Questioning Indefinites in Dialogues

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Abstract

The standard analysis of indefinites (e.g. Russell or more recently in the Discourse Representation Theory) views them as introducing a new discourse referent that is considered as independent from both the textual and extra-textual context. Still it can be observed that in many situations such as dialogue there are cases where sequences of indefinites are explicitly referring to the same entity, when for instance its properties have to be refined. On the basis of a corpus study of task-oriented dialogue transcriptions, we show that indefinites can only be coreferential if the events that bear them as arguments are coreferential as well. We thus identify the basic cues that may lead to the automatic determination of such situations (e.g. adverbials, sub-categorising statements etc.) and apply them to analyze our corpus examples. We also show that the configuration of dialogue acts (re-statements, question-answer pairs) directly influence the subsequent use of indefinite following an initial statement.

1. Standard Analysis of Indefinites

The standard analysis of indefinite noun phrases is based on Russell, viewing them as introducing a quantifier. In traditional first order logic, existential and universal quantification states a relation between the denotations of two predicates, and is opposed to designation which consists in naming individuals by constants. For a sentence like (1), the standard translation for *a* is the following :

(1)   A man is walking : $\exists x\ man(x) \wedge walking(x)$

The advantage of this analysis is to isolate noun phrases which do not refer to a particular individual, and to give a rather good approximation for linguistic observations like those well known as "quantifier scope ambiguities". But an important limitation of this view is that it is unable to give a correct account of phenomena like cross-sentential anaphora and "donkey sentences" (Kamp, 1981).

This limitation was one of the criteria[1] for considering that indefinites in a restricted sense – *a N, Ns, two Ns* – are not to be treated as quantifiers like *at least one N, every N, exactly two Ns*. It leads to a separate treatment of quantified NPs and indefinites in the DRT framework (Kamp and Reyle, 1993). Whereras quantified NPs introduce a tripartite structure, where the quantifier expresses a particular relation between a restrictor and a scope, indefinite NPs introduce just a new variable for an individual. In the following, we concentrate on such indefinites.

The fact that indefinites introduce a new variable is intended to reflect the idea that they are used to introduce new discourse referents, whereas definite descriptions, demonstratives and pronouns are used to refer to already known entities. Such a correlation between linguistic forms and assumed familiarity or cognitive status has been proposed in particular by Prince's Taxonomy (1981) and refined by the Givenness Hierarchy (Gundel et al.,1993). For both, the use of indefinite descriptions is optimally associated to "brand new" entities (Prince, 1981), for which the hearer can only access a representation of the type described by *N* (Gundel et al., 1993). But following Gundel et al., a cognitive status of the Givenness Hierarchy entails all lower statuses, and a particular form can be often replaced by forms which require a lower status. Since the status "type-identifiable" is entailed by all other statuses, all other statuses meet necessary conditions for use of the indefinite article. Nevertheless, as shown in data from different languages, it is not the case. Therefore, Gundel et al (1993) invoke supplementary conversational implicatures, stating that the use of an indefinite noun phrase implicates that the referent is not uniquely identifiable, and hence not familiar.

Related to this cognitive aspect of the use of indefinites – non familiarity – is a linguistic one, which is context independance. From a linguistic point of view, Corblin (1987) opposes the category of indefinites to the categories of definites and demonstratives on the basis of their relations to the context. He considers the category of indefinites as a typically context independent category, taking this feature as a consequence of the basic referential operations associated with the interpretation of indefinites : enumeration and extraction. This means, that a sentence of the type "*n N X*" (*Two dogs bark*) an always be interpreted as an extraction of *n* individual values from the the class of *N*, based on information given by *X*. It follows from this principle that each possible extraction is strictly independent from all the others, since the conditions for an extraction are fully defined by a given class *N*, a number *n* and predicative information *X*. This view on the functioning of indefinites excludes any connection to the context or to previous extractions.

The condition of non familiarity and the interpretation principle of context independance justify the standard view on indefinites, which is a non coreferential one.

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[1] Other criteria and a more detailed overview can be found in Corblin (1994).

Indeed, coreference – defined as referentiel identity for two or more linguistic forms (Milner, 1982) – links usually a first expression introducing a new referent to subsequent mentions of this referent (see example 2) :

(2)   <u>A man</u> is walking. <u>The man</u> is followed by a dog.

Since the referent has already been isolated *via* the first mention making it uniquely identifiable, the conditions of non familiarity and context independance do not hold for subsequent mentions. Therefore, the use of a second indefinite intended to refer to the same referent is not suitable (see example 3) :

(3)   <u>A man</u> is walking. <u>A man</u> is followed by a dog.

Not only does this not correspond to the cognitive status of the referent, but it would also suggest a context independent interpretation : In (3), the second indefinite simply operates a second extraction of an individual from the class *MEN*, but since nothing forces nor prevents the identity of the two mentioned individuals, the discourse is somehow odd.

The standard analysis of indefinites – seeing them as introducing new discourse referents which are non familiar and context independant – seems to fit well in the general picture. Still, it does not account entirely for the data we observed.

2.   The Data

Our data stems from a french corpus of task oriented dialogues[2], involving two persons, A and B, in a task of figure manipulation. Following the instructions given by a A, B has to reconstruct simple pictures(Figure 1a). The pictures are composed of geometrical figures, available from a virtually illimited stack of objects of various shapes (Figure 1b).
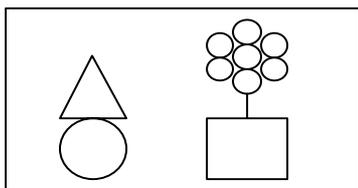

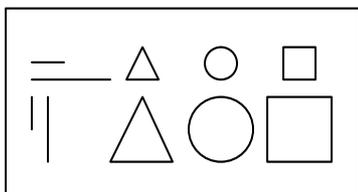Figure 1a. Example of a picture to construct

Figure 1b. Available geometrical figures

Analysing the dialogues, we found several cases where sequences of indefinites are explicitly referring to the same entity :

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[2] The corpus has been collected by N.Ozkan (1994).

(4a)   A   et tu prends <u>une deuxième barre</u>
       take <u>a second line</u>
(4b)   A   <u>une petite</u>
       <u>a small one</u>

(5a)   A   et tu vas prendre <u>une ligne verticale</u>
       and you have to take <u>a vertical line</u>
(5b)   B   <u>une grande</u> ?
       <u>a big one</u> ?
(5c)   A   <u>une grande</u> oui
       <u>a big one</u>, yes

(6a)   A   donc au bord de cette route, il y a <u>deux maisons</u>
       so beside this road, there are <u>two houses</u>
(6b)   A   donc <u>une maison qui se trouve à gauche de cette route</u> et <u>une autre à droite</u>
       <u>one house on the left of this road</u> and <u>another one on the right</u>

(7a)   A   et tu vas prendre <u>un rond</u>
       and you have to take <u>a circle</u>
(7b)   B   <u>un grand</u> ou <u>un petit</u> ?
       <u>a big one</u> or <u>a small one</u> ?
(7c)   A   <u>un petit</u>
       <u>a small one</u>

(8a)   A   alors, il va falloir que tu fasses <u>un toit</u>
       now you have to make <u>a roof</u>
(8b)   A   il faut que tu mettes <u>un grand triangle</u>
       you have to put <u>a big triangle</u>

In (4), (5) and (7), there are respectively two, three and four indefinites specifying the same referent, i.e. the figure to be manipulated. In (6b), the two indefinite noun phrases *une maison qui se trouve à gauche de cette route* and *une autre à droite* do not introduce new referents, but rather refer to the same entities as *deux maisons* in (6a). Finally, in (8), *un toit* and *un grand triangle* stand for the same object, even if they project probably different points of view on this entity.

In each of these cases, introducing two different discourse referents for the indefinite noun phrases cannot be the correct reading, since the indefinite descriptions are clearly understood as referring to the same object. What we need therefore is first a mechanism which blocks the introduction of new referents for indefinites under certain conditions, and second, a clearer idea about what can be the very nature of these conditions.

3.   Cues for Coreferential Indefinites

3.1.   "Condition of newness" as a default

A proposition concerning the first point – blocking the introduction of new discourse referents for indefinites under special conditions – has been elaborated by Corblin (1994). He proposes to consider the "condition of newness" underlying the analysis of indefinites within the DRT framework as a default condition. From a logical point of view, he first shows that the introduction of two different discourse referents for two indefinite descriptions does not have any consequences on the model

theoretic interpretation of a DRS. Indeed, defining embedding as a function from the universe of the DRS into the universe of the model does not exclude the possibility of mapping two different discourse referents onto the same individual in the model, since this relation is not an injective one. This means that the standard version of DRT (Kamp and Reyle, 1993) does not predict any difference between a coreferential and a non coreferential use of indefinites.

In order to strengthen the intuition that it is much more natural to use two indefinites for two different individuals, but without excluding definitly a coreferential use, Corblin proposes to extend the standard version of the theory regarding to two points : First, the embedding function is redefined as an injective function. Second, the rule for indefinites is redefined as a defeasible rule, stating that an indefinite is interpreted as introducing a new discourse referent, as long as there are no explicit indications against this.

The problem is now to give a more detailed, and ideally formalized description of the conditions under which this rule has to be overwritten. Corblin (1987, 1994, 1995) mentions only some informal cues, like enumeration of properties (9), previous announcements (10) and identity statements (11).

(9) Tu as trompé Marie. Tu as déçu <u>une femme qui t'adorait.</u>

(10) Here is a story about Mary. One day, <u>a woman</u> crossed the road…

(11) Pierre was looking for Mary. <u>A woman</u> crossed the road. It was Mary.

The last type of examples seems to play a central role in suspending the default interpretation of indefinites by stipulating explicitly – through the use of the verb *to be* – the identity of the mentioned entities. It can be related to another – may be the best known – case of coreference between indefinites, which is an attributive use[3], like in (12).

(12) My teacher is <u>a woman</u>.

In these cases, the indefinite is not used in order to isolate, *via* the specific reference calculus for indefinites, a referent, but rather to define a property of a referent identified independently, based on discourse features.

Discourse features, and more specifically rhetorical structure (Mann and Thompson, 1986) or discourse relations (Asher, 1993) can also be seen as indicators to take into account the interpretation of (9) and (10). This brings us to the next section, which relates recent work bringing together a particular kind of discourse structure and coreference between indefinites.

3.2. Event Coreference and Indefinites

In a recent paper on event coreference and discourse relations within the framework of SDRT (Asher, 1993), Gaiffe and Danlos (2000) give evidence for the need of a new discourse relation *Particularisation*. The arguments are based on the observation of discourses like (13) and (14) :

(13) Ted damaged a garment. He stained a shirt.

(14) Guy experienced a lovely evening last night. He had a fantastic meal.

(14) is a classical example of *Elaboration*, since the event introduced in the second sentence (S2) is a part of the event introduces in the first sentence (S1). Example (13), however, cannot be analysed like this. Indeed, the event introduced in S2 is not a part of the event introduced in S1 : the events are the same. In other words, (13) is a particular case of event coreference, where the second sentence contains more specific information about the event than the first one (Danlos, 1999). For this kind of discourse configuration, a new discourse relation *Particularisation* has been proposed. The introduction of this new relation is justified in particular by the fact that event coreference implies necessarily a coreferential relation between the arguments of the same thematic role. This is for example the case for the indefinites *a garment* and *a shirt* in (13).

Therefore, the discourse relation *Particularisation* can be useful regarding our goal – establishing formal criteria overwriting the default rule for the introduction of a new referent for an indefinite. Indeed, since

Particularisation $\rightarrow$ event coreference $\rightarrow$ argument identity,

Particularisation can be seen as one of the criteria we are looking for. Applied to (13), it means, that the *Particularisation* relation between the first and the second event cancels the introduction of a new discourse referent for the indefinite *a shirt* by setting it identical to another one.

The problem we have to solve then is to establish a *Particularisation* relation between two discourse segments $\pi1$ and $\pi2$, corresponding to S1 and S2. Following Danlos and Gaiffe (2000), this can be done based on a set of linguistic constraints C_{part}. If $\pi1$ and $\pi2$ have to be related by a discourse relation τ, and S1 and S2 met the constraints C_{part}, then the *Particularisation* relation is inferred by default (>) :

$(\tau, \pi1, \pi2) \wedge C_{part} >$ Particularisation $(\pi1, \pi2)$

The elements of C_{part} are the following :
(a) Cue phrases : S1 and S2 are not related by a cue phrase, excepted such cue phrases as *more precisely* or *in fact*.
(b) Semantic relations between the constituents of S1 and S2 : In order to concentrate on what will be useful in the following, we limit ourselves to cases where the predicates of S1 and S2 are identical[4]. In this case, the conditions for a particularizing event coreference between S1 and S2 are given below (Arg_n^τ stands for an argument of the

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predicate of sentence n, with the thematic role r, with n $\ni$ {1,2,..} and r $\ni$ {agent, patient,…}) :

particularizing_event_coreference (S1,S2) if
$\quad$ Predicate$_1$=Predicate$_2$ $\wedge$
$\quad$ for each Arg$_2^r$:
$\quad\quad$ Arg$_2^r$ = SPEC (Arg$_1^r$) $\vee$
$\quad\quad$ Arg$_2^r$ = IDENT(Arg$_1^r$) and some other
$\quad\quad\quad$ element in S2 brings new
$\quad\quad\quad$ information

$\quad$ SPEC stands for a relation of semantic specification and includes hyponomy (*a garment* vs. *a shirt*) and identification (*a tree* vs. *a tree near the house*). IDENT stands for a semantic relation of identity and includes pronominal anaphora (*a tree* vs. *it*) and semantic identity (same expression, synonymy,…). Roughly speaking, these conditions state that, if the predicates of two sentences are identical, either the arguments in S2 have to give more information than the arguments in S1, or, if the the arguments do not give new information, another element in S2 (for example, a temporal adverbial like *yesterday*) has to do it.

3.3. Bringing them together…

$\quad$ Our main goal is to account for coreferential indefinites, such as presented in section 2. Therefore, we were looking for a mechanism integrating coreferential indefinites into a DRT-like semantic framework, and for linguistic cues triggering this mechanism. A suitable mechanism has been proposed by Corblin (1994) – see section 3.1. Danlos and Gaiffe (2000) consider the *Particularisation* relation within an SDRT-like framework as a cue for coreference between indefinites – see section 3.2

$\quad$ The main steps for dealing with indefinites can thus be defined as follows : If an indefinite occurs in a sentence S$_i$ giving raise to an S-DRS π_i, then
- the indefinite introduces a new discourse referent *x* into π_i
- if π_i has to be linked to a previous S-DRS π_{i-1} by a relation τ and the conditions for a particularizing discourse C$_{part}$ are met, then a *Particularisation* relation is inferred by default :
$\quad$ (τ,π_{i-1}, π_i) $\wedge$ C$_{part}$ > *Particularisation* (π_{i-1},π_i)
- *Particularisation*(π_{i-1},π_i) implies event coreference between S1 and S2, and event coreference implies the identity of the arguments
- therefore, *x* has to be marked as identical with another discourse referent of π_{i-1}

Applying this to the toy example (15) yields to :

(15) Ted damaged a garment. He damaged a shirt.

$\quad$ S1 : Ted damaged a garment.
$\quad$ π_1 $\exists$g$\exists$e $\quad$ garment(g) $\wedge$ damaged(e,Ted,g)

$\quad$ S2 : He damaged a shirt.
$\quad$ π_2 $\exists$s$\exists$e' $\quad$ shirt(s) $\wedge$ damaged(e,h,s) $\wedge$ h = ?

$\quad$ (τ,π_1, π_2) $\wedge$ C$_{part}$, since :

(a) $\quad$ no cue phrases linking S1 to S2

(b) $\quad$ semantic relations :

Ted	Arg$_1$^{agent}
damaged	Pred$_1$
a garment.	Arg$_1$^{patient}
He	Arg$_2$^{agent} = IDENT (Arg$_1$^{agent})
damaged	Pred$_2$ = Pred$_1$
a shirt.	Arg$_2$^{agent} = SPEC (Arg$_1$^{agent})

(τ,π_1, π_2) $\wedge$ C$_{part}$ > *Particularisation* (π_1,π_2)

Particularisation(π_1,π_2) $\rightarrow$ event coreference $\rightarrow$ argument identity

π_2 $\exists$s$\exists$e' shirt(s) $\wedge$ damaged(e,h,s) $\wedge$ e'=e $\wedge$ s=g $\wedge$ h = Ted

$\quad$ Following this reasoning, the coreferential relation between the indefinites *a garment* and *a shirt* is established, based on the *Particularisation* relation between the two sentences of (15).

4. Application to the data

$\quad$ In this section, we try to apply the machinery presented in 3.3. to our corpus examples. Since the criterion of *Particularisation* has been introduced for examples taken from written discourse, we have to adapt it in several ways to oral dialogues. Nevertheless, we try to keep the same backbone of the reasoning, based on a comparison of the predicates and arguments in order to obtain a coreferential reading for the indefinites occuring in our corpus examples

4.1. Example type A

(4a) $\quad$ A $\quad$ et tu prends <u>une deuxième barre</u>
$\quad\quad\quad\quad$ *take <u>a second line</u>*
(4b) $\quad$ A $\quad$ <u>une petite</u>
$\quad\quad\quad\quad$ *<u>a small one</u>*

$\quad$ This example contains two indefinites, *une deuxième barre* and *une petite*, specifying the same object. Therefore, the discourse referent introduced for *une petite* has to be merged with the referent for *une deuxième barre*.

$\quad$ One possibility to justify this is to establish a *Particularisation* relation between the discourse segments for (4a) and (4b). Nevertheless, the problem is more complicated than for the toy examples : The first difference concerns the illocutionary force of the discourse segments. Up to now, *Particularisation* has been used for statements, whereas (4a) and (4b) are orders. The second difference concerns the syntactical completeness of the utterances. Since we are interested in the modelling of spoken discourse, we have to deal with additional phenomena such as VP- and noun head ellipses, like in (4b).

$\quad$ Our representation of the speech acts and propositional contents follows Grisvard and Gaiffe (1999). An utterance is represented as

IF (S, H, PC)

with IF = Illocutionary Force {tell_to, say_that, ask_if, ask_wh-}, S = Speaker, H = Hearer and PC = Propositional Content. The propositional content is equivalent to an S-DRS. Representing the first utterance of (4) in this form leads to :

tell_to(A, B, π_1)

with

π_1 : $\exists l \exists e$ second(l) $\wedge$ line(l) $\wedge$ take(e, B, l) $\wedge$
       e > now

Introducing a representation for (4b) gives raise to :

tell_to(A, B, π_2)

with

π_2 : $\exists s \exists e'$ small(s) $\wedge$ EVENT(e', B) $\wedge$ e' > now

Indeed, at a first time, all we know about the propositional content from the ellipsis is the introduction of a small entity. However, (4b) being an order, the eventuality under its scope must be a future event which the hearer as an agent (Grisvard and Gaiffe, 1999). From the dialogue context, and taking into account discourse coherence constraints such as Common Theme Maximization (Asher et al., 1997), we infer supplementary information about π_2 : the category of e' and of s, and the fact that s has to be an argument of the event. Intergrating this information into π_2 leads to :

π_2 : $\exists s \exists e'$ small(s) $\wedge$ EVENT(e', B) $\wedge$ e' > now
       $\wedge$ category(EVENT) = take $\wedge$ category(s) = line

The next step is linking π_1 and π_2 by a discourse relation. Therefore, the conditions C_{part} for a particularizing discourse have to be tested. There is no discourse cue between (4a) and (4b), and the semantic relations are the following :

Tu (=B)	Arg_1^{agent}
prends	$Pred_1$
deuxième barre.	$Arg_1^{patient}$
Tu (=B)	Arg_2^{agent} = IDENT(Arg_1^{agent})
prends	$Pred_2 = Pred_1$
une petite barre.	Arg_2^{agent} = SPEC (Arg_1^{agent})

The agent is the same in (4a) and (4b). The category of the predicates are compatible. The patients of (4a) and (4b) are compatible too : they are of the same category, as required in Gaiffe and Danlos (2000). Since nothing has been detailed concerning the modifiers, we consider here that it is sufficient to have modifiers which are not mutually exclusive[5]. Since *small* do not exclude

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[5] In further work, this hypothesis needs to be refined in order to take into account more fine-grained linguistic observations : Corblin (1987), for example, points out that the use of different types of modifiers can be seen as an indicator for a non coreferential interpretation, even for

second, C_{part} holds and we can infer *Particularisation* (π_1, π_2). From that follows that the events in π_1 and π_2 are the same and therefore, s in π_2 has to be identical with l in π_1 :

π_2 : $\exists s \exists e'$ small(s) $\wedge$ EVENT(e', B) $\wedge$ e' > now
       $\wedge$ category(EVENT) = take $\wedge$ category(s) = line $\wedge$ e = e' $\wedge$ s = l

In comparison to previous examples, the *Particularisation* relation holds here between the propositional content of two orders, and not between two statements.

4.2.   Example type B

(5a)   A   et tu vas prendre <u>une ligne verticale</u>
             and you have to take <u>a vertical line</u>
(5b)   B   <u>une grande</u> ?
             <u>a big one</u> ?
(5c)   A   <u>une grande</u> oui
             <u>a big one</u>, yes

The dialogue in example (5) contains three indefinites specifying a same referent : *une ligne verticale* (5a), *une grande* (5b) and *une grande* (5c). Here, the problem is a little bit more complex than in (4) : Not only have we to insert a discourse relation justifying the identity between indefinites, but we have also to deal with typically dialogical aspects, such as questions and answers.

The first step is the introduction of a representation for (5a) :

tell_to(A, B, π_1)

with :

π_1 $\exists l \exists e$ line(l) $\wedge$ vertical(l) $\wedge$ take(e,B,l) $\wedge$
    e > now

Treating (5b) consists then in resolving the ellipsis, like in (4). Additionally, (5b) is a question, and we consider it as a form of yes-no question (which can be paraphrased as *Should I take a big vertical line ?*). Therefore, it introduces a proposition for which the truth has to be validated in the continuation of the dialogue :

ask_if(B, A, π_2)

with :

π_2 $\exists b \exists e'$ line(b) $\wedge$ vertical(b) $\wedge$ big(b) $\wedge$
    take (e',B,b) $\wedge$ e' > now

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definite descriptions, such as in : *Cette <u>rose rouge</u> me gêne. Je vais jeter la <u>rose fânée</u>*. We think, however, that this assumption is a little bit too strong. It is also possible that the conditions in dialogues with an immediatly accessible perceptual environment are not exactly the same as in discourse, where the objects can be identified only based on discursive information.

π_2 can be attached to π_1 by a discourse relation *NotEnoughInformation* (Asher, 1998). (5c) has an illocutionary force of *say_that*.

say_that(A, B, π_3)

π_3, introduced for the propositional content of (5c), is a response to (5b). Therefore, the relation between π_2 and π_3 is *QuestionAnswerPair* (Asher and Lascarides, 1998).

Since the *ask_if* act can be merged with the *say_that* act into a global *say_that* act, where π_3 confirms the truth of π_2, it yields to a new representation with a new S-DRS $\pi_{2'}$.

say_that(A, B, $\pi_{2'}$)

$\pi_{2'}$ $\exists b \exists e'$ line(b) $\wedge$ vertical(b) $\wedge$ big(b) $\wedge$
    take(e',B,b) $\wedge$ e' > now

This new DRS may be attached to π_1. The conditions C_{part} holds : there are no discourse cues linking the utterances, and the semantic relations are the following :

Tu	Arg_1^{agent}
vas prendre	$Pred_1$
une ligne verticale.	$Arg_1^{patient}$
Tu	Arg_2^{agent} = IDENT (Arg_1^{agent})
va prendre	$Pred_2 = Pred_1$
une grande ligne verticale.	Arg_2^{agent} = SPEC (Arg_1^{agent})

The agent and the predicate are the same in (5a) and (5b). The patient in (5b) is more specific, since *grande ligne verticale* implies *ligne verticale*. Therefore, C_{part} holds, and we can infer *Particularisation* ($\pi_1,\pi_{2'}$). The final discourse structure of (5) is given in Figure 2.
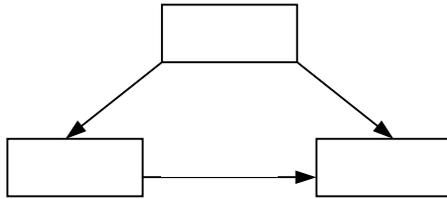

Figure 2. Discourse Structure for (5)

From *Particularisation* ($\pi_1,\pi_{2'}$) follows, that the events in π_1 and $\pi_{2'}$ are the same and so do the particpants :

$\pi_{2'}$ $\exists b \exists e'$ line(b) $\wedge$ vertical(b) $\wedge$ big(b) $\wedge$
    take(e',B,b) $\wedge$ e' > now $\wedge$ e' = e $\wedge$ b = l $\wedge$ e > now

In this example, the *Particularisation* relation has been extended in a manner to hold between the propositional content of an order (*tell_to*) and a statement (*say_that*).

problèmes :

4.3. Example type C

(6a) A donc au bord de cette route, il y a <u>deux maisons</u>
   so beside this road, there are <u>two houses</u>

(6b) A donc <u>une maison qui se trouve à gauche de cette route</u> et <u>une autre à droite</u>
   <u>one house on the left of this road</u> and <u>another one on the right</u>

In example (6), *deux maisons* introduces a new complex discourse referent with a cardinality constraint. The indefinites *une maison qui se trouve à gauche* and *une autre à droite* introduce new discourse referents too, but the new referents have to be related to the complex one, since they refer to parts of it.

(6a) leads to a first representation of the speech act as :

say_that(A, B, π_1)

with :

$\pi 1$ $\exists h \exists r \exists s$ house(h) $\wedge$ card(h) = 2 $\wedge$ road(r) $\wedge$
    state(s) $\wedge$ beside(s, h, r)

(6b) can be interpreted as :

say_that(A, B, π_2)

with :

$\pi 2$ $\exists y \exists z \exists r' \exists s' \exists s''$ house (y) $\wedge$ house(z) $\wedge$ state(s') $\wedge$
    state(s'') $\wedge$ road(r') $\wedge$ on_the_left_of(s',y, r') $\wedge$
    on_the_right_of(s'',z , r') $\wedge$ r' = ?

At this stage, nothing says that y and z are part of m. Postulating *Particularisation*(π_1,π_2) would lead to this result. However, as defined in Gaiffe and Danlos (1999), this relation holds between events and not between states. Therefore, we have to adapt it to coreference between states. Let us say that the conditions on discourse cues remain inchanged, and the conditions on the semantic relations concern the arguments and the predicate of the state.

The relation could be justified since there are no discourse cues, and with regard to the following reasoning :

on_the_left_of(s, x, y) > beside(s, x, y)

on_the_right_of(s, x, y) > beside(s, x, y)

meaning that the states *being on the left* and *being on the right* are more specific than the state *being beside* and, therefore, include it. The identity of the argument *y*, *road*, is guaranted, since it is used deictically in (6a) and (6b). The agents of state s, s' and s'' are semantically compatible. Now, what happens here is a *Particularisation* relation holding between, on the one

hand, the sum of the states s' and s" ($\pi 2$), and, and the other hand, the state s ($\pi 1$). Therefore, the sum of the agents of s' and s" has to be identical to the agent of s. From this, it follows that the two indefinites in (6b) introduce referents which are parts of the referent introduced in (6a).

It is worth to mention that the *Particularisation* relation holds indeed between s and the sum – and not only one part – of s' and s". In fact, a discourse composed only of s and s' would be awkward :

(16) There are two houses beside the road. One house stands on the left of this road.

An explanation for this is the fact that *Particularisation* cannot hold between the two sentences, since the cardinalities of the arguments are incompatible. But this example seems also to indicate that the *Elaboration* relation needs to be redefined more precisely : In fact, such as defined in Asher and Lascarides (1993), nothing prevents from the establishment of such a relation between the states in (16). That means that the awkwardness of this example cannot be predicted with the current state of the definition of this discourse relation.

4.4.   Example type D

(7a) A   et tu vas prendre <u>un rond</u>
        and you have to take <u>a circle</u>
(7b) B   <u>un grand</u> ou <u>un petit</u> ?
        <u>a big one</u> or <u>a small one</u> ?
(7c) A   <u>un petit</u>
        <u>a small one</u>

This example differs from (5) in one point : the question in (7b) is not a yes-no-question, but a wh-question about the kind of object to be manipulated. The specification of this object is realized through the use of four indefinites. Establishing a *Particularisation* relation between (7a) and a complex segment composed of (7b) and (7c) would be one possibility to treat these indefinites adequately.

As in (5), the first utterance is an order of the form :

tell_to(A, B, π_1)

with :

π_1 $\exists c \exists t$ circle(c) $\wedge$ take(t,B,c) $\wedge$ t > now

(7b), as a wh-question, is a propositional function (paraphrased as *Which circle should I take ?*), taking a NP as an argument :

ask_wh(B, A, π_2)

with

π_2 $\lambda NP.[NP][TAKE]$

$[TAKE] = \lambda x.\ \exists e$ take(e, B, x) $\wedge$ circle(x) $\wedge$ (big(x) $\vee$ small(x)) $\wedge$ e > now

π_2 $\lambda NP.\ [NP]\ [\lambda x.\ \exists e$ take(e, B, x) $\wedge$ circle(x) $\wedge$ (big(x) $\vee$ small(x)) $\wedge$ e > now]

(7c) is a response to (7b), providing the NP which has to be applied to π_2.

say_that(A,B, π_3)

with

π_3 $\lambda P.\ \exists s$ small(s) $\wedge P(s)$

Applying this to π_2 yields to :
$\pi_{2"}$ $\lambda P.\ \exists s$ small(s) $\wedge P(s)$ [$\lambda x.\ \exists e$ take(e, B, x) $\wedge$ circle(x) $\wedge$ (big(x) $\vee$ small(x) $\wedge$ e > now]

$\pi_{2"}$ $\exists s$ small(s) $\wedge \exists e$ take(e, B, s) $\wedge$ circle(s) $\wedge$ (big(s) $\vee$ small(s) $\wedge$ e > now

$\pi_{2"}$ $\exists s \exists e$ small(s) $\wedge$ take(e, B, s) $\wedge$ circle(s) $\wedge$ e > now

This new DRS may be attached to π_1. The conditions C_{part} holds : there are no discourse cues linking the utterances, and the semantic relations are the following :

Tu	Arg_1^{agent}
vas prendre	$Pred_1$
un cercle.	$Arg_1^{patient}$
Tu	Arg_2^{agent} = IDENT (Arg_1^{agent})
va prendre	$Pred_2$ = $Pred_1$
un petit cercle	Arg_2^{agent} = SPEC (Arg_1^{agent})

The agent and the predicate are the same for π_1 and $\pi_{2"}$. The patient in $\pi_{2"}$ is more specific, since *petit cercle* implies *cercle*. Therefore, C_{part} holds, and we can infer *Particularisation* ($\pi_1,\pi_{2'}$).

From *Particularisation* ($\pi_1,\pi_{2"}$) follows, that the events in π_1 and $\pi_{2"}$ are the same and so do the particpants :

$\pi_{2"}$ $\exists s \exists e$ small(s) $\wedge$ take(e, B, s) $\wedge$ circle(s) $\wedge$ e > now $\wedge$ e = t $\wedge$ s = c

4.5.   Example type E

(8a) A   alors, il va falloir que tu fasses <u>un toit</u>
        now you have to make <u>a roof</u>
(8b) A   il faut que tu mettes <u>un grand triangle</u>
        you have to put <u>a big triangle</u>

For this example, it seems impossible to establish the coreference of the indefinites *un toit* and *un grand triangle* on the basis of linguistic indicators for event coreference. We do not have cue phrases, nor semantic relations linking the arguments or the predicate. Indeed, even if *mettre un grand triangle* can be seen as specifying the action of *faire un toit* in this particular context of the task, establishing this relation needs to take into account extralinguistic knowledge. Danlos (1999) proposed therefore to extend the notion of hyperonomy between lexical items so as to cover extralinguistic hyperonomy between clauses. This type of extended hyperonomy is not

only close to the notion of inference, but it depends also on the application specific context.

One possibility to treat example (8) would be to use an inference rule, such as :

R1 : putting a triangle > moving geometrical figures

modelling the fact that *putting a triangle* is a particular form of *moving geometrical figures*. In addition, we need an application specific rule, stating that in this context, making pictures (such as a roof) consists in moving geometrical figures :

R2 : moving geometrical figures > make a roof

Based on this knowledge, it is possible to infer that putting a triangle is a specification of making a roof, and therefore, (8a) and (8b) refer to the same event. Since event coreference implies the identity of the arguments, *a roof* and *a triangle* have to refer to the same entity.

5. Summary and Discussion

The standard analysis of indefinites sees them as context independent and therefore non coreferential. However, we presented corpus examples, containing sequences of indefinites explicitly referring to the same entity. The problem was then to account for such cases in an DRT or SDRT-like framework.

This paper presents an attempt to do this, based on recent work on a new discourse relation – *Particularisation.* This relation has one specificity : it implies the identity of the participants involved in the related events. It can therefore be considered as one possibility to take into account coreferential readings of indefinites.

However, the *Particularisation* relation has been defined for discourse and not for spoken dialogues. Adapting it to our dialogue examples demands in particular to deal with NP- and VP-ellipses and with a variety of speech acts – questions, answers and orders – which are different from statements. The first problem can be (partially) solved by taking into account the second one : Indeed, it has been shown that different speech acts impose different constraints their propositional content (Grisvard and Gaiffe, 1999). Based on this observation and on work about common theme maximazation (Asher et al., 1997), is it possible to infer missing information. In order to deal with the second problem – the variety of speech acts – it is first necessary to combine them into more complex discourse segments (for example, a question and an anwser into a statement). Secondly, we have to admit that *Particularisation* can hold not only between statements, but also between orders, between an order and a statement, and between a statement and the sum of several statements.

The mechanism we present here may seem quite complicated, if compared to the mechanisms for identity postulation for anaphora or identity assertion for *to be* constructions in DRT. Nevertheless, we think that there are necessary since a coreferential reading of indefinites does not function in exactly the same way as anaphora resolution or identity assertion.

Concerning anaphora resolution in DRT, the principle consists in introducing a new discourse referent and to choose a suitable antecedent from those which are accessible in the discourse universe. The difference with the coreferential reading of indefinites is the choice of the antecedent : whereas the only choice constraints for antecedents of anaphora are pragmatic ones (excepted gender, number and semantic restrictions), there is no choice at all for coreferential indefinites involved in a *Particularisation* relation : the identity is mandatory for the arguments of the same thematical role.

The main difference with identity assertions such as in *Fred is a linguist* is the following : for coreferential indefinites in particularizing discourses, the identity is not asserted, but stipulated. Kamp and Reyle (1993 : 258) point out that this is not a trivial point, even if the truth-conditional interpretations for stipulated and asserted identity are the same. Stipulated identity (represented by a condition $x = y$) represents the fact that a certain NP is being used as a means for picking up a certain discourse referent introduced by independent means. Asserted identity (represented by a condition x *is* y) represents the fact that the interpreter understands the identity statement of x and y, but it does not mean that he or she thinks necessarily that this statement is true. If needed, such a condition, in which no conflation has taken place, can in some way be marked as "dubious", in order to reflect the interpreter's epistemic state more accurately.

Finally, given the unusual mechanisms involved in coreferential readings of indefinites, it seems worth to ask why speakers use indefinites in such a way. The response tho this question lies in the specific interpretation principle for indefinites : As opposed to definites, demonstratives and pronouns, indefinites do not presuppose an external mechanism in order to identify a particular individual : they don't designate. The only thing they do is to provide information about properties of individuals satisfying the description. To put it in other words, an indefinite description "a N" presupposes a domain of entities of type N, but cannot be used to identify a particular individual of this domain. In many cases, this domain is context dependent, either given by discourse information or by perceptual information, as it is the case for our dialogues : here, the interpretation domains for the indefinites are provided by the virtual stacks of geometrical figures (Figure 1b). To give an example, an expression like *a triangle* presupposes the existence of a set of triangles. Such a domain of triangles is indeed available, given by the virtual stacks of big and small triangles, represented explicitly in (Figure 3).
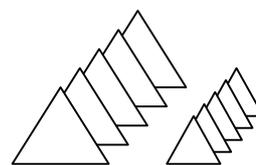

Figure 3. Interpretation domain for *a triangle*

The utterance *Take a triangle* means then that the hearer has to choose one of the triangles of this domain. Now imagine that the speaker would like to precise the size of the triangle which has to be manipulated. Since there are always more than one possible referents in the perceptual domain, he has to use an indefinite description

Take a small triangle. A definite description *Take the small triangle* would be inappropriate, simply because the structure of the perceptual domain don't allow the hearer to identify uniquely a particular triangle.

What we would like to stress here is the important role of the contextual structure for the use of different types of referring expressions. Concerning the use of coreferential indefinites, we assume the following : Since an indefinite description is not used to uniquely identify a referent, but to identify a contextual domain, the specific role of a sequence of coreferential indefinites is to state a relation between two or more domains. In case of *Particularisation* between two utterances, this relation is a domain restriction, like in our corpus examples.

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