Priming Spatial Perspective

Elena Andonova (eandonova@nbu.bg)
Department of Cognitive Science and Psychology, New Bulgarian University, 21 Montevideo Street
Sofia, 1618 Bulgaria

Kenny R. Coventry (kenny.coventry@northumbria.ac.uk)
Cognition and Communication Research Centre, Northumbria University,
Newcastle upon Tyne, NE1 8ST UK

Abstract

Spatial perspective choices have been shown to be sensitive to individual differences, mode of learning, and contextual factors. In two studies using a confederate priming paradigm, we investigated whether higher level conceptual priming at the level of spatial schemas can be found in speakers' preference for route vs. survey perspective descriptions of how to get from one place to another. Perspective priming was found both when speakers started with or without an individual preference. Priming occurred even after their partners switched from route to survey perspective descriptions, though not vice versa. The implications of these findings for accounts of priming conceptual structure are discussed.

Keywords: priming, spatial perspective, route, survey, confederate paradigm.

Introduction

Research over the last few decades has produced a rich set of findings on the existence of priming effects at different levels of language representation, for example, syntactic and lexical structure. Further, conceptual/semantic priming has been studied in experimental tasks such as fragment completion, category-exemplar generation and others. However, less is known about priming at a higher level of representation. Here we ask whether priming also occurs for such higher level representations that are even further abstracted from the lexical and semantic features of individual words and concepts. For example, while *tigers* are associated with animals and *boxes* with artifacts, no clear and unambiguous association exists between *left* and a specific direction (is it my left, your left, or left on the map?) [1].Thus, spatial reference and spatial perspective offer a suitable testing ground for priming higher level conceptual schemas. This research asks whether priming occurs for the choice of global spatial description adopted to explain how one gets from one place to another.

In the literature a distinction has been made between route and survey types of spatial description. A route or environment can be described from an embedded (or egocentric) perspective, that is, from within the environment, based on the way-finder, as embedded in the path, or from an external (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, we will refer to these as the 'route perspective' and the 'survey perspective,' following Taylor and Tversky (1996). Previous studies have demonstrated that a number of factors, including individual differences, environmental structure, and learning mode, influence preferences for 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 participants who were doing navigation gave more accurate responses to route perspective tasks (Taylor, Naylor, & Chechile, 1999). Taylor & Tversky (1996) found that 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. Bugmann, Coventry, and Newstead (2007) found that context of retrieval (frequency of visitation vs. importance of activities) can affect spatial perspective choices, too.

Intra-individual variability in spatial perspective choices involves speakers switching perspective – participants tend to mix perspectives quite regularly (Taylor & Tversky, 1996). On the other hand, consistency in the use of a reference frame has also been established in a number of studies. For example, Vorwerg (2009) found that speakers tended to repeat spatial reference frame, lexical and syntactic choices across successive spatial utterances in a localization task. There are multiple reasons why a speaker may or may not switch from one perspective to another, for instance, 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 recent years, there has been some evidence that speakers are sensitive to interlocutors' presence, ability, and interactive behavior (Schober, 2009; Striegnitz, Tepper, Lovett, & Cassel, 2009; Andonova, 2010). Watson, Pickering, & Branigan (2004) found priming effects of reference frame in a confederate task

[1] Ambiguity is not an inherent feature of all spatial reference, however, e.g., cardinal directions such as North and South.

where speakers described the location of an abstract shape with respect to different objects.

All in all, a number of factors contribute to speakers' choices of spatial perspective, including differences across individuals, environments, and learning patterns. It remains unclear, however, to what extent such choices may be influenced by the preceding context of speaking. Do they depend on what perspective speakers have heard being used by a previous speaker in a given situation? Are people more likely to adopt a given perspective if they heard it used initially (earlier) or most recently (later)?

Experiment 1

This first experiment was designed to examine whether speakers are primed by the previous use of spatial perspective by another person (a peer). To test for a priming effect, we designed a pre-scripted series of descriptions used by a confederate in association with the individual maps and routes that they applied to. These descriptions varied systematically in terms of the underlying spatial perspective such that half of the participants heard the confederate use an embedded (route/egocentric) perspective and the other half heard the confederate use an external (gaze/survey) perspective on the first block. We examined the mean percent use of embedded (route) perspective in participants' descriptions on the second block of cards which followed after the confederates' initial block. Two more blocks with four cards each followed after the first (confederate) block and the second (participant) block, again in the same order – the third block of cards was described by the confederate and the fourth/last one was described by the participant. The confederate's descriptions on the third block either continued in the same spatial perspective (either route perspective on both confederate blocks or survey perspective on both confederate blocks) or switched to the alternative perspective (for example, if the confederate used the route perspective on the first block, then they used the survey perspective on the third block). This manipulation allowed us to address a second research question in this experiment, i.e., whether priming from the first (confederate/prime) block continues to affect participants' responses on the fourth (participant) block of descriptions when the confederate switches spatial perspective half-way through the experimental session or not. In other words, do speakers become primed by their partner's spatial perspective choice on the later block independent of whether this perspective was also used consistently on the earlier block as well? How flexible and dynamic is spatial perspective use? If this kind of conceptual priming of perspective is guided by primacy, i.e., a focus on initial choice of perspective by the partner, then speakers may not re-align perspectives after their partner made the switch. On the other hand, if the use of spatial perspective is flexibly adaptive to the dynamics of use by one's partner, then participants' responses should involve using the new perspective as well rather than the perspective they were initially exposed to in their partner's descriptions.

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 early confederate prime on the first block (route vs. survey perspective) for the second block participants' responses and experimental condition (consistent route, route-then-survey, survey-then-route and consistent survey perspective) for responses on the fourth block.

Participants 96 participants (69 female) took part in the experiment. They were university students with a mean age of 22.19 years (range 19 – 44) who received course credit or were paid for their participation. All were native German speakers. The data of six of them were not included in the analyses because of confederate error or of because of their responses on the post-test questionnaire.

Stimuli and Procedure The experimental stimuli consisted of sixteen different cards each containing a simple map drawing (see Figure 1 for an example) with a different two-leg route on it indicated by a green and red dot for the start and end of the route, respectively.

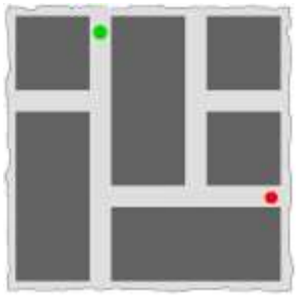

Figure 1: An example of a map and a route (the green and red dots mark the start and end points of the route).

Cards were organized into four blocks of four cards each. The first and third blocks consisted of perspective prime trials and were described by an experimental confederate. The second and fourth block of cards were the target trials and were described by the experimental participants. The spatial perspective of the confederate primes was consistent within each block and was in either route or survey perspective. In addition, confederates' scripted descriptions *across* the two blocks were either perspective consistent (invariable) or inconsistent, i.e., the confederate switched perspectives between the early and the later block of maps they described.

A confederate priming paradigm was used. Each participant was seated across a desk from the confederate

with a visual barrier placed between them. A stack of cards with identical maps and routes were placed in front of each of them on a vertical stand. 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. Confederates were student assistants of the same age and population who were trained to act as participants. Participants and confederates took turns in blocks of four trials describing the routes on the cards. Confederates also spoke first, ensuring that their utterances (primes) preceded those of the participants on target trials. Participants were instructed to describe the routes on their cards and to pay attention to both their maps and their partner's maps as they would do a test on map memory at the end of the experiment. This instruction ensured that participants were not ignoring their partners' maps and descriptions. At the end of the experimental session, participants filled out a questionnaire which included questions asking what they thought the experiment was about and what they thought about their partner's behavior. Testing was conducted in the German language.

Results and Discussion

The percentage use of route perspective only (vs. survey and mixed perspective) was calculated for each block for each participant and the statistical analyses were run on these participant means. An independent samples t-test showed an effect of perspective prime on participants' choice of perspective on their early experimental block, i.e., after hearing the first block of four descriptions by the confederate involving the manipulation of spatial perspective (route vs. survey), $t(88)=6.593$, $p<.001$. Participants used descriptions in the route (embedded/egocentric) perspective significantly more after hearing route perspective primes (M=75.53 %) than after hearing survey perspective primes (M=29.26%). This result reveals a strong priming effect of spatial perspective.

We analyzed participants' responses on the later experimental block by means of a one-way ANOVA with experimental condition as an independent variable (consistent use of route perspective, consistent use of survey perspective, inconsistent prime use of route perspective and inconsistent prime use of survey perspective). This analysis revealed a priming effect on the later block as well, $F(3, 86)=9.823$, $p<.001$ (see Figure 2). An LSD post-hoc test showed reliable differences between the consistent route and each of the other three conditions (the consistent survey condition, the inconsistent survey condition, and the inconsistent route condition), all p's <.001. The difference between the consistent survey and inconsistent survey conditions and the difference between the consistent survey and the inconsistent route conditions were not reliable but in the expected direction. There was no difference between the responses of participants in the two inconsistent perspective prime conditions.

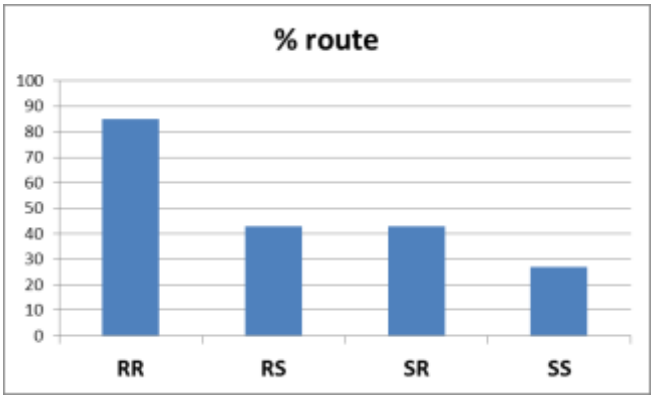

Figure 2: Mean percentage use of the route perspective on the later participant block in the four priming conditions.

Note: RR – consistent route priming; RS – route-then-survey priming; SR – survey-then-route priming; SS – consistent survey priming condition.

We also compared the mean percent use of route perspective on the first and second participant blocks by related samples (matched pairs) t-tests for each of the four conditions separately. The only reliable difference was in the route-then-survey condition, $t(25) = 3.652$, $p = 0.001$, where participants' use of the route perspective dropped from 72% on their first block to 42% on their second block.

Experiment 1 set out to investigate whether speakers' choices of spatial perspective in describing routes depend on the perspective used by their partner. The results show that this was indeed the case: speakers' choices were influenced by the way their partner used spatial perspective both on the initial block and on the later block of route description tasks. The analysis of the degree to which speakers' choice shifted on the later block, however, has revealed some additional aspects that deserve discussion here. First, the consistent route priming condition produced responses that were significantly different from the other three conditions, yet the consistent survey priming condition did not differ reliably from the two inconsistent conditions where confederates switched perspective half-way through the session. This means that consistency may be necessary but insufficient as an explanation for these results. Second, the two inconsistent priming conditions led participants to produce almost identical patterns of responses on the later post-switch block, despite the different directions of switching – from route to survey vs. from survey to route perspective. In this case, neither which perspective was used most recently nor which perspective was the first to be used by the confederate made an impact. It may appear that the inconsistency of perspective use by one's partner as such is the leading factor. However, participants' responses in the two inconsistent conditions also did not differ significantly from choices in the consistent survey priming condition. Thus, a more plausible explanation is that the mere use of the alternative, non-default survey perspective by one's partner on any of the priming blocks leads to a uniformly

low rate of use of the route perspective. This conclusion is further supported by the finding that it was only in the route-then-survey priming condition that speakers' choices shifted significantly between the early and the later block of descriptions. Basically, speakers mostly abandoned the use of the route perspective as soon as their partner did.

Experiment 2

The first experiment established the effect of partners' choices of spatial perspective on speakers' use of perspective. However, the confederate was always the first to describe maps, so it is not clear whether participants followed suit independent of what their own default or preferred spatial perspective was or not. It is also unclear whether the route perspective was the default choice for this task and the survey or mixed perspective was the alternative as we expected. A second study was run to find out if speakers' *initial* or *default* choices of spatial perspective could be reversed or at least modified to some degree by what they heard as perspective use in their partner's descriptions.

Method

The design of the second experiment was exactly the same as the first experiment with one important modification. An additional block was introduced in the beginning of the session which was to be described by the participants, thus allowing us to establish the general baseline preference for spatial perspective for each of them.

Participants Sixty-nine participants took part in this study for course credit or payment. Data for three participants were not included in the analyses for the same reasons as in experiment 1.

Stimuli and Procedure The same stimuli and procedure were used as in experiment 1 with one important difference. There were five blocks of cards/maps altogether. The participant described the initial, middle, and last block (blocks 1, 3, 5) and the confederate described the second and fourth block.

Results and Discussion

In this study, participants described the first set of cards and the priming by confederate description only occurred afterwards. Thus, the mean % use of route perspective on this initial block was treated as an individual baseline for each participant and the degree to which subsequent priming affected their responses was calculated on the basis of subtracting these individual baseline averages from the mean % route perspective used on the third (middle) and fifth (last) block of cards (after the confederate primes on the second and fourth blocks).

On the initial participant block, we ran a one-sample t-test to establish whether participants had a preferred or default spatial perspective or alternatively whether their choices did not differ from chance. Their initial choices did show a preference for the route perspective in descriptions, $t(66)=2.14$, $p<.05$. This is in line with interpretations offered in the discussion of the first experiment.

On the middle participant block, we found an effect of confederate priming condition, $t(65)=4.90$, $p<.001$ on the mean percent use of the route perspective after subtracting the initial baseline use of route perspective. If the confederate had used route perspective primes, participants' use of the same perspective increased by 11.03%. When the confederate had described in the survey perspective, participants' use of the route perspective decreased by 30.06% in comparison with their own baseline descriptions on the initial block. This constitutes evidence of a clear priming effect.

We also compared the mean percentage use of route perspective on the initial and middle (participant) blocks by related samples (matched pairs) t-tests for each of the two priming conditions separately. The only reliable difference was in the survey prime condition, $t(32) = 5.11$, $p<.001$, where on the middle block participants reduced their mean % use of route perspective in comparison with their initial block preferences from 58.33% to 28.27%. In the route prime condition, participants increased their use of route perspective from 61.53% to 72.56% although this difference was not reliable, $t(33) = 1.88$, $p = .07$.

We then ran a one-way ANOVA with condition (consistent route, inconsistent route-then-survey, inconsistent survey-then-route, and consistent survey priming by confederate) as an independent variable and mean % use of route perspective on the last block as the dependent variable, again subtracting the baseline (see Figure 3). There was again an effect of condition on the average % change in route perspective use, $F(3, 63) = 3.70$, $p<.05$. LSD tests revealed reliable differences between the consistent route and the consistent survey conditions ($p<.05$). None of the other differences were reliable. In the consistent route priming condition, participants used the route perspective on average 10% more on the last block than on the initial baseline block, and in the consistent survey condition, they used the route perspective on average 34.38% less on the last than on the initial block.

Figure 3: Mean percentage change in route perspective on the last participant block in the four priming conditions.

Note: RR – consistent route priming; RS – route-then-survey priming; SR – survey-then-route priming; SS – consistent survey priming condition.

We then compared the mean percentage use of route perspective on the *initial* and last (participant) blocks by related samples (matched pairs) t-tests for each of the four conditions separately. There were reliable differences in the route-then-survey condition, $t(18) = 2.11$, $p<.05$, in the survey-then-route condition, $t(16) = 2.55$, $p<.05$, in the consistent survey condition, $t(15) = 3.91$, $p<.01$, but not in the consistent route prime condition, $t(14) = 1.00$, $p<.4$. Participants reduced their use of the route perspective significantly on the last block in comparison with their initial choices after they heard the confederate primes switch from route to survey or vice versa, or after the confederate consistently used the survey perspective.

Finally, we compared the mean percentage use of route perspective on the *middle* and last (participant) blocks by related samples (matched pairs) t-tests for each of the four conditions separately. There was a reliable difference in the route-then-survey condition only, $t(18)=3.65$, $p<.01$. Participants significantly reduced their use of the route perspective on the last block in comparison with the middle block only when the confederate primes switched from route to survey perspective half-way through the experimental session.

The results of experiment 2 mirror those of experiment 1. Even though participants were the first to start describing maps and thus free to set their own preference for a spatial perspective independent of any influence from their partner, the choice of perspective embedded in the confederate descriptions on the second block influenced speakers' subsequent response significantly, leading them to reduce their use of the route perspective if their partner used survey perspective. In this sense, we find again, as in Experiment 1, that speakers are ready to abandon the use of the route perspective in favor of survey or mixed descriptions as soon as their partner indicates a dis-preference for the route perspective. Note that the priming effect in these cases was of a strikingly similar magnitude in the two studies (30%). Speakers' perspective choices were remarkably similar across the two studies as a function of confederate priming on the early immediately preceding block, i.e., on the early block (2) after the first confederate priming block (1) of experiment 1 as well as on the middle block (3) after the first confederate priming block (2) of experiment 2.

In addition, due to the introduction of an initial participant block in experiment 2, we could test whether the priming effect found on the early blocks constituted a change away from a baseline in both directions, i.e., whether speakers increased their use of the route perspective after route priming as well as reduced their use of route perspective after survey priming by comparing speakers' preferences on the initial and middle blocks. This turned out not to be the case. While route perspective use decreased significantly after survey priming, it did not receive a boost from route priming. We interpret this as potentially a ceiling effect associated with the unmarked member of this route-survey perspective dichotomy.

Further insights into the workings of priming were gleaned from the analyses of speakers' responses on the last block after their partner had already produced two blocks of descriptions. Once again, we found striking behavioral similarities on the last block in the two experiments (block 4 of experiment 1 and block 5 of experiment 2). Here, in experiment 2, as in experiment 1, speakers' preferences changed significantly only in the route-then-survey priming condition. Thus, additional priming coming from the second confederate block did not boost the use of a given spatial perspective in the two consistent conditions (route-route and survey-survey), and partners switching from survey to route perspective did not impact upon speakers' later choices. It was only the switch from the default route to the alternative (non-dominant) survey perspective that helped change their minds. This pattern resonates closely with the results of the first experiment and supports the interpretation offered there.

Conclusion

The studies reported here addressed whether spatial perspective choices are subject to priming by partners' speaking patterns. The results of both studies point to a positive answer to this question. In experiment 1, participants described how to get from one point to another on simple maps after hearing an experimental confederate produce such descriptions in either route or survey perspective. In experiment 2, participants described maps before and after a confederate offered their descriptions. In both cases, priming was found to occur on the immediately subsequent block. This indicates that speakers were sensitive to perspective choices made by their partners even after they had made their own initial commitment to one of them. Participants did show considerable variability in initial preferences but they also demonstrated flexibility by aligning their choices with those of their partners. Thus, even if individual cognitive styles existed (Levelt, 1982), they could be modified accordingly.

The patterns of spatial perspective priming were strikingly similar in profile and even in magnitude across the two studies, i.e., independent of whether participants or confederates set the precedent in spatial perspective choice.

Furthermore, in both studies, speakers' choices were modified again after their partner switched away from their initial preference for a spatial perspective half-way through the experiments and continued to produce descriptions in the alternative spatial perspective. Notably, however, this priming effect occurred only if the switch was made in the direction of the weaker, generally dis-preferred spatial schema, namely, the survey perspective.

These findings have implications for priming mechanisms generally, both in terms of the effects of consistency vs. inconsistency of priming, and in terms of the different

impact of priming with the preferred vs. the dis-preferred member of a conceptual opposition.

Acknowledgments

Thanks go to the research assistants, confederates, and the research team of I5-DiaSpace. The financial assistance of the German Science Fund (DFG) is acknowledged for funding provided to SFB/TR8 Spatial Cognition at the University of Bremen where this research was conducted. This research was partially supported by a HWK fellowship (Hanse Institute for Advanced Studies, Germany) awarded to Kenny Coventry.

References

Andonova, E. (2010). Alignment of Spatial perspective. In S. Ohlsson & R. Catrambone (Eds.), *Proceedings of the 32nd Annual Conference of the Cognitive Science Society* (pp. 2506-2511). Austin, TX: Cognitive Science Society.

Bugmann, D., Coventry, K.R., & Newstead, S.E. (2007). Contextual Cues and the Retrieval of Information from Cognitive Maps. *Memory & Cognition, 35(3),* 381-392.

Levelt, W.J.M. (1982). Cognitive styles in the use of spatial direction terms. In Jarvella, R.J., Klein, W. (eds.): *Speech, Place, and Action*. Chichester: Wiley, pp. 251-268.

Schober, M. (2009). Spatial Dialogue between Partners with Mismatched Abilities. In: Coventry, K.R, Tenbrink, T., Bateman, J. (eds.): *Spatial Language and Dialogue.*Oxford: Oxford University press.

Striegnitz, K., Tepper, P., Lovett, A., Cassel, J. (2009). Knowledge Representation for Generating Locating Gestures in Route Directions. In: Coventry, K.R, Tenbrink, T., Bateman, J. (eds.): *Spatial Language and Dialogue*. Oxford: Oxford University press.

Taylor, H.A., Naylor, S.J., & Chechile, N.A. (1999). Goal-specific Influences on the Representation of Spatial Perspective. *Memory & Cognition, 27(2),* 309-319.

Taylor, H.A., & Tversky, B. (1996). Perspective in Spatial Descriptions. *Journal of Memory and Language, 35,* 371-391.

Tversky, B., Lee, P.U., & Mainwaring, S. (1999). Why Speakers Mix Perspectives. *Spatial Cognition and Computation, 1,* 399-412.

Vorwerg, C. (2009). Consistency in Successive Spatial Utterances. In: Coventry, K.R, Tenbrink, T., Bateman, J. (eds.): *Spatial Language and Dialogue*. Oxford: Oxford University press.

Watson, M.E., Pickering, M.J., Branigan, H.P. (2004). Alignment of Reference Frames in Dialogue. In K.D. Forbus, D. Gentner, & T. Regier (Eds.), *Proceedings of the 26th annual conference of the Cognitive Science Society* (pp. 1434-1440). Hillsdale, NJ: Lawrence Erlbaum.