

Definite reference: Saliency is only a poor substitute for uniqueness

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Abstract

In a Visual World eye tracking experiment we compared the effect of previous mention and uniqueness of referents with the effect that the visual saliency of referents has on referent identification. The effect was measured in terms of the size and time course of the increase of focusing frequency for the target referents. It appears that saliency on its own, in the absence of other factors, leads to a significant effect of referent identification. This effect, however, is considerably smaller and occurs later than the effect that either previous mention or uniqueness have for referent identification. We conclude that uniqueness and previous mention effects are not driven by general saliency-based processes that would also be instantiated by visual saliency, but operate independently.

Keywords: Definiteness; definite reference; uniqueness; anaphora; saliency; visual saliency; eye tracking; visual world.

Parameters of referent identification

The probably most common view of definite reference is that speakers use definite referential expressions (DREs) of the form "the [NP]" to refer to an identifiable unique entity, singled out either anaphorically, i.e., by previous mention, or by the descriptive content of the NP, and would not use a DRE unless this uniqueness condition were fulfilled¹. It is also generally understood that the notion of uniqueness rarely applies absolutely, as it does in the case of *the highest mountain in Europe* or *the sum of 3 and 4*, but is usually taken to be relative to the discourse context. "Discourse context" either means the linguistic context, as in (1), or the utterance situation, e.g., when (2) is uttered in a typical class room.

- (1) John has a son and a daughter. The girl is eight.
(2) There's a diagram on the blackboard.

When the uniqueness condition is not fulfilled, a DRE leads to incoherence, as in (3). - Also utterances like (4),

¹ This view of definite reference does not comprise so-called "weak definites" (Poesio 1994, Carlson et al. 2006), which do not in the same sense identify specific referents as do regular definites, but behave semantically more like English bare singular NPs (as in *go to school*, *be in prison*). An utterance of *Fred was reading the newspaper* (with a weak definite interpretation for *the newspaper*), e.g., would not be taken to refer to a specific newspaper, just like *Fred is in prison* does not refer to a specific prison. - The current paper is only concerned with clearly referential "strong" definites.

with intonational emphasis on the determiners, would support the intuition that uniqueness of reference is central to the use of DREs.

- (3) John has two daughters. #The girl is eight.
(4) His failure to meet the target was not A reason for his dismissal; it was THE reason.

It has frequently been observed, however, that DREs are used also under circumstances where the uniqueness condition is obviously not fulfilled, and apparently with no harm to acceptability or communicative success. For instance in (5) - an example from McCawley (1979) - the discourse provides two dogs, but the DREs are still clearly understood, and with no sign of oddity or incoherence:

- (5) The dog got in a fight with another dog. - I'll have to see to it that the dog doesn't get near that other dog again.

A discussion of similar cases led David Lewis to reject the notion of uniqueness as a basis for DREs and to propose *referent saliency* as a substitute (1979:178): "It is not true that a definite description *the F* denotes *x* if and only if *x* is the one and only *F* in existence. Neither is it true that *the F* denotes *x* if and only if *x* is the one and only *F* in some contextually determined domain of discourse. The proper treatment of descriptions must be more like this: *the F* denotes *x* if and only if *x* is the most salient *F* in the domain of discourse, according to some contextually determined saliency ranking."

Although the cases Lewis (1973:114ff; 1979) discussed are cases where the saliency of a referent arises from the utterance situation, rather than from the linguistic structure of discourse, the notions of saliency that were developed with some success in subsequent work (Ariel 1985, Gundel et al. 1993, Grosz et al. 1995, von Stechow 1995, Roberts 2003, and many others) have remained limited to linguistic discourse parameters.

Still, the idea of a foundation of definiteness in a *general notion of saliency* remains appealing. It suggests the perspective of providing a general cognitive foundation for definite reference - which, apparently, also Lewis was hoping for. In addition, a general saliency-based notion of definiteness could also be applied to DREs that pick their referents directly from the utterance situation rather than from a linguistically given context and that seem to function independently of anaphora or uniqueness. - We had

observed, for instance, in an earlier experiment where participants were interactively selecting specific blocks from large sets of Lego® blocks spread out on a table, that participants frequently produced DREs like *the long blue one* in a situation where several identical long blue blocks were present, to refer to the visually most salient long blue block that was on top of a pile of white blocks, while the other long blue blocks that were visually less salient. No notion of anaphoric identification or uniqueness could explain such cases. If a general notion of salience could be developed that covers such cases of visual salience and could also substitute for anaphora and uniqueness, we would be pretty close to a general notion of definite reference.

According to what many researchers currently believe, referent identification for DREs may come about in an utterance situation in roughly the following ways:

(a) Via the descriptive content of the DRE, whenever there is exactly one referent that fits the descriptive content, either absolutely or within the more restricted domain of the current utterance situation.

(b) Referent identification for DREs may also come about when the DRE is anaphorically related to a preceding reference to a particular referent that has already been identified in the preceding discourse, even when this referent is not the only one that fits the descriptive content of the DRE.

(c) Whenever there is no unique referent available in the sense of (a) or (b), but the anaphoric relation is ambiguous, or the descriptive content of the DRE allows for more than one potential referent in the domain, some kind of ranking mechanisms may select one of the potential referents. This would be the place for salience ranking, at least according to what many researchers currently believe.

Now one could perhaps interpret Lewis' salience proposal in the modest sense that salience operates just in the cases under (c). But this would not explain his emphatic opposition to the uniqueness notion in the quote given above. More likely Lewis had in mind a more general contextual salience ranking that selects the intended referent from the set of things that are in the extension of the descriptive content of a DRE. Such a mechanism would then indeed be a major step on the way towards a general notion of cognitive salience. But with no theory of such a mechanism in place the general salience hypothesis is hard to test.

What is feasible, however, is an experimental comparison of the contributions that *uniqueness* and *anaphora* make towards the identification of DRE referents and the contribution that purely *visual salience* in the utterance situation makes. Each of the three parameters can be isolated from the other two, and each pair of parameters (with the obvious exception of a pairing of uniqueness and salience) can be made to cooperate in referent identification.

We set up a Visual World style eye tracking experiment (following roughly Tanenhaus et al. 1995) to investigate this. The experiment will perhaps not yet permit any conclusions about *salience in general*, but it will be informative at least with regard to the interaction of *visual salience* with anaphora, and uniqueness.

A Visual World experiment

Design and Materials

We tracked subjects' eye movements with respect to a visual scene while they listened to short narratives in German, containing DREs that could be interpreted as referring to either one or more objects in the visual scene. The narratives consisted of a short lead-in, followed by two sentences (see boxes below with translations of sample stimuli). The critical DRE always occurred at the start of Sentence 2. In Condition 1 the target of the DRE had already been identified in Sentence 1, so that the DRE in the second sentence would function anaphorically. In Condition 2 the DRE constituted the first reference to the target.

Sample stimuli - Condition 1: second mention DREs

- 1A [Display has only one stag] In the woods. A stag is standing at the river bank and is watching a snake on the other side. The stag has heard the hissing and is getting nervous.
- 1B [Display has several lions, one at a water bowl] At the zoo. A lion is standing at the water bowl and is watching the elephant. The lion is due to be moved, in order not to be regularly disturbed by the trumpeting.
- 1C, [Display has several children, one visually isolated, the others grouped] In the park. A child is playing with a red ball and is being watched by its grandmother. The child feels already grown up and doesn't like being watched.
- 1D [Display has several children, one visually close to blackboard] In the classroom. A child is standing in the front at the blackboard, explaining something to the teacher. The child is nervous, speaking hesitantly,

Sample stimuli - Condition 2: first mention DREs

- 2A [Display has only one stag] In the woods. A fox is approaching the clearing and sees the snake. The stag has heard the hissing and is getting nervous.
- 2B [Display has several lions] At the zoo. The warden is preparing a new compound for the elephant. The lion will then no longer disturb the elephant with his growling.
- 2C [Display has several children, one visually isolated, the others grouped] In the park. A park keeper has just checked the pond and has been watched by the grandmother. The child is getting ready to go home with its grandmother.
- 2D [Display has several children, one visually close to blackboard] In the classroom. There is an exercise on the blackboard that the teacher wrote up. The child has quickly found the solution and is glad about the praise.

Conditions 1 and 2 were crossed with four types of visual displays, in which the target was either the unique object satisfying the descriptive content of the DRE (Condition A), cf. Figure 1, or there were several such referents none of which was visually more salient than any other (Condition B). In conditions C and D there were also multiple objects satisfying the descriptive content of the DRE, but the target was visually more salient, either because it was visually isolated while its competitors were grouped (Condition C), cf. Figure 2, or because it was close to another object referred to already in Sentence 1 (Condition C), cf. Figure 3.



Figure 1 Sample display for Condition 1A



Figure 2 Sample display for Condition 2C

This set up allows us to observe the effects of referent identification by uniqueness of referent only, with no support by any other parameter (Condition 2A); in Condition 1B we have referent identification solely on the basis of anaphora, and in conditions 2C and 2D solely on the basis of visual salience. Uniqueness and anaphora are combined in Condition 1A, and salience and anaphora are combined in conditions 1C and 1D. There is no combination of uniqueness and visual salience, because obviously no ranking can be applied to the element of a singleton. - The conditions are summarized in Table 1.



Figure 3 Sample display for Condition 2D

	A	B	C	D	
1	unique				anaphoric
	anaphoric	anaphoric	anaphoric salient by isolation	anaphoric salient by closeness	
2	unique				1st mention
			salient by isolation	salient by closeness	
	unique		salient		

Table 1 Summary of conditions

Hypotheses

We hypothesize, as suggested above, that anaphora, uniqueness, and salience contribute each on their own to the referent identification of a DRE, and that the combination of two of these factors shows an increased effect in either faster or more reliable referent identification.

Hypothesis A The relative focusing frequency for the target referent starts to increase immediately after the target DRE has been recognized, in the anaphora-only condition (1B), in the uniqueness-only condition (2A), and also in each of the two salience conditions (2C, 2D). Comparison with the fully ambiguous condition (2B) will show that each of the three factors are effective in referent identification, possibly though in different strengths and with a difference in time course.

Hypothesis B There is an increased effect of referent identification, either visible from the time course or from higher peaks in focusing frequency, when two factors contribute to the identification of the target referent.

Procedure

32 stimulus sets were constructed, as described, four per condition. The validity of the visual stimulus material was controlled to make sure that target objects and their competitors lead to equal focusing frequencies as long as none of them is referred to linguistically, during the lead-in sequence. The presentation of the stimulus materials was randomized. The participants were 27 University of Osnabrueck students, average age 22, who were either paid or rewarded by course credits. The visual stimuli were presented via a 30" Apple Cinema HD display, the auditory stimuli via ER-4B Earphones, and eye movements were recorded with a head-mounted Eye Link II, at a rate of 250 Hz. ROIs for targets and competitors were defined manually. The time course of fixations was summed in slots of 100 ms.

Results

Our results show that strictly unambiguous discourse-unique DREs in conditions 1A, 1B, 1C, 1D, and 2A led to a significant increase of focusing frequency for the targets, starting at about 200 ms and peaking at about 1200 to 1500 ms after onset of the DRE. No significant difference was found between anaphoric definiteness (1B) and referential uniqueness (2A), nor was there any interaction of the two.

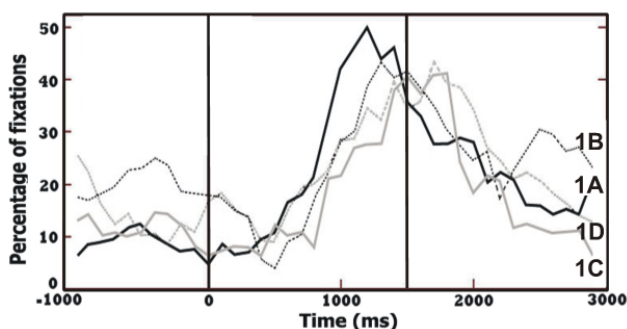


Figure 4: Time course of relative focusing frequencies for target referent in anaphora conditions

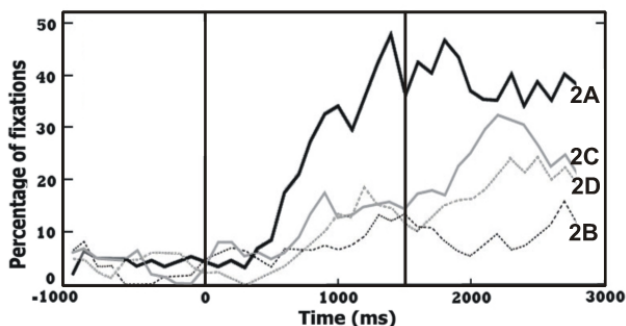


Figure 5: Time course of relative focusing frequencies for target referent in fist-mention conditions

When the DREs were neither anaphorically definite nor referentially unique, but the target was visually more salient

than its competitors (2C, 2D), the overall relative focusing frequency for the target was lower than in the strictly unambiguous conditions (1A, 1B, 1C, 1D, and 2A), and there was a clear delay in the rise of focusing frequency, peaking only at about 2200ms after onset of the DRE. Overall focusing frequencies in the salience conditions (2C, 2D) were not significantly different from the fully ambiguous condition (2B) during the first 1500ms after onset; the difference became significant only at a later stage, between 1500ms and 2500ms. No significant difference was found between the two salience conditions (2C vs. 2D). There was an overall significant difference between the salience conditions (2C and 2D) on the one hand and the anaphora and uniqueness conditions (1A, 1B, 1C, 1D, and 2A) on the other in the time slot between onset and 1500ms.

We thus reject Hypothesis B, while Hypothesis A is broadly supported. But what follows for the relation between uniqueness, anaphora, and salience?

Discussion

Our results show no processing difference between the different types of anaphorically definite DREs and DREs with unique referents. The processing of DREs whose referential success rests solely on their target's visual salience, however, clearly differs from the processing of strictly unambiguous DREs.

The late increase in focussing frequency for the target under the salience conditions suggests that visual salience does not come into play in the process of referent identification for DREs right away when the DRE is recognized; the focussing frequency for unique or anaphorically identified referents shows a significant rise already more than 1200ms earlier. Our results thus seem to suggest that salience is considered only after anaphora and uniqueness have failed to identify a suitable referent.

If this conclusion is correct it argues strongly against the idea put forward by David Lewis of building the semantics of DREs on salience rather than on uniqueness or anaphora. The picture that emerges from our experiment lets salience appear in the role of an independent parameter that becomes relevant only *after* anaphora and uniqueness have already failed, and then brings about referent identification independently, albeit in a degraded fashion. It has also become clear that salience does not increase either the speed of referent identification or the focussing frequency when a referent is both anaphorically identified and salient (conditions 1C, 1D compared to 1B). This latter observation is plausible, of course, since we saw that the effect of salience on focussing frequency only starts at a time (at 1500ms) when the effect of anaphora has already passed its peak.

What, then, is the role of visual salience in referent identification for DREs? One could speculate that salience comes in via some process of charitable interpretation, or possibly more specifically via Gricean reasoning, roughly along the following lines: The listener realises that the DRE is ambiguous with respect to the display and assumes that the speaker would not have used the DRE if she had noticed the

ambiguity. So, presumably, the speaker must have paid attention only to *one* of the available referents. This, or so the listener may reason, is presumably the referent that caught the speaker's attention more than the competing referents, i.e., the most salient one. - Note, however, that also this Gricean story presupposes a uniqueness semantics for DREs.

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