Alignment of Spatial Perspective

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Abstract

Most of the experimental research on dialogue that has provided evidence for interactive alignment focuses on speakers aligning at the lexical and syntactic levels of representations and dialogic contributions, i.e., having converging choices of lexical and syntactic means of referring to pictured objects and events. Less is known about alignment at the conceptual level, or situation models. This paper addresses alignment in spatial perspective (route vs. survey perspective) between speakers in a confederate experimental task taking turns in describing routes on schematic maps. The findings of two experiments show that speakers' spatial perspective choices are aligned with those of their partners both before and after partners switch perspective. Furthermore, this alignment effect holds both if partners show consistency adhering to the same perspective for a sequence of descriptions and when they display inconsistency by switching spatial perspective for every new description they provide.

Keywords: spatial perspective; interactive alignment.

Introduction

Imagine asking someone on the phone for directions on how to go some place while looking at a simple map. Now imagine being told to go 'left' while your current orientation is facing 'downward' on the map. This is potentially a problem because of the ambiguity inherent in this term. It is unclear if *left* is mapped onto your perspective and orientation at a given time as situated in the environment or to be interpreted from the external viewpoint of looking at the map as if from above. Now imagine further that it is your turn to make a suggestion for a route to the person on the phone. How likely are you to use the same perspective your partner used just now vs. another? The inherent ambiguity of terms such as *left* and *right* when produced and understood within different perspectives and frames of reference is an excellent testing ground for frameworks of interaction and coordination in a dialogic situation.

The interactive alignment model (Pickering & Garrod, 2004) posits that much of speech production choices in dialogic situations can be explained via an automatic mechanism involving priming at multiple levels of linguistic representation and percolation between these levels. Furthermore, alignment of situation models is achieved on the basis of such lower-level alignment of representations. While the model also allows for alignment via explicit reasoning and modeling of the partner's mental states and mental model updating, it places a particular emphasis on these low-level mechanisms. Alternative accounts of dialogue behavior question the explanatory power of automatic priming in dialogic convergence and underline the role of (explicit) modeling of partners and their mental states of representation. Common conversational ground is the outcome of a joint effort on behalf of interlocutors who attend to the degree to which information is mutually shared (Clark, 1996).

Research on dialogue has addressed how speakers deal with variability and ambiguity in order to achieve alignment of situation models. One and the same object or event can trigger multiple perceptual and conceptual representations. For example, in a study of goal-directed dialogue (Garrod & Anderson, 1987), different description schemes were used by speakers referring to a maze and movement in it (path, coordinate, line, figural schemes). Similarly, in a study of how people describe complex multiple-object scenes, speakers' choices varied significantly depending on the nature of the array (Andonova, Coventry, & Tenbrink, in press).

Multiple perspectives, or ways of speaking about the world, are reflected on different levels of language but also in variation at a conceptual level. In spatial reference, different conceptualizations can be found in the choices of spatial perspective and frames of reference. In particular, perspective taking involves abstracting from the visual scene and organizing and packaging information in accordance with one or another type of viewpoint. Spatial perspective varieties can be characterized in different ways. Here we will adopt a binary distinction which is a simplified yet common typology. A route or environment can be described from an embedded (route or egocentric) perspective, that is, from within the environment, based on the way-finder, as embedded in the path, or from an external (survey or allocentric) perspective, that is, a viewpoint external to the environment, commonly associated with maps and cardinal directions, the way people would look at a map or a drawing of a route. For the sake of brevity and simplicity, here we will refer to these as the route perspective and the survey perspective. Previous studies have demonstrated that a number of individual, environmental, and learning factors are sources of variation in spatial perspective in verbal descriptions. Mode of acquisition has been shown to affect perspective choices in spatial memory; for example, participants who studied maps gave more accurate responses later in survey perspective tasks whereas those who were navigating gave more accurate responses to route perspective tasks (Taylor, Naylor, & Chechile, 1999). Taylor & Tversky (1996) tested

the influence of four environmental features on spatial perspective choices and found that although overall most participants' descriptions followed a survey or a mixed perspective, preference for the use of route perspective was enhanced in environments that contained a single path vs. multiple paths and environments that contained landmarks of a single size scale vs. landmarks of varying size. Bugman, Coventry, and Newstead (2007) found that context of retrieval (frequency of visitation vs. importance of activities) can affect spatial perspective choices, too.

Variability in spatial perspective choices is frequently accompanied with perspective switching behavior– participants tend to mix perspectives quite regularly, for example, 27 out of 67 participants in Taylor & Tversky's (1996) first experiment and 74 out of 192 participants in their second experiment mixed perspectives in their descriptions. There are multiple reasons why a speaker may switch from one perspective to another, for example, because of some features of the environment or the task. However, although most studies have researched spatial perspective choices in a monologue setting, one important reason for initial perspective choice and subsequent switches may be the behavior of the interlocutor (conversation partner) in a typical dialogue setting of giving road instructions, for example. Two exceptions to the dominant monologue settings of spatial perspective research are a study by Schober (1993) which showed that speakers set spatial perspectives differently with actual addressees than with imaginary ones and another by Striegnitz, Tepper, Lovett, & Cassel (2008) in which there was an increased use of survey perspective in response to clarification questions and in re-phrasal of previously given route descriptions.

The variability of spatial perspective and perspective switching make this phenomenon a suitable testing ground on coordination of speakers' choices in dialogue. Thus, two strands of research and related questions are in the combined focus of this paper—spatial perspective use and interactive alignment.

When dialogue partners refer to the same scene, they select a frame of reference or a perspective for the description. Thus, in dialogue, perspective use and perspective switching are part of the overall process of coordination. Does choice of perspective depend then on the previous use or preference for a certain perspective shown by one's dialogue partner, i.e., do speakers align in their choices of a spatial descriptive schema? If so, to what extent can this influence be modulated by the degree of consistency of partners' choices? Furthermore, how flexible is this process of coordination and perspective choice? Does the first 'conceptual pact' one strikes implicitly with one's partner remain dominant throughout an interaction, or alternatively, if the partner switches perspective, is one more likely to adhere to the previously used perspective, or to switch along, and re-align?

In the studies presented here, there were two clearly possible perspectives on the scene and route to be described: survey and route perspective. Route perspective is by far the more natural way to describe routes whereas survey perspective is more typical of location descriptions. In order to enhance the probability of use of survey perspective and to bring the two more into balance, the maps to be described were positioned vertically, which also corresponds to viewing maps on a screen.

In the first experiment, we ask first whether speakers align choices of spatial perspective when their partner follows one perspective consistently in a short sequence of descriptions (four maps with routes). We also ask whether spatial perspective alignment persists even when the partner switches perspectives and offers a subsequent series of descriptions in an alternative perspective.

Experiment 1

As stated above, this experiment was designed to examine two related questions. First, whether speakers align on spatial perspective, and second, if they continue to align with their partners even when their partners switch perspective between an early and a later experimental block. If speakers rely only on a general model of partner preferences built on the basis of their experience during the early block, then perspective switch by the confederate would not reverse speakers' choices in accordance with the new spatial perspective bias exhibited in the later block. If speakers are sensitive not only to initial partner preferences but they also update their model of their partner (after the switch), then they should also show a tendency to switch perspective in a similar way. A third possibility also exists—the fact that their partners have used both route and survey perspectives and that they switched between them may reduce speakers' preferences for either perspective and lead them to choose between perspectives more or less randomly.

Method

The design of the experiment included prime perspective (route vs. survey) and experimental block (early vs. later) as independent variables and mean percent choice of route perspective on each experimental block as the dependent variable.

Participants 24 participants (3 male) took part in the experiment. They were university students with a mean age of 21.08 years (range 19 – 31) who received course credit or were paid for their participation. All were native German speakers.

Stimuli Thirty-two simplified map drawings were used in the study. Six different maps were created and a total of 16 different routes. Stimuli were pseudo-randomized with the constraints that no two consecutive maps should be the same, and neither the start nor the end points of the routes on consecutive maps should be the same. Routes were pre-drawn on the maps so as to exclude a route planning component in the task and focus exclusively on choice of spatial perspective (see Fig.1 for an example). There were

16 experimental trials (8 prime-target pairs) and 16 fillers. The maps and routes on the experimental prime-target trials were designed to be compatible with both route and survey perspective descriptions. Confederates' descriptions of routes were either in a route perspective or a survey perspective. Filler maps and routes were drawn in such a way as to minimize the use of spatial perspective, for example, a circular trajectory. Furthermore, confederates' scripted descriptions on these trials did not contain any indication of spatial perspective.

Each experimental prime-target pair was preceded by two filler items. There were two blocks of experimental pairs, an early and a later one. In accordance with the design of the experiment, the perspective of the confederate primes was consistent within each block and was either route or survey. However, confederates' scripted descriptions on the two blocks differed in spatial perspective, i.e., the confederate switched perspectives between the early and the later block of trials.

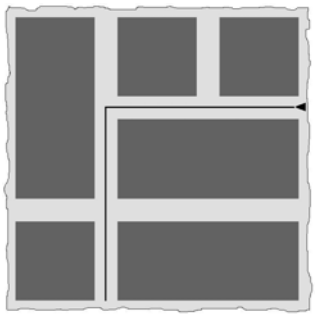

Figure 1: Example of a map and its pre-drawn route. The triangle indicates the position and orientation at the start.

Procedure Each participant was seated across a desk from the confederate and a visual barrier was placed between them and a stack of cards with identical maps and routes drawn were placed in front of them on a vertical stand. Cards were positioned vertically to motivate more the use of the generally weaker and less common survey/gaze perspective. In addition, the confederate used a list of pre-scripted descriptions matching their cards in either route or survey perspective. The scripted responses of the confederate were not visible. We took special care to minimize possible suspicions on behalf of the participants that their partner in the experiment may not be a naïve participant such as they were, including greetings, familiarization procedures, instructions, etc. Confederates were student assistants of the same age and population generally who were trained to act naïve. Participants and confederates took turns in describing the routes on these cards. A red and a green dot marked on the back of each card were used to indicate whose turn it was to speak. Confederates were the first to speak, thus ensuring that their utterances (primes) precede those of the participants on target trials. Participants were instructed to monitor the descriptions of their partner for accuracy and to offer a correction whenever they noted an incorrect description. Three deliberate errors were built into the script on filler items. This instruction ensured that participants were attending to their partners' descriptions and choice of perspective. At the end of the experimental session, participants filled out a questionnaire which included questions asking participants to say what they thought the experiment was about and what they thought about their partner's behavior. As nobody indicated any suspicions that their partner may not have been a naïve participant such as they were, the data of all participants were accepted for analysis.

This procedural setup is a close replica of the procedure in Branigan, Pickering, McLean & Cleland (2007) which studied the effects of participant role on syntactic alignment.

Results

The pre-analysis procedure was identical for the data in Experiment 1 and Experiment 2 and will be described here jointly. Participants' responses were classified according to the spatial perspective used as belonging to one of three categories: route perspective, survey perspective, or mixed perspective. Experimental pairs on which the confederate made a mistake (1.99%) were excluded from the analysis, as well as those when the participant offered a correction to their partner's description of an experimental item (20.39%). Route perspective was the preferred default option and in the majority of these cases participants offered a 'correction' of the confederate's survey perspective description into a route perspective one. The following are examples of participant responses to the map and route in Fig.1 coded as route perspective (a), survey perspective (b), and mixed perspective (c) in their original German and in translation:

(a) *hier gehst du geradeaus und biegst dann links ab*
E. here you go straight and then turn left

(b) *hier gehst du erst nach äh links und dann nach unten*
E. here you first go uhm left and then down

(c) *hier geht's geradeaus und dann nach unten*
E. here one goes straight and then down

The data for each participant for each block (early and late) were converted into mean percent use of route perspective.

The hypothesis that speakers align at the conceptual level of spatial perspective was tested in a 2 (prime: route vs. survey) x 2 (block: early vs. later) analysis of variance on the mean percent use of route perspective. A main effect of prime perspective was found, $F(1, 44)=12.49$, $p=.001$, $\eta_p^2=.22$. No effect of experimental block (early vs. later) was found, and there was no interaction between experimental block and prime perspective. On the early block, participants in the *survey* prime condition described the routes drawn on

their maps in the route perspective only 54.92% of the time while those in the *route* perspective condition did so 88.92% of the time (Table 1). On the later block, following their partner's switch, participants primed by the *survey* perspective also produced significantly fewer descriptions in the route perspective than those who were primed by the route perspective (69.42% vs. 95.17%, respectively).

Table 1: Mean percent use of route perspective before and after prime perspective switch in Experiment 1.

	Early block (pre-switch)	Later block (after switch)
Prime: Route	88.92	95.17
Prime: Survey	54.92	69.42

Experiment 2

The results of the first experiment provided evidence for speakers' alignment with their partner at the conceptual level of spatial perspective both before and after their partner switched from route to survey perspective or the other way round. However, within each of the two experimental blocks, confederates adhered consistently to one perspective only. Thus, when they switched perspective on the later block, prime perspective also remained constant for all four experimental pairs within that block. It is not clear, however, whether speakers' alignment on spatial perspective may have been influenced by this high degree of consistency within an experimental block. The second experiment set out to test whether speakers would also show conceptual alignment of spatial perspective with their partner even if the partner showed high inconsistency and switched perspective all the time, that is, between trials rather than between experimental blocks (as in Experiment 1). Constantly switching perspective may make the confederate's choices appear more random and may thus lead participants to adopt a generally 'random' choice approach themselves. To distinguish between this possible outcome and systematic alignment with one's partner even in the face of the partner's inconsistency, a second experiment was conducted in which speakers' choices were analysed as a function of the immediately preceding prime for each target item.

Method

The design of the second experiment was basically the same with one exception. It included prime perspective (route vs. survey) and experimental block (early vs. later) as independent variables and mean percent choice of route perspective on each experimental block as the dependent variable. However, prime perspective in this case was inconsistent, i.e., constantly alternating between trials.

Participants 19 participants (3 male) took part in the experiment. They were university students with a mean age of 21.32 years (range 19 – 28) who received course credit or were paid for their participation. All were native German speakers.

Stimuli The same visual stimuli were used as in Experiment 1. However, in this second experiment, the confederate switched between route and survey perspective on each trial. The first description they gave was route in one of the experimental lists and survey in the other. Thus, the perspective of the confederate primes was inconsistent.

Procedure The procedure was identical to the one used in Experiment 1.

Results

Participants' responses were classified according to the spatial perspective used as in Experiment 1. The data for each participant for each block (early and late) and for each prime condition (survey vs. route) were converted into mean percent use of route perspective.

A 2 (prime: route vs. survey) x 2 (block: early vs. later) analysis of variance on the mean percent use of route perspective revealed a main effect of prime perspective, $F(1, 61)=5.47$, $p=.023$, $\eta_p^2=.08$. No effect of experimental block (early vs. later) was found, and there was no interaction between experimental block and prime perspective. On average across early and later blocks, participants in the *survey* prime condition described the routes drawn on their maps in the route perspective 68.52% of the time while those in the *route* prime condition did so 88.16% of the time (Table 2).

Table 2: Mean percent use of route perspective on the early and later block in Experiment 2.

	Early block	Later block
Prime: Route	84.21	92.11
Prime: Survey	73.33	62.50

Discussion and conclusions

Experiment 1 showed that speakers do align spatial perspectives with their partners. Those who heard their partner use a survey perspective consistently on the early block of four consecutive experimental trials were less likely to adhere to the otherwise preferred default of route perspective and used instead survey perspective themselves or a mix of the two perspectives in their descriptions. The magnitude of this alignment effect on the early block was 34% and although it was reduced somewhat on the second block to 26%, it nevertheless occurred on this later block of four experimental trials as well. What is more, the 8% reduction was not so considerable as to produce a statistically significant interaction between prime perspective and experimental block, i.e., the alignment

tendency appeared to be equally strong across blocks. This is particularly striking in view of the nature of the second (later) experimental pairs. During those trials, the confederate used the alternative perspective to the one he or she used on the early block, thus displaying a switch from survey to route perspective or vice versa. In this sense, although on each set of four consecutive trials the confederate had made consistent perspective 'choices' in their descriptions, across the two experimental blocks their behavior appeared inconsistent, and yet, participants had the same tendency to align with their partners later as well as earlier during the experimental session. This is notable for two reasons. First, it shows that spatial perspective is used flexibly, and that speakers make use of the possibility to switch perspective with relative ease. Second, it also shows that speakers were not entrained on the first perspective only that they heard their partner use but that they updated. In this sense, this experiment has provided evidence for speakers' sensitivity to their partners' changes in behavior and preference for a representation scheme.

Participants' alignment with their partners in spatial perspective in the first experiment was not significantly reduced on the later post-switch experimental block. However, one good reason for this persistence of alignment even after the switch *between* experimental blocks may have been that the behavior of their partners *within* experimental blocks remained consistent. Experiment 2 put this possibility to the test. Here confederates' pre-scripted descriptions switched between the two perspectives constantly, i.e., if their first, third, fifth, etc. utterances were in a route perspective, then their second, fourth, sixth descriptions were in survey perspective, and vice versa. The analysis of the data revealed that participants aligned even in this case, i.e., they were more likely to use a survey perspective description after they heard their partner use one than if they heard their partner use a route perspective description, an alignment effect of almost 20% difference in choices. Furthermore, this effect did not interact with experimental block (early vs. late), that is, the alignment tendency did not become weaker as time went on. Although the interaction did not reach statistical significance, it is worth noting here that numerically the perspective alignment effect in the later experimental block was much greater (almost 30%) than in the early block. If nothing else, the tendency to align appeared to have been enhanced later. Note that there was no general difference between the early and the later block in this second experimental design, i.e., no sudden change of partner behavior unlike the switch between blocks in the first experiment. In this sense, the growing alignment tendency could be interpreted not as enhanced activation of one of the spatial perspective schemes but more of a general (perspective non-specific) convergence across speakers and accumulation of priming. However, this interpretation can only be offered with a proviso. As described earlier, items where the participant objected to the description used by their partner were not included in data for analysis as priming could not be tested because of an interruption of direct the prime-target sequence and possible interference from self-priming by the alternative 'correction' that participants used in both experiments, although such trials occurred less frequently in the second experiment. Nevertheless, the important finding from Experiment 2 was that speakers aligned in spatial perspective even in cases where their partners exhibited a highly inconsistent descriptive behavior by constantly switching between the two perspective schemas. Such inconsistency by the partner did not lead participants to view either perspective as equally suitable and then adopt one of the two as the easy, less effortful strategy. It did not lead them to make random choices, either. Instead, participants aligned systematically with their partners, i.e., they were prepared to switch perspectives regularly.

Further research into spatial perspective alignment will help solve more mysteries. A memory task experiment (Andonova & Coventry, 2009) has revealed spatial perspective priming. A comparison of the two studies indicates common underlying mechanisms that need to be explored further.

The main conclusions of the two experiments described here are as follows. We found evidence for spatial perspective alignment across speakers in a route description task. Perspective alignment was sensitive to consistency of use by one's partner in the early stages of the interaction (a much weaker alignment tendency of approximately 10% on the early block in Experiment 2 in comparison with the robust 34% effect in Experiment 1). Perspective alignment persisted even after a switch in partner behavior, i.e., alignment persisted even when perspective did not.

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