Influences Beyond Language? A Comparison of Spatial Referencing in Native French Speakers from Four Countries

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Abstract

Research has shown that spatial referencing differs across cultures. Whether "Western" samples, specifically ones speaking the same native language, show the same referencing patterns has not been investigated thus far. Examining spatial referencing behavior across different tasks, we compared samples from four different countries speaking the same language with respect to their application of the intrinsic frame of reference (FoR) and the three variants of the relative FoR. Our findings indicate influences of factors beyond language: While the four French-speaking samples showed an overall preference for the reflection variant of the relative FoR, they differed significantly regarding the extent to which reflection and the intrinsic FoR were applied. Moreover, in all samples, characteristics of the referenced objects, namely whether they were animate or inanimate, influenced FoR use. The order of tasks also had an impact on referencing behavior.

Keywords: space; spatial cognition; frames of reference (FoRs); linguistic relativity; object characteristics; animacy; French.

The Question of Language's Influence on Cognition

In the past decades, the debate about linguistic relativity (known as the Sapir-Whorf-Hypothesis, e.g. Sapir, 1949; Whorf, 1956), that is, whether language determines cognition, has been revived (e.g. Gumperz & Levinson, 1996). An influential research area spurring this revival concerns frames of reference in the domain of space.

Languages differ regarding spatial referencing, that is, how they preferentially describe the position of objects in relation to one another (e.g. Majid, Bowerman, Kita, Haun, & Levinson, 2004; Mishra, Singh, & Dasen, 2009). Moreover, it has been shown that across different languages, frames of reference (FoRs) covary in language and cognition (e.g. Danziger, 2011; Haun, Rapold, Janzen, & Levinson, 2011; Levinson, 2003). However, there is still much debate on how this covariation comes about, specifically whether language determines cognition or vice versa or whether environmental factors influence both language and cognition (see e.g. the debate between Levinson, Kita, Haun, & Rasch, 2002, and Li & Gleitman, 2002; and see Haun et al., 2011; Li, Abarbanell, Gleitman, & Papafragou, 2011).

In their overview of cross-cultural findings, Majid and colleagues (2004) investigated environment (urban vs. rural), habitual action (subsistence patterns) and cognitive styles (individualism vs. collectivism) as possible mediators between FoRs in language and cognition. They found that none of these factors beyond language systematically accounted for differences in non-linguistic FoR use between speakers of different languages.

Commonly, in spatial referencing research, language and culture are treated as one entangled factor (e.g. Burenhult & Levinson, 2008). As they are closely intertwined (e.g. Kodish, 2003), differential effects of language and culture are arguably difficult to investigate. However, feasible approaches would be to investigate individuals living in the same country but speaking different languages or the other way around: individuals speaking the same language but living in different countries.

Research in this vein indicates that both language and extra-linguistic factors play a role for referencing strategies. Eggleston (2012) compared three samples, namely Spanish speakers from Barcelona and from Nicaragua and a Nicaraguan sample speaking Sumu-Mayangna. While the former two spoke the same language, the latter two lived in the same country. She found that the samples differed with respect to referencing preferences. Shared language was a stronger predictor of spatial referencing behavior than shared environment. Eggleston concludes that the two factors interact. Similarly, indicating influences beyond language, Troadec (2003) found differences in FoR-preferences between two different French speaking samples in Polynesia, in that the absolute FoR was preferred on an island while the relative FoR was preferred in a city. Taken together, these findings indicate that while language and spatial cognition covary, speaking the same language alone does not necessitate identical FoR-preference. Instead, there seem to be differing conventions between communities, at least when the language allows for application of all FoRs.

Frames of Reference

In times of ever-increasing international cooperation it is important to know possible sources of miscommunication. Implications of research on spatial referencing thus go far beyond research offices, as illustrated by the following example: Task forces from different countries have to come up with strategies of how to enter a building in which terrorists are keeping hostages. If the order "we enter the building from the back left, you guys go in from the front right entrance" are interpreted in different manners, this may have devastating consequences. Knowledge on differences regarding how we describe where things are is one important step in the direction of successful international cooperation.

In order to describe the location of objects in relation to one another, frames of reference (FoRs) are used. They comprise several constituents (cf. Levinson, 2003): a coordinate system (e.g. front, back, left and right), a figure object whose location is to be described and a ground object in relation to which the location of the figure is described (Talmy, 1983).

Three main FoRs have been identified in the literature (Levinson, 2003): absolute, intrinsic and relative FoR. The relative FoR is subdivided into three variants: translation, reflection and rotation. The absolute FoR uses fixed bearings, such as the cardinal directions for the coordinate system. Applying this FoR, a figure object might then be described to be "northeast" of the ground object.

Applying the intrinsic FoR, the coordinate system is centred in the ground object, the figure object's position is thus described from the perspective of the ground object. Hence, this FoR can only be applied when the ground object has intrinsic front, back, left and right sides.

Using a relative FoR, the position of the figure object in relation to the ground object is described from an observer's perspective; the primary coordinate system originates in the observer's front, back, left and right sides. This primary coordinate system is then projected onto the ground object and transformed into a secondary coordinate system in one of three possible ways: Applying translation, the secondary coordinate system results from a mere shift of the primary system into the ground object. Here, left and right remain oriented as in the observer's primary coordinate system. A figure between the observer and the ground is described to be "behind" the ground object. In the case of reflection, the primary coordinate system is reflected off the ground object. A figure between the observer and the ground is hence described to be "in front of" the ground object, left and right again remain oriented as in the primary coordinate system. In the third variant, rotation, the secondary coordinate system results from rotating the primary system and centring it in the ground as if another observer was facing the observer of the scene. Here, similar to the reflection variant, a figure between the observer and the ground is described to be "in front of" the ground object, however, left and right are also switched. Thus, between the intrinsic and the three relative FoRs, the order "we enter the building from the back left, you go in from the front right entrance" can be interpreted in at least four different ways. However, individuals are mostly unaware of ambiguities in their spatial descriptions (cf. Grabowski & Miller, 2000).

The "Western" Bias

Research investigating the link of language and cognition by means of spatial referencing has almost exclusively focused on comparing "Western" (North-American and European) with "Non-Western" (Indigenous) samples. It has been shown that while "Westerners" preferentially use egocentric (relative) referencing strategies, many "Non-Western" cultures use allocentric (absolute) referencing, some even exclusively (e.g. Levinson, 2003). While there is a prevalent implicit assumption that "Westerners" are all the same (e.g. Pederson, 1993), empirical findings comparing referencing behavior within and between Western cultures are scarce. Those studies attempting to do so (e.g. Grabowski & Miller, 2000; Flaherty & Richardson, 1996) found that there are differences regarding the application of at least two distinctive FoRs commonly used by speakers of European languages: The intrinsic and the relative FoR. Importantly, the variants of the latter have received very little attention in past research efforts on spatial referencing. In research, the reflection variant is commonly treated to be "the" relative FoR and the only one investigated. However, use of the other two variants has also been reported (e.g. translation in Tongan and Hausa: Bennardo, 2000; Hill, 1982; translation and rotation to some extent in Chinese, Tongan and Farsi speaking samples: Beller, Hüther, Singmann, & Bender, subm.; Beller, Singmann, Esfandiari, & Bender, subm.; Bender, Rothe-Wulf, Hüther, & Beller, 2012). Accounting for the different ways individuals can reference from their own perspective, we found that FoR-preferences of two "Western" populations speaking different languages, namely US-Americans and Germans, differ regarding the

extent to which variants of the relative FoR are applied (Beller et al., subm. [a]; Bender et al., 2012; Hüther, 2010). In the current study, we examined if referencing differences would also occur between Western cultures speaking the same language, namely French.

Determining the Role of Situational Aspects

The French language allows for the application of all described FoRs. While a preference for the relative FoR is assumed in native speakers of French (e.g. Mishra et al., 2009; Pederson, 1993), there are no empirical investigations of speakers of French regarding the variants of the relative FoR and the intrinsic FoR.

To shed light on the issue of language versus other factors influencing referencing preferences in Western populations, we compared four samples speaking the same language but living in different countries: Belgians, French, Québécois and Swiss. Thus, we kept native language constant while the environment (country) varied between samples. If language alone were the main determinant of referencing preferences, the different groups of French native speakers should not significantly differ in their use of FoRs, irrespective of where they live. However, if FoR-use is a matter of conventions within communities, samples from different countries may differ despite their speaking the same language. Moreover, testing for possible situational factors influencing FoR-use (as suggested by Li & Gleitman, 2002), we varied whether the referenced objects were animate or inanimate. We assumed a stronger preference for the intrinsic FoR with animate objects. The intrinsic orientation of living beings may be more salient than that of inanimate objects thus making the application of the intrinsic FoR easier. Also, one may be more likely to take, say, a bird's perspective than that of a pencil. We thus assumed influences of the given spatial task at hand, in that intrinsic referencing would occur more often with animate than with inanimate objects.

Considering the three variants of the relative FoR as well as the intrinsic FoR, we set out to answer the following questions: Which referencing preferences can be observed in native speakers of French from France, Switzerland, Belgium, and Canada? Are there inter-individual differences within the countries, indicating variations in FoR-use within communities? Do the samples differ with regard to their preferred FoR, indicating that language is not the only determinant of referencing preferences? And finally, are individuals' referencing choices intra-individually consistent across different situations or do situational influences such as differences in animacy of the to be referenced objects correspond to different FoR-use?

Method

FoR-use of the four French speaking samples was assessed using an online questionnaire in French. We developed the questionnaire using the Questback software. Within each sample, two versions of the questionnaire were administered in order to control for sequence effects.

Participants A total of 186 students (131 female) of the social sciences completed the questionnaire. The Belgian sample consisted of 55 students (46 female; mean age 21.8 years, SD = 4.82) from the University of Liège. The French sample consisted of 46 students (34 female; mean age 22.5 years, SD = 4.51) attending different universities. The Canadian sample consisted of 57 students (29 female; mean age 25.5 years, SD = 6.07) from the University of Montreal. The Swiss sample consisted of 28 students (22 female; mean age 24.3 years, SD = 4.27) from the University of Geneva. All participants indicated that French was their native language. Participation was voluntary and was not compensated.

Materials and Procedure All materials were presented in French. After being informed about the procedure and indicating their consent, each participant filled out a questionnaire comprising 40 tasks. Each task contained one of the following eight descriptions:

- The candle [the starfish] is located *behind and to the right* of the pencil [the bird].
- The candle [the starfish] is located *in front and to the left* of the pencil [the bird].
- The candle [the starfish] is located *behind and to the left* of the pencil [the bird].
- The candle [the starfish] is located *in front and to the right* of the pencil [the bird].

Each of the eight descriptions was presented five times, every time with different pictures as answer options. Out of eight photographs displaying different configurations of animate (starfish and bird) or inanimate (candle and pencil) objects, participants were asked to choose the one that best fitted the description. The photographs differed regarding the direction into which the ground object (bird or pencil) was facing and regarding the position of the figure (starfish or candle). In each task, four of the depicted object configurations corresponded to a distinct FoR (the three relative FoR variants or the intrinsic FoR); choosing one of the other four pictures did not indicate application of one of the FoRs. Animate and inanimate object configurations were presented as two blocks. An example item is shown in Figure 1. Here, choosing b) corresponds to the reflection variant of the relative FoR, c) to the rotation variant, h) corresponds to the translation variant, and selecting d) indicates application of the intrinsic FoR.
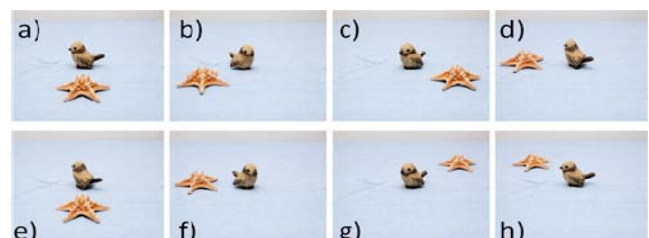

Figure 1: Example of an item with configurations of animate objects. The task was to select the photograph correspond-ing to the description *"The starfish is located in front and to the left of the bird."*

Table 1: Percentages of FoR choices in the four samples considering object animacy and order of tasks.

Country		order	items with inanimate objects					items with animate objects				
			ref.	rot.	trans.	int.	n.c.p.	ref.	rot.	trans.	int.	n.c.p.
Belgian	(N=30)	A	**83.2**	1.3	5.7	7.5	2.3	**71.3**	1.8	4.7	19.3	2.8
	(N=25)	B	**46.2**	1.8	6.4	43.6	2.0	42.2	2.6	4.8	**44.2**	6.2
	(N=55)	*Total*	*64.7*	*1.6*	*6.1*	*25.6*	*2.2*	*56.8*	*2.2*	*4.8*	*31.8*	*4.5*
French	(N=21)	A	**65.5**	5.0	3.6	21.7	4.3	**54.1**	4.1	4.1	30.5	7.4
	(N=25)	B	38.4	2.2	3.8	**49.2**	6.4	38.2	6.2	3.8	**44.0**	7.8
	(N=46)	*Total*	*52.0*	*3.6*	*3.7*	*35.5*	*5.4*	*46.2*	*5.2*	*4.0*	*37.3*	*7.6*
Canadian		A	**80.0**	0.8	7.8	7.7	3.8	**56.7**	1.6	5.6	30.5	5.6
	(N=25)	B	**60.4**	3.0	5.8	29.0	1.8	41.6	5.0	7.2	**41.8**	4.4
	(N=57)	*Total*	*70.2*	*1.9*	*6.8*	*18.4*	*2.8*	*49.2*	*3.3*	*6.4*	*36.2*	*5.0*
Swiss	(N=14)	A	**84.6**	8.6	0.7	2.1	3.9	**69.6**	8.9	1.8	15.4	4.3
	(N=14)	B	**79.6**	1.8	1.4	13.2	3.9	**65.4**	4.6	2.1	24.6	3.2
	(N=28)	*Total*	*82.1*	*5.2*	*1.1*	*7.7*	*3.9*	*67.5*	*6.8*	*2.0*	*20.0*	*3.8*

Note: Percentages are aggregated across participants and 20 items per block (animate and inanimate); order A: inanimate-animate, order B: animate-inanimate; ref. indicates application of the reflection variant of the relative FoR, rot.=rotation, trans.=translation, int.=intrinsic FoR and the n.c.p. (no clear preference) column denotes the percentages of answers that did not correspond to one of the investigated FoRs (i.e. choices of one of the other four answer options).

Participants were randomly assigned to one of two questionnaire sequences: Approximately half of each sample answered the 20 tasks with inanimate objects first (A), the others started with the 20 animate items (B). After completion of all 40 tasks, demographics were requested and participants were thanked and debriefed.

Data Analysis and Results

To answer our research questions, we combined descriptive and inferential statistics in analyzing FoR-use in the four samples. As evident in Table 1, albeit to differing extents, in all four investigated French speaking countries the reflection variant of the relative FoR was predominantly used, followed by the intrinsic FoR.

In order to be able to test for significant differences in the samples' FoR-use, we first identified for every participant how often they applied the different FoRs in the two blocks (the possible maximum being 20 per block, indicating application of the same FoR on every item). We then conducted a repeated measures ANOVA with FoR (reflection, rotation, translation, intrinsic, and no clear preference) and block (animate vs. inanimate) as within-subjects-factors and nationality (Belgian, French, Canadian or Swiss) and block order (animate or inanimate items first) as between-subjects-factors. Aside from the expected main

effect of FoRs (F (1.360, 242.041) = 159.4, $p < .001$, $\eta_p^2 = .472$), it revealed a significant interaction of FoRs x nationality (F (4.079, 242.041) = 2.7, $p = .029$, $\eta_p^2 = .044$). For all analyses, Greenhouse-Geisser corrected values are reported. As apparent in Table 1, the main differences between the samples from the different countries concerned the extent to which the intrinsic FoR and the reflection variant of the relative FoR were applied. Aggregating the data over all items and participants, we found that in the French sample, while the reflection variant of the relative FoR was applied the most (48.1%), the intrinsic FoR was applied in over a third of the items (37.3%). In the other three countries, the reflection variant dominated much more clearly over the other referencing options: in the Canadian sample, 60.8% of the aggregated answers corresponded to the reflection variant (26.2% intrinsic), in Belgium 62.2% (27.3% intrinsic) and the Swiss sample showed the clearest preference with 74.8% of the answers corresponding to the reflection variant (only 13.8% intrinsic).

The repeated measures ANOVA also showed a significant interaction of FoR and animacy (F (1.411, 242.041) = 16.7, $p < .001$, $\eta_p^2 = .086$). As evident from Table 1, this effect was mainly due to overall increased application of the intrinsic FoR with animate objects as opposed to inanimate objects. There was also a significant interaction between

Table 2: Consistent referencing preferences in % by nationality and object animacy.

Country		items with inanimate objects					items with animate objects				
		ref.	rot.	trans.	int.	n.c.p.	ref.	rot.	trans.	intr.	n.c.p.
Belgium	(N=55)	**67.3**	0	3.6	23.6	5.5	**54.6**	0	1.8	30.9	12.7
France	(N=46)	**50.0**	2.2	0	36.9	10.9	**41.3**	0	0	34.8	23.9
Canada	(N=57)	**71.9**	0	5.3	17.5	5.3	**45.6**	0	1.7	28.1	24.6
Switzerland	(N=28)	**85.7**	3.6	0	7.1	3.6	**60.7**	3.6	0	14.3	21.4

Note: Table displays averaged percentages of number of individuals whose FoR-choice was consistent across at least 15 of 20 items per block. N.c.p. (no clear preference) subsumes participants who were not intra-individually consistent.

FoR and order (F (1.360, 242.041) = 11.9, p < .001, η_p^2 = .063): Participants who worked on the animate items first showed a stronger overall preference for the intrinsic FoR (intrinsic: 38.3%; reflection: 48.9%) than those who worked on the inanimate items first (intrinsic: 17.3%; reflection: 70.5 %).

Taking a closer look at the variance in FoR-choices within the countries, we established for all participants whether they were intra-individually consistent in their FoR-use across tasks. We considered an individual to be consistent, when he/she chose the same FoR in at least 15 of 20 items (75%). Interestingly, intra-individual consistency was also affected by animacy of the items (cf. Table 2). For inanimate items, the majority of participants behaved intra-individually consistent in terms of their FoR choice (France was the exception with 10.9% of participants that were not intra-individually consistent). For animate items, FoR-choice across items was less intra-individually consistent (cf. Table 2). There were also inter-individual differences within the countries: In the Belgian, French and Canadian samples a considerable number of participants (consistently) applied either reflection or the intrinsic FoR, whereas the Swiss sample applied reflection very consistently both intra-individually (cf. Table 2), and inter-individually. All samples preferred the reflection variant over the other two variants of the relative FoR.

Discussion

Considering the three variants of the relative FoR as well as the intrinsic FoR, we found significant differences in referencing behavior between four samples speaking the same native language but living in different countries. French allows for choosing freely between the different FoRs, thus misunderstandings occurring due to this variation in descriptions/interpretations of the same spatial array are possible. While all samples generally preferred reflection over the other variants of the relative FoR, the French used the intrinsic FoR more than the Canadian, Belgian and Swiss samples, the latter almost exclusively applied reflection. Unlike the other investigated countries, France is not officially bilingual. Since second language proficiency influences spatial referencing (cf. Flaherty & Richardson, 1996), this may account for the French sample differing from the others. The observed general preference for reflection corresponds to our previous findings in German samples. However, indicating situational influences on referencing behavior and thus supporting our hypothesis, the intrinsic FoR was used more frequently with animate than with inanimate items. In previous studies (e.g., Beller et al., subm. [a]) we had found no significant differences with respect to object's animacy. The current study may have facilitated detection of such differences by using photographs, thus making the referencing tasks more life-like. Another possible explanation inherent in the depicted objects is that the animate objects were bigger and the intrinsic front of the bird may thus have been more salient than that of the pencil. However, this possible effect of the material would have affected all samples in a similar fashion and hence cannot account for the observed differences between our samples. Presenting the animate and inanimate tasks in blocks may also have had an influence (see Surtees, Apperly, & Noordzij, 2011). Specifically, task order influenced FoR choice: when animate items came first, the intrinsic FoR was applied more on the following inanimate items as well, and the same effect appeared for the reflection variant of the relative FoR when the order was reversed. This might be explained by some sort of priming effect and/or a tendency to reference consistently (set effects). Regarding consistency, we found that differences within countries were due to inter-individual differences rather than intra-individual differences in referencing. This suggests that while miscommunication regarding the position of objects occurs between people in a given country, individuals tend to keep to their preferred referencing strategy. Note, however, that intra-individual consistency was lower with animate than with inanimate items. Overall, our findings empirically support the generally expected preference for a relative FoR in Western cultures, more specifically, for the reflection variant. However, our data show that the intrinsic FoR is also applied to considerable extents in all investigated populations. Moreover, we found that the extent to which this FoR is applied by French speakers differs both between and within countries. One cannot help but wonder why these possible sources of misunderstandings are not gradually adapted or at least made explicit within language communities, so that the same sentence will not be interpreted in different ways. How does this fit in with Sapir's (1949) famous claim that "We see and hear and otherwise experience very largely as we do because the language habits of our community predispose certain choices of interpretation"? Our findings regarding interindividual differences and differences between countries indicate that interpretation choices may not so strongly be predisposed by the language habits of our community, whether the community is defined by speaking the same language or by living in the same country. We are required to talk about things in space everyday, yet FoRs seem to still be somewhat variably applied, possibly hindering successful communication.

With respect to limitations of the current study, it must be said that our rather homogenous samples of university students majoring in the social sciences do not necessarily warrant generalizability of our findings to the entire population of the investigated countries. On the upside, however, the observed differences cannot be attributed to differences between the samples concerning factors like age or level of education. Moreover, assessing referencing preferences by means of a questionnaire may not adequately represent strategies applied in everyday settings. However, our questionnaire allowed for assessment of the different samples in their usual surroundings with the exact same measure, thus avoiding possible experimenter effects induced by specific dialects for instance. Regarding this train of thought, one might argue that different variants of

French are spoken in the investigated samples, and that differences in referencing behavior may be due to the differences in the linguistic habits of these groups. However, we used the same descriptions across all groups, and, more importantly, our tasks did not require speech production but rather interpretation of a given sentence by choosing one of eight possible depictions. This procedure diminishes possible influences of different dialects on referencing strategies as linguistic input was both minimal and held constant across groups.

In summary, our findings suggest that with respect to the FoRs commonly applied by Westerners, there are differences even between speakers of the same language that seem to be influenced, at least in part, by their living in different countries. In addition, we also found that aspects of the referenced objects had an impact on FoR-preferences. How these differences between speakers of the same language, yet living in different places, come about remains a question for further research.

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