast conditions: Anaphora, *OR* = 0.67, *SE* = 0.12, *p* = 0.024; Contrast type: *OR* = 0.69, *SE* = 0.14, *p* = 0.041; *Der*-contrast: *OR = 0.905, SE = 0.025; Dieser*-contrast: *OR = 0.873, SE = 0.032; Der-no-contrast*: *OR = 0.937, SE = 0.018; Dieser-no-contrast: OR = 0.902, SE = 0.026* (See Table S1 in the supplementary materials, Figure 3). The interaction between these two factors was not significant, *OR* = 1.17*, SE* = 0.42, *p* = 0.659.

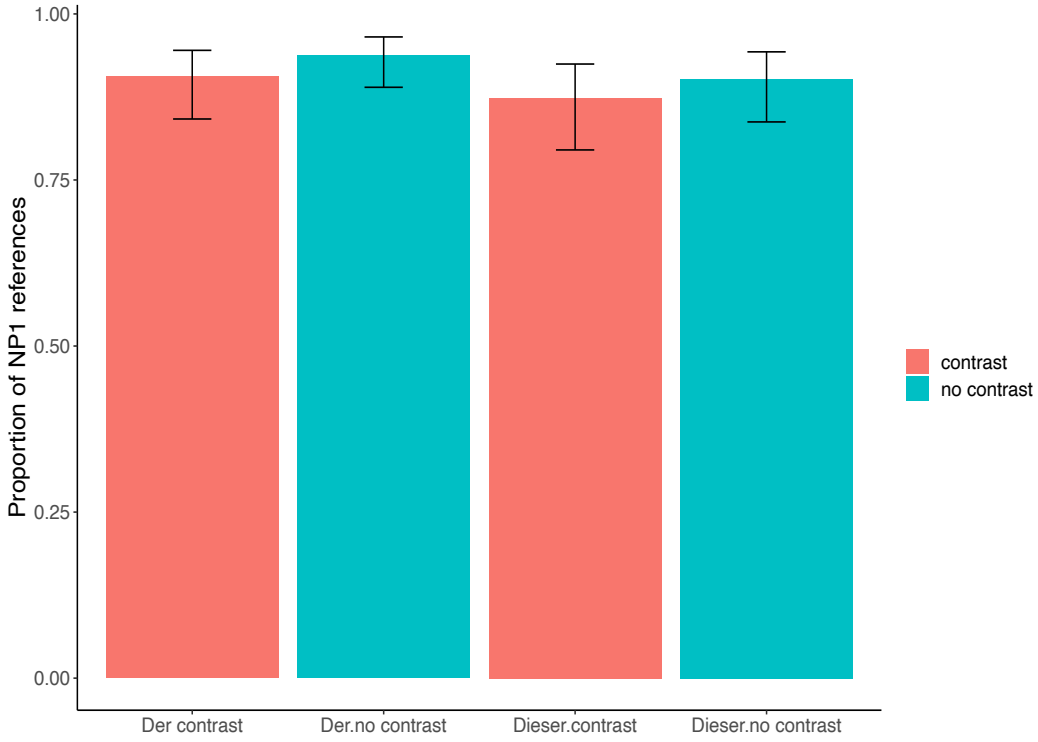

Figure 3. Estimated proportions of NP1 references out of all NP references in topic contrast and no-contrast contexts with *der* and *dieser.* Note: Error bars show the 95% confidence intervals.

Overall, our results suggest that irrespective of contrast type, participants preferred NP1 references with *der and dieser*.

6. General Discussion

In this paper, we investigated whether a contrast context (i.e., NP1 in contrast to NP2) or no-contrast context (i.e., NP1 together with NP2) affects online processing of *der* and *dieser* regarding integration to a discourse model and antecedent preference. In addition, we also explored whether *der* and *dieser* are used to refer to NP1 or NP2 in these contexts.

Our eye-tracking reading experiment (Experiment 1) showed that in both contrast and no-contrast contexts the processing of *dieser* was easier than that of *der*, with lower regressions-out and shorter total times in the disambiguation region. This suggests that participants prefer *dieser* to *der*. These results support our first prediction on the topic persistence function of *dieser*.

Our second assumption was that *der* would be preferred in the contrast context rather than the no-contrast context because it requires a topic contrast. Experiment 1 supported this prediction, showing significantly fewer regressions-out in the contrast context with *der*, compared to the no-contrast context with *der*. While a similar pattern for *der* was observed in the same region of total times, pairwise comparisons of *der* in both contexts were not statistically significant. Our results suggest that a demonstrative *der* is preferred by readers and is processed faster when the antecedent has a contrastive feature (e.g., NP1 in contrast to NP2) as opposed to where *der* is used in a no-contrast context (e.g., NP1 together with NP2). Experiment 2 showed that in a sentence completion task, participants preferred continuations in which *der* and *dieser* refer to NP1 rather than NP2 in both contrast and no-contrast contexts (e.g., the cellist (NP1) in contrast to/together with the flutist (NP2). *Der/Dieser* hat). This suggests that longer total times and higher odds ratios of regressions-out for *der* compared to *dieser* in both contexts as observed in Experiment 1 are not attributable to NP1 references. This is because, in Experiment 2, our participants used both types of anaphoric demonstrative pronouns for NP1 references. Both experiments clearly demonstrate that a topic reference is preferred not only with *dieser* but also with *der*.

Another interpretation could be that in no-contrast contexts, noun phrases (NPs) behave more like conjoined NPs (e.g., 'John and Peter...') where the two NPs are closely connected/bundled. This differs from the contrast condition. Even if there would be an expectation that a plural pronoun would be used to refer to these conjoined NPs, previous studies in both German and English have shown that the use of plural and singular pronouns is equally acceptable (Hielscher & Musseler, 1990; Moxey et al., 2004). However, it is still reasonable to assume there is some processing effort involved in referring to individuals from conjoined NPs because they need to be mentally 'unbundled'. This may contribute to the additional processing demands observed in no-contrast conditions. A related question is, 'Why do we not observe this processing difficulty with *dieser*?' One reason may be that *dieser* serves a 'singling out' function, making it a more suitable anaphor for 'unbundling' compared to *der* (Ahrenholz, 2007; Anderson & Keenan, 1985: Bisle-Müller, 1991).

Our findings that *der* – in contrast contexts – has less processing difficulty than in no-contrast contexts, can be linked to the claims in Bosch (1988), and Zifonun et al. (1997) for German and van Kampen (2007) for Dutch and Swedish. Since it seems to flag a contrastive antecedent, readers/writers prefer *der* in a contrast context. Our finding can be linked with those of other studies that have discussed demonstrative determiners crosslinguistically (Ahrenholz, 2007; Anderson & Keenan, 1985; Bisle-Müller, 1991; Diessel, 1999). As mentioned earlier, the literature assumes three functions of demonstrative determiners in complex demonstratives: (a) contrast / non-uniqueness, (b) topic Shift, and (c) topic Persistence. These functions can partly be transferred to the function of demonstrative pronouns. In German, however, with two different demonstratives, it seems likely each specializes in one function: *der* for contrast and *dieser* for topic persistence (see Fuchs and Schumacher, 2020 for evidence for the topic persistent function of *dieser*). Consequently, further research is warranted.

In the sentence completion Experiment (Experiment 2), writers referred to the first mentioned entity, which is in the subject/topic position, but not the second NP, which is in a prepositional phrase (e.g., cellist/NP1 in contrast to flautist/NP2 or cellist/NP1 together with flautist /NP2). Our findings contribute to the discussion of previous studies that have shown demonstratives' preference for the non-topic antecedent, object, last-mentioned entity or recent entity (Bader & Portele, 2019; Bosch, 2003; Fuchs & Schumacher, 2020; Hinterwimmer & Bosch, 2018; Kaiser, 2011; Patil et al., 2020; Zifonun et al., 1997).

The recency effect observed in previous studies may be attributed to either (a) the short distance between demonstratives and their recent entities, as they immediately followed NP2, or (b) the thematic roles (agent vs. patient) explaining the recent antecedent of these two demonstratives. In our experimental design, we maintained a consistent distance between NP1 and NP2 in relation to the demonstratives and the thematic roles of antecedents remained the same across conditions. Here, we demonstrate that information structure, specifically contrast type, can influence the antecedent preferences of *der*. Both demonstratives, particularly *dieser* in both online and offline processing, can also serve as a topic reference in sentence completion tasks (i.e., NP1 references instead of NP2 references). These findings extend Repp and Schumacher's (2023) corpus analysis of the informal language in the crime novel of Tschick, where they observed that *der* can refer to antecedents in the subject position and antecedent with the thematic role of agent. In essence, Repp and Schumacher (2023) found that both *der* and the personal pronoun *er* tend to prefer subject and agent references (see Figure 2 in Repp & Schumacher, 2023).

Our findings from Experiment 1 show longer reading times for *der* compared to *dieser* (i.e., total times and regressions-out in the disambiguation region). As mentioned earlier, our sentence completion experiment results suggest that these reading difficulties might not be attributed to topic references with *der* and *dieser* (i.e., 'the cellist' but not 'the flautist' and 'the cellist' together with 'the flautist' played a few wrong notes – '*Der / Dieser* fixed the strings'). One possible reason behind longer reading times for *der* might be that readers' prior expectations in the disambiguation region lean towards the demonstrative determiner use of *der* (*der* + cellist) instead of a pronominal use. To investigate this further, we conducted a brief corpus analysis to examine the distribution of pronoun *der* and *dieser* as well as determiner *der* and *dieser*. To accomplish this, we retrieved instances from the Cosmas Tagged T2 corpus (https://www2.ids-mannheim.de/cosmas2/projekt/referenz/archive.html). Our results indicate that the percentage of determiner use of *der* is 95%, while the pronominal use is 5% (cases: *Der*_pronoun (n) = 13.352; Der_determiner (n) = 254). In contrast, determiner use of *dieser* accounts for 50% of cases, with demonstrative pronoun use also making up 50% (cases: Dieser_pronoun (n) = 9.402; Der_determiner (n= 9.525). What is interesting is that, even though the assumption is less usage of *der* in written discourse (see Ahrenholz 2007; Patil et al., 2020; Weinert 2007), our small-scale corpus analysis indicates that people do use *der* in written (newspaper) discourse, and even more frequently than *dieser*. While further research is needed, but it is not the focus of the current study. The combination of our results and the corpus analysis suggests readers tend to prefer the d-pronoun use of *der* in both contrast and no-contrast contexts, while the d-pronoun use of *dieser* does not significantly deviate from their expectations.

It should be noted that in the EGG study, Repp and Schumacher (2023) discovered that during an experiment in which participants listened to stories from audiobooks, demonstrative *der* elicited a more pronounced N400 response compared to personal pronouns. Consequently, Repp and Schumacher (2023) argue that *der*, when contrasted with personal pronouns, is perceived as a less expected and more distinct form of reference. In their study, due to the design of the EEG experiment, they were unable to distinguish between the determiner and pronoun uses of *der* in the stories. However, our study specifically hypothesizes that *dieser* would cause less processing difficulty in reading compared to *der*. Our findings point to subtle distinctions within the d-pronoun and determiner systems of demonstratives. Further research is needed to differentiate demonstrative forms in online processing, encompassing both EEG and eye-tracking studies.

A relevant direction for further research is to investigate the online processing and production of both determiner and pronoun forms of these demonstratives to gain a broader understanding of when and how they are disambiguated. To gain a better understanding of the demonstrative pronoun system, it would be beneficial to examine contexts with only one potential antecedent and design experiments that can help elucidate these subtle differences. Additionally, there is a need to move beyond the recency and spatial approaches to information structures and semantics.

A limitation of the current study is the absence of eye movement and reading time data for the demonstrative determiner use of these two demonstratives when referring to a protagonist in both contrast and no-contrast contexts. Our corpus analysis indicates there would be less of a penalty if the determiner

der was used (note that this is the definite article in most instances). Another limitation is that our design is clearly biased towards NP1 to test topic persistency. However, our offline sentence completion experiment results suggest participants do not prefer NP2 references in both contexts.

In conclusion, our results provide novel insights regarding demonstrative pronoun resolution in online reading and offline sentence production tasks. We also contribute to previous findings: (i) *dieser* was preferred when referring to the topic of a sentence in both contrast and no-contrast contexts, and (ii) the processing of *der* in a contrast context is faster than in a no-contrast context. We hope our findings will move the state-of-the-art in psychological and theoretical modelling of anaphora resolution forward beyond the recency and/or thematic role approach to demonstrative pronoun in cases requiring such inferences.

Acknowledgments

This research was funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) – Project-ID 281511265 – SFB 1252 Prominence in Language – in the project C04 “Conceptual and referential activation in discourse” at the University of Cologne, Department of German Language and Literature I, Linguistics.

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