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Spatial representations activated during real-time comprehension of verbs

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Abstract

Previous research has shown that naïve participants display a high level of agreement when asked to choose or draw schematic representations, or image schemas, of concrete and abstract verbs [Proceedings of the 23rd Annual Meeting of the Cognitive Science Society, 2001, Erlbaum, Mawhah, NJ, p. 873]. For example, participants tended to ascribe a horizontal image schema to *push*, and a vertical image schema to *respect*. This consistency in offline data is preliminary evidence that language invokes spatial forms of representation. It also provided norms that were used in the present research to investigate the activation of spatial image schemas during online language comprehension. We predicted that if comprehending a verb activates a spatial representation that is extended along a particular horizontal or vertical axis, it will affect other forms of spatial processing along that axis. Participants listened to short sentences while engaged in a visual discrimination task (Experiment 1) and a picture memory task (Experiment 2). In both cases, reaction times showed an interaction between the horizontal/vertical nature of the verb's image schema, and the horizontal/vertical position of the visual stimuli. We argue that such spatial effects of verb comprehension provide evidence for the perceptual–motor character of linguistic representations.

Keywords: Image schemas; Verbs; Language processing; Spatial representation

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1. Introduction

People say that they look up to some people, but look down on others because those we deem worthy of respect are somehow "above" us, and those we deem unworthy are somehow "beneath" us. But why does respect run along a vertical axis (or any spatial axis, for that matter)? Much of our language is rich with such spatial talk. Concrete actions such as a push or a lift clearly imply a vertical or horizontal motion, but so too can more abstract concepts. Arguments can go "back and forth," and hopes can get "too high." Lakoff (1987) offers further examples of spatial metaphors in languages other than English, and Boroditsky (1999, 2000) has demonstrated that speakers of different languages employ different spatial metaphors when reasoning about events in time. In concert, some linguists argue that certain aspects of linguistic meaning can only be captured by spatial "image schema" representations (Langacker, 1987; Talmy, 1983).

Such spatial elements could be part of the metaphoric understanding that underlies much of our language, and is rooted in embodied experiences and cultural influences (Gibbs, 1996; Lakoff, 1987). For example, respect may be associated with an upwards direction because as children we look up to our taller and wiser elders. Alternatively, perhaps these spatial elements are more like idioms, or linguistic freezes—historical associations that are buried in a word's etymology but are not part of our core understanding of the concept (Murphy, 1996). This issue forms the central question of the current research: *Are the spatial representations associated with certain verbs merely vestigial and only accessible metacognitively, or are they automatically activated by the process of comprehending those verbs?*

We operationalized this question by presenting participants with sentences and testing for spatial effects on concurrent perceptual tasks. An interaction between linguistic and perceptual processing would support the idea that spatial representations are inherent to the conceptual representations derived from language comprehension (Barsalou, 1999). The interactions we predicted were specific to the orientation of the image schema associated with various concrete and abstract verbs. Rather than relying on observational data of phrases and idioms, we empirically categorized our verbs using the norming studies of Richardson, Spivey, Edelman, and Naples (2001).

1.1. *Norming studies of image schemas*

Assuming a spatial element to the representation of linguistic items, it would be reasonable to expect some commonality among these representations across speakers, since we experience the same world, have similar perceptual systems, and generally communicate successfully. Therefore, in the same way that psycholinguists use norming studies to support claims of preference for certain grammatical structures, Richardson et al. (2001) surveyed a large number of participants with no linguistic training to see if there was a consensus amongst their spatial representations of words.

The methods and results of Richardson et al. (2001) are summarized in Fig. 1. Thirty verbs were studied in two norming tasks. A mixture of concrete action verbs such as *push* and *lift* and abstract verbs or psychological predicates such as *argue* and *respect* were used. The verbs were

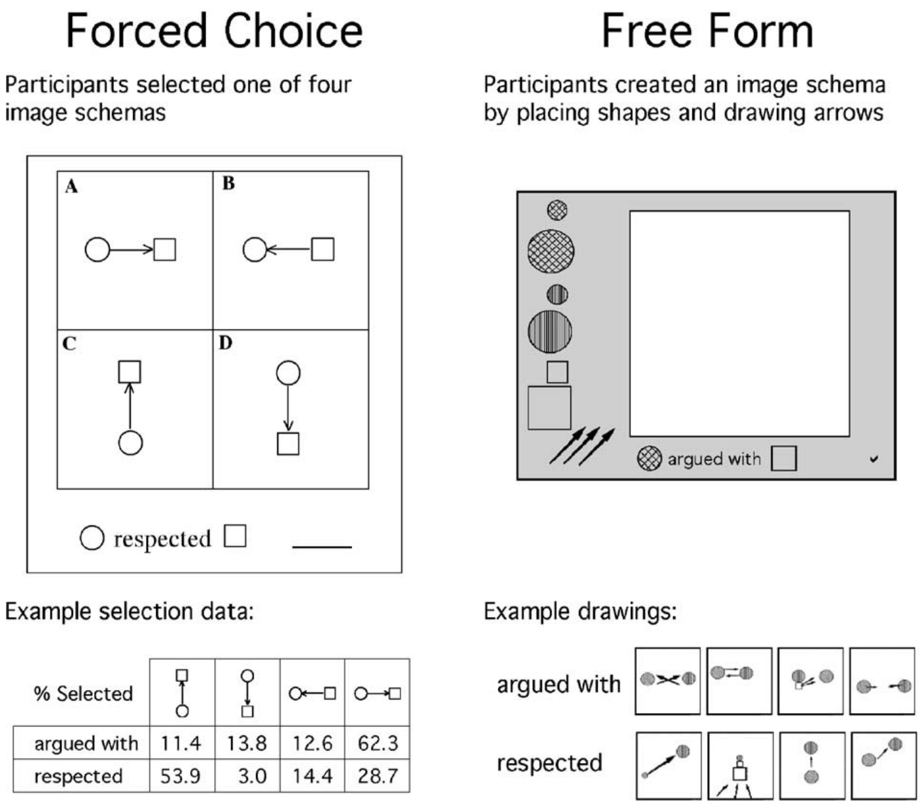

Fig. 1. Schematic of the method and results of Richardson et al. (2001).

divided into groups according to the expected primary axes of their image schemas (vertical, horizontal, and a group of neutral verbs, e.g., *showed*).

In a forced-choice task, the past tense form of each verb was placed in a simple rebus sentence, with circle and square symbols representing agents and patients, respectively. One hundred and seventy-three participants were asked to select one of four simple image schemas that best reflected the meaning of each verb. The image schemas consisted of a circle, a square and an arrow linking them in an up, down, left or right orientation. The results revealed a high degree of agreement: on average, about two thirds of the participants chose the same image schema for a particular verb. This consistency held equally for the abstract and concrete verbs. To test our predictions regarding the horizontal or vertical orientation of the image schemas, an "aspect angle" was calculated for each verb. The left and right image schemas were given an aspect angle of 0°, and the up and down image schemas 90°. The mean aspect angles for the horizontal (18°), neutral (42°), and vertical groups (69°) suggested that participants agreed with the experimenters' intuitions.

In their second norming task, Richardson et al. (2001) allowed participants to create their own image schemas in an open-ended task. Participants were presented with the same sentences and asked to depict their meaning using a simple computer-based drawing environment. Responses were quantified using the same aspect angle metric, which in this case represented the degree to which the drawings were extended along a horizontal or vertical axis. The aspect angles for the horizontal (21°), neutral (36°), and vertical (45°) verbs again suggested that participants agreed with each other and with the experimenters' intuitions.

By comparing each verbs' mean aspect angle in the forced-choice and free-form drawing tasks via a pointwise correlation analysis, Richardson et al. (2001) found considerable item-by-item consistency ($r = .71$, $p < .0001$). This suggests that the experiments tapped into some stable commonality in the way that verbs are represented across participants and tasks. However, it is possible that the horizontal or vertical character of specific verbs is only manifested in offline tasks that require a deliberative spatial response. It has yet to be demonstrated that verbs activate such spatial representations as a consequence of normal language comprehension.

1.2. A spatial effect of verbs?

The current research tested the prediction that comprehending concrete and abstract verbs with horizontal or vertical image schemas will interact with other forms of spatial processing along those axes. Because we assumed that our hypothesized spatial representations bear some similarity to visuospatial imagery (albeit a weak or partially active form), we predicted that it would interact with perceptual and memory tasks in a similar fashion.

Evidence of visual imagery interfering with visual perception was discovered at the turn of the century (Kuelpe, 1902; Scripture, 1896), and re-discovered in the late 1960s (Segal & Gordon, 1969). In demonstrations of the "Perky effect" (Perky, 1910), performance in visual detection or discrimination is impaired by engaging in visual imagery. In some cases, imagery can also facilitate perception (Farah, 1985; Finke, 1985). It is not certain what mechanisms produce these differing effects (for a review, see Craver-Lemley & Reeves, 1992). For our purposes, it suffices to note that facilitation only occurs when there is a relatively precise overlap in identity, shape or location between the imaginary and the real entity (Farah, 1985). In the more general case of generating a visual image and detecting or discriminating various stimuli, imagery impairs performance (Craver-Lemley & Arterberry, 2001). Experiment 1 tested the hypothesis that non-specific imagery activated by verb comprehension will *interfere* with performance on a visual task.

Experiment 2 investigated how verb comprehension interacts with a memory task. It has been robustly shown that imagery improves memory (Paivio, 1969). Also, visual stimuli are remembered better when they are presented in the same spatial locations at presentation and test (Santa, 1977). We hypothesized that spatial structure associated with a verb would influence the encoding of visual stimuli. In Experiment 2, participants heard a sentence and saw two pictures of the agent and patient of the sentence. We predicted that the picture pairs would later be recognized faster if they were presented in the same orientation as the associated verb's image schema.

2. Experiment 1

In this dual-task experiment, participants heard and remembered short sentences, and identified briefly flashed visual stimuli as a circle or square. The critical sentences contained the verbs for which Richardson et al. (2001) had collected image schema norms. The data from these two norming tasks were combined and the result used to categorize the verbs empirically as either horizontal or vertical, reflecting the primary axis of the image schema that had been ascribed by participants. We predicted an interaction between the linguistic and visual tasks: after comprehending a sentence with a vertical verb, participants' discrimination would be inhibited when the visual stimulus appeared in the top or bottom locations of the screen, or in the left and right positions after a horizontal verb had been presented.

2.1. Method

2.1.1. Participants

Eighty-three Cornell University undergraduates participated for course credit.

2.1.2. Stimuli

The aspect angles produced by Richardson et al.'s (2001) norming experiments were combined by *z*-scoring the values for each task, then averaging the two values for each verb. The 15 verbs with the highest values were designated as the vertical verbs; the lowest 15 were the horizontal verbs. All verbs were placed in a present-tense sentence with typical agents and patients, and were a mixture of concrete and abstract verbs (see Appendix A). Six filler sentences and a comprehension question relating to each were written. All 36 sentences were recorded by an experimenter speaking in a flat intonation and saved as mono MP3 sound files.

The visual stimuli consisted of a fixation cross subtending approximately 2° of visual angle, and a black circle and square, each subtending approximately 3.5° of visual angle. The fixation cross always appeared in the center of the screen, and the circle and square appeared in one of four positions, 9° above, below, to the left, or to the right of the center of the screen. Participants viewed the stimuli from a distance of approximately 20.

2.1.3. Procedure

Each trial began with a central fixation cross presented for 1000 ms. A sentence was presented binaurally through headphones. There was then a pause of 50, 100, 150 or 200 ms. This randomized "jitter" was introduced, so that participants could not anticipate the onset of the target visual stimulus. The target, a black circle or square, then appeared in either the top, bottom, left or right position, and remained on screen for 200 ms. Participants were instructed to identify the stimulus as quickly as possible, pressing one key to indicate a circle and another to indicate a square. Reaction times and accuracy rates were recorded. To ensure that participants attended to the sentences, randomly placed within every block of six trials, a short comprehension question followed identification of the visual stimuli, always in conjunction with a filler (rather than a target) sentence. The questions were interrogative forms of the filler sentences with an object substitution in half of the cases (e.g., "Did the dog fetch the ball/stick?"). Participants responded "yes" or "no" by pressing designated keys. The order of the sentences, the location and the shape of the visual stimuli were all fully randomized.

2.2. Results and discussion

Mean accuracy for the comprehension questions was 97%, demonstrating that the participants attended to the auditory stimuli. In the analysis of responses to the visual stimuli, trials

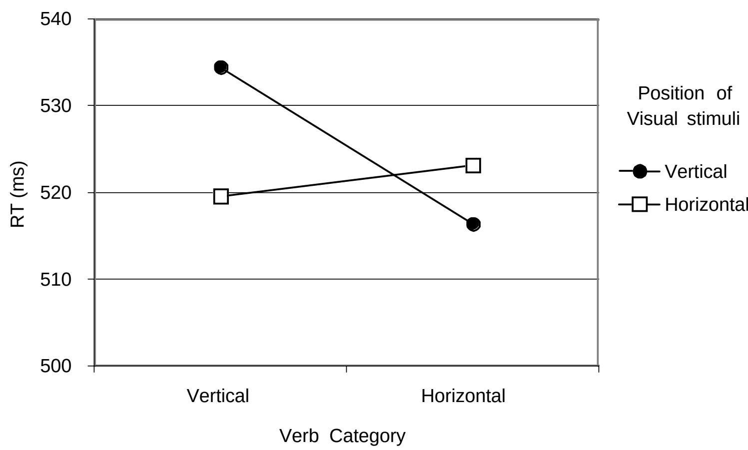

Fig. 2. Results of Experiment 1. An interference effect between verb category and stimulus position.

were excluded if the target was incorrectly identified (3% of trials) or if the reaction time exceeded two standard deviations from the mean (3% of remaining data).

The results are depicted in Fig. 2. The four stimuli positions were collapsed into vertical and horizontal categories, since our norming data only distinguish verbs by their primary axes. The data were analyzed using a 2 (position: horizontal/vertical) × 2 (verb category: horizontal/vertical) repeated-measures ANOVA. As predicted, verb category interacted with stimulus position, $F(1, 82) = 6.13$, $p < .02$. Although the same interaction between stimulus position and verb category was numerically present in an analysis by items, this effect did not reach significance ($F(1, 28) = 2.42$, $p > .1$). Simple main effects analyses showed that the visual stimuli were identified faster in the vertical positions when preceded by a horizontal verb ($M = 519$ ms, $SE = 15$ ms) than a vertical verb ($M = 534$ ms, $SE = 15$ ms), $F(1, 82) = 4.06$, $p < .05$. Conversely, when the stimulus was in a horizontal position, it was identified faster when preceded by a vertical ($M = 516$ ms, $SE = 13$ ms) rather than a horizontal ($M = 523$ ms, $SE = 13$ ms) verb, although this difference was not significant $F(1, 82) = 1.22$, $p > .25$. There was no significant main effect of stimulus position (vertical: $M = 527$ ms, $SE = 10$ ms; horizontal: $M = 520$ ms, $SE = 9$ ms; $F(1, 82) = 1.92$, $p > .1$) or of verb category (vertical: $M = 525$ ms, $SE = 10$ ms; horizontal: $M = 521$ ms, $SE = 10$ ms; $F < 1$). We carried out further analyses using concreteness as a factor, but there was not a significant main effect ($F(1, 74) = 2.86$, $p > .09$), no interaction with either stimulus position ($F < 1$) or verb category ($F < 1$), and there was no three-way interaction ($F(1, 74) = 1.81$, $p > .18$). We conclude that our results were not affected by the abstract or concrete nature of the verbs.[1]

The results provide a first indication that comprehending a verb, whether concrete or abstract, can activate a spatial representation that (in its orientation of the primary axis, at least) resembles the image schema associated with the meaning of that verb. Moreover, because the verbs modulated perceptual performance in a spatially specific manner predicted by norming data, this suggests that Richardson et al.'s (2001) results were not an artefact of tasks requiring deliberate spatial judgments.

3. Experiment 2

When explicit spatial information is conveyed in a narrative, participants are able to incorporate it into a mental model (Bower & Morrow, 1990), or use it to construct a mental image (Denis & Cocude, 1992). We now have evidence that spatial representations are ascribed consistently to, and activated by, verbs. We then tested, whether implicit spatial information also influences the way stimuli are encoded and recognized by having participants remember pairs of pictures that depict spoken sentences. During study trials, participants heard a sentence while pictures were presented sequentially in the center of the screen. During test, the pictures were presented simultaneously in either a horizontal or vertical alignment. We predicted that the pictures would be recognized more easily when orientated along the axis of the associated verb.

3.1. Method

3.1.1. Participants

Eighty-two Cornell University undergraduates participated for course credit, none of whom participated in Experiment 1.

3.1.2. Stimuli

The auditory stimuli consisted of the same verbs and sentences used in Experiment 1. An artist drew a cartoon sketch of each of the agents and patients used in Experiment 2. These were designed such that, as much as possible, they had no clear vertical versus horizontal orientation. For example, cars and people were drawn “head on” (and looking straight ahead) rather than facing to the left or right. The artist was not told which pictures were going to be presented together, and did not know what verbs were being used. Thus, any image schema that the artist might possess for that verb did not influence his drawing of the pictures. The pictures appeared on screen in black frames that subtended approximately 11° of visual angle, and were viewed from a distance of approximately 20.

3.1.3. Procedure

Fig. 3 shows a schematic of Experiment 2. In the study trials, the participant heard the first few words of the sentence corresponding to the agent (e.g., “The athlete . . . ”) and saw a centrally presented picture of the agent. The picture was displayed for the duration of the subject noun phrase. Then the screen went blank, and the participant heard the middle segment of the sentence containing the verb (e.g., “. . . succeeds . . . ”). Ten of 30 target sentences included a participle with the verb. No visual stimulus was presented. The last segment was then heard, and the participant saw a centrally presented picture of the object noun phrase (e.g., “. . . at the tournament”). The segments were played smoothly back to back, such that they sounded like a natural sentence. There were six trials in each study block.

Each study block was followed by a test block of 12 trials. In each test trial, two pictures were presented in either a horizontal or vertical alignment. They appeared 9° from the center in either the top, bottom, left or right positions. All pictures had been seen in the previous

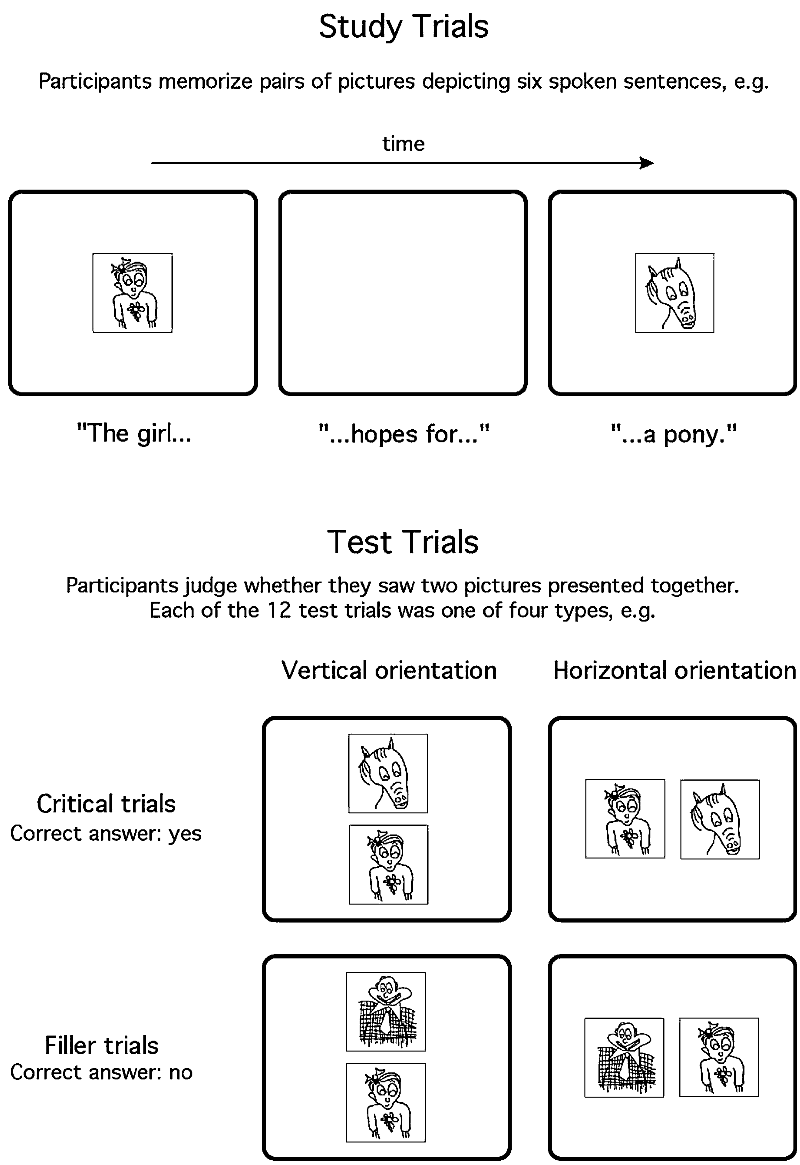

Fig. 3. Schematic of the method of Experiment 2.

study block. In half of the test trials, the two pictures were taken from different sentences; in the other half, the critical trials, the pictures were from the same study sentence. Participants pressed one key to indicate the two pictures had been paired in the same study sentence, and another to indicate they had not been. Participants were shown five cycles of a study block followed by a test block. There was a 1000 ms pause between each trial, and a rest period between each study–test cycle. The order of trials and the orientation of pictures were fully randomized.

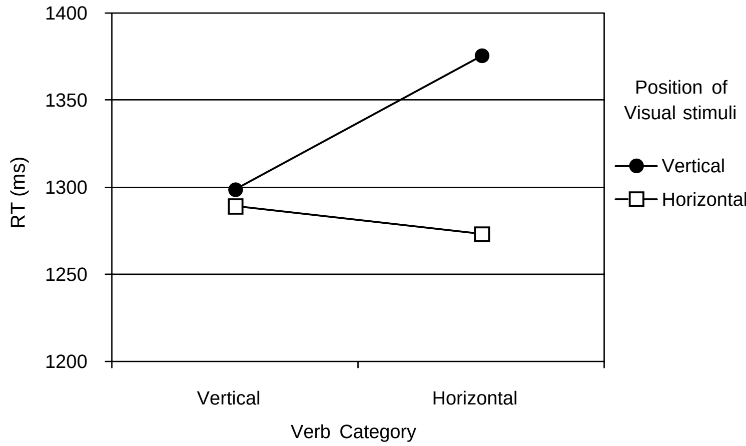

Fig. 4. Results of Experiment 2. Memory performance was facilitated when picture and image schema orientation were congruent.

3.2. Results and discussion

Only critical trials in which the two pictures had been paired in a study sentence were analyzed. When pictures were presented in a horizontal orientation, participants' accuracy was 95% for horizontal verbs and 93% for vertical verbs; when the pictures were presented vertically, accuracy was 92 and 91%, respectively. These small differences were not significant. There was no main effect of orientation ($F(1, 81) = 3.49$, $p > .05$), nor of verb category ($F(1, 81) = 2.10$, $p > .15$), and no significant interaction ($F(1, 81) = 0.30$, $p > .5$). For the remaining reaction time analyses, trials were excluded if the incorrect answer ("no") was given, or if the RT exceeded two standard deviations from the mean (2% of remaining data).

The data were analyzed using a 2 (orientation of visual stimuli: vertical/horizontal) × 2 (verb category: vertical/horizontal) repeated-measures ANOVA (see Fig. 4). Verb category interacted with the orientation of the visual stimuli, both by participants $F(1, 81) = 5.49$, $p < .03$, and items $F(1, 28) = 5.18$, $p < .05$. Simple main effects analyses showed that pictures in a vertical orientation were responded to faster if they were associated with a vertical ($M = 1299$ ms, $SE = 28$ ms) rather than a horizontal ($M = 1396$ ms, $SE = 33$ ms) verb, $F(1, 81) = 8.54$, $p < .005$, and pictures in a horizontal orientation were responded to faster if associated with a horizontal ($M = 1273$ ms, $SE = 30$ ms) rather than a vertical ($M = 1289$ ms, $SE = 30$ ms) verb, although this difference was not significant $F < 1$. The main effect of verb category was not significant (vertical: $M = 1292$ ms, $SE = 20$ ms; horizontal: $M = 1325$, $SE = 23$ ms; $F(1, 81) = 2.91$, $p > .09$). Pictures were correctly identified faster in a horizontal ($M = 1281$ ms, $SE = 21$ ms) than in a vertical ($M = 1337$ ms, $SE = 22$ ms) orientation, $F(1, 81) = 8.78$, $p < .005$.

Further analyses using verb concreteness as a factor revealed a significant main effect ($F(1, 49) = 22.60$, $p < .001$) such that concrete verbs ($M = 1251$ ms, $SE = 19$ ms) were identified faster than abstract verbs ($M = 1374$ ms, $SE = 25$ ms). Concreteness did not interact with verb category ($F(1, 49) = 3.91$, $p > .05$) or orientation ($F < 1$), and there was no three-way interaction ($F < 1$).[2] We concluded that concreteness does not impact our main hypothesis, and that its overall effect on reaction times is a result of the advantage that concrete words have across many types of memory and lexical decision tasks (Paivio, Yuille, & Smythe, 1966).

Verb comprehension influenced how visual stimuli were encoded in that recognition times were faster when the stimuli were tested in an orientation congruent with the verb's image schema. In contrast to the interference effect found in visual discrimination (Experiment 1), image schemas facilitated performance in this memory task. One interpretation is that during study, verb comprehension activated an image schema. The spatial element of this image schema was imparted to the pictures, as if the verb image schema was acting as a scaffold for the visual memory. The pictures were then encoded in that orientation, and hence identified faster when presented at test in a congruent layout (Santa, 1977).

4. General discussion

We have presented evidence that verb comprehension interacts with perceptual–spatial processes, at least with verbs that imply literal or metaphorical spatial relationships. The verbs were categorized empirically as having either horizontal or vertical image schemas (Richardson et al., 2001). The spatial orientation of the verbs' image schemas exerted influences on spatial perception and memory, interfering with performance on a visual discrimination task, and facilitating performance in the encoding of a visual memory. There are two implications of these results. First, they provide behavioral evidence that converges with linguistic theory (Lakoff, 1987; Langacker, 1987; Talmy, 1983) and norming data (Gibbs, Strom, & Spivey-Knowlton, 1997; Richardson et al., 2001) in support of the "cognitive psychological reality of image schemas" (Gibbs & Colston, 1995). Second, they suggest that linguistic representations are intimately linked with perceptual mechanisms in that they influence on-line performance and delayed memory tasks.

There is an alternative, though closely related, explanation for our results. It could be the case that the effects we observed were not primarily driven by spatial representations activated by verbs, but by representations of the whole sentence. Although our offline norming studies (Richardson et al., 2001) presented verbs in rebus sentences with meaningless shapes (e.g., circle hopes for square), the current online experiments presented the verbs with typical agents and patients (e.g., "the girl hopes for a pony"). Therefore, it is, in principle, possible that our effects were generated by mental models of the sentences. It is the goal of future research to tease apart these two accounts. Nonetheless, whichever characterization turns out to provide a better account of these findings, it is clear that the overarching framework in which language recruits spatial representations during real-time comprehension (not merely during metalinguistic judgments) is supported compellingly by these results.

Why should it be surprising that language comprehension exerts spatial effects on perception? Most traditional accounts view language as an encapsulated system of amodal symbol manipulation, functioning independently from what is typically viewed as perceptual processing and the computation of knowledge regarding how entities and objects interact in the world (Chomsky, 1965; Fodor, 1983; Markman & Dietrich, 2000). This modular view certainly would not predict such interactions between language and perception. In contrast, accounts such as Barsalou's (1999) Perceptual Symbol Systems theory hold that cognitive representations are governed by the same systems that control perception and action. We suggest that an aggregate of many perceptual and motor experiences may become associated with a verb, and the spatial commonalities among these experiences is reflected in the verb's representation. This spatial component would then be activated during comprehension, possibly as part of a perceptual–motor simulation of the sentence (Barsalou, 1999).

Several recent findings further suggest that language comprehension involves perceptual or motor activation (Fincher-Kiefer, 2001; Pecher, Zeelenberg, & Barsalou, 2003; Richardson & Spivey, 2002; Solomon & Barsalou, 2001; Spivey, Tyler, Richardson, & Young, 2000). Stanfield and Zwaan (2001) demonstrated that reading a sentence can prime responses to orientation-specific depictions of items described in the sentence, even though orientation was only implied in the text. For example, after reading "John hammered the nail into the wall/floor," participants saw a picture of a nail and were faster to verify that the object was featured in the sentence if it was depicted in its congruent orientation. Interactions between language and motor processes were shown by Glenberg and Kaschak (in press). Judgements of the sensibility of an action were faster when the response was a physical action (towards/away from the body) that was in the same direction as the described action (e.g., "close/open the drawer"). Interestingly, this effect held for the transfer of abstract entities, (e.g., "Liz told you the story"/"you told Liz the story"), a result that mirrors our findings with abstract verbs. These behavioral results are supported by evidence from the neuropsychological literature that language processing produces activation in perceptual–motor areas (Büchel, Price, & Friston, 1998; Cree & McRae, 2002; Pulvermüller, 1999; Tanel, Damasio, & Damasio, 1997) and some results linking spatial processing specifically with language (Chatterjee, 2001; Coslett, 1999).

The consistent spatial effects of (both concrete and abstract) verbs have been seen in two off-line norming tasks (Richardson et al., 2001) and in the present research, two studies of on-line language comprehension. This evidence can be used in support of the assertion, often made by cognitive linguistics, that certain aspects of lexical meaning, both literal and metaphoric, are captured by spatial representations. Our results endorse perceptual–motor theories of cognitive representation (Barsalou, 1999) because these spatial representations are activated during language comprehension, and interact with concurrent cognitive and perceptual processes.

Notes

1. Strictly speaking, the absence of a significant interaction between concreteness and other variables makes further analysis inappropriate. With that caveat, separate analyses can be carried out on the concrete and abstract verbs, although five and three subjects, respectively, had to be removed from the analyses for not contributing to all cells in the design. Simple effects ANOVAs showed that the interaction between verb category and stimulus position was non-significant for concrete verbs alone ($F(1, 77) = 0.59$, $p > .4$), but significant for abstract verbs alone ($F(1, 79) = 6.92$, $p < .01$).
2. Once more, the lack of a significant interaction between concreteness and the other experimental variables dictates that analyzing concrete and abstract verbs separately is technically unwarranted. When these analyses were carried out, however, they showed

that the concrete verbs alone had a significant interaction between verb category and stimuli orientation ($F(1, 64) = 7.53$, $p < .01$, with 17 participants removed for not contributing to all cells of the design); but the abstract verbs did not ($F(1, 59) = 1.53$, $p > .2$, with 22 participants removed).

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Appendix A

Verb	Abstract/ concrete	Sentence	Aspect angles		Category
			Forced-choice	Free-form	Horizontal/ vertical
Argue	a	The husband argues with the wife.	23	4	H
Rush	a	The girl rushes to school.	19	11	H
Give	a	The philanthropist gives to the museum.	16	14	H
Warn	a	The boy warns his brother.	30	14	H
Want	a	The child wants the cake.	21	15	H
Offend	a	The racist offends the lawyer.	37	23	H
Tempt	a	The woman tempts the man.	25	26	H
Regret	a	The politician regrets the interview.	40	26	H
Obey	a	The servant obeys the master.	24	31	H
Increase	a	The storeowner increases the price.	73	32	V
Respect	a	The man respects his father.	52	35	V
Hope	a	The girl hopes for a pony.	55	36	V
Succeed	a	The athlete succeeds at the tournament.	68	44	V
Own	a	The mobster owns the casino.	55	47	V
Rest	a	The jogger rests his feet.	46	70	V
Push	c	The miner pushes the cart.	10	12	H

Appendix A. (*Continued*)

Verb	Abstract/ concrete	Sentence	Aspect angles		Category
			Forced-choice	Free-form	Horizontal/ vertical
Pull	c	The mechanic pulls the chain.	10	16	H
Hunt	c	The poacher hunts the deer.	27	19	H
Point	c	The salesman points at the car.	10	20	H
Impact	c	The car impacts the wall.	40	21	H
Show	c	The teacher shows the film.	22	22	H
Smash	c	The hammer smashes the vase.	63	46	V
Float	c	The balloon floats through the cloud.	80	46	V
Flee	c	The criminal flees the police.	10	47	V
Fly	c	The eagle flies to the river.	74	49	V
Walk	c	The student walks to class.	11	50	V
Lift	c	The strongman lifts the barbell.	87	58	V
Bomb	c	The plane bombs the city.	82	60	V
Sink	c	The ship sinks in the ocean.	85	61	V
Perch	c	The sparrow perches on the fence.	79	64	V

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