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The interpretation of plural definites in discourse: the case of spatial adpositions

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Abstract

In this paper we offer a study on the interpretation of plural definites in discourse (the tank engines) and their interaction with spatial adpositions ('to' and 'at'). The novel empirical findings in the paper support the following assumptions on the contribution of spatial adpositions to the interpretation of plural definites. First, the interpretation of plural definites can be influenced by the lexical aspect type of adpositions. While 'to' as 'telic' predicate can license both a 'collective' and a 'distributive' reading for plural definites, 'at' as an 'atelic' predicate only licenses a 'collective' reading. Second, the precise lexical content of adpositions determines which interpretation is accessed. It is claimed that 'at' denotes a 'general location' relation between locatum and landmark object, and thus licenses a collective reading for plural definites.

KEYWORDS: DEFINITES; ADPOSITIONS; DISCOURSE ANALYSIS; LEXICAL ASPECT; SENTENCE PROCESSING

1. Introduction

The goal of this paper is to present empirical evidence on the interaction of plural definite descriptions (plural definites), e.g. *the tank engines*, with spatial adpositions, e.g. *to* and *at*. We aim to reach this goal by investigating two topics. First, whether the interplay between adpositions and plural definites can determine the type of interpretation of a sentence (e.g. 'collective' vs.

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'distributive' reading) or not. Second, whether the lexical content of predicates can also determine which interpretation of plural definites is accessed, or not. In particular, we investigate whether *at* is interpreted as denoting a notion of general location, or a more restricted notion of 'external' location. The paper is organized as follows. In the remainder of this introduction, we spell out our background. In section 2, we present our experiment and the findings. In section 3, we offer some conclusions.

1.1. Theoretical background and questions

There is a long philosophical and linguistic debate on the interpretation of plural definites such as *the boys* or *the tank engines*, and the sentences they occur in. Two topics have probably played a central part in this debate, while other topics have been somewhat neglected in the literature. We briefly introduce and review both central topics, in order to pin-point and illustrate the neglected topics we will focus on, in our paper.

A first central topic is whether plural definites are *referential* or *anaphoric*, in their interpretation. If plural definites introduce new referents¹ in discourse, then they depend on their interpretation from extra-linguistic knowledge (or *implicit* context, e.g. von Stechow, 1994). If plural definites are anaphoric, then they depend for their interpretation from previous discourse (or *explicit* context, e.g. von Stechow, 1994).

A second central topic is whether plural definites, when they combine with a predicate, license a *collective* or *distributive* interpretation² for the corresponding sentence. That is, whether the combination of plural definites and a Verb denotes a property that applies to the referents as a 'whole' (collective) or to each referent, individually (distributive). The following examples illustrate these distinctions ((1)–(2) are from Winter, 2001):

- (1) *The boys* are lifting a piano
- (2) *The boys* are smiling
- (3) Some boys and some girls went away. *The boys* went to the station
- (4) Mario, Wario and Luigi are boys, Peach and Rose are girls. *The boys* are sleeping at the hotel

The sentences in (1)–(2) are typical cases in which the interpretation of the plural definite *the boys* is computed with respect to the extra-linguistic context. The plural definite appears at the beginning of the sentence, so no previous discourse is apparently accessible. The sentences in (3)–(4) are typical cases in which previous discourse is explicitly accessible, since the plural definite *the boys* can occur in the second sentence of a mini-discourse. This plural definite is interpreted as denoting those boys that fall in the denotation of

1 the indefinite *some boys*, in (3). In (4), the identity statement *Mario, Wario*
 2 *and Luigi are boys* denotes the relevant referents (Nouwen, 2003; Brasovenau,
 3 2008; Schwarz, 2009; among others).

4 The sentence in (1) also represents a typical example of collective inter-
 5 pretation: the referents in the denotation of *the boys* are understood to lift
 6 the piano as a 'single entity'. The sentence in (2), instead, represents an exam-
 7 ple of distributive interpretation. We understand that each boy in the denota-
 8 tion of *the boys* is smiling, on an individual basis (Schwarzschild, 1996, 2009;
 9 Winter, 2001, 2002; a.o.). The interpretation of *the boys* in the second sentence
 10 of examples (3) and (4) is, however, still in need of a clear explanation. The
 11 interpretation of the plural definite *the boys* depends, to an extent, from the
 12 interpretation of its anaphoric antecedent (i.e. *some boys* in (3), *Mario, Wario*
 13 *and Luigi* in (4)). However, the exact contribution of the predicate it combines
 14 with, respectively *went to the station* and *are sleeping at the hotel*, seems not
 15 to be entirely clear. Two questions can be easily identified, and form the main
 16 empirical questions that we aim to answer, to achieve our goal.

17 A first empirical question is whether the specific contribution to *lexical*
 18 *aspect* of a predicate can influence the interpretation of plural definites. We
 19 do not know whether a sentence including a plural definite can receive col-
 20 lective or distributive interpretation. It is generally assumed that there is a
 21 tight connection between lexical aspect, and type of reading that a predicate
 22 contributes to a sentence. For instance, stative verbs (e.g. *to be*, *to sit*, etc.) are
 23 often assumed to denote collective predicates (Brisson, 1998; 2003). It is also
 24 generally assumed that spatial adpositions can contribute to lexical aspect. If
 25 *to* combines with an activity verb such as *walk*, it can coerce this verb into
 26 denoting an accomplishment (*walk to the station*: Krifka, 1998; Kratzer, 2003;
 27 Zwarts, 2005, 2006; a.o.). So, an open question is whether an adposition such
 28 as *to* or *at* can influence the emergence of a collective or distributive read-
 29 ing, for a plural definite. Given examples such as (3)–(4), it is also not clear
 30 whether this reading can bear on the anaphoric interpretation of *the boys*, for
 31 instance.

32 A second empirical question is whether the fine-grained details of a predi-
 33 cate's interpretation may offer another dimension of meaning to the interpre-
 34 tation of definites. Some authors suggest that *at* refers to position of an entity
 35 as being external and adjacent to a landmark object (Herskovits, 1986; Zwarts
 36 and Winter, 2000; Kracht, 2002; a.o.). Others argue that *at* denotes a form of
 37 general location, so it denotes a quite general and abstract relation between
 38 locatum and landmark object.³ If this 'at' relation holds, then one or more
 39 entities can be located anywhere around (or even inside) a landmark object
 40 (Coventry and Garrod, 2004; Feist, 2006; Ursini and Akagi, 2013; for exper-
 41 imental data). The second hypothesis predicts that the mini-discourse in (4)
 42

may describe a scenario in which Mario is front of the hotel, Wario behind, and Luigi inside. The plural definite *the boys* appears to denote that the boys, as a 'collective', are located in a general location, which is close to the hotel. So, it is not clear whether the interpretation of plural definites may depend on the lexical content of the predicate it combines with, as the *at* case suggests.

We attempt to answer these questions as follows. We first discuss the referential vs. anaphoric readings (section 1.2), then the distributive vs. collective readings (section 1.3), then offer a brief synopsis of the discussion (section 1.4).

1.2. Theoretical background: Referential vs. anaphoric readings

The first topic has its roots in two classic and deeply influential views: the *referential* view introduced in Russell (1905), and the *saliency/anaphoric* view introduced in Christophersen (1939).⁴ The referential view holds that definites 'refer' to *new*, unique individuals in discourse with a certain property, rather than to sets of individuals. The saliency view holds that definites *select* which individual(s) is the most salient in *previous* discourse, with respect to the speaker and hearers. The referential view correctly predicts that the plural definite *the boys* denotes a 'set' of boys which has lifted a piano (or smiled), in (1)–(2). However, this view has problems with (3)–(4), since *the boys* may denote those boys who went to the station, rather than all those introduced in the first sentence. The saliency view appears to work well with examples (3) and (4). However, this view has problems with the interpretation of *the boys* in (1)–(2), since there is no previous explicit context that introduces the referents denoted by *the boys*. The saliency view does not offer a precise formulation of the notion of saliency, at least not in an explicit way.

Such problems invited solutions that aimed to refine and possibly reconcile the two approaches. One is Karttunen (1976), a work that proposed that the notion of saliency ('familiarity', in his works) can be best understood as familiarity *in discourse*. Definites may introduce referents which are 'new' in discourse (e.g. (1)–(2)), or may refer to referents which have already been explicitly introduced in previous sentences (e.g. (3)–(4)). Several proposals in the Dynamic Semantics mould have refined this view. Several works assume that definites are always interpreted with respect to some opportune context. So, they usually incorporate a (formal) notion of familiarity (Heim, 1982; Chierchia 1995; Grosz *et al.*, 1995; von Stechow, 2003; Nouwen, 2003; Kamp *et al.*, 2005; Brasovenau, 2008).

The view that definites are inherently anaphoric in meaning has not been gone unchallenged, however. Certain classes of definites appear to resist any anaphoric interpretation. Examples include superlative constructions (e.g. *the best restaurant in town*), associative anaphora or bridging cases,

and other cases in which a suitable antecedent is not explicitly mentioned in previous discourse.⁵ Several works such observe that definites may often appear in several other syntactic constructions that do not allow access to an explicit context. They also observe that definites may only depend on world knowledge, as the implicit context, for their interpretation (Löbner, 1985, 1998; Fraurud, 1990; Asher and Lascarides, 1998; Abbott, 1999, 2010, 2011). A full discussion on similar other examples would lead us too far afield. However a general observation is that both referential and anaphoric interpretations for definites seem to co-exist. Their distribution seems to be in complementary fashion, and to depend on the type and presence of an antecedent, in context.

Intermediate positions have also been suggested in the literature, and appear to have a solid empirical support. For instance, Poesio and Vieira (1998) is a work that offers experimental evidence in support of this complementary distribution. This work investigates how speakers access the interpretation of definites, singular and plural alike. They show that 'initial mention' definites, as in (1)–(2), are for the most part interpreted referentially. They also show that definites occurring in discourse, instead, are usually interpreted anaphorically. In particular, plural definites are always interpreted anaphorically when the referents making up the plural definite are explicitly introduced in discourse, as in (4). In these cases, plural definites establish an anaphoric relation with the referents that the coordinated NPs denote. These referents constitute, in turn, a relevant 'collective' referent, the one captured by the first sentence in discourse (e.g. Brasoveanu, 2008: ch. 2–4). Experimental and cross-linguistic evidence of this complementary distribution is offered by Schwarz (2009). This work thoroughly and convincingly illustrates that languages such as German and its dialects encode this distinction at a morpho-syntactic level. For instance, several German dialects make a clear distinction between non-contracted forms of definites (e.g. *zu dem*, lit. 'at the'), and contracted forms of definites (e.g. *zum*, a contraction of *zu* and *dem*). The first forms are only possible in anaphoric (multi-sentential) examples, such as (3)–(4), the second forms are for the most part licensed in cases such as (1)–(2).

We can therefore conclude that plural definites in discourse strongly tend to be interpreted in an anaphoric way, in particular when there are suitable antecedents. In such cases, the explicit context constrains the exact interpretation of plural definites in a precise way. One case is (4), in which the coordinated Noun Phrases *Mario*, *Wario* and *Luigi* denotes the 'collective' referent for *the boys*, in the second sentence. So, the contribution of 'previous', anaphoric material in these examples is reasonably clear. However, the contribution of 'following' material, the predicates plural definites combine with, requires some specific discussion, especially when we consider the distinction

between collective and distributive interpretations. We discuss this aspect by presenting the second important debate.

1.3. Theoretical background: Collective, distributive, cumulative readings

The second debate has its roots in the analysis of singular and plural nouns' interpretation, within a 'lattice-theoretic' approach (Scha, 1981; Link, 1983, 1998; Landman, 1991; Schwarzschild, 1996; Chierchia, 1998; Winter, 2001, 2002; a.o.). In this approach, plural nouns are assumed to denote a certain type of model-theoretic objects, usually labelled as *sum individuals* or *sum referents*. If Mario, Wario and Luigi are referents that fall in the denotation of *boy*, then the plural noun *boys* denotes the *power-set* that can be generated by the combination of these referents. Hence, a plural noun not only denotes the single (or 'atomic') referents included in the denotation of the corresponding singular nouns. It also denotes the 'pairs' and 'triples' that result by this generating process (e.g. 'Mario and Wario', 'Mario and Luigi', 'Wario and Luigi', 'Mario, Wario and Luigi').⁶ Aside from this core assumption, two standard assumptions play a crucial role in this approach.

A first standard assumption is that plural definites, as the combination of a plural noun with a definite article, denote the maximal referent in the denotation of a plural noun. In our toy example, this maximal sum referent is the trio composed of Mario, Wario and Luigi taken as a 'single' entity, the referent denoted by *the boys*. A second standard assumption is that the interpretation of plural definites depends, to a good extent, to the contribution of the predicate they combine with. Examples such as (1) invite an interpretation in which the plural definite *the boys* denotes a 'collective' of boys which lift the piano in a concerted effort. Examples such as (2) invite instead an interpretation in which each of the three boys making up a maximal sum individual is currently smiling. The first interpretation is generally known as having *collective* reference, since it involves several referents interpreted as being a 'unique' or 'collective' entity. The second interpretation is known as having *distributive* reference, since it involves a property that holds (it is 'distributed') for each referent in the denotation of the plural definite.

A similar argument has been offered in various works within the 'Event Semantics' literature. Event Semantics approaches assume that verbs and adpositions denote predicates which include implicit referents, denoting the spatio-temporal particulars in which nominal referents are involved. Within this approach sentence (1), in its collective interpretation, denotes at least one event in which a collective of boys lifts a certain piano. Sentence (2) denotes a 'set' of events in which each boy performs a smiling event. Several works have suggested that this relation is mediated by thematic relations, which are

determined by the lexical content of a verb. In its standard interpretation, *to lift* requires a 'collective' referent as the 'agent' acting in an underlying event of lifting. The verb *to smile* requires that each of 'agents' is involved a different event of smiling, each event 'distributed' to each referent (Parsons, 1990; Krifka, 1990, 1992, 1996; Landman, 1997, 2000; 2004; Kratzer, 2003; a.o.).

Recent works, however, suggest that the picture is more complex than it may appear at first glance. The contribution to *lexical aspect* of a verb seems to play a vital role in determining the emergence of a collective or distributive reading. The predicate denoted by a verb can force a collective or distributive interpretation on a plural definite. This form of semantic coercion seems to depend on the lexical aspect of the predicate (Verkuyl, 1993, 2008; Fong, 1997, 2001; Kratzer, 2003; Rothstein, 2004; a.o.). It is also widely acknowledged that spatial adpositions can contribute to lexical aspect in their combination with verbs. Intuitively, the combination of verb and adposition can be treated as a 'complex' predicate (e.g. *went to the station*). The lexical aspect of this predicate can then be determined by the compositional combination of verb and adposition. Take an activity verb such as *walked*, and an 'achievement' adposition (phrase) such as *to the station*. The resulting complex predicate *walked to the station* should denote an achievement event, as a result (Parsons, 1990; Krifka, 1998; Kratzer, 2003; a.o.). So, a complex predicate can also determine whether a plural definite is interpreted as collective or distributive, in a compositional way (Brisson, 1998, 2003; Zwarts, 2005, 2008; a.o.).

We discuss the precise compositional details, as they play an important part in our discussion. Verbs denoting *states* and *activities* tend to be unambiguous in their interpretation, although this interpretation depends to an extent to the lexical content of the predicate. Verbs denoting achievements and accomplishments, on the other hand, are usually ambiguous between the two readings. For instance, *lift* in (1) can be seen as an activity verb that has an inherently collective interpretation. However, *smile* in (2) can be seen as a verb that can be ambiguous between a distributive and a collective reading⁷ (Schwarzschild, 2009; a.o.). The following examples illustrate instead verbs that can be ambiguous between the two readings:

- (5) *The boys are eating a pizza*
- (6) *The boys are sleeping at a hotel*
- (7) *The boys are sitting in the room*
- (8) *The boys have gone to the pub*

Example (5) can be interpreted as denoting a set of events in which each boy eats a corresponding pizza, or as a single event in which the boys share slices of a single pizza. Examples (6) and (7) allow us to discuss the precise

contribution of spatial adpositions to lexical aspect and, given the considerations regarding the interplay between lexical aspect and plural definites' interpretation, the interaction between *the boys* and the various adpositions in the examples. Since the distinction between 'states' and 'activities' and the one between 'achievements' and 'accomplishments' are immaterial for our purposes, we shall only maintain a distinction between 'telic' (states, activities) and 'atelic' (achievements, accomplishments) predicates.

Several authors have observed that spatial adpositions contribute to lexical aspect in a subtle way, depending on the type of specific spatial interpretation of an adposition. A general consensus in the literature is that 'locative' or 'static' adpositions, such as *at* in (6), denote atelic predicates (states e.g. Parsons, 1990; Krifka, 1998; Zwarts, 2005). The same reasoning may be applied to the copula *to be*, which does not include its own aspectual contribution. The contribution of adpositions, in particular the ones in (5)–(8), requires some discussion.

As atelic predicates, *at* and *in* in (6) and (7) have unambiguous reference. For instance, *at* imposes a collective reference on the Noun Phrases it combines with (Nam, 1995; Zwarts and Winter, 2000). This collective reference is the result of *at* denoting a general location for the referents it applies to. If each boy is sleeping in a different location which is related to the hotel (e.g. inside, in front, behind the hotel), then each boy is 'at' the hotel. So, the boys as a sum individual also sleep at the hotel. In this case, then, the collective reading emerges in a 'bottom-up' manner. The result of *at* denoting the location of each boy is that *at* also denotes the location of the boys as a 'collective' referent⁸ (Feist, 2006). The interpretation of *in*, instead, tends to force a (trivially) distributive reference on a plural definite. In (7), for instance, we understand that each boy sits in the same location, so the same relation holds between room and each boy. In certain cases, a collective interpretation can emerge with *in*, too, for instance when a collective verb such as *gather* occurs (e.g. Brisson, 1998; 2003; a.o.). However, spatial adpositions tend to determine the interpretation of definites such as *the boys*, insofar as they combine with aspectually neutral Verbs.⁹ Consequently, the interpretation of *the boys* is for the most part determined by interpretation of the adposition phrases *at the hotel* and *in the room*, as predicates.

Adpositions that express motion, known as 'directional' or 'dynamic' adpositions, are usually assumed to denote telic predicates, from a perspective of lexical aspect. Examples include *to*, but other directional adpositions such as *from*, *through*, also fall in this category (Krifka, 1998; Fong, 1997, 2001; Zwarts, 2005; a.o.). Several directional adpositions can also be ambiguous between an activity (or 'atelic') reading and an achievement reading. So, they license both a collective and a referential interpretation, in two slightly different ways (e.g.

1 *across, over, around*: Winter, 2006; Zwarts, 2006). For our purposes, it suf-
 2 fices to say that directional adpositions, when combining with verbs denot-
 3 ing directed motion such as *have gone* in (8) (i.e. telic verbs), form a complex
 4 telic predicate, *have gone to a pub*. This predicate can be ambiguous in trig-
 5 gering a collective or distributive interpretation, sentence-wise. So, a sentence
 6 such as (8) can be interpreted in two ways. First, it can denote a single event in
 7 which the boys, as a collective, have reached a possibly unique pub. Second, it
 8 can denote several distinct events that involve one (different) boy, and the pub.
 9 Hence, we label directional adpositions, such as *to*, as ‘telic’ and static adposi-
 10 tions such as *at* as ‘atelic’ for expository purposes. One *proviso* we make is that
 11 these two adpositions are closer in interpretation than these labels suggest,
 12 since the readings they license may partially overlap.

13 The presence of an explicit context may furthermore contribute to the
 14 interpretation of this plural definite. The explicit context may offer informa-
 15 tion about the referents that are part of its denotation of a sentence, and are
 16 involved in a ‘collective’ or ‘distributive’ event. Consider the following mini-
 17 discourse examples:

18 (9) Mario, Wario and Luigi are boys. *The boys* have gone to the pub

19 (10) Mario, Wario and Luigi are boys. *The boys* are sleeping at the hotel

20
 21 The example (9) can be either understood as denoting a single event in
 22 which the boys went to the pub together, or several events in which each
 23 boy reached the pub alone. Since the first sentence offers an explicit context
 24 which also licenses an anaphoric interpretation, the mini-discourse in (9)
 25 can be ambiguous between two interpretations. Under the collective inter-
 26 pretation, the ‘trio’ composed of Mario, Wario and Luigi collectively reach
 27 the pub in a single event of motion. Under the distributive interpretation,
 28 each boy reaches the pub in a distinct event, one by one. The example in
 29 (10), instead, is understood as denoting a single state, in which the afore-
 30 mentioned trio sleeps somewhere with respect to the hotel. Informally, the
 31 static adposition *at* contributes a collective reading to the anaphoric inter-
 32 pretation of the plural definite *the boys*.

34 1.4. Theoretical background: Theoretical answers, experimental 35 questions

36 Our discussion in the previous two sections invites the following conclusions.
 37 The interpretation of plural definites can be defined on at least two distinct,
 38 but closely interacting dimensions of meaning. One dimension pertains to
 39 the ability of plural definites to be either referential or anaphoric. Plural def-
 40 inites can be either interpreted with respect to an implicit or explicit context

(i.e. world knowledge or previous discourse). Another dimension pertains to their ability to have collective or distributive interpretation, and be interpreted as denoting a single state involving a trio of boys (e.g. (10)), or a collection of similar events of reaching a pub, each involving a different boy (e.g. (9)). In the context of discourse, the anaphoric interpretation of plural definites is the favourite reading, if the context introduces the referents which are part of the denotation of a plural definite, as in (9)–(10). Whether a plural definite in a sentence has collective or distributive reference, then, depends on the predicate it combines with. This property holds whether a verb or a combination of verb and adposition denotes the relevant predicate.

We can now focus on our two initial questions, and offer two positive answers, at least from a theoretical perspective. Our first answer is that the contribution to lexical aspect of predicates can also influence the interpretation of plural definites. Hence, our second answer is that the specific aspectual contribution of a predicate may trigger a collective, distributive or ambiguous reference for a plural definite. For instance, if plural definites combine with telic spatial adpositions (e.g. *to*), then they can be ambiguous between a collective and a distributive reading. If they combine with atelic spatial adpositions (e.g. *at*), then their interpretation will depend from the lexical aspect value of the adposition. While *at* triggers an inherently collective reading, *in* triggers an inherently distributive reading. This reading can depend from the interpretation assigned to an adposition, e.g. *at* as denoting general location.

These answers find some quite indirect support by experimental evidence. For instance, works on the interaction between noun phrases and verb predicates support the view that noun phrases and predicates interact with respect to the collective/distributive distinction. Papers include Poesio and Vieira (1998); Frazier *et al.* (1999); Vieira and Poesio (2000); Poesio (2003); Frisson and Frazier (2005); Pylkkänen and McElree (2006); a.o.. However, little evidence is offered in favour of these answers for spatial adpositions, which offer an interesting, and subtle testing ground for this interplay between plural definites and predicates. An experimental answer would offer us a better understanding of this phenomenon, both on how a predicted reading is actually accessed, and how ambiguous readings are resolved. That is, we may discover how speakers can access a collective or distributive reading, or whether they access either reading, in opportune licensing conditions.

The remainder of the paper aims to fill this void and address these two questions from an experimental perspective, since it tests whether our answers regarding the interaction of plural definites and spatial adpositions correctly predict the interpretation of these interacting elements by native speakers of English.

2. The experiment

The goal of this section is to present an experiment that investigates our empirical questions, and discuss which answers the findings support.

2.1. Participants

Participants were undergraduate students from the Psychology and Linguistics Departments ($N=53$). The participants were divided into two groups, as follows. A first group of participants participated in the testing of the first experimental hypothesis, clarified in the next section ($N=30$). A second group participated in the testing of the second experimental hypothesis, also clarified in the next section ($N=23$). All participants were native monolingual speakers of English. Each participant received course credit for attendance.

2.2. Procedure

In this section we introduce the specific experimental method used to test participants, a variant of the *Truth-Value Judgement Task* (henceforth: TVJT or TVJ task, Crain and Thornton, 1999). We discuss the nature of the TVJT first, and then explain what changes we brought to this task for our specific requirements.

The TVJ task was originally designed to test children's intuitions on the interpretation of sentences in discourse. In the original design, two experimenters are involved in an experimental session with children. One experimenter presents a story involving some fictional characters (e.g. animals, cartoon characters, etc.) to the child. The other experimenter uses a hand puppet, and impersonates an external character that watches the stories, alongside the child and the experimenter(s). This experimenter offers questions to the child at the end of each story, with the aim of testing children's *intuitive* understanding of language via their *spontaneous* answers to questions. This experimenter may also ask follow-up questions, aimed at testing whether children's answers are motivated by a correct understanding of the experimental hypothesis or not.

A standard TVJT story presents a set of events in which most, but not all of the characters perform a certain action. For instance, a simple story may involve five horses who decide to have a jumping competition, and challenge themselves to jump a quite high fence. While four of them are able to jump this fence, a fifth horse cannot complete the task and tumbles. After all the events of jumping unfold, the puppet (e.g. a 'Kermit the frog' puppet), poses a question to the child, saying that he is not sure about what happened. Consider a case in which the experiment aims to test the child's understanding of

sentences with the universal quantifier *every*. In this case, the puppet may ask a sentence such as:

(11) Did every horse jump over the fence?

In this case, only a 'no' response would be correct, because one horse tumbled and failed to jump over the fence. The child's response, then, will determine whether he is able to correctly interpret *every*. If she answers 'yes', then she probably cannot access the meaning of *every* as a property holding for each horse:¹⁰ one horse has not successfully jumped over the fence. If she answers 'no', then she can probably access the standard interpretation of *every*, since she will correctly reject that a property holds for each horse, in this story.

Three aspects of the TVJ task are particularly relevant, for experimental purposes. First, since the puppet offers the question, children will not feel pressured to answer positively to appease the *adult* experimenters. Instead, they will offer an answer which will present their intuitive understanding of the sentence. Second, the child is not asked to make a meta-judgement on a property of linguistic expressions, but just to answer 'yes' or 'no' to a relatively simple question. The design of the experiment, however, allows from this simple binary answer to assess whether child's understanding is according to an experimental hypothesis or not. Third, a story is presented in such a way that both a 'yes' and a 'no' answer correspond to outcomes that could have been instantiated at some point in the story. However, only one turned out to be correct: this is known as the *Condition of Plausible Dissent* (Crain and Thornton, 1999; Meroni *et al.*, 2006).

The TVJT is thus a task that requires time and resources when used to test children and their more limited attentional resources. Once one sets his experimental focus on adults, it can be simplified to exploit adults' broader attention resources and understanding. For this reason we used a variant of TVJT which differs from the basic task in the following details.

First, instead of acting out a story in front of the participants, we prepared a power-point presentation presenting the story as a sequence of slides, depicting the succession of events in a story. We narrated aloud the story to the participants, while scrolling the power-point presentation. Before any stories were presented, an introductory sequence of slides presented the main characters appearing in the story and the instructions on how to offer the answers. Participants were instructed to circle their chosen answer ('yes' or 'no') on an answer sheet, after the target question was introduced. Beside the main characters, the introduction presented another character, the amnesiac teddy bear 'Mr. Little Bears'. Mr. Little Bears¹¹ was described as watching the stories with

the participants. Because of his bouts of amnesia, he had to ask the participants whether a certain event occurred or not. In this way, he played the part of the puppet in the experimental design.

Second, we tested up to four participants per session, with each participant sitting at the same distance from the screen on which the presentation was run. No participant was aware of the nature of the experiment and the experimental hypotheses. Each participant was invited to sign an ethics approval form before the experiment. The experimental sessions lasted an average of 10 minutes per experiment.

Third, since we aimed at testing two hypotheses rather than one, we divided the participants in two sequential 'streams' of testing. The first stream of 30 participants watched a story which involved an ambiguous question at the end, since it contained the adposition *to*. The second stream of 23 participants¹² watched a story which involved a non-ambiguous question at the end, since it contained the adposition *at*. In the first stream, participants were asked to write an answer on an answer sheet, choosing between three options: 'yes', 'no' and 'not sure'. The 'not sure' option was introduced in order to test whether participants could find the question too ambiguous to warrant a 'yes' or 'no' answer. If participants wanted to change answer, they were instructed to cross their first answer and choose a second answer. Only the second answer was considered valid, for scoring purposes. Only one participant chose the 'not sure' option in this first experiment. Hence, we decided to reduce choices to 'yes', 'no' in the second stream.

Fourth, since this experimental paradigm required less direct involvement from the experimenters, we took turns in attending the experimental sessions and narrating the story to the participants, as well as collecting the data and ensuring that all bureaucratic matters were taken care of. Let us look at the materials, then.

2.3. Materials

The materials used to test the experimental hypotheses were as follows. We focused on our two adpositions, *to* and *at*, to respectively test the contribution of ambiguous (dynamic) prepositions and of non-ambiguous (static) prepositions. A few words on these prepositions will clarify their exact semantic contribution in discourse and thus the scenarios they describe, beside their contribution to the collective or distributive reading of definites.

A standard assumption regarding the interpretation of *to* is that this preposition refers to a sequence of events in which a moving entity reaches a certain location, when the last event is completed (Parsons, 1990; Fong, 1997; Zwarts, 2005). The interpretation of *at* seems to be more controversial. Some authors treat this adposition as denoting a form of 'general location' (Nam, 1995; Feist,

2006; Ursini, in press; for a related analysis). Others treat this adposition as denoting an external, adjacent location to a ground (Herskovits, 1986; Zwarts and Winter, 2000; a.o.). We would like to suggest that *at* denotes a form of general location, as previous findings suggest (Feist, 2006). So, our findings would also shed light on the purely spatial meaning shade of *at*.

The testing of these hypotheses was carried out via the presentation of two distinct stories. Both stories had five main protagonists, characters taken from ‘Thomas The Tank Engine’ line of toys. These characters were: Thomas, Arthur, Spencer, Diesel 10 and Duncan. Aside Mr Little Bears, in both stories other characters and locations were introduced, and played a relevant role in the story.

The design of the stories was the following. In the *to* story, the five tank engines woke up and decided to have breakfast at Harold the helicopter’s farm. While Thomas, Duncan, Spencer and Diesel 10 reached the farm and received free bread from Harold the helicopter, Arthur decided to stop mid-way and have a shower at a water tower, hence not reaching the farm and free bread. Each tank engine reached the farm independently, so there were a total of four arrival events, plus one ‘aborted’ arrival event, that of Arthur. Each ‘arrival event’ was depicted in a different slide, including Arthur’s change of mind. In the first and the second story, there was a unique location that the engines could reach: a tank engines station. In this way, participants could access the collective reading of both sentences. Since the relevant tank engines reached the same location, the four events in which each engine performed this action could be combined in a ‘collective’ event in which a certain group of engines reached a single station. The same reasoning holds for the second story. The engines ended up ‘at’ the hotel, as the result of each engine reaching one specific location related to the hotel.

This minimal diversion from a purely ‘collective’ story had one strong design-driven reason.¹³ In the first story, this diversion granted that the CPD was met, and thus that participants could entertain both answers as equally acceptable. Each of the events constituting the ‘collective’ event under discussion was spelt out. The story motivated why a certain engine did not go to the station, and why the remaining engines participated in ‘collective’ event, in which they all reached the station. In the second story, the diversion allowed to illustrate that each engine reached a different position with respect to the Hotel (i.e. in front, behind, even inside). Each arrival event was described in detail. In this way, participants could easily evaluate whether the tank engines, as a ‘collective’, were at the station, with the story providing the opportune explicit context. Hence, both stories had a virtually identical experimental and theoretical set-up, and tested the two different experimental hypotheses and predictions about collective and distributive reference. At the end of this story,

Mr Little Bears appeared and offered the following comment and question to the participants:

- (12) 'Our tank engines are very hungry today! But I am not sure about one thing:

Have the tank engines gone to the station?

According to our predictions, then, participants could have answered 'yes' or 'no' in equal measure, with 'not sure' at chance rate. The reasons for these answers are as follows. If the plural definite *the tank engines* was interpreted collectively, then all the engines except Arthur formed a 'collective' that reached the station. Hence, participants could answer 'yes' and indicate that these four engines, as a 'collective', reached the station. If the plural definite was interpreted distributively, then each engine played a role in the evaluation of the story. Hence, Arthur's change of plans warranted a 'no' as the correct answer. If the participants were not really able to make up their mind, they could have answered 'not sure'.

In the *at* story, the five tank engines were tired from a gruesome week of work and decided to have a night of rest at the Powerpuff girls' Hotel. Each of the engines went to this Hotel alone. The Powerpuff girl 'Blossom', another fictional character, offered a different accommodation to each of the tank engines, in her role as the Hotel's owner. Given our discussion of *at* as a general location adposition, the locations for the tank engines were the following. Thomas slept *inside* the Hotel, Diesel 10 and Arthur in front of the Hotel, Duncan on top, Spencer behind. Each arrival and choice of sleeping location was depicted in a different slide, so that there were a total of five arrival events. Thomas initially decided to sleep outside, but since he was feeling cold, he opted for sleeping inside, instead. The CPD was also met, via change of plans that made an 'external location' answer a possible choice, at some point in the story. In this story, the collective interpretation arose as a result of the tank engines occupying different regions related to the Powerpuff Hotel, that could collectively labelled as 'at' the Hotel. While each tank engine was in some specific location, the engines as a collective were 'at' the Hotel. At the end of the story, Mr Little Bears appeared and offered the following comment and question to the participants:

- (13) 'Our tank engines are very tired today! But I am not sure about one thing:

Are the tank engines sleeping at the Powerpuff Hotel?

According to our predictions, then, the participants could have answered only 'yes', with 'no' as a mistake in interpretation. Since we assume that the

exact interpretation of *at* corresponds to that of general location, the correct answer should have been unanimously positive. If this assumption is incorrect, then a unanimous negative answer should be observed, instead. Before moving to the predictions, we observe that our story presented a scenario in which the engines occupied regions of space that were all adjacent to the landmark object. We did not attempt to test whether *at*, as denoting general location, could also be considered acceptable if tank engines were 'far' from the Hotel. However, the story (and the matching picture) made clear that at least one engine, Thomas, was not outside the Hotel, but inside this location.

Summing up, the predictions for both stories are as follows. For the *to* story, which included three possible answers, we predict that 'yes' and 'no' answers would have been even. Hence, the 'not sure' answer should occur at chance rate. For the *at* story, which did not include a 'not sure' answer, the 'yes' answers should have been the norm, while the 'no' answers should have been due to performance factors. The next section presents the results.

2.4. Results and discussion

The main findings of the experiments were that the predictions were borne out. The results are as follows.

For the *to* story, a total of 30 participants was interviewed. Fourteen participants answered 'yes', 15 participants answered 'no', one participant answered 'not sure'. The percentages were respectively 46.6%, 50% and 3.4%, as per predictions (including a chance rate for 'not sure'). Note that four participants chose to re-interpret their initial answer, from 'yes' to 'no', while two participants made the inverse choice, and the lone 'not sure' participant made this choice after initially choosing a positive answer. After the experiment, participants were asked to motivate their particular answer to the question, as a follow-up. Each participant that answered 'yes' pointed out that a relevant 'group' of engines indeed reached the station. Each participant that answered 'no' pointed out that one engine, Arthur, did not reach the station and made the underlying story false. The 'not sure' participant decided to answer in this way only after some thinking. She motivated her answer by saying that she was not sure about which answer was really the 'correct' one. No other participant chose a 'not sure' answer, a fact that led us to slightly change the experimental set-up for the *at* story.

For the *at* story, a total of 23 participants was interviewed. Twenty-two participants answered 'yes', one participant answered 'no'. The percentages were respectively 95.7% and 4.3%. All the participants chose not only the collective interpretation for *the tank engines*, as answers were mostly of one type. They also interpreted *at* as expressing general location, rather than 'external' location, since answers were mostly 'yes'. The only participant answering

1 'no' pointed out that one engine's position was more accurately described as
 2 being 'in' the hotel, so a 'yes' answer was more problematic ('border-line true',
 3 according to the participant, for one engine. For this reason, she preferred to
 4 answer 'no', after some reflection. We think that these data invite the following
 5 generalizations.

6 First, all of our predictions are substantially borne out. Recall that telic
 7 adpositions such as *to* should license both a collective and a distributive read-
 8 ing, for a plural definite such as *the tank engines*, on equal grounds. In answer-
 9 ing the first target question, participants could choose to consider the four
 10 relevant engines, as a collective, to be the salient entity in discourse and thus
 11 answer 'yes'. The results mirror this equal possibility for one of the two answers
 12 to occur. Atelic adpositions such as *at*, instead, are not ambiguous and thus
 13 can only license a collective interpretation for *the tank engines*. Only one read-
 14 ing is predicted, and only one reading is observed. Note, furthermore, that
 15 our assumptions about the precise 'spatial' interpretation of *at* are borne out
 16 as well. Participants invariably answered positively to the target question.
 17 This is sharply in contrast with a theory of *at* as expressing external location
 18 (e.g. Kracht, 2002), and perfectly in line with our (and others') theory of *at*
 19 as expressing 'general' location (e.g. Nam, 1995). Importantly, these data also
 20 show that one central prediction is borne out, although in a rather indirect
 21 way. Plural definites in discourse are interpreted in an inherently anaphoric
 22 way. Participants offered their answers by considering the definite *the tank*
 23 *engines* as referring to the five tank engines in the story, as the answers inher-
 24 ently prove. Overall, participants could access readings as per predictions.

25 Second, the details regarding participants' answers, collected in the exper-
 26 iment's follow-ups, confirm the validity of the experimental hypotheses. The
 27 only participant who offered a 'not sure' answer did so after changing mind. In
 28 the experiment's aftermath, she commented that she made her second choice
 29 because she felt that her intuitions about the experiment were not clear and
 30 spontaneous any more. Other participants invariably commented that they
 31 chose the answer they found the most appropriate, out of two possible options.
 32 In the second experiment, the more straightforward options resulted in a
 33 'swift' set of answers. In general, participants were sure about their choice:
 34 only one participant changed her answer. Interestingly, the only participant
 35 answering negatively commented that her answer was based on Thomas being
 36 the only tank engine who was 'at' the hotel, according to her understanding of
 37 the question. Other tank engines were somewhere else, but not 'at' the hotel,
 38 according to her interpretation. Overall, participants had a clear idea what was
 39 the correct answer to the experimental question.

40 Third, we observe that our data broadly not only support the single pre-
 41 dictions we have made about the interaction between spatial adpositions and
 42

plural definite. They also support the general assumption that plural definites are interpreted in an anaphoric way, when the explicit context introduces the referents making up the denotation of a plural definites. Participants always mentioned that, in offering their choice, they took in consideration the information provided in the story leading up to the question. For instance, in offering an answer to the first question, participants either mentioned that a collective of tank engines went to the station, so the 'yes' answer was more appropriate. Or, that Arthur changed idea during the story, so a 'no' answer was more appropriate. In offering an answer to the second question, participants always mentioned that the tank engines as a collective were occupying some location related to the hotel. So, the tank engines were effectively 'at' the hotel. Overall, the anaphoric component plays a part in interpretation, at least in discourse.

3. Conclusion

In this paper we have presented novel experimental evidence regarding the interaction between plural definites and spatial adpositions, in discourse. These novel data offer a further insight on at least three topics regarding the interpretation of definites in discourse.

First, these data suggest that spatial adpositions can determine the interpretation of plural definites, according to the type of collective or distributive reading that they can license in a sentence. This type is in turn determined, to some extent, by the lexical aspect contribution of the predicate they combine with, i.e. whether a predicate is telic or atelic. Since adpositions act as predicates, alone or in combination with verbs, they may determine whether a plural definite is interpreted as having collective or distributive denotation. They denote whether a certain property holds of a referent denoted by a plural definite as a 'collective', or for each referent in the denotation of a plural definite. In our specific case, we have seen that the directional/dynamic adposition *to* may license both readings for a plural definite such as *the tank engines* on equal grounds. The locative/static adposition *at* only licenses the collective reading. This finding is consistent with general assumptions about predicates and their interaction with plural definites (e.g. Brisson, 1998, 2003; Landman, 2000, 2004; *inter alia*). It extends these assumptions to cover a still understudied set of predicates, that of spatial adpositions. Since it investigates what is the role of lexical aspect, it sheds light on how the collective/distributive readings can be accessed.

Second, these data suggest that the contribution of predicates to the interpretation of plural definites, what we have defined as their 'lexical content', plays a vital role in sentence interpretation. The second experiment focused

on the ability of *at* to license only a collective reading for plural definites, and offered clear evidence in this regard. If telic predicates forcibly license only one type of interpretation (either collective or distributive), then plural definites should be interpreted only in one way, accordingly. The vast majority of 'yes' answers in the *at* experiment support this account. These answers further suggest that the collective reading for plural definites can in a sense emerge in discourse, as the result of apparently different predicates holding at the same time. If each tank engine instantiates one possible 'at' location, then the tank engines as a collective will certainly occupy a 'complex' 'at' location. Importantly, this form of entailment pattern is licensed also because the landmark object denoted by the singular definite *the hotel* is unique. If each of the tank engines is 'at' the same hotel, then the tank engines as a collective are 'at' the hotel, as well.

Third, these data also suggest that *at* denotes a related which can be roughly defined as denoting a general location relation. Our second experiment strongly suggests that this adposition denotes a relation between locatum and landmark object which is in a sense underspecified with respect¹⁴ to the exact position of the locatum. Since participants systematically accepted *at* as also denoting a case in which one of the tank engines was inside the hotel, rather than outside, the hypothesis that *at* denotes external location is not borne out. Some important observations pertain to the validity of the data offered in these experiments. We list two possible observations.

First, both experiments offer evidence pertaining to the collective interpretation of *to* and *at* that is in part indirect, in nature. We aimed to strike a balance between the needs of experimental set-ups and the testing of our experimental hypothesis. Hence we used stories in which the collective reading arises from the unfolding of our stories. This balance turned out to be fine-grained enough to offer sound evidence regarding this reading, as the data show. However, it would be in theory possible to test what we could call a 'true' collective reading, e.g. a case in which a story shows that all the relevant engines except one jointly reach the station, or end up sleeping at the hotel.¹⁵ We leave the testing of such an experimental set-up for future research, however.

Second, the second experiment does not offer what could be called 'definitive' evidence that *at* denotes an 'unrestricted' form of general location. In the experimental set-up, each tank engine occupied a position which was very close to the hotel, so participants could have been biased by the implicit context to answer in a positive manner. We also leave such a question for future research.

We can nevertheless conclude that our initial empirical questions find experimental answers which are positive. Speakers of English interpret (anaphoric)

plural definites has having collective or distributive reference, depending on whether the predicate they combine with licenses one or both interpretation. In the case of spatial adpositions, telic adpositions such as *to* license both interpretations (collective or distributive). So, speakers access both interpretations in context. Atelic adpositions such as *at* license either one, so speakers will only access one interpretation. The first question receives a positive experimental answer. Furthermore, speakers interpret plural definites has having a unique interpretation, when the predicate they combine with licenses one interpretation. So, speakers always interpret plural definites as having collective reference, when combining with *at*. The second question also receives a positive experimental answer.

It should be obvious that these three topics and, in general, the empirical findings we offered in this paper do not exhaust the whole debate regarding the interpretation of definites. We would like to suggest three topics we have not addressed in this paper, and that we would like to investigate in further research.

First, we have left open the possibility that certain predicates may *only* license a distributive reading. Some verbs seem to behave in this way (see Schwarzschild, 2009 for discussion). Some authors suggest that *in* may be an adposition denoting an inherently distributive predicate (e.g. Brisson, 1998; 2003). A similar suggestion could be made for the so-called *projective* locative adpositions, such as *in front of* or *behind*. Whether this suggestion is on the right track or not, is something that we leave for future research.

Second, although we have proposed that our findings hold for telic and atelic adpositions, it is nevertheless an open problem whether these generalisations hold for each adposition within these broad classes. One problem is whether our experiments would have yielded the same results if we would have used adpositions such as *through* and *from*, rather than *at* and *to*. These adpositions express different spatial configurations, but it is not clear whether this difference is relevant or not. Several directional/dynamic adpositions can be ambiguous between a 'telic' and an 'atelic' reading. So, they may either receive an ambiguous or unique interpretation, depending on which lexical aspect interpretation is accessed. Furthermore, the exact interpretation of an adposition also depends on the verb it combines with, as it is well-known in the literature (e.g. Zwarts, 2005). We thus leave for future research an exploration of this complex 'layer' of interpretation for adpositions.

Third, we have not addressed whether our treatment of adpositions and plural definites can be extended to singular definites as well, whether they are anaphoric or referential in nature. Our experiments very indirectly tested the contribution of singular, referential definites, since the target questions

involved the singular definites *the station* and *the hotel* in object position. We think that the data in Poesio and Vieira (1998) offer empirical evidence which is in line with our findings. However, it is an open question whether singular definites have the same interpretative properties as plural definites, both in discourse and in subject position. We also leave an answer to this question for future research.

We therefore conclude that, if our analysis is correct, our data can offer a novel and more accurate analysis of the interpretation of plural definites in discourse, and sheds light on their with spatial adpositions as predicates.

Notes

1. In this paper, we shall adopt the DRT convention and call ‘referents’ all model-theoretic entities that represent extra-linguistic entities at a linguistic level. See Kamp *et al.* (2005: 750–760) for a basic discussion.

2. Other labels for this reading are *maximal* (collective) vs. *non-maximal* or *partitive* (distributive), as in Brisson (1998, 2003). We will only use the labels ‘collective’ and ‘distributive’, to avoid confusion. See Le Bruyn (2007, 2008) for discussion, and Note 8 for a further clarification.

3. Here we use rather neutral labels to define the located entity and the entity acting as a reference, but the most common terms are respectively *figure* and *ground* (e.g. Talmy, 1978, 2000).

4. The label ‘anaphoric’ is sometimes considered synonymous with ‘salient’ in the literature on definites. As we show in the remainder of the introduction, the two concepts are different, and in a sense saliency readings are only one type of anaphoric readings.

5. We would like to thank an anonymous reviewer for bringing this literature and examples to our attention, in particular for pointing us to Schwarz (2009).

6. In set-theoretic, extensional notation, the denotation of *boy* would be **boy**'={Mario, Luigi, Wario}, whereas the denotation of *boys* would be **boys**'={Mario, Luigi, Wario, {Mario, Luigi}, {Mario, Wario}, {Luigi, Wario}, {Mario, Luigi, Wario}}. The definite article would select the ‘ideal’ element in this power-set, i.e. we have **the boys**'={Mario, Luigi, Wario}. See e.g. Link (1998: ch. 1) for a more thorough introduction to theories of plurality, and Schwarzschild (1996: ch. 1) for a discussion between set-theoretic and lattice-theoretic notations.

7. A distributive reading may be licensed, but only in the opportune implicit context. For instance, each boy may lift a toy piano, possibly light in weight. This aspect is immaterial, for our discussion.

8. In the literature, this type of collective reading is often defined as a *cumulative* reading (e.g. Krifka, 1998; Rothstein, 2004). For the discussion at hand, our coarse-grained treatment of cumulativity and collectivity as virtually the same phenomenon, and their interplay with distributivity, is precise enough, and refer the reader to the literature for a more thorough analysis of this property (e.g. Beck and Sauerland, 2000; Rothstein, 2004). We would like to thank an anonymous reviewer for bringing this aspect of the discussion to our attention.

9. We thank an anonymous reviewer for raising the issue, and inviting us to discuss this aspect in detail.

10. Although there is an intense debate on how children interpret ‘every’ and other ‘logical’ words (e.g. whether is similar or different to adults), many current proposals suggest that their interpretation is adult-like, once they can access their processing resources are ‘powerful’ enough to understand such words. See Notley *et al.* (2008) for a recent analysis.

11. This name is a pun, as it is the literal translation of the first author's surname into English. We only explained this detail to participants if asked to.

12. The asymmetry in number of participants stems from contingent reasons. While 30 participants per stream were registered, four participants did not attend the experimental sessions for various reasons, not related to the experiment. Data from three participants were also discarded, as they were bilinguals, but still had the right to participate in the experiment.

13. We remind the reader that the sub-type of collective reading under discussion is the cumulative reading. Our experimental design aims to capture precisely this reading, as well as meeting the CPD condition.

14. We would like to thank a second anonymous reviewer for bringing this aspect to our attention.

15. We would like to thank again a second anonymous reviewer for bringing this aspect to our attention.

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