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# Landmark Frames of Reference in Interactive Route Description Tasks

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*Summary: The current study investigated the use of frames of reference in an asymmetrical spatial dialogue task. Participants navigated through a real environment by following instructions provided by other participants guiding them over the phone. The dialogues were transcribed and analysed to locate the introduction of landmarks. We examined which frames of reference were used to introduce these landmarks and how far their use was determined by each participant's role within the dyads (i.e. guide vs. guided person). Results revealed that both partners contributed to the dialogue by introducing landmarks. However, the guides introduced more landmarks than the guided persons and were also more likely to use perspective taking when doing so. These results are discussed in the light of perspective taking and collaboration in dialogue. Copyright © 2013 John Wiley & Sons, Ltd.*

Dialogue is a joint activity involving two partners who interact to achieve a common goal (e.g. Clark, 1996), such as finding the most convenient time to schedule a meeting. In some cases, the interaction may involve partners describing spatial locations to each other.

One of the specificities of spatial dialogue is that utterances and referring expressions are introduced with respect to a given frame of reference, that is, a coordination system that makes it possible to locate objects and specify the spatial relations between them (Schober, 1998; Shelton & McNamara, 2001). For instance, a speaker might ask his or her partner to pass 'the book that's to your left'. In this case, the frame of reference is centred on the partner, with the objects' locations and the relations between them being specified with regard to the partner's point of view. However, the speaker could just as easily use a number of other frames of reference to convey the same demand. For instance, he or she could locate the book with regard either to his or her own point of view—'the book that's to my right'—or to another object present in the dialogue environment—'the book that's next to the phone'.

The current study focused on how dialogue partners use reference frames during route description. In route description dialogue, one of the speakers (the *guide*, hereafter referred to in the female gender) helps her partner (the *guided person*, hereafter referred to in the male gender) to reach a destination in a given physical environment. In some cases, guides provide guided persons with directions before the latter actually start interacting with the environment. In other cases, however, the guided person is provided with information (i.e. which steps should be followed, which actions should be taken and which landmarks should be encountered) online, as he is actually navigating through the environment. The aim of the present study was to show how each partner's role (either guide or guided person) determines which frames of reference are used during online route description dialogue.

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## Using language in spatial dialogue

Spatial language is defined as 'expressions that involve spatial positions and movements of objects in the world' (Steels & Loetzsch, 2009, p. 70). During dialogue, spatial language can be used for various purposes, including describing the location of an object or discussing a route. As mentioned earlier, spatial language can be produced with regard to a given frame of reference, relating the object being described to a vantage point that corresponds either to the perspective of one of the partners or to another object present in the dialogue environment. Another possibility is for speakers to produce neutral descriptions—that is, the description is produced in such a way that the interpretation that it made of it is the same regardless of which frame of reference is used for interpretation (Schober, 1995).

In some spatial dialogue situations, both partners share the same perspective on the scene being described—for instance, where they are both looking at it standing side by side. At other times, however, each partner will have a different perspective on the scene, as in the case when the partners are facing each other and the objects being described are located between them. Partner A's right then corresponds to Partner B's left and vice versa (see, for instance, Duran, Dale, & Kreuz, 2011; Mainwaring, Tversky, Ohgishi, & Schiano, 2003; Schober, 1993, 1995, 2009; Tversky & Hard, 2009; van der Kleij & te Brake, 2010). Such situations require dialogue partners to converge on the frame of reference used to introduce and interpret utterances and referring expressions, in order to make sure that they are referring to the same *right* and *left*. For instance, the partners might both decide to use Partner B's perspective to describe the scene, in which case they would adopt a B-centred frame of reference. A series of experiments conducted by Watson, Pickering and Branigan (2004, 2006; see also 2009) showed that as the interaction unfolds, dialogue partners gradually end up using the same frames of reference for language production and comprehension. Importantly, this can lead both partners to refer to an object that is to Partner B's right as 'the object on the right', even though it is actually to Partner A's left. Importantly, using a spatial perspective that is different from one's own to introduce and interpret utterances and referring

expressions is cognitively costly, as it requires the ability to perform mental rotations (Schober, 2009).

Why would speakers make use of such a costly strategy? The answer to this question resides in the collaborative nature of dialogue in general (i.e. not just spatial dialogue). Research in the field has shown that dialogue is guided by the principle of the *least collaborative effort*, by virtue of which each speaker tries to minimize not only the individual costs incurred by producing and understanding language but also the collective costs incurred by the need for both partners to make sure that they have understood each other correctly (Clark & Brennan, 1991; Clark & Wilkes-Gibbs, 1986). Producing a spatial description from the addressee's perspective triggers individual costs for the speaker due to perspective taking, but it also facilitates the addressee's subsequent comprehension. Likewise, interpreting a spatial description from the speaker's perspective triggers individual costs for the addressee, but avoids the speaker having to introduce an utterance from a perspective that is not his or her own. Importantly, as suggested earlier, convergence implies that only one of the speakers switches perspective. Whose perspective is actually used will depend mainly on each partner's perceived ability to collaborate. If one partner is perceived of as lacking the resources or the information necessary for him to adopt the other partner's perspective, both partners will use the first partner's perspective as the frame of reference for the interaction (Duran et al., 2011; Mainwaring et al., 2003; Schober, 2009).

However, the adoption of one of the partners' perspectives is not the sole strategy available during spatial dialogue. As mentioned earlier, speakers also have the possibility of taking on a neutral perspective—that is, a perspective that does not refer to any particular frame of reference. Using a neutral perspective satisfies the principle of least collaborative effort, by minimizing not only collaborative effort but also individual effort. In this case, neither speaker has to estimate and adopt the other's point of view, and yet they each understand each other. Hence, although speakers are capable of taking each other's perspective, another strategy that is frequently used during spatial dialogue consists in adopting a neutral perspective, where one is available (Mainwaring et al., 2003; Schober, 1995).

In sum, spatial dialogue is characterized by language being produced and interpreted with regard to different spatial frames of reference, which must be coordinated in order for the interaction to be successful. The focus of the current study was on route description dialogue and, more specifically, on situations where the guided person is provided with information in real time, as he is navigating through the environment. This represents a specific spatial dialogue situation for at least two reasons. First, it involves using components that are specific to route description, as explained in the succeeding text. Second, route description dialogue is necessarily an asymmetrical situation, not only because the guide is supposedly more knowledgeable than the guided person but also because only the guided person navigates through the actual environment.

## Route description

Route description dialogue is an activity where speakers use components that are specific to this kind of activity. Allen (1997, 2000), for instance, identified several components in studies of the factors that affect route description. When describing a route, the guide introduces expressions that convey information not only about the route to be followed but also about the places that will be seen along the way. Among these expressions, noun phrases are introduced to refer to the different kinds of objects that will be encountered en route. These noun phrases generally represent landmarks, pathways or choice points. *Landmarks* are reference points that constitute the different steps that must be followed to get from the starting point to the arrival point. *Pathways* are the streets, pavements and paths that form the actual route (e.g. 'once you have crossed *the bridge*, make a left on *32nd Street*'). *Choice points* are intersections and, more generally, points at which the guided person must choose between two (or more) different directions (see also Wunderlich & Reinelt, 1982, whose classification also encompasses the dynamic aspects of route description dialogue).

Such classifications describe the content of route descriptions, but they do not specify which frames of reference are preferentially used during such interactions. As mentioned earlier, Schober (1995) has suggested that speakers engaged in spatial dialogue sometimes locate objects in relation to a specific perspective; in other cases, their descriptions reflect a neutral frame of reference. Moreover, according to Schober's classification, frames of reference used to describe objects in relation to one of the speakers' perspective may be speaker-centred, addressee-centred or both-centred. However, as Hund, Haney, and Seanor (2008) pointed out, when a guide describes a route to a guided person, knowing that the latter will be following her instructions while actually navigating through the environment, she is most likely to use a *route perspective strategy*. In other words, the guide will describe the route in relation to the guided person's position in the environment at the time of navigation, using expressions such as 'your left', 'in front of you' and so on (Perrig & Kintsch, 1985; Taylor & Tversky, 1992, 1996). One consequence of this is that the guide's perspective is not relevant to route description dialogue, as the descriptions produced by both the guide and the guided person refer to the guided person's environment only. What this means is that the guide is highly unlikely to produce speaker-centred descriptions, and the guided person is highly unlikely to produce addressee-centred descriptions, as this would imply referring to the guide's environment. Hence, it seems that some of the categories of Schober's classification do not apply to route description dialogue. What is needed for this kind of task is a classification that acknowledges the fact that in route description dialogue, only frames of reference linked to the guided person are relevant to the task.

This criterion is met by Denis' (1997) classification, according to which guides can introduce expressions such as landmarks in two different ways. They can introduce expressions without specifying their spatial location (e.g. 'there is a church'). Such expressions are hereafter referred to as *nonlocated expressions*. Guides can also introduce expressions by specifying their spatial location. Such expressions are hereafter referred to as *located expressions* and encompass both expressions introduced in relation to another object (e.g. 'the library will be to the right of the church' or 'the

street that is next to the library' are object-centred descriptions) and expressions introduced in relation to the guided person (e.g. 'the café is to your right' or 'the street on your left' are traveller-centred descriptions). Although they refer to different frames of reference, both traveller- and object-centred landmarks reflect the guided person's perspective, as introducing object-centred descriptions implies determining which objects are visible from the guided person's point of view. This classification is—at least partly—compatible with Schober's (1995), as nonlocated expressions reflect a neutral frame of reference. Traveller-centred expressions reflect a speaker- or addressee-centred frame of reference (depending on the role played by the guided person). The main difference between both classifications concerns descriptions such as 'the street that is next to the library', which would be considered as object-centred by Denis (because the street is located in relation to the library) and neutral by Schober (because this description is true regardless of which vantage point is being used). Note that in the remainder of this study, the term 'object-centred' refers to Denis' classification.

In any event, just like most studies conducted on this subject, Denis' study only focused on descriptions initiated by the guide. This might be because route description is generally thought of as a task where the guide performs most of the work, as it is she who possesses all the knowledge needed for the task to succeed. Importantly, however, route description dialogue—just like any other kind of dialogue—is collaborative, which implies that both partners are expected to contribute to the success of the interaction (Clark, 1996). For instance, the guided person may be expected to provide the guide with feedback, so that she can assess his state of mind (e.g. Clark & Schaefer, 1989). The guided person may also provide the guide with information about the environment through which he is navigating, so that she can determine whether he is performing the task correctly. In short, owing to the collaborative nature of dialogue, in all likelihood, guided persons introduce landmarks during route description dialogue just as guides do. But if this is the case, do guided persons use frames of reference in the same way as guides do? The aim of the current study is to address this question. Specifically, Denis (1997) showed that guides may introduce both located and nonlocated expressions. In dialogue, producing neutral expressions is a strategy used by speakers to minimize collaborative effort, as it does not generate any additional perspective-taking costs for either the speaker or the addressee (Mainwaring et al., 2003; Schober, 1995). This may also be the case in route description dialogue, where guided persons may try to minimize collaborative effort through the use of nonlocated expressions. In addition, guides can minimize the guided persons' individual efforts by using frames of reference that facilitate the guided persons' understanding, that is, by producing located landmarks. Although this generates additional perspective-taking costs for the guides, it minimizes interpretation costs for the guided persons.

Unlike the use of nonlocated expressions, the strategy that consists in minimizing the guided persons' efforts through the use of located landmarks is available to guides, but not to guided persons, as it would be irrelevant for the latter to refer to the former's environment—as pointed out earlier. One way in which guided persons can minimize collaborative effort is *not* to use frames of reference that would elicit extra processing costs for the guides, that is, located ones. This should lead guided persons to introduce more nonlocated landmarks than guides.

### Current study

The current study focused on the introduction of landmarks by guides and guided persons during a real-time route description dialogue. Guides interacted with guided persons over the phone, and their dialogues were recorded, transcribed and analysed. We examined who introduced the landmarks during the interaction (i.e. either the guide or the guided person) and how these were introduced (i.e. what kind of frame of reference was used). Following the rationale set out earlier, the aim of the current study was to test two hypotheses. The first hypothesis was that although both guides and guided persons contribute to the interaction, guides introduce more landmarks than guided persons. The second hypothesis was that guides are more likely to introduce located landmarks—and therefore less likely to introduce nonlocated landmarks—than guided persons.

## METHOD

### Participants

Fifty-five students initially took part in the experiment. They were split into two groups (guides and guided persons), depending on their initial knowledge of the navigation environment. The guided persons were students who were new to the university and who had never or seldom navigated the task environment (all of them had lived in the university town for less than 3 months at the time of the experiment). Their group included 45 first-year psychology students (five men) with a mean age of 18.80 years ($SD = 1.1$). Unlike the guided persons, the guides did have initial knowledge of the task environment, as they were advanced psychology students (i.e. MA or PhD students) who had lived in the university town for at least 3 years at the time of the experiment. Their group included 10 students (three men) with a mean age of 25.6 years ($SD = 4.92$). Dyads were created featuring one guide and one guided person. Hence, each dyad was asymmetrical as regard the level of knowledge of each of its members (Wunderlich & Reinelt, 1982). However, the data from one of the dyads were removed from the analyses because the guided person did not manage to find the arrival point. In addition, two of the guides performed the task six times, whereas all the other guides performed it a maximum of five times; because this might have affected the way in which these two guides performed the task, the data corresponding to the sixth repetition of the task were also removed from the analysis (two dyads). In the final dataset, each guide provided route descriptions for between one and five guided persons (Table 1). A statistical analysis—which is reported in the Results section—was performed to make sure that task repetition did not significantly affect the results.

Table 1. Number of dyads guided by each guide

| Guide number | Number of dyads guided |
|---|---|
| Guide #1 | 3 |
| Guide #2 | 4 |
| Guide #3 | 5 |
| Guide #4 | 5 |
| Guide #5 | 5 |
| Guide #6 | 2 |
| Guide #7 | 5 |
| Guide #8 | 5 |
| Guide #9 | 3 |
| Guide #10 | 5 |

## Apparatus and material

*Scenario*

The task of the guide was to guide another participant (the guided person) over the phone so that he could get from one point to another in a southern French town. The route was approximately 800 m long and ran from the train station to a museum, with an intermediate stop in front of a theatre.

*Apparatus*

The guide was equipped with a land phone connected to a Logitech headset. The guided person used a Samsung mobile phone equipped with a hands-free set to make him more comfortable during the interaction.

## Procedure

Each session was handled by two experimenters, one of them dealing with the guided persons, the other with the guides.

One of the experimenters met the guided person at the station. The latter was told that he was about to be guided over the phone by a person with extensive knowledge of the town. The experimenter then showed him how the phone worked. The experimenter also told the guided person about the features of the route (i.e. about the starting and arrival points and the intermediate stop) he was about to follow. The guided person was instructed to indicate that he had reached the arrival point (or had become lost) by ending the interaction.

The other experimenter met the guide in a test room. She sat at a desk and had access to a land phone. She was told that another participant who had no prior knowledge of the town was currently waiting at the station for her to guide him over the phone. The experimenter insisted on the fact that the guided person would actually be following the route as the guide gave her instructions.

In both cases, the experimenters emphasized that the participants could take as much time as they needed to perform the task, but could not ask the experimenters for help. As soon as the interaction started, an audio recording (of the guide) and a video recording (of the guided person) were triggered by the experimenters.

## Coding

The dialogues were transcribed verbatim from the recordings. A short dialogue example can be found in Table 2. Each time a landmark was introduced for the first time, it was coded according to the frame of reference it reflected. (Each landmark was coded only once, even if it was reused several times.) Allen's (1997, 2000) definition was used to determine what counted as a landmark: according to this definition, landmarks are sub-goals that specify the steps that should be followed by the guided person to get from the starting point to the arrival point. Hence, all street names, buildings, monuments, squares and so on, which were produced either by the guide or by the guided person in order to help the guided person get from the starting point to the arrival point, were counted as landmarks. Following Denis' (1997) classification, landmarks were then coded as nonlocated or located.

*Nonlocated landmarks*

Nonlocated landmarks were ones that were introduced without any particular frame of reference (e.g. 'there is a hotel', 'there is a theatre', 'the rectorat [French administrative building] do you know where that is?' and 'should I walk towards Street X or Street Y?'); in other words, no spatial information was given concerning the location of these landmarks.

Table 2. Short dialogue example

| Speaker | Original French transcription | English translation |
|---|---|---|
| Guided person | ah là ça y est je vois le cinéma le Cézanne donc je continue | Ah here it is I can see the 'Cézanne' cinema so I'll continue |
| Guide | tu vois le restaurant Yogi il est à côté | Can you see the restaurant 'Yogi' it's just next to it |
| Guided person | Oui | Yes |
| Guide | et bien il doit y avoir une petite rue entre le cinéma et le restaurant | Well there should be a little street between the cinema and the restaurant |
| Guided person | ben là en fait il faut que j'attende parce que je suis sur le trottoir d'en face | Well right now I have to wait because I'm on the other footpath |
| Guide | oui il faut traverser y a un passage piéton pour traverser | Yes you must cross over there is a pedestrian crosswalk to cross over |
| Guided person | oui | Yes |
| Guide | donc là tu es | So now you are |
| Guided person | là je passe dans la rue entre le restaurant et le cinéma | Right now I'm in the street between the restaurant and the cinema |
| Guide | donc il faut que tu cherches la rue Laroque | Now you must look for Laroque Street |
| Guided person | Ok | Ok |

*Located landmarks*

This category included traveller-centred landmarks, which were introduced with a frame of reference centred on the guided person's point of view (e.g. 'the statue in front of you' and 'on your right you will see the Aix sweet factory'). References to the left and to the right were also taken as referring to the guided person's perspective (e.g. 'the shop on the right' and 'the street on the left'). The only exception to this was when the terms 'left' and 'right' were used to locate a landmark in relation to another landmark (e.g. 'the shop is to the right of the driving school'). When the guided person indicated his location in relation to a landmark (e.g. 'there's a shop next to me' and 'I'm in front of the baker's'), the landmark was also coded as located, as this was taken as meaning that the landmark was located in relation to the guided person.

The located landmarks category also included object-centred landmarks, which were introduced with a frame of reference centred on another landmark (e.g. 'a square with a booth and a fountain', 'the theatre that is in the street' and 'you will see a restaurant with a shop next to it'). Note that when landmark A was located in relation to landmark B (e.g. 'the driving school in front of the train station'), only the landmark whose location was actually described (i.e. the driving school) was coded as introduced and as object-centred. The other landmark (i.e. the train station) was not coded as introduced, as its sole function was to help locate the main landmark. The train station was only coded as a landmark if it was introduced either earlier or later in the interaction as a main landmark. Likewise, in some cases, one of the speakers would introduce a nonlocated landmark, notice that his or her partner did not understand him or her and introduce other landmarks to help the partner locate the landmark (e.g. A: 'there is a driving school'; B: 'I'm not sure I can see it'; and A: 'next to the train station'). In this example, the driving school was coded as nonlocated, as no information concerning its location was provided when it was introduced for the first time; the train station was not coded as introduced as its main function was to help locate the driving school.

All dialogues were double coded for frame of reference use, resulting in 90.83% inter-coder agreement (*Cohen's* $\kappa = 84.50$, which corresponds to almost perfect agreement according to Landis & Koch's, 1977, classification). All remaining discrepancies between coders were solved through discussion.

## RESULTS

The task lasted 877.8 seconds on average ($SD = 346.4$). The mean number of speech turns per dyad was 109.6 ($SD = 50.94$). The total number of landmarks introduced was 1204 (Table 3). Among these, 59.97% were introduced by the guides and 40.03% were introduced by the guided persons.

The analyses were run in SPSS 20.0. The three analyses consisted in either linear or logistic mixed models using a first-order autoregressive (AR1) variance–covariance matrix. Logistic models are used to consider categorical dependent variables with a binary outcome, by determining whether the odds of one modality occurring rather than the other vary across conditions (Jaeger, 2008). As with mixed models, they allow to deal with unbalanced data—that is, data where the number of measures per group differs between groups or data where the number of measures per participants differs between participants. In addition, mixed models allow for the inclusion of random intercepts and slopes to account for variability across participants (Baayen, Davidson, & Bates, 2008).

Mixed models should include the maximal random effects structure justified by the design (Barr, Levy, Scheepers, & Tily, 2013). In other words, all random slopes and intercepts should be included in the model whenever relevant—and possible. Given that dyadic data were examined in the current study (see Heck, Thomas, & Tabata, 2010; Knutsen & Le Bigot, 2012; McMahon, Pouget, & Tortu, 2006, for examples of analyses conducted on dyadic data), the models included random intercepts for guides (to account for intercept variability across guides) and random intercepts for dyads clustered within guides (to account for intercept variability across dyads). In addition, random slopes for dyads clustered within guides were also included in the analyses to account for dyads differing in sensitivity to fixed effects. (Random slopes for guides were not included in the models, as this would have been redundant with the random slopes for dyads.) However, including these slopes sometimes caused the models to converge, which meant that the maximum likelihood estimates for the data could not be found. When this happened, only by-guides and by-dyads intercepts were included in the analysis.

As mentioned earlier, the analyses conducted used an AR1 variance–covariance matrix. In mixed models, variance–covariance matrices are used to specify the correlation between measures within a single analysis unit (in this case, dyads). AR1 matrices are used when it is assumed that the measures in the analysis unit are correlated with the measures that precede and succeed them in time.

Finally, because the number of measures varied across groups, the Satterthwaite correction was applied. This correction can be used to estimate degrees of freedom in cases where the number of measures differs from one group to

Table 3. Number of landmarks introduced as a function of role in the dyad

| | Located | | | |
|---|---|---|---|---|
| | Traveller-centred | Object-centred | Nonlocated | Total |
| Introduced by guide | 421 (0.58) | 244 (0.34) | 177 (0.25) | 301 (0.42) | 722 |
| Introduced by guided person | 145 (0.30) | 102 (0.21) | 43 (0.09) | 337 (0.70) | 482 |
| Total | 566 | 346 | 220 | 638 | 1204 |

*Note*: The corresponding proportions are given in parentheses.

another—which was the case here, as the number of landmarks introduced by the speakers differed between dyads.

A first analysis was conducted using a logistic mixed model to determine whether the fact that each guide performed the task several times affected frame of reference use during the experiment. The focus was on determining whether task repetition caused the probability of located landmarks being introduced to increase. In order to do this, each interaction was coded according to whether it corresponded to the first, second, third, fourth or fifth time that a given guide performed the task. This coding was used as the fixed factor in the analysis, which also included type of frame of reference used (located vs. nonlocated) as the outcome variable, random intercepts for guides, and random intercepts and slopes for dyads clustered within guides. The effect of the fixed factor failed to reach significance, $F(4, 43) = 2.076$, $p = .101$, so it could not be concluded that repeated task performance affected reference frame use.

The purpose of the second analysis was to determine whether the guides introduced more landmarks than the guided persons. In order to do this, a linear mixed model was ran with role of the partner (guide vs. guided person) as the fixed factor, the number of references produced as the outcome variable, random intercepts for guides, and random intercepts and slopes for dyads clustered within guides. The model revealed that the role of the partner significantly predicted the number of landmarks introduced, $F(1, 46) = 7.220$, $p = .010$, $b = 5.857$. Guides introduced more landmarks ($M = 17.26$, $SD = 4.150$) than guided persons ($M = 11.40$, $SD = 13.82$).

The purpose of the third analysis was to determine whether the role played by each partner within the dyad affected reference frame use. In order to do this, a logistic mixed model was run with role of the partner producing the landmark (guide vs. guided person) as the fixed factor, type of frame of reference used (located vs. nonlocated) as the outcome variable, and two random intercepts for guides and the clustering of dyads within guides.

The model revealed that the role of the partner significantly predicted reference frame use, $F(1, 1202) = 72.98$, $p < .001$. As suggested by Table 3, the odds of introducing located landmarks were higher when the landmarks were introduced by the guide than when they were introduced by the guided person, $OR = 3.106$, $CI_{0.95} = 2.394, 4.030$, $p < .001$.

Finally, a multinomial mixed model was run to extend the results by using a three-modality frame of reference dependent variable (nonlocated vs. object-centred vs. traveller-centred). Unlike logistic models, multinomial models are used to consider categorical dependent variables with more than two modalities. However, this model systematically failed to converge; the corresponding results are therefore not reported here. This does not allow to determine whether the difference between the guides and the guided persons reported in the third analysis stems from traveller-centred landmarks or from object-centred landmarks.

## DISCUSSION

The aim of the current study was to investigate how guides and guided persons use frames of reference when engaged in route description dialogue. Previous studies conducted to investigate this point tended to concentrate on the spatial descriptions produced by the guides, rather than on those produced also by the guided persons (Allen, 1997, 2000; Hund et al., 2008; Roger, Bonnardel, & Le Bigot, 2009; Wunderlich & Reinelt, 1982). However, route description dialogue is still governed by the least collaborative effort principle, just like any other kind of dialogue. Accordingly, both partners are expected to contribute to the success of the interaction (e.g. Clark, 1996). The current study explored the idea that although each partner appeals to the same kinds of frames of reference, the roles these partners play affect how they then use these. This is because the nature of the collaborative effort reduction strategies available to the partners depends on the roles they play within the dyad.

Our results corroborated this assumption in several ways. First, even though the guides introduced more landmarks than the guided persons, the fact that 40.03% of the landmarks were introduced by the guided persons invalidates the idea that it is the guides who make by far the greatest contribution to the task. Both partners contributed actively to the task by introducing potentially relevant information for the dyad to use.

Second, guides and guided persons differed with regard to the numbers of nonlocated and located landmarks they introduced. As predicted, the guides tended to produce fewer nonlocated landmarks and made greater use of located landmarks than the guided persons. This finding can be set against the types of collaborative effort reduction strategies that were available to each of the partners when they performed the task. Guides can be defined as *environment experts*: they know how the landmarks are related to each other and can therefore efficiently produce not only object-centred landmarks but also landmarks reflecting the guided person's point of view, even if they do not have visual access to the task environment during the experiment. Importantly, introducing object- or traveller-centred landmarks was more costly than introducing neutral landmarks. The guides had to infer which objects were visible to the guided person at the time of production (for object-centred landmarks) or estimate and adopt the guided person's viewpoint (for traveller-centred landmarks). Nonetheless, the guides' introduction of these landmarks facilitated the guided persons' comprehension, in that they were adapted to the latter's perspective.

As regard the guided persons, although they necessarily adopted a located frame of reference when interpreting a located landmark, the fact that they introduced fewer located landmarks than the guides means that they did not systematically use the same frames of reference as the guides. One possible explanation for this is that using such frames of reference might have generated extra comprehension costs for the guides. This nuances the finding of Watson et al. (2004, 2006, 2009) that dialogue partners systematically converge on which frames of reference use when describing a spatial scene, by revealing that how partners use frames of reference depends on their role in the dyad—as predicted.

In addition, the current study suggests that nonlocated landmarks constitute the *default* use of landmarks by guided persons in route description dialogue, as the guided persons introduced such landmarks much more often than located

landmarks (see also Tversky, 1996, who developed the idea that speakers adopt a consistent perspective in extended discourse). The advantage of using neutral landmarks lies in the fact that they allow the task environment to be described without having to appeal to a specific frame of reference. It thus seems that the guided persons tried to minimize both collaborative and individual effort through the introduction of neutral landmarks (Mainwaring et al., 2003; Schober, 1995). However, it is unclear whether nonlocated landmarks constituted the default use of landmarks for guides as well. Indeed, the pattern of results suggests that they are more likely to use located landmarks than nonlocated ones. It thus seems that in route description dialogue, guides were more likely to take up the most costly strategy than the least costly one, probably to make sure that they would be understood by the guided persons. The patterns of results obtained for guides and guided persons both suggest that route description dialogue is a collaborative activity—however, collaboration manifests itself differently depending on each partner's role in the dyad.

As mentioned earlier, the final statistical analysis failing to converge did not allow to determine whether the difference between the guides and the guided persons stemmed from object-centred or traveller-centred landmarks. However, the pattern of results obtained seems to suggest that both partners were more likely to introduce traveller-centred landmarks than object-centred ones, which corresponds to the same pattern of results as that found by Denis (1997) for guides. It thus seems that although how speakers use frames of reference during spatial dialogue depends on the role they play in the dyad, Denis' (1997) classification applies to both guides and guided persons.

### Methodological and conceptual limits of the study

The results of the current study have revealed that reference frame use during route description dialogue depends on each partner's role in the dyad (i.e. guide versus guided person). However, this study presents a number of limits, two of which are discussed in this section. First, the results reported earlier should be interpreted with caution, as the gender distribution was unbalanced. Second, this study also raises the question of whether the results are mainly due to the knowledge asymmetry between participants—that is, to guides being more knowledgeable of the task environment than guided persons—or to both partners being in different environments during the interaction. It seems reasonable to assume that the partners' behaviour is affected by both. Future work should therefore focus on examining partners' behaviour in a situation where they both have prior knowledge of the task environment, in addition to addressing the unbalanced gender distribution problem.

### Conclusion

To sum up, the asymmetrical nature of route description dialogue affects the frequency with which each frame of reference—nonlocated or located—is introduced by the guide or the guided person. We have suggested that this reflects the way in which dialogue is guided by the least collaborative principle, the underlying idea being that frames of reference can be used to minimize both individual and collective effort. Because dialogue partners play different roles within the dyad, they do not have access to the same effort minimization strategies. Thus, even though it seems that Denis' classification can be applied to genuine dialogue, it is important to take the asymmetrical nature of the task into account when investigating route description dialogue.

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