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*Published in:*  
Journal of Pragmatics

*Publication date:*  
2011

*Document Version*  
Publisher's PDF, also known as Version of record

[Link to publication in Tilburg University Research Portal](#)

*Citation for published version (APA):*  
Arts, A., Maes, A., Noordman, L. G. M., & Jansen, C. (2011). Overspecification facilitates object identification. *Journal of Pragmatics*, 43(1), 361-374.

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## Overspecification facilitates object identification

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### ARTICLE INFO

#### Article history:

Received 3 April 2009

Received in revised form 23 June 2010

Accepted 11 July 2010

#### Keywords:

Overspecification

Maxim of quantity

Exophoric referential expressions

Language comprehension

Perceptual mapping

### ABSTRACT

Referential expressions often contain more information than what is strictly necessary for unique identification of the entity the expression refers to. If this extra information slows down the identification process, then this would suggest a violation of one of the Gricean maxims in the category quantity. A perception experiment was conducted in which overspecification was defined exophorically as the elements of referential expressions that denote non-uniquely identifying information of entities in a particular task environment. In the experiment, identifying information either related to object characteristics (size, color, shape) or location (on vertical or horizontal axis). The results of the experiment provide information about the effect of overspecification on the identification time. Overspecified expressions lead to faster identification when they allowed the reader (i) to fully complete a mental image of the entity and (ii) to delimit search behavior to a specific part of the task context. Extra information about vertical location (top, bottom) proved more efficient than extra information about horizontal location (left, right).

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## 1. Introduction

### 1.1. Reference and accessibility

In producing text, language users constantly make decisions about the form and information level of referential expressions. The choice of speakers and writers is based on a complex interplay between different types of knowledge available to the producer and/or the language partner. World knowledge, knowledge about the discourse produced so far, and knowledge about the physical situation of the discourse all belong to these types of knowledge. An initial reference to an entity may be highly informative. The language partner is expected to add a new entity to the mental model that dynamically develops in processing language. This process renders entities that were mentioned at an earlier point in the information exchange less accessible, because the most recent entity becomes most prominent. Subsequent reference to a previously mentioned entity (anaphoric reference) constantly forces a decision on the part of the language producer about the information level and with that also about the form of referential expressions. An anaphoric reference can be successful even with highly attenuated forms. Referential theories base their predictions on this dynamic process. A point of departure in accessibility theory (Ariel, 1990, 1991, 2001) is the mental availability of the entity. Low mental availability (i.e., the entity was not mentioned before or has little prominence in the mental model or in the physical environment) leads to a more informative referential expression. In contrast, high mental availability leads to a lesser informative referential expression. The *givenness hierarchy* (Gundel et al., 1993) departs from the same basic principle: the information level of a referential

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expression is indicative for the degree of supposed *givenness* of the entity the expression refers to. An entity that is highly *given* is also mentally available to a high degree. Arnold and Griffin (2007) review studies on how language producers shape their referential expressions. They conclude that the choice for explicit vs. attenuated lexical forms (as well as between acoustically prominent and attenuated pronunciations) is mainly driven by considerations of audience design, a view which nicely corresponds with the assumptions behind the notions accessibility and givenness.

### 1.2. Endophoric and exophoric overspecifications

In many communicative situations referential expressions contain more information than what is necessary for unique identification of the referent. These expressions are called overspecifications. One can define the specification level of referential expressions, and accordingly of overspecifications, from two different perspectives. The specification level can be assessed relative to preceding expressions in the unfolding discourse, in which case the expressions are endophorically used. The specification level can also be evaluated on the basis of knowledge available in the physical context, in which case the expressions are exophorically used and serve to identify objects in our environment. In spoken discourse, the form of referential expressions is often the result of a combination of endophoric and exophoric considerations. The distinction between exophoric reference and endophoric reference reflects the distinction between embedded communication and displaced communication (Spivey and Richardson, 2008; Zwaan and Kaschak, 2008). In embedded communication, the communicative situation is the same as the referential situation. The language users perceive this situation and can act in this situation. In displaced communication, the communicative situation is different from the referential communication and the language users cannot perceive and act in this situation. Embedded communication is more basic than displaced communication.

Overspecifications occur frequently and they do have a special function. Endophoric overspecifications in narratives have been investigated by Vonk et al. (1992). They demonstrate that overspecified noun phrases are produced at discourse boundaries and that they are indeed interpreted by readers as signals to start the construction of a new episode in their discourse representation (see also Van Vliet, 2008). Gordon et al. (1993) demonstrate that overspecified referential expressions can lead to a so called repeated-name penalty. A repeated name in a discourse where a more attenuated form is appropriate can hinder the reader, because it suggests a different referent than the intended.

In a language production experiment carried out by Maes et al. (2004) exophoric overspecifications have been demonstrated to occur in instructive texts. Instructive writers who could not expect direct feedback, often used overspecified referential expressions; the expressions contained more information than what was necessary to identify the objects relevant to the instruction. The overspecification was observed in initial as well as anaphoric references: 52 percent of the initial references and 75 percent of the anaphoric references were overspecified.

The occurrence of overspecifications may depend on the availability of feedback. In a non-feedback situation a language producer may assign more importance to his<sup>1</sup> referential task than in a feedback situation. In a non-feedback situation the language partner cannot ask for clarification if correct interpretation of a referential expression proves to be impossible. To ensure correct interpretation, the language producer may decide to include extra information which may result in overspecification of the expression. In this respect, Clark and Wilkes-Gibbs (1986) discuss the principles of mutual and distant responsibility: in a feedback situation the language partners are mutually responsible for the success of the referential process (principle of mutual responsibility), whereas in a non-feedback situation the language producer needs to adopt all responsibility (principle of distant responsibility).

Deutsch and Pechmann (1982) and Pechmann (1984) report the results of production experiments in which, respectively, 28 percent and 60 percent of the referential expressions showed overspecification. Pechmann (1989) suggests that speakers produce overspecifications because they start generating a referential expression before they have an overview of all other entities that are potential competitors. Engelhardt et al. (2006) found in a production experiment that speakers overspecify about one-third of the time. The reason is that it would be too difficult for the speaker to determine which information is redundant and consequently to express only the non-redundant information. Arnold and Griffin (2007) had participants describe cartoons in which one or two characters occurred. In both cartoon types pronouns could be used unambiguously to describe the cartoon, because in the two-character cartoons the characters were of different gender. The results indicated that speakers in describing the two-character cartoons were less likely to use a pronoun than in the single-character cartoons. If speakers had to describe two characters, they used an overspecified expression. Arnold and Griffin attribute this result to the speaker's need to divide attention in the case of the two-character story. Also Nadig and Sedivy (2002) found that speakers sometimes produce information that is redundant from the addressee's perspective. In an experiment, adults and children were asked to give instructions to a participant to pick up an object (for example a big glass) in a display of four objects. The contrasting object (a little glass) was either visible to both participants, visible only to the speaker, or absent (participants were aware of this manipulation). Both children and adults produced modifiers for the target object more often when the contrasting object was visible only to them, compared with the no-contrasting-object conditions. In particular perceptually salient features such as color tended to be redundantly produced. Nadig and Sedivy (2002) claim that the production of "overidentifying" descriptions does not hinder communication, but may in fact be helpful. Wardlow Lane et al. (2006:274) showed that speakers are more likely to refer to redundant attributive information of an object (in their

<sup>1</sup> 'His' meaning 'his' or 'her'.

experiment the size of the object) when they were explicitly asked not to. This may suggest that the production of redundant information is “not under speakers’ intentional control”.

In this article, we study overspecifications from a purely exophoric perspective. Language users were asked to identify an object in a set of perceptually available objects on the basis of written descriptions with different degrees of overspecification. This referential task is typical, for example, in written instructions to perform a task, where users have to switch constantly from text to task and back to the text, and the referential job consists of finding the appropriate objects in the task environment on the basis of referential expressions given in the instructions. In formal instructions (like manuals) mostly functional descriptions are used (e.g., the on/off button or the wake up button). In the last decades, more and more informal instructive environments have been created on the Internet, where people ask for help and receive written instructions to perform actions. This requires the understanding of a rich variety of referential expressions. Most studies on overspecifications have dealt with the *production* of these expressions in *spoken* language. It is not known, however, whether overspecified expressions, and in particular exophoric overspecifications, facilitate or hinder the *comprehension* of a *written* instruction. Engelhardt et al. (2006) demonstrated that listeners did not judge overspecifications to be any worse than non-overspecifications. On the other hand, in a Visual World experiment they found that overspecifications triggered eye movements that could be interpreted as an indication of confusion. The aim of the present experiment is to get more direct evidence for the facilitating or hindering effect of exophoric overspecifications in understanding written instructions.

### 1.3. Overspecification, minimal specification and underspecification

From an exophoric perspective, overspecification occurs if, in providing referential expressions, a producer of language is overly specific, in the sense that more is said than the absolute minimum required for unambiguous identification of the intended referent. Minimally specified referential expressions are expressions that provide the minimal information the recipient needs for unambiguous identification of the intended referent. Underspecified referential expressions are expressions that do not provide sufficient information for unambiguous identification of the intended referent.

In (1) the noun phrase *the black ball* is an initial referential expression.

(1) Could you pick up *the black ball* for me?

In a physical task context where the recipient can spot only one ball this initial referential expression is overspecified. The attribute ‘black’ is superfluous in the physical task context that is applicable in this discourse situation.

In a physical task context where the recipient can spot two balls, one black and one white, this same initial referential expression is minimally specified. The attribute black is necessary and sufficient for correct identification of the intended referent in the physical task context.

In a physical task context where the recipient can spot two balls, both black, this same initial referential expression is underspecified. The attribute black does not provide the necessary information for correct identification of the intended referent; a distinguishing aspect about the ball needs to be mentioned to enable the recipient to successfully complete the identification task. Such a distinguishing aspect may be object information, for instance perceptual information about the size of the ball, functional information about the type of ball (tennis ball or football) or location information, for instance in the corner, under the chair, as long as the information is distinguishing in the applicable physical task context. The inclusion of the distinguishing information enables the recipient to complete the identification task, but renders the expression overspecified: the distinguishing information in itself is sufficient to identify the referent and, therefore, the attribute ‘black’ is superfluous.

A perception experiment was conducted in which the participants were asked to read an object description and subsequently identify the object in a computer display. The central focus was on the effect of the information level of referential expressions for the language recipient. The object descriptions were either minimally specified or overspecified and consisted of object information and/or location information; functional information was held constant. The central question was: does overspecification have a positive effect in identifying the targeted entity or would the recipient be better served with an expression that contains precisely enough information (minimal specification) for identification of the targeted entity, but not more information? The perception experiment tested the effect of overspecification on the identification time (i.e., the time needed to identify the targeted entity).

## 2. Overspecification vs. Gricean maxim of quantity

The use of overspecifications is not in agreement with major pragmatic theories, in particular (neo-)Gricean theory (Horn, 2005; Levinson, 2000) and Relevance theory (Carston, 1991; Sperber and Wilson, 1986; Wilson and Sperber, 1981). Grice (1975:45) formulates two conversational maxims within the category quantity:

1. Make your contribution as informative as is required (for the current purposes of the exchange).
2. Do not make your contribution more informative than is required.

The overspecification observed in our earlier production experiment (Maes et al., 2004) as well as in the research discussed above seems to contrast with the second conversational maxim. With the maxims, Grice aims to characterize

speaker meaning and to differentiate between what is said and what is meant by the speaker. The maxims and violations of the maxims lead to implicatures. An implicature is a part of what is meant without being part of what is said. The goal of (neo-)Gricean theory is to characterize conversational implicatures as part of speaker meaning. If implicatures are part of speaker meaning, this implies that the interpreter ought to be able to derive the implicatures. Grice as well as neo-Griceans, for example, Horn and Levinson, discuss the maxims both from the perspective of the speaker and the hearer. Horn (1984, 2005) calls his Q-Principle, which is more or less equivalent to Quantity 1, hearer-based and his R-Principle, which is more or less equivalent to Quantity 2, Relation, and Manner, speaker-based (Horn, 1984:13). Horn shows that the intertwining of speaker- and hearer-oriented perspectives in theories of language goes back to authors like Paul (1889) and Zipf (1949). Levinson (2000) talks about the listener's correlate of the maxims. According to him, implicatures can be viewed as inferences drawn by the hearer. In Optimality theory, a bi-directional interpretation of the Gricean maxims is proposed as well (Blutner, 2000).

In this paper we assume that the maxims (of quantity in our case) apply to both production and comprehension; the speaker anticipates the interpretation by the listener. Our aim is to empirically test whether violations of the maxim of quantity affect the comprehension process, more specifically, whether the comprehension process is negatively affected in case more information is given than is necessary for unique identification of the referent. We are not investigating possible conversational implicatures of overspecification.

Not only on the basis of (neo-)Gricean theory but also on the basis of Relevance theory one would predict that overspecifications have a negative effect on comprehension. Relevance theory differs from (neo-)Gricean theory in the sense that Relevance theory aims at describing the process of utterance interpretation in a psychologically plausible way. Relevance theorists reject Gricean maxims because the maxims do not describe the process of utterance interpretation. Saul (2002) argues that this was not Grice's project; his aim was not to describe in a psychologically plausible way what is said and what is implicated. Therefore, according to Saul, the approach of neo-Griceans and Relevance theorists can coexist. According to the Relevance theory, the human cognitive system is oriented towards achieving the greatest number of cognitive effects for the least effort. In conversation, the addressee expects to arrive at an interpretation of an utterance which has a worthwhile range of cognitive effects without requiring gratuitous expenditure of effort. An interpretation which meets this requirement is 'optimally relevant'. With respect to overspecifications in referential expressions, one can argue that overspecifying information is redundant and therefore that it leads to more effort than is necessary. Overspecified expressions are not 'optimally relevant'.

### 2.1. Testing the maxim of quantity

The redundancy observed in referential expressions seems to contrast with the parsimony advocated by Grice in the second maxim of quantity. It should be remembered, however, that the maxims are formulated with respect to the performance of a task, as stated in the first maxim: "required for the current purposes of the exchange". In that sense it is an empirical question whether overspecification of referential expressions can really be seen as a violation of the second maxim. In the non-feedback situation of the production experiment discussed earlier (Maes et al., 2004) the principle of distant responsibility (Clark and Wilkes-Gibbs, 1986) may have caused the participants to provide extra information in the referential expression; we expected that the success of the communicative exchange would be the main concern of the language producer, and that the producer would not make any decisions that might be disadvantageous to the recipient. If, however, overspecification would lead to an increase of the time that recipients need to identify the intended referent (the identification time), then the statement that overspecification is a violation of the Gricean maxim would be justified. But if overspecification would have no effect on the identification time, or would decrease that time, then the overspecification cannot be seen as a violation of this maxim. The latter would testify to the sound judgment of the language producer who takes the comprehender's perspective: the recipient needs more information than the minimum to quickly and correctly identify the object. Overspecification may also be profitable from the producer's perspective since the producer may be reluctant to decide which information is redundant and which not.

There is much evidence that humans produce more information than is required for performance of the task, and this may result in addressees expecting this kind of referential behavior (see Arnold, 2008; Arnold and Griffin, 2007 expectancy hypothesis). Furthermore, on the assumption that the resulting redundancy is not a penalty but an advantage to communication, we may expect that the identification time for overspecified referential expressions is shorter than the identification time for minimally specified expressions. But, as we will show below, this expectation should be qualified with respect to the type of information that is used to find an object.

### 2.2. Overspecification: object vs. location information

In general, when one has to identify an object, different kinds of information can be instrumental: a description of the characteristics of the object or a description of the location of the object. In the psychological literature on visual attention, it is a controversial issue which type of representation – i.e., location vs. object – determines selection in perception (Soto and Blanco, 2004). Visual attention may primarily select from a spatial representation of the visual field and is then directed to particular locations in the visual field (Posner, 1980). On the other hand, visual attention may primarily select objects. In this

conception, visual attention is directed to objects in the visual scene (Neisser, 1967). In the study by Soto and Blanco (2004), participants had to identify a target stimulus that was presented in one of four circles. The target stimulus was a tilted line. The participants had to identify the orientation of the line. This task was embedded in a cueing paradigm. The target line appeared within one of four circles, differing in location and in color. In the experiment, both location could be cued (with the four corners of the display as values: left upper corner, right upper corner, left lower corner, right lower corner) and object could be cued (green, yellow, blue and red circles). The results indicated an effect of both spatial cueing and object cueing: the reaction times were shorter for targets at cued locations than for targets at uncued locations; the reaction times were shorter for targets displayed within cued objects than within uncued objects. In addition, the spatial cueing effect was larger than the object cueing effect. This result suggests that selection by location is more efficient than selection by object.

In order to investigate the effect of overspecifications with object information and location information, we conducted a perception experiment in which the participants were asked to read an object description and subsequently identify the object in a visual panel. On each trial there were four objects, one in each quadrant of the panel. The objects were simple geometric figures that could be described by two kinds of information: object information and location information. The object information referred to the dimensions shape (round, square, triangular, rectangular), color (white, gray), and size (large, small). The location information referred to the dimensions vertical (top, bottom) and horizontal (left, right). The information was included in object descriptions as modifiers of the same head noun (the button). The object description could be minimally specified as well as overspecified, as will be explained in section 3. The task we used has some analogy with a cued search task. Participants in our task had to find an object in a display. The cueing in this experiment was verbal: it consisted of a verbal description using location and/or object information.

We now can formulate specific hypotheses about the overspecifying information in this study. Given the set up of the study, we define overspecification as those information elements which are not necessary to minimally and unambiguously specify an object in a spatial array of four objects. With two crucial types of information (object information and location information), we have defined three cases of overspecification. The first case is that the minimally specified description consists of object information and that the additional information is also object information (the round button vs. the round *white* button). The second case is that the minimal description consists of object information and the additional information of location information (the round button vs. the round button *on the left*). The third case is that the minimal description consists of location information and the additional information of object information (the button at the top left vs. the *white* button at the top left). In this way we manipulated both object and location information as minimal and overspecified information.

*Minimal information: object information, additional information: object information*

Deutsch (1976), Mangold-Allwinn (1994), Sonnenschein (1984), and Sonnenschein and Whitehurst (1982) found that additional (overspecified) object characteristics facilitate the identification of objects. Levelt (1989) speaks in this respect of the creation of a mental image, a ‘Gestalt’ of the object that needs to be identified. The provision of additional object information by the language producer would allow the language recipient to develop an increasingly complete ‘Gestalt’. This could speed up the identification process because the recipient simply needs to map this mental image within the physical task context. The perception experiment provided the possibility to test this expectation.

**Hypothesis 1.** Overspecified expressions that contain only object information lead to shorter identification times than minimally specified expressions that contain only object information.

*Minimal information: object information, additional information: location information*

Van der Sluis and Kraher (2007) and Beun and Cremers (1998) report results pertaining to the overspecification of referential expressions in a production experiment. In the experimental setting that they describe, it was possible for the language producer to complement the linguistic contribution with a physical pointing gesture. In judging overspecification, they incorporated these physical pointing gestures. Many participants were of the opinion that a pointing act would be beneficial for the addressee (Beun and Cremers, 1998; Cremers, 1996). Van der Sluis and Kraher (2007) found that more location information is produced in difficult tasks.

It is possible that in language situations that do not allow for physical pointing because the language partners cannot see one another, the language producers may try to find ways to make up for this shortcoming by providing information about the location of the entity in the referential expression. This can be seen as the verbalization of the physical pointing gesture that could have been used had the language situation been different. The addition of location information in the referential expression is expected to limit the search process, because location information indicates a specific section in the perceptual image that needs to be searched. This expectation resulted in Hypothesis 2.

**Hypothesis 2.** Overspecified expressions that contain location information in addition to object information lead to shorter identification times than minimally specified expressions that only contain object information.

*Minimal information: location information, additional information: object information*

If the location information in the expression allows for unique and unambiguous identification of an object, would it still be beneficial to the reader if object information was provided in the expression? This question takes the minimally specified

expression that contains location information as point of departure. In general, we may expect that overspecification leads to shorter identification times, but as Soto and Blanco (2004) demonstrated, location information is more efficient in a search task than object information. Therefore, location information in itself is expected to lead to short identification times because it limits the search process (the basis for Hypothesis 2). However, the addition of object information might detract from this search process because it may be difficult to ignore and not verify the object information that was processed. This may weaken the effect of location information.

**Hypothesis 3.** Overspecified expressions that contain object information in addition to location information lead to longer identification times than minimally specified expressions that only contain location information.

### 3. Method

Participants in the present study were asked to read an object description and subsequently identify the object in a panel, a task which is similar to reading an instruction and switching to the task environment. The language used in the experiment was Dutch. The experiment was conducted individually, and a computer was used to present the experimental materials to the participants.

#### 3.1. Participants

Fifty-six students of Tilburg University took part in the experiment. The participants were paid for their participation.

#### 3.2. Materials

##### 3.2.1. Characteristics of the reference objects

The experimental panels always contained four objects, which were consistently presented as buttons. One of the buttons was the reference object. A first requirement was that the object would have different characteristics which could all be used for reference. This made it possible to formulate minimally specified and overspecified expressions. For this reason, the panel was constructed in such a way that every button could be referred to by mentioning three types of object-information units and two types of location-information units (see Fig. 1):

object-information units:

- shape (round, square, triangular, rectangular),
- size (large, small),
- color (white, gray);

location-information units:

- position on the vertical axis (top, bottom),
- position on the horizontal axis (left, right).

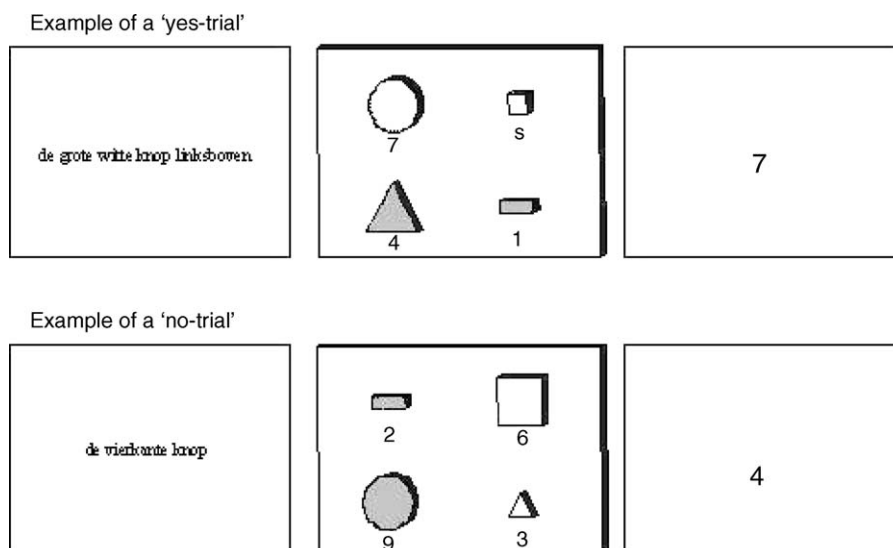


Fig. 1. Examples of two experimental trials (a yes-trial, translation *the large white button at the top left*, and a no-trial, translation *the square button*).

**Table 1**  
Overview of minimally specified expressions.

					Example
Shape	Size	Color	Vertical	Horizontal	The round button
					The large white button
	Size	Color	Vertical	Horizontal	The large button at the top
					The large button on the left
	Size	Color	Vertical	Horizontal	The white button at the top
					The white button on the left
			Vertical	Horizontal	The button at the top left

### 3.2.2. Construction of minimally specified expressions

With the exception of shape, the information units could only lead to unique identification of the button if they were used in combination. Shape was chosen as the unit that was to have four values (round, square, triangular, rectangular) which all were used in every panel so that an equal distribution of shapes in every panel was guaranteed, and size and color were chosen as units that were to have two values each (large and small for size, and gray and white for color). In every panel two of the buttons were large and two were small, and two of the buttons were gray and two were white.

These decisions implied that there were seven types of minimally specified expressions that could lead to unique identification. Table 1 provides an overview of these seven types of expressions. In ordering the attributes (shape, size, and color) we followed the normal order of modifiers in Dutch noun phrases, which is the same as the order discussed by Clark and Clark (1977) for English. Object information always preceded the head noun in the order size, shape, color. Location information always followed the head noun. In Dutch, if location information is presented pre-nominally, it needs to be morphologically modified and the combination of pre-nominal horizontal and vertical information is ill-formed in Dutch. This is why we presented all location information post-nominally.

### 3.2.3. Construction of overspecified expressions

Every minimally specified expression was expanded using one or more of the remaining types of information units still available for reference. This led to a total of 20 possible overspecified expressions. Table 2 (section 4) is an expansion of Table 1 and provides an overview of the overspecified expressions that were created using the minimally specified expressions as the point of departure.

The resulting 27 expressions were the expressions that were tested in the experiment, in 8 replications. In total, 216 expressions ( $27 \times 8$ ) were tested. For the information unit with four values (i.e., shape), every value occurred twice in the set of eight replications. For the information units with two values (i.e., size, color, horizontal and vertical), every value occurred four times in the set of eight replications. In that way, all possible values of the different information units were distributed evenly over the 27 expressions, and over the 8 related replications. Also, for every set of eight replications the target object occurred twice in each of the four quadrants. The length of the expressions varied between 8 and 22 cm.

### 3.2.4. Construction of object panels

Two hundred and sixteen different digital panels were built. A panel always contained two small buttons, one gray and one white, and two large buttons, again one gray and one white. All four shapes were used in every panel. The positions of the buttons remained constant: one button in the top-left corner, a second button in the top-right corner, a third button in the bottom-left corner and a fourth button in the bottom-right corner.

The different characteristics that the buttons could display resulted in a total of 16 different buttons that could be used for construction of the digital panels: every shape (four values) could be either gray or white, and either small or large.

In each trial, one button had to be identified. We made sure that each of the 16 buttons was subject of identification for about the same number of times, and that each quadrant contained the target button an equal number of times.

The distance between the participant's eye and the monitor screen was 54 cm. At this distance, the display area used for the presentation of the expression subtended 24 degrees of visual angle horizontally.

## 3.3. Procedure

On each trial a participant saw three screens in succession; the corresponding tasks were a reading task, an identification task and a judgment task. See Fig. 1 for an illustration of two trials.

### 3.3.1. Reading task

The first task in each experimental trial was the reading task. The participants needed to read an object description that appeared on the computer screen. After reading, they pushed a green key on a response panel. This action made the written text disappear and a second screen appear.



### 3.3.2. Identification task

The second screen contained the panel. As soon as this screen appeared, the participants needed to start the identification task. They were to identify the button in the panel and to memorize the number that was printed beneath the button (always a number between 0 and 10). After completing this task the participants pushed the green key on the response panel again. This action made the panel disappear and made a third screen appear.

The time between the moment that the panel appeared on the screen and the moment that the participant pushed the key to make this screen disappear was the identification time. The identification time was the only dependent variable in the experiment. Reading time was not used as a dependent variable because the verbal descriptions varied in length.

### 3.3.3. Judgment task

To assign a purpose to the identification task, a judgment task was included. The third screen contained a number, in large print, centered on the screen. This number could be either identical to or different from the remembered number in the identification task. The participants had to judge whether the number was identical (the yes-trials) or different (the no-trials). To do this, they pushed either the green key (in a yes-trial) or the red key (in a no-trial) on the response panel. Half of the trials were constructed as 'yes-trials'; the other half as 'no-trials'. As a rule, in the no-trials, the number that was shown on the third screen was a number that did not occur in the panel. The material was designed in this way so as not to confuse the participants unnecessarily. If in the no-trials a number had occurred in the third screen that also occurred with a non-target button in the panel, this might have caused confusion and this might have affected the identification time in subsequent trials.<sup>2</sup>

The participants received oral instructions. They were told to read the description on the first screen carefully but quickly, and to subsequently identify the correct button in the panel as quickly as possible. It was explicitly stated that no mistakes occurred in the first two steps of the experiment: the written description of the button did not contain any mistakes and the panel always contained the button that was described in the first step. The only 'mistakes' that were built in the experiment occurred in the third step of the experiment. The participants were told that the number that appeared in the third step did not always correspond with the number they had seen beneath the identified button in the panel, and that they should push the red key instead of the green key on the response panel if this was the case. The participants were asked to keep their fingers on the response buttons, so as to keep the time that was needed to push either the green key or the red key on the response panel as invariable as possible.

Since the participants had to push the green key on the response panel far more often than the red key (for the yes-trials in all three steps, for the no-trials in the first two steps), we expected accidental mistakes in step three related to motor-coordination. We therefore asked the participants to alert the experimenter whenever they were aware of making a mistake. In the analysis, for these trials the no-answer was treated as a yes-answer and vice versa. Participants had no problems with the task: the average number of mistakes per participant in the total of 216 trials was 1 (minimum 0, maximum 4).

The participants were told that the experiment included seven breaks, and that the breaks would be alternately participant-paced (the participants could take as long a break as they felt necessary) and experimenter-paced (these breaks were necessary because the experimenter needed to download the next part of the experiment). It took the participants on average 25 minutes to complete the task. The frequent breaks were built in to prevent a possible decline in alertness on the part of the participants.

We used the NESU-program for running the experiment. NESU (Nijmegen Experiment Set-Up) was developed at the Max Planck Institute in Nijmegen.

## 4. Results

The hypotheses were tested using comparisons between minimally specified expressions and related overspecified expressions, as within-subjects factor. The tests were one-tailed.

Table 2 lists the 27 expressions that were tested in the experiment, ranked according to identification time.

Expressions could occur in comparisons more than once. For example, the overspecified expression *the round button at the top left* occurred in the comparison with the minimally specified 'object' expression *the round button* to test Hypothesis 2, and also in the comparison with the minimally specified 'location' expression *the button at the top left* to test Hypothesis 3.

<sup>2</sup> The three tasks as described could have been limited to two tasks by using a touch screen. In such a design, the participant would have been asked in the identification task to touch the button that had been identified. The employment of numbers would not have been necessary. Both types of physical acts (indicating a button on a touch screen and pushing a key on a response panel) were expected to increase the identification time. We opted for the response panel because we expected that the physical act of indicating a button on a touch screen would render the increase in identification time more variable than the physical act of pushing a key on a response panel.

**Table 2**

The 27 expressions ranked according to identification time; minimal expressions are gray scaled.

					Identification time	Example
Shape	Size	Color	Vertical	Horizontal	1030	The round button at the top left
			Vertical		1036	The large button at the top
			Vertical		1065	The white button at the top
Shape	Size	Color	Vertical	Horizontal	1070	The large round white button at the top left
			Vertical	Horizontal	1073	The button at the top left
Shape	Size		Vertical		1081	The large round button at the top
Shape		Color	Vertical	Horizontal	1082	The round white button at the top left
Shape	Size	Color	Vertical		1082	The large white button at the top
			Vertical	Horizontal	1085	The large round button at the top left
Shape	Size	Color		Horizontal	1093	The white button on the left
			Color	Vertical	Horizontal	1104
Shape		Color	Vertical		1110	The round white button at the top
Shape			Vertical		1119	The round button at the top
Shape	Size	Color	Vertical		1119	The large round white button at the top
Shape	Size	Color	Vertical	Horizontal	1134	The large white button at the top left
			Vertical		1156	The large round white button
Shape	Size		Vertical	Horizontal	1158	The large button at the top left
Shape				Horizontal	1174	The round button on the left
Shape	Size	Color		Horizontal	1201	The large round white button on the left
Shape		Color			1212	The round white button
Shape					1214	The round button
Shape	Size	Color		Horizontal	1219	The large white button on the left
				Horizontal	1219	The large white button
				Horizontal	1221	The large round button on the left
Shape	Size			Horizontal	1221	The large button on the left
Shape	Size				1242	The large round button
Shape		Color		Horizontal	1248	The round white button on the left

**Hypothesis 1.** Overspecified expressions that contain only object information lead to shorter identification times than minimally specified expressions that contain only object information.

Table 3 shows the average identification times for the minimally specified expressions that contained only object information and the related overspecified expressions with object information only. The information units that rendered expressions minimally specified are printed in bold type.

**Table 3**

Identification times in milliseconds for minimally specified expressions and overspecified expressions that contained only object information.

Minimally specified		Overspecified	
Shape	Size color	Shape size	Shape color size color*
1214	1219	1242	1212

\* The expression 'shape size color' is an overspecification of both the minimally specified expression 'shape' and the minimally specified expression 'size color'.

The average identification time of the minimally specified expressions (1216) and of the overspecified expressions (1203) do not confirm the expectation as stated in the hypothesis ( $p > .50$ ). However, in individual expressions, reference to all object information in the overspecified expression led to a shorter identification time than that for the minimally specified expressions: 1156 vs. 1214,  $F(1,55) = 4.46$ ,  $p < .05$ ; 1156 vs. 1219,  $F(1,55) = 3.27$ ,  $p < .05$ .

Reference to a part of the object information in the overspecified expression did not affect the identification time in a statistically significant way.

**Hypothesis 2.** Overspecified expressions that contain location information in addition to object information lead to shorter identification times than minimally specified expressions that only contain object information.

Table 4 shows the identification times for the minimally specified expressions that contained only object information and the related overspecified expressions with location information.

**Table 4**

Identification times in milliseconds for minimally specified expressions that contained object information and related overspecified expressions containing in addition location information.

Minimally specified		Overspecified					
Shape	Size color	Shape vert	Shape horiz	Shape vert horiz	Size color vert	Size color horiz	Size color vert horiz
1214	1219	1119	1174	1030	1082	1219	1134

The average identification time for the overspecified expressions (1126) is shorter than for the minimally specified expressions (1216), supporting the hypothesis:  $F(1,55) = 18.69, p < .001$ . This effect seems entirely due to the reference to the vertical axis in the overspecified expression: the sole reference to the vertical axis or reference to both axes in the overspecified expression led to a shorter identification time than that for the minimally specified expressions: 1119 vs. 1214,  $F(1,55) = 12.60, p < .01$  and 1030 vs. 1214,  $F(1,55) = 41.02, p < .001$ ; 1082 vs. 1219,  $F(1,55) = 20.46, p < .001$  and 1134 vs. 1219,  $F(1,55) = 6.24, p < .05$ . The sole reference to the horizontal axis did not affect the identification time in a statistically significant way.

**Hypothesis 3.** Overspecified expressions that contain object information in addition to location information lead to longer identification times than minimally specified expressions that only contain location information.

Table 5 shows the identification times for the minimally specified expression that contained location information and the related overspecified expressions with object information.

**Table 5**

Identification times in milliseconds for the minimally specified expression that contained location information and the related overspecified expressions containing in addition object information.

Minimally specified	Overspecified						
Vert horiz	Vert horiz shape	Vert horiz size	Vert horiz color	Vert horiz shape size	Vert horiz shape color	Vert horiz size color	Vert horiz shape size color
1073	1030	1158	1104	1085	1082	1134	1070

The identification time of the minimally specified expression (1073) and the average identification time of the overspecified expressions (1095) do not confirm the expectation as stated in the hypothesis. However, in individual expressions, reference to only the size of the object in the overspecified expression led to a longer identification time than that for the minimally specified expression: 1158 vs. 1073,  $F(1,55) = 5.76, p < .05$ . Reference to the size and color of the object in the overspecified expression also led to a longer identification time than for the minimally specified expression: 1134 vs. 1073,  $F(1,55) = 3.14, p < .05$ . The remaining overspecified expressions showed no effect when compared with the minimally specified expression.

There is an effect of the kind of object information that is added to the minimally specified information. The addition of shape results in an identification time of 1030 ms, the addition of color in 1104 ms and the addition of size in 1158 ms. These means are significantly different:  $F(2,110) = 9.81, p < .001$ . The effect of these three attributes is also manifest if one compares three groups of items: those that contain shape, those that contain size (without shape), and the item with color. The mean for the shape group is 1067 ms, for the size group 1146 ms, and for the color item 1104 ms. These means are significantly different:  $F(2,110) = 6.75, p < .01$ .

Given the different effect of object information and location information, it is no surprise that the test of overspecifications against minimal specifications for the whole set of data, regardless the kind of information, yielded no significant difference. For the set of minimally specified expressions we found an average identification time of 1132 ms. The average identification time found for the set of overspecified expressions was 1142 ms; the  $F$  was smaller than 1. Interesting in this respect is that the average identification time for all items that contained both vertical and horizontal location was 1092 ms, while the average identification time for the other items was 1160 ms. This difference was significant:  $F(1,55) = 21.81; p < .001$ . This supports our decision to formulate specific hypotheses depending on whether the minimal information and the overspecifying information is object or location information.

## 5. Discussion

The fact that, for the whole set of 27 items, no significant difference was found in overall identification times between overspecifications and minimal specifications warrants a first conclusion: overspecification did not affect the identification

time adversely. Overspecification rendered the expression more informative than necessary but this did not delay or speed up the identification.

### 5.1. Complete mental image (shape, color, and size) (Hypothesis 1)

The comparison between the minimally specified expressions that contained only object information and the related overspecified expressions containing object information indicated that the provision of additional object information led to a decrease in identification times, but only when the additional information fully completed the mental image of the object. Overspecification that only partially completed the mental image had no significant effect on the identification time (Table 3). This partly confirms Hypothesis 1. Again, the provision of extra object information did not result in a significant increase in identification time. These results are in agreement with results from perception research, as discussed earlier. What is perceived first is the stimulus as a whole, the complete Gestalt with all information, whether that information is redundant or not (Garner, 1966). Separate attributes are perceived later during recognition of the stimulus (Neisser, 1967).

### 5.2. Minimal expression containing only object information – addition of location information (Hypothesis 2)

The comparison between the minimal expressions that contained only object information and the related overspecified expressions containing location information showed that the provision of location information resulted in shorter identification times, as long as there was a reference to the vertical dimension (Table 4). This indicates that the verbalization of physical pointing can be beneficial. These results partly confirm Hypothesis 2; in most cases, overspecification in the form of verbalization of physical pointing decreased the identification time and it never increased the identification time.

Given the effect of location information, and in particular the attribute of vertical location, it should be noted that there is a difference between object information and location information in the formulation of the referential descriptions. In Dutch, the object attributes are obligatorily pre-nominal, whereas the location attributes, when used in combination, are obligatorily post-nominal, which lead to the decision to present all location information post-nominally. This may have led to a recency effect for location information and in particular for the attribute vertical that needs to be expressed after the attribute horizontal in Dutch. Might this explain the fast identification times for items with location information, and particularly for items with the attribute vertical? If location information has an advantage on the basis of a recency effect, then both the items with the attribute horizontal and the items with the attribute vertical should be quicker than items that have no location information. However, the average identification time for items with horizontal (and not vertical) is 1197 ms; the average identification time for items without location information is almost the same: 1209 ms. If the advantage of the attribute vertical were due to a recency effect, a recency effect should have occurred also for the attribute horizontal, and this was not the case.

#### *Horizontal vs. vertical dimensions*

The results in Table 4 indicate that the sole reference to the horizontal axis did not lead to a shorter identification time, as opposed to the sole reference to the vertical axis. There is indeed a difference in vertical and horizontal references. Reference to the horizontal axis is more likely to be ambiguous than reference to the vertical axis. An example of such an ambiguity is the expression: “The ball is to the right of the car”, where right can be considered from the point of view of the speaker but also from the point of view of the object itself that has an intrinsic right and left. But this ambiguity did not occur in our experiment, since the participants had no choice but to interpret the expressions to the horizontal axis with respect to their own position. These results indicate that the interpretation of a reference to the horizontal axis is more time-consuming than the interpretation of a reference to the vertical axis. This suggests that a reference to the horizontal axis is more difficult than a reference to the vertical axis, even in wholly unambiguous situations.

There is ample evidence that the horizontal dimension and the vertical dimension play a different role in perception and language. Clark (1973) analyzed properties of human space and related these to properties of the words describing spatial objects. Many properties of spatial terms have their foundation in our biological characteristics. Properties of the horizontal and vertical dimensions in perception and language are based on the way in which we are positioned in the world. Three dimensions in human space (above-below, front-back, left-right), are all related to the way our body is positioned. The vertical dimension is unambiguous; in standing position “above” and “below” is the same for speaker and hearer. This is not true for the other two dimensions, however. The interpretation of “left” and “right” and “front” and “back” depends on the position of speaker and hearer.

There are many tasks that show that the vertical dimension is easier than the horizontal dimension. According to Gibson (1969:376) “Distinguishing what is up and what is down is a primitive accomplishment. The other axis in space, right and left on the horizontal plane, notoriously results in more confusions than does up and down.” Clark and Clark (1977) state that children pay attention to the natural directions vertical and horizontal very early in life, orienting most strongly to the vertical direction. Rudel and Teuber (1963) demonstrated that children can learn a contrast between a u-shaped curve with its opening upward and one with its opening downward more easily than a contrast between a u-shaped curve with its opening to the left and one with its opening to the right. Apparently, vertical asymmetries are easier to learn than horizontal asymmetries. In Piagetian conservation tasks, the vertical dimension is dominant: children attend to the height and ignore

the width of water beakers (Lumsden and Poteat, 1968). Also, in visual pattern recognition experiments, vertically oriented figures lead to better performance than horizontally oriented figures (Fitts et al., 1956). Data from tracking studies indicate that participants show greater facility in responding to two stimuli that are symmetrical around a vertical axis than around a horizontal axis (Fitts and Simon, 1952).

### 5.3. Minimal expression containing only location information – addition of object information (Hypothesis 3)

The comparison between the minimal expression that contained only location information and the related overspecified expressions containing object information showed that the identification time increased in two instances: in the case of the addition of only the information unit size, and in the case of the addition of the information units size and color (Table 5). Hence, Hypothesis 3 was confirmed for these two instances. In all other instances, the addition of object information did not affect the identification time. It should be noted that in all these instances, except one (the color-only condition), the information unit shape occurred in the overspecified expression. These results suggest that the addition of shape information does not increase the identification time. A possible explanation is that a reference to shape contributes to the construction of a complete mental image, and that the availability of such a complete mental image contributes to an efficient identification of an object. The results found in relation to Hypothesis 3 support this explanation. Table 5 shows an average identification time of 1067 ms for the four overspecified expressions containing shape, as opposed to 1104 for the overspecified expression with color and 1146 for the two overspecified expressions with size (and not shape).

The reference to both axes in the minimally specified expression already enabled the participants to identify the object uniquely. They did not need to make use of the overspecifying information in the expression, but they could direct their attention immediately to that specific part of the panel (top left, top right, bottom left, or bottom right) and identify the button. However, the overspecifying information proved to increase the identification time, but only if shape was absent in the expression. Is it possible to explain the difference in identification times between the expressions in Table 5 that do contain vs. do not contain shape as part of the overspecifying information?

First, as mentioned before, shape may contribute more strongly to the completeness of the mental image than size and color. Visual imagery of an object can easily be commenced if information about its shape is available. Visual imagery is limited if only information about the size or color, or both, of an object is available. It should be noted, however, that there is another difference between the attributes as used in the experimental material: shape had four values, whereas both size and color had two values each. This may have made shape more distinctive. Secondly, an inherent difference between the three object characteristics in this experiment could play a role in explaining the difference in identification times: color and shape are absolute characteristics (there is no need for a comparison with other objects to determine the color and shape of an object) and size is a relative characteristic (a comparison with another object in the perceptual image is necessary to determine the size of an object). Empirical support for this distinction comes, for example, from Grodner and Sedivy (in press) who observed that scalar modifiers like size lead to slower fixation on a target than the modifier color. Pechmann (1994) found that color was earlier available than size in a referential communication task. In production, Belke and Meyer (2002) and Belke (2006) found that overspecifications of color were more pervasive than overspecifications of size.

These differences between the object characteristics may explain the identification times of the overspecified expressions that contained location information and one extra information unit, two extra information units and three extra information units (Table 5). When one extra information unit is added, the identification decision regarding an absolute characteristic (shape or color) may be reached faster than the identification decision regarding a relative characteristic (size).

When two extra information units are added, the mental image becomes more complete when size or color is combined with shape than when size and color are combined with each other. The combination with shape makes it possible to construct a mental image.

When three extra information units are added, a complete mental image can be created. Table 3 shows that a complete mental image significantly decreased the identification time if the expression contained no location information at all. Apparently, an expression that enables the creation of a complete mental image facilitates the identification task. The results suggest that the completeness of the mental image positively affects the process of mapping the referential expression in the physical task context. This may explain why the addition of three object characteristics did not result in an increase in identification time if the referential expression already contained all the location information needed to uniquely identify the object (Table 5).

In sum, the above supports the notion that the participants processed all information in the referential expression, including the overspecifying information. Whether or not a mental image could be built on the basis of the information in the expression affected the identification time, even if location information in that same expression already allowed for unique identification of the object of reference. A reference to the shape of the object seemed to contribute strongly to the mental image. If shape was not part of the extra information, then there was a greater probability that the extra information increased the identification time.

Given the different effects of information units, one may wonder whether the values within the attributes are equally discriminable. If, for example, the values of size (large, small) have low discriminability and the values of shape (circle, square, rectangle, triangle) have high discriminability, one would expect that the expressions with the attribute size require a longer identification time than the expressions with shape. The mean identification time of all the expressions with the

attribute shape was 1147 ms, with the attribute size 1149 ms, with the attribute color 1141 ms, and with the attribute horizontal 1141 ms. These identification times were almost identical. This suggests that the values within the four attributes are equally discriminable. All these means were slightly larger than the means for the expression without the attributes, which indicates that overall the attributes did not facilitate identification. But the mean identification time for the expressions with the attribute vertical was significantly shorter (1090) than for the expressions without the attribute vertical (1202). This again supports our decision to have specific hypotheses depending on location information and object information.

#### 5.4. Overspecification and the maxim of quantity

The experiment leads to the following conclusions with respect to overspecifications. First, exhaustively overspecified object information leads to shorter identification times than minimally specified object information (effect of Gestalt); vertical plus minimally specified object information leads to shorter identification times than minimally specified object information (effect of verticality). Second, overspecifications in which just size or size as well as color are added to location information require a longer identification time than expressions that only contain location information. This is in agreement with the second maxim of quantity. Third, in all other cases, overspecifications did not hinder (or speed up) identification.

In many tasks more information is expressed and transmitted than is necessary for the execution of the task. One might say that this is a violation of the maxim of quantity. But this experiment shows that overspecification in most cases does not hinder identification and even speeds up identification in some cases. From that point of view one might argue that the extra information may indeed be required and may be instrumental for the listener. The uncertainty of the speaker, the strive for precision for the listener, and the importance of the task are possible reasons why the additional information may be profitable. In other words, an apparent violation is explained away by postulating a reason why the extra information is beneficial. This renders the maxim of quantity difficult to refute (see also Levelt, 1989). It is not so much a principle that leads to predictions that can be tested empirically, as a heuristic tool to describe behavior. However, Noveck and Reboul (2008) show that the Gricean maxims have led to an active area of experimental investigations on several topics including reference resolution. Dale and Reiter (1995:253) suggest that the Gricean maxims may be interpreted as a simple approximation to the general principle of “if a speaker utters an unexpected utterance, the hearer may try to infer a reason for the speaker’s failure to use the expected utterance” and “that the Gricean maxims should not be interpreted too literally; no doubt Grice himself would have been the first to say this.”

## 6. Conclusion

Redundancy of information is a general property in human cognitive processing. Redundancy is not a penalty to communication, but a means to make the signal robust, and it can even speed up identification processes in communication. Readers may need more than the minimum information to arrive at quick and unique identification of the task-related object (Maes et al., 2004). Overspecification increases if the task becomes more critical (Arts, 2004). The results of this perception experiment show that in only two instances, overspecification increased the identification time. In all other instances, overspecification either decreased the identification time or did not significantly affect the identification time. The latter instances of overspecification can be seen as a violation of Grice’s maxim in the category quantity. However, Grice’s addition “for the current purposes of the exchange” (Grice, 1975:45) can be interpreted as a condition that rights such a violation. Overspecification may serve the purpose of the exchange in a better way than minimal specification; overspecification may facilitate identification and cannot be considered merely cumbersome to the reader of the text.

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