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Referent Management in Discourse: The Accessibility of Weak Definites

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Abstract

In this paper, we experimentally investigate the discourse properties of weak definites (*go to the doctor*), and compare them to indefinites (*go to a doctor*) in German. While indefinite and weak definite noun phrases are highly similar when it comes to their sentence-level meaning, our visual world eye tracking study shows that weak definites are significantly less accessible than indefinites when an ambiguous pronoun needs to be resolved in the subsequent discourse. However, contra some accounts of weak definites, our results also show that it is very much possible for an anaphoric expression to access a weak definite. In sum, our experiment suggests that weak definites introduce new referents into a discourse, but that those referents are embedded into an event structure associated with the stereotypical meaning of a weak definite construction. As a result, referents introduced by weak definites are less prominent than referents introduced by indefinites.

Keywords: weak definites; discourse processing; referent management; pronoun resolution; accessibility

Introduction

Knowing who is being talked about is a crucial component of understanding any text. A prerequisite for this is keeping track of discourse referents. Relevant information for interpreting pronouns has been shown to include knowledge about who has been introduced in the immediately preceding discourse, in which grammatical or semantic role was a referent mentioned, and whether and how a referent has been re-mentioned (e.g., Arnold, 1998; Kaiser, 2011; Kehler, Kertz, Rohde, & Elman, 2007). This information has been proposed to result in a constantly updating ranking of referents; high-ranking, or prominent, referents are usually good candidates for resolving anaphoric expressions to (von Heusinger & Schumacher, 2019). In this paper, we investigate a type of expression where it is up for debate whether or not a referent is introduced into the discourse at all: weak definites.

Weak definites

Weak definites are definite noun phrases that differ from regular definites in their semantic, pragmatic, and discourse properties (e.g., Aguilar-Guevara & Zwarts, 2010; Carlson, Sussman, Klein, & Tanenhaus, 2006; Klein, Gegg-Harrison, Carlson, & Tanenhaus, 2013; Krifka & Modarresi, 2016; Leonetti, 2019). For instance, unlike regular definites (1b, 2b), weak definites (1a, 2a) do not imply uniqueness of their referent. This means that the sentence in (1a) could be uttered felicitously in a situation in which Ann is reading multiple news-

papers. The sentence in (1b), on the other hand, can only describe a situation where Ann reads exactly one book.

- (1) a. Ann reads the newspaper.
b. Ann reads the book.
- (2) a. Each student went to the doctor.
b. Each student went to the American architect.
c. Each student went to a doctor / an architect.

Furthermore, weak definites always take narrow scope, while regular definites allow only for a wide scope reading (e.g., Aguilar-Guevara & Zwarts, 2010). Unlike in (2a), all students went to the same person in (2b). Indefinites, as in (2c), show a high preference for a narrow scope reading (but do allow for a wide scope reading in specific pragmatic contexts).

With respect to their sentence semantics, weak definites seem to behave very differently from regular, strong definites, and very similarly to indefinite noun phrases. However, at the pragmatic and lexical level, there are also well-documented differences between indefinites and weak definites. First, weak definites come with enriched meaning. For example, the sentence *Peter went to the doctor* does not only express that Peter went to a person who is a doctor, but also that Peter probably waited in a waiting room, talked to an assistant, received some consultation, as well as other stereotypical sub-events that are associated with a doctor's visit. This is generally not true for indefinites (see Aguilar-Guevara, 2014; Schwarz, 2014, for discussion).

Second, weak readings of definites are typically triggered by specific verb-noun combinations describing specific types of contexts. The contexts that trigger the weak reading, which we will refer to as weak contexts, typically express a stereotypical situation and must display a conventionalized sense extension, such as *going to the doctor* (Carlson et al., 2006). If such a stereotypical situation cannot be assigned to a noun-verb pair, the weak reading is dispreferred. If Peter for example *complained* to the doctor, a weak reading is much less probable.¹

¹We can for instance test this by adding *and Ann, too*. In *Peter complained to the doctor, and Ann too*, we would assume that Peter and Ann complained to the same doctor. In *Peter went to the doctor, and Ann too*, they could each have visited a different doctor.

Weak definites in a discourse

Weak definites also differ from regular definites and indefinites in their discourse behavior. Specifically, it is often argued that weak definites do not introduce discourse referents that can (easily) be taken up by an anaphoric expression. There are three distinct accounts of weak definites, which differ in their predictions about the accessibility of weak definites by anaphora in the subsequent discourse: (a) the property approach, (b) the kind approach, (c) the dependent (and embedded) definite approach.

The weak definites-as-properties account (e.g., Carlson & Sussman, 2005; Carlson et al., 2006; Dayal, 2011) assumes that the definite article of a weak definite is just a syntactic marker and does not express its regular meaning (i.e., its existence and uniqueness presupposition). Weak definites are therefore interpreted as properties, much like bare nouns. This theory is supported by the observation that weak definites often alternate with “bare singular” constructions in English (*to go to bed* vs. *to go to the cinema*). Weak definites, like bare nouns, express a property and this property is incorporated into the verb meaning. Rather than applying the verb to an individual argument, this process modifies the verb meaning. This incorporation is very similar to the lexical process of compounding, as in *doghouse* or *dog owner*. Much like weak definites, lexical compounds include more than the literal meaning of its elements. *Dog owner* does not just refer to the concept of a person who owns a dog, but for instance also implies that that person walks their dog every morning. The weak definites-as-properties account predicts that weak definites do not introduce discourse referents and therefore do not license anaphoric pronouns, very similar to lexical compounds not allowing anaphoric relations to the individual parts of the compound: *Peter is a dog owner and walks #him/the dog every morning*. Note that the full definite description *the dog* can be used since it introduces a new discourse referent and does not need to be anaphorically linked, even though its content may be related to already introduced content.

A second approach assumes that weak definites refer to kinds rather than to individual objects or people, much like generic sentences (e.g., *The lion is a dangerous animal*) (e.g., Aguilar-Guevara & Zwarts, 2010). Evidence in favor of this account is for example the observation that kind-modifying adjectives do not seem to change the weak reading (*the children's hospital*), while other types of modification do (*the big hospital*). This approach assumes that the definite article does express its regular meaning with a uniqueness and existence condition; this condition is not fulfilled by an individual (object) referent, but by a kind referent. The kind account also makes a clear prediction with respect to anaphoric uptake: Kinds can only be taken up with the indefinite partitive pronoun *one* referring to an instantiation of the kind. Personal pronouns are not grammatical in this context, as in *Shockley invented the transistor. My grandfather immediately bought #it/one* (see discussion in Modarresi, Fortmann, & Krifka,

2019).

Finally, the dependent definite approach assumes that weak definites are a subtype of dependent definites. Krifka and Modarresi (2016), who combine ideas from various theories on weak definites, develop an approach that describes weak definites as definites embedded under an event denoted by a verb that expresses, together with the weak definite, a stereotypical situation (see also Bosch & Cieschinger, 2012; Corblin, 2013). In their theory, the weak definite contributes its uniqueness condition to the most local context. They do not discuss the existence presupposition, but Schwarz (2014) assumes that this presupposition is more global and is one condition that distinguishes weak definites from indefinites (see also the discussion about the presupposition of relational definites in Singh, Fedorenko, Mahowald, & Gibson, 2016). The dependent definite approach predicts that a weak definite introduces a discourse referent, but that this discourse referent is deeply embedded in an event and therefore less accessible than discourse referents that are not embedded under an event. The approach also predicts that discourse referents introduced by a weak definite are accessible and can be taken up by a personal pronoun: Dependent definites, such as *her gift* in the sentence *Santa Claus gave each girl her gift*, can be taken up anaphorically by a personal pronoun in a subsequent sentence: *Laura opened it immediately*.

The three accounts briefly outlined here make different predictions about the accessibility of weak definites. We test these predictions with singular personal pronouns, which refer to individual people/objects. The weak definites-as-properties account assumes that weak definites are properties and therefore predicts that no anaphoric link is possible. The kind account predicts that an anaphoric link would be possible with partitive *one*, but not with the personal pronoun. The dependent definite approach predicts that weak definites can be accessed, but that this access is more difficult than accessing regular definites or indefinites.

Current study

We conducted a visual world eye tracking experiment to test the accessibility of weak definites in online comprehension. Native speakers of German listened to short stories that featured two referents: a subject referent and an object referent that was either introduced by an indefinite or by a weak definite noun phrase.² The screen showed pictures of the two referents. The final sentence of each story contained an ambiguous pronoun, where we analyzed participants' looks to the subject and object picture to measure which referent the pronoun was resolved to. The experiment was conducted in German, because German definite articles have two morphological forms: a strong one and a reduced one that cliticizes to certain prepositions (e.g., *zu dem* vs. *zum*). Crucially, both forms express a uniqueness condition, but the strong form has the additional condition that its index is introduced or bound

²The second referent was always introduced in a prepositional phrase, but for ease of reference, we label it the object.

at the utterance level. The weak form does not have this requirement and can easily be associated with a weak reading. (Schwarz, 2013). This morphological property makes German a very fruitful test case for the investigation of weak definites.

Assuming that the referent of a weak definite is indeed less accessible than the referent of an indefinite predicts that the object referent should be a poorer competitor to the subject referent for pronoun resolution when the object noun phrase is a weak definite than when it is an indefinite. At pronoun encounter, we should then find fewer looks to the picture of the object referent in the weak than in the indefinite condition. In the same vein, we should find more looks to the subject picture in the weak definite than in the indefinite condition, because the pronoun will be more often interpreted as the subject referent of the preceding sentence. If weak definites and indefinites both introduce referents that can equally easily be accessed, we expect no differences between the weak definite and indefinite condition.

Method

Participants

Twenty students from the University of Cologne participated in the eye tracking study for either course credit or monetary compensation (€8/hour). One participant was removed from the analysis because of a low accuracy on comprehension questions, leaving 19 participants. All participants were monolingual speakers of German and had self-reported normal or corrected-to-normal vision.

Materials

Speech stimuli We constructed 32 German experimental items. Each item consisted of three sentences, see (3).³

(3) In der Bar war es mal wieder rappellvoll.

Peter bestellte ...

beim Kellner. [WEAK DEFINITE]

bei einem Kellner. [INDEFINITE]

Weil es furchtbar laut war, musste **er** sich ein gutes Stück herüberbeugen.

The bar was very crowded again. Peter ordered with a waiter. Because it was incredibly loud, he had to lean forward a bit.

The first sentence set up a context, after which the second sentence introduced two human referents. Subject referents were always introduced with a proper name. The referents of object noun phrases were always introduced by a descriptive noun phrase embedded in a prepositional phrase. This was done to make the weak form of the definite article visible to participants in the weak definite condition; noun phrases involving a cliticized form of the article (e.g., *beim* in (3))

³All experimental items and fillers can be accessed at <https://tinyurl.com/ycb85kkk>.

strongly favor a weak reading. All referents were introduced by masculine nouns, since stereotypical contexts licensing weak definite readings in German typically require the noun to be a generic masculine. In addition, masculine articles can be cliticized to more prepositions than feminine articles.

The third sentence always started with a subordinate clause headed by a conjunction (e.g., *because, even though*), followed by a main clause featuring a personal pronoun that was ambiguous between the subject and the object of the preceding sentence. The sentence did not provide any disambiguating information for the critical ambiguous pronoun.

All test materials were identical between the weak definite and the indefinite condition except for the prepositional phrase of the second sentence. The prepositional phrase either included a preposition with the cliticized form of the definite article (e.g., *beim*), yielding the weak definite condition, or a preposition and the full form of the indefinite article (*bei einem*), yielding the indefinite condition. Any differences in ambiguous pronoun resolution found in the experiment are therefore very likely to come from the weak definite vs. indefinite manipulation.

The 32 experimental short stories were distributed across two lists in a Latin square design. Both lists also included 64 filler stories, which were similar to the experimental items in structure and in length. Like the experimental items, filler materials only featured male referents. However, the final sentences of the filler items never displayed any ambiguity between the two referents of the second sentence (either because no ambiguous pronoun was used or because a pronoun was used in the presence of additional disambiguating information). Half of the filler items were followed by a written comprehension question requiring a ‘yes’ or ‘no’ answer. Because filler items were randomly distributed over the lists, comprehension questions randomly followed a third of the trials in the experiment.

All materials were recorded by a trained female speaker of German, one item at a time. After recording and using Praat (Boersma, 2001), experimental audio files were separated and re-arranged so that the first and third sentence of an item were identical across the two experimental conditions and only the second sentence differed (because the prepositional phrase in object position differed).

Visual displays Four pictures accompanied each story: pictures of the two referents of interest (subject and object) and two filler pictures of natural objects (e.g., a balcony, a pear). Pictures depicting the referents were created by a professional illustrator. Filler pictures were selected from a database of normed pictures (Duñabeitia et al., 2017). In experimental trials, the objects in the filler pictures neither appeared in the story, nor were they semantically linked to the story. In filler trials, the objects in the visual display were sometimes mentioned in the speech input. The four pictures of an item were presented within a grid, see Figure 1. Throughout the experiment, subject referent pictures and object referent pictures appeared in each corner equally often.

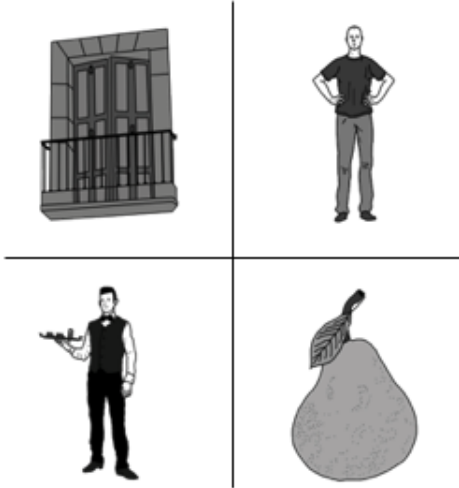


Figure 1: Sample visual display. The subject referent (*Peter*) is presented top right, the referent in object position (*waiter*) is presented bottom left.

Procedure

Eye movements and eye fixations were recorded at 1000 Hz using an EyeLink 1000 with a tower mount. Participants listened to the stimuli over headphones while looking at a computer screen. Participants were asked to listen carefully to the stories in order to be able to answer comprehension questions. In addition, participants were told that there was no correct or incorrect picture to look at, but that the pictures might help them follow the stories.

Each trial started with a familiarization phase in which the subject referent of the upcoming trial was introduced, since these referents could not be identified via specific visual features (e.g., props, typical clothes). The familiarization phase consisted of a display showing the subject referent along with his name. Participants were told that this person would appear in the immediately following story but that they would not need to memorize any features about his physical appearance, as the comprehension question would not target such features. Participants used a mouse click to indicate they felt familiar with the picture of the subject referent, after which a fixation dot appeared in the middle of the screen. When participants fixated on the dot, the experimenter pressed a button at the host computer, which initialized presentation of the visual display. The audio of the trial started 500 ms after the appearance of the visual display. After the end of the short story, the trial moved to either a comprehension question or to a screen where they could press “continue” to move on to the next trial.

Data analysis

We preprocessed the data and conducted the statistical analyses in R (R Core Team, 2019, version 3.4.3), using the tidyverse (Wickham et al., 2019) and lme4 packages (Bates, Maelcher, Bolker, & Walker, 2014). We excluded data from one participant because their comprehension question accuracy was below 80% (mean response accuracy of the other participants: 98.4%). We also excluded 17.9% of the data because of blinks or because none of the four pictures was fixated on within the time frames of analysis. A similar proportion of data was excluded in both conditions (weak definite condition: 17.6%, indefinite condition: 18.2%). In addition, the proportion of fixations on the filler pictures was also similar in both conditions (weak definite condition: 7.7%, indefinite condition: 7.2%).

We analyzed fixation times starting at 100 ms preceding pronoun onset until 1400 ms after pronoun onset. We divided the resulting 1500 ms into five time frames of interest, of 300 ms each. Since it takes around 200 ms for the eye to launch a saccade as response to a stimulus (Matin, Shao, & Boff, 1993), the first time frame (i.e., 100 ms before pronoun onset until 200 ms after pronoun onset), served as a baseline.

Next, we calculated the mean fixation length on the picture of the subject referent, the picture of the object referent, and the pictures of the two unrelated objects. We first determined for each millisecond where participants were looking. When they fixated on one of the four pictures, the associated referent or unrelated filler object received a score of 1, while the three other referents/objects received a score of 0. When no picture was fixated, all referents and objects received a score of 0. After this procedure, mean fixation length was generated for each participant, trial, and time frame individually.

For the inferential statistics, we fitted linear mixed regression models. For each time frame, we fitted a model that included condition (weak definite or indefinite) and the maximal random effects structure permitted by the data. The condition variable was sum-coded prior to model fitting. In one set of analyses, we modelled the influence of condition on fixation length on the object picture; in the other set of analyses, we modelled the influence of condition on fixation length on to the subject picture.

Results

Figure 2 shows the proportion of participants’ fixations on the two human referents over time following the onset of the ambiguous pronoun, with looks to the object picture on the left and the looks to the picture of the competing subject referent on the right. As can be seen, participants looked more to the object referent picture when they had encountered an indefinite noun phrase in object position of the preceding sentence when they had encountered a weak definite noun phrase. The exact opposite is true for the mean proportion of looks to the subject picture: Participants looked more to the picture of the subject referent in the weak definite condition than in the indefinite condition.

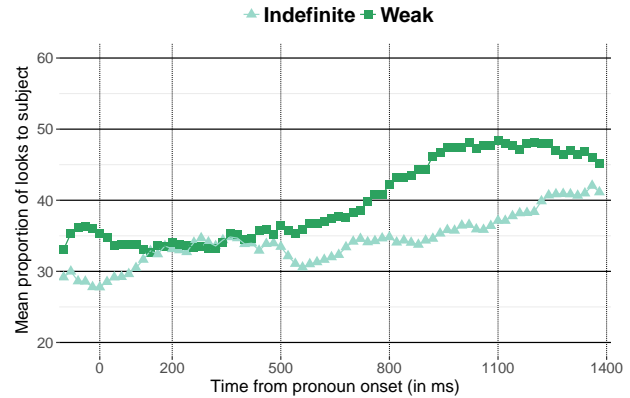
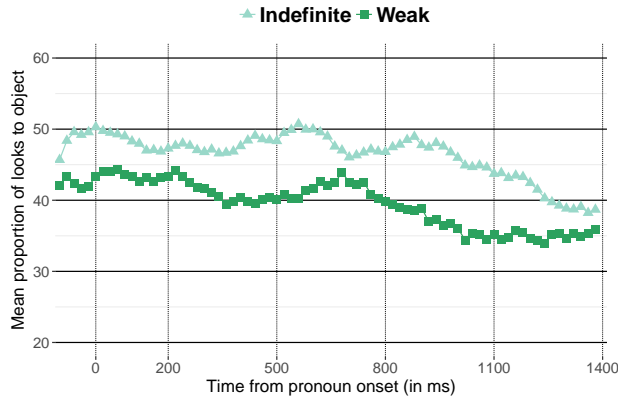


Figure 2: Time course of looks to object picture (left) and subject picture (right) from 100 ms before pronoun onset until 1400 ms after pronoun onset. Zero marks the onset of the ambiguous pronoun.

The patterns shown in Figure 2 are supported by the results of the inferential statistics of the fixation time on the pictures of the object and subject referents. The model output for both the object and subject analysis is provided in Table 1. If we assume that an absolute *t*-value of or above 2 attests statistical significance (Baayen, 2008), we see that between 800 ms and 1100 ms after the pronoun onset, participants fixated less on the object picture in the weak definite condition than in the indefinite condition. In the same time frame, we also find that participants fixated less on the subject picture in the indefinite than in the weak definite condition, which confirms that the pronouns were ambiguous between two referents: If a participant did not interpret the pronoun as the object referent, they interpreted it as the subject referent, and vice versa.

Taken together, these data support the hypothesis that participants are less likely to resolve the ambiguous pronoun to the object referent in the weak definite condition than in the indefinite condition.

Discussion

We designed a visual world eye tracking experiment to assess the accessibility of weak definites in German. Our experimental materials required participants to resolve an ambiguous pronoun to either the subject or the object of the preceding sentence; the object was introduced in a prepositional phrase that either hosted a regular indefinite or a weak definite. We found that participants had a stronger tendency to resolve the pronoun to the object when that object was an indefinite than when it was a weak definite. In the same vein, pronoun resolution to the subject was more likely when the competing object was a weak definite than when it was an indefinite. We therefore conclude that our results show that weak definites display lower discourse prominence than indefinites in online processing, although both kinds of expressions display strong resemblance in their referential properties.

When comparing the overall proportion of looks to the object vs. the subject following the onset of the pronoun (see

Figure 2), it appears that participants fixated on the object relatively often: the proportion of looks to the object picture is approximately equal to the proportion of looks to the subject picture. This may seem surprising given the general preference to resolve pronouns to the subject of the preceding sentence (especially since the pronoun also appears in subject position). However, it should be noted that the referent introduced in the weak definite or indefinite noun phrase was always a Goal. In addition to grammatical function, pronoun resolution has also been shown to be influenced by semantic role, with a shifted bias toward Goals in contexts with transfer events (physical/conceptual) (e.g., Arnold, 2001; Elman, Kehler, & Rohde, 2006).

While our results indicate that indefinites are more accessible than weak definites, they at the same time suggest that weak definites are not entirely inaccessible, as would be predicted by the property and kind accounts discussed in the introduction. Because people are quick to adapt to their linguistic environment (Fine, Jaeger, Farmer, & Qian, 2013), we examined participants' behavior over the course of the experiment to estimate whether exposure to our experimental items made weak definites more accessible. We compared the proportion of looks to the object referent in the weak definite condition in the first versus second 50% of the target items each participant heard. If weak definites became more accessible as the experiment went on, the proportion of looks to the object following the ambiguous pronoun would be expected to be higher in the second half of the experiment than in the first half. As can be seen in Table 2, this was not the case. Participants fixated on the object introduced by a weak definite when hearing an ambiguous pronoun approximately equally often in the beginning of the experiment as toward the end of the experiment (and potentially even a little less).

Turning then to the three competing accounts of weak definites, weak definites-as-properties, weak definites-as-kinds and weak definites-as-dependent-definites, we argue that our results are most compatible with the dependent definite analysis. Both the weak definites-as-properties account (e.g., Carl-

Table 1: Model estimates for the fixation time on the object referent and subject referent picture in the weak definite vs. the indefinite condition, per time frame. Significant *t*-values highlighted in bold.

Time frame	Fixation time object			Fixation time subject		
	Estimate	<i>SE</i>	<i>t</i> -value	Estimate	<i>SE</i>	<i>t</i> -value
-100 - 200	0.038	0.036	1.06	-0.045	0.036	-1.25
200 - 500	0.056	0.035	1.57	-0.008	0.049	-0.16
500 - 800	0.050	0.037	1.35	-0.031	0.052	-0.61
800 - 1100	0.085	0.036	2.34	-0.093	0.037	-2.50
1100 - 1400	0.057	0.040	1.42	-0.060	0.034	-1.77

Table 2: Proportion of looks to the object referent in the weak definite condition, in the first versus second 50% of the target items for each participant, in the critical time bin (800-1100 ms after the onset of the ambiguous pronoun) and in all five time bins grouped.

	First half	Second half
800-1100ms	39%	35%
All time bins	41%	39%

son et al., 2006; Dayal, 2011) and the weak definites-as-kinds account (Aguilar-Guevara & Zwarts, 2010) assume that weak definites do not introduce an individual (object) referent, and so predict no or low accessibility of weak definite noun phrases. While the results of our study show that there is a difference in discourse accessibility between weak definites and indefinite noun phrases, they furthermore suggest that weak definites do introduce referents that are accessible. This result would be surprising under the property or kind analysis.

The dependent definite approach, on the other hand, predicts that the referent of a weak definite is anaphorically accessible, but not as easily as the referent of regular definite and indefinite noun phrases. The weak definite introduces a discourse referent that is embedded in an event created by the verb expressing a stereotypical meaning. We surmise that our data are most compatible with this account, because first, we do find a significant difference between the accessibility of referents introduced by indefinite or weak definite noun phrases but second, referents introduced by weak definites still seem to be easily accessible for anaphoric reference.

Our study thus suggests that in language comprehension, weak contexts influence referent management in a discourse. Upon encountering a weak definite, a new referent is added to the mental inventory, but this referent is not highly activated or prominent. This also makes two clear predictions about language production: a) referents introduced in weak definite expressions are less likely to be re-mentioned in the subsequent discourse than referents introduced in indefinite or strong definite noun phrases, and b) if referents of weak defi-

nites are re-mentioned, this is less likely to happen by means of a reduced referring expression (e.g., a pronoun) than when referents of indefinites or strong definites are re-mentioned. We plan to test these hypotheses in a production study.

Another interesting topic for future research could be to test the time course of the accessibility of weak definites versus indefinites. If a weak context leads to a weak representation of a referent, it could be hypothesized that that referent more quickly becomes inaccessible than a referent introduced in a strong context. In the current experiment, the ambiguous pronoun always appeared in the sentence immediately following the weak definite or indefinite noun phrase. Intervening linguistic material might have increased the difference in accessibility found between the weak definite condition and the indefinite condition.

Conclusion

Referent management is a crucial component of discourse processing. To resolve anaphoric expressions, comprehenders have been shown to use different sources of linguistic information from the preceding discourse, including referents' grammatical functions and semantic roles (e.g., Arnold, 1998; Kaiser, 2011; Kehler et al., 2007). Our experiment confirms referents' having been introduced in a weak or highly habitualized context as another factor that can guide the interpretation of pronouns in a discourse.

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