2015

Obama cares about visuo-spatial attention: Perception of political figures moves attention and determines gaze direction

Mark S. Mills
University of Nebraska-Lincoln, mark.mills2@huskers.unl.edu

Kevin B. Smith
University of Nebraska-Lincoln, ksmith1@unl.edu

John R. Hibbing
University of Nebraska-Lincoln, jhibbing1@unl.edu

Michael D. Dodd
University of Nebraska–Lincoln, mdodd2@unl.edu

Behavioural Brain Research 278 (2015) 221–225

Contents lists available at ScienceDirect

Behavioural Brain Research

journal homepage: www.elsevier.com/locate/bbr

Short Communication

Obama cares about visuo-spatial attention: Perception of political figures moves attention and determines gaze direction

Mark Mills[a,*], Kevin B. Smith[b], John R. Hibbing[b], Michael D. Dodd[a]

[a] Department of Psychology, University of Nebraska-Lincoln, United States
[b] Department of Political Science, University of Nebraska-Lincoln, United States

HIGHLIGHTS

- Peripheral target detection (E1) and saccadic free-choice (E2) tasks.
- RT facilitated for Democrat (Republican) cues when target appeared left (right).
- Saccades following Democrat (Republican) cues more likely directed left (right).
- Concepts not directly associated with physical space bias spatial processing.

ARTICLE INFO

Article history:
Received 17 July 2014
Received in revised form
25 September 2014
Accepted 28 September 2014
Available online 7 October 2014

Keywords:
Conceptual cueing
Free-choice task
Attention
Saccades
Political ideology

ABSTRACT

Processing an abstract concept such as political ideology by itself is difficult but becomes easier when a background situation contextualizes it. Political ideology within American politics, for example, is commonly processed using space metaphorically, i.e., the political "left" and "right" (referring to Democrat and Republican views, respectively), presumably to provide a common metric to which abstract features of ideology can be grounded and understood. Commonplace use of space as metaphor raises the question of whether an inherently non-spatial stimulus (e.g., picture of the political "left" leader, Barack Obama) can trigger a spatially-specific response (e.g., attentional bias toward "left" regions of the visual field). Accordingly, pictures of well-known Democrats and Republicans were presented as central cues in peripheral target detection (Experiment 1) and saccadic free-choice (Experiment 2) tasks to determine whether perception of stimuli lacking a direct association with physical space nonetheless induce attentional and oculomotor biases in the direction compatible with the ideological category of the cue (i.e., Democrat/left and Republican/right). In Experiment 1, target detection following presentation of a Democrat (Republican) was facilitated for targets appearing to the left (right). In Experiment 2, participants were more likely to look left (right) following presentation of a Democrat (Republican). Thus, activating an internal representation of political ideology induced a shift of attention and biased choice of gaze direction in a spatially-specific manner. These findings demonstrate that the link between conceptual processing and spatial attention can be totally arbitrary, with no reference to physical or symbolic spatial information.

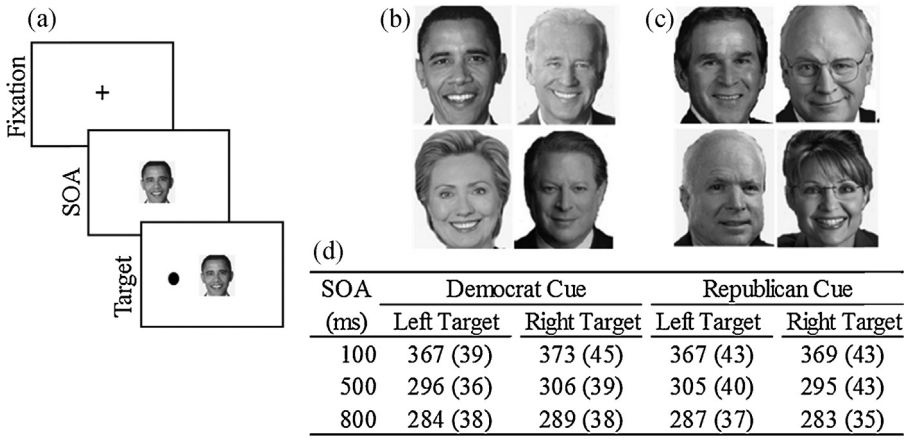
Published by Elsevier B.V.

1. Introduction

In American politics, the term "left" is associated with liberal perspectives and Democrats, whereas "right" is associated with conservative perspectives and Republicans. This spatial metaphor for ideology is largely an arbitrary artifact of legislative seating arrangements in 18th Century France [1,2]. Supporters of the French Revolution sat to the left of the president of the National Assembly whereas supporters of the king sat to the right. The terms "left" and "right" have been used since as descriptive terms for opposite ends of ideological and political spectrums, even though the actual spatial elements of the original seating arrangements have long since been abandoned. The left/right distinction in present day politics differentiates ideological views, but there is no spatial association with the physical left/right. Nonetheless, as the metaphor used to represent the concept of ideology relies on remote associations between semantic labels and space, it is

* Corresponding author at: 238 Burnett Hall, Department of Psychology, University of Nebraska-Lincoln, Lincoln, NE 68588, United States. Tel.: +1 402 472 0547.
E-mail address: mark.mills2@huskers.unl.edu (M. Mills).

http://dx.doi.org/10.1016/j.bbr.2014.09.048
0166-4328/Published by Elsevier B.V.



(d)

SOA	Democrat Cue		Republican Cue	
(ms)	Left Target	Right Target	Left Target	Right Target
100	367 (39)	373 (45)	367 (43)	369 (43)
500	296 (36)	306 (39)	305 (40)	295 (43)
800	284 (38)	289 (38)	287 (37)	283 (35)

Fig. 1. (a) Typical trial sequence in Experiment 1, (b) Democrat cues, (c) Republican cues, (d) Mean RT and standard deviation for Democrat and Republican cues as a function of target location (left/right) and SOA.

possible that activating an internal representation of ideology induces neural activity associated with the processing of spatial information.

One consequence of processing remote spatial associates of ideology may be a corresponding spatial bias in perceptual processing associated with visual attention, such that activating a representation of the political left biases processing of "left" regions in the visual field whereas activating a representation of the political right biases processing of "right" regions. Previous work indicates that activating internal representations of space generate covert shifts of attention to specific regions of the external visual field. For example, perceiving numbers shift attention to regions of space consistent with numerical magnitude (e.g., low numbers shift attention leftward, whereas high numbers shift attention rightward; [3]). Furthermore, there is evidence that more abstract concepts, but still closely associated with physical space, also generate covert shifts of attention. For example, Chasteen et al. [4] presented central cues relating to the concept of divinity (e.g., "God", "Devil") and found that peripheral target detection was facilitated when a target appeared at a location compatible with the cue, despite the cue being spatially non-predictive of target location: God-related words facilitated detection when the target appeared above fixation and Devil-related words facilitated detection when the target appeared below fixation (see also [5]). These studies indicate that spatial information permeates abstract concepts, suggesting the possibility that abstract concepts, however remotely associated with space, should also induce a corresponding spatial bias in perceptual processing.

Another consequence of processing remote spatial associates of ideology may be a corresponding spatial bias in the choice of where to look, such that activating a representation of the political left biases the direction of gaze toward "left" regions of the visual field whereas activating a representation of the political right biases the direction of gaze toward the "right". The pre-motor theory of attention [6] holds that spatial attention involves the pre-programming of eye-movements toward the attended region. Given that conceptual processing affects the direction of spatial attention (e.g., [3,4]) and that eye movements and spatial attention are tightly linked (e.g., [7]), concepts influencing attention should also influence choice of gaze direction. In support, Ruiz-Fernàndez et al. [8] presented a small or large number flanked by two faces and instructed participants to "explore the scene". They found that participants looked left (right) following the presentation of a small (large) number, indicating that number magnitude causally affects the choice of gaze direction (see also [9–11]).

The purpose of the present study is to examine whether exposure to figures with differing ideology influences the direction of spatial attention and choice of gaze direction. Specifically, we sought to determine whether perception of well-known political figures is associated with a spatial bias to process and direct gaze in a manner consistent with the ideological category of the political figure. Participants were presented with a central cue stimulus (picture of either a Democrat or Republican political figure). Experiment 1 used a peripheral target detection task in which a target was presented to the left or right of the cue with a variable stimulus-onset-asynchrony (SOA) and a simple target detection response was required. Unlike abstract cues such as "God" and "Devil", which have a tight coupling with the physical space of up/down in many religions, an image of an individual (e.g., Obama) independent of any mention of political affiliation does not have a direct connection with directionality. Therefore, we are able to determine whether remote spatial associations between Democrat/left and Republican/right trigger corresponding shifts in spatial attention such that targets following a Democrat would be detected faster when presented to the left versus right, whereas targets following a Republican would be detected faster when presented to the right versus left. Experiment 2 used a free-choice task in which participants freely viewed the cue before making a volitional eye-movement to either a left or right placeholder of their choosing to determine whether participants would look left (right) following the presentation of a Democrat (Republican).

2. Method

2.1. Participants

Students from the University of Nebraska-Lincoln participated in either Experiment 1 ($N = 72$) or 2 ($N = 34$). All had normal or corrected-to-normal vision and were naïve to the purpose of the experiment.

2.2. Stimuli and apparatus

Cues were colored photographs of eight different well-known political figures (see Fig. 1), four of which were Republican (George W. Bush, Dick Cheney, John McCain, Sarah Palin) and four of which were Democrat (Barack Obama, Joe Biden, Al Gore, Hilary Clinton). In Experiment 1, stimuli were 3.0° in diameter. In Experiment 2, stimuli were 208 × 175 pixels. Stimuli were displayed on a Pentium IV PC with VGA monitor (85 Hz) in a dimly lit, sound attenuated

testing room. Participants were seated approximately 44 cm from the monitor. In Experiment 2, eye-movements were recorded using an SR Research Ltd. EyeLink II system (Mississauga, Ontario, Canada), which has high spatial resolution and a sampling rate of 500 Hz. Thresholds for detecting the onset of saccadic movements were accelerations of 8000°/s^2, velocities of 30°/s, and distances of 0.5° of visual angle. Movement offset was detected when velocity fell below 30°/s and remained at that level for 10 consecutive samples. Each participant underwent a nine-point calibration procedure followed by a nine-point calibration accuracy test. Calibration was repeated if any point was in error by more than 1° or if the average error for all points was greater than 0.5°. Viewing was binocular but only the dominant eye was recorded.

2.3. Procedure: Experiment 1

A typical trial sequence is shown in Fig. 1a. Each trial started with the presentation of a central fixation point (black, 1.0° in diameter). Participants were instructed to fixate this point and to not move their eyes for the duration of the experiment. Following a period of 750 ms, a cue (Republican/Democrat) was presented at fixation and remained visible through the end of the trial. Participants were instructed to ignore the cue as it was irrelevant to their task and did not predict the location of the upcoming target. A variable cue-target SOA of 100, 500, or 800 ms preceded target presentation. The target (a black circle subtending 1.0°) appeared either 6° to the left or right side of fixation with equal probability and participants were instructed to press the spacebar as quickly as possible once the target was detected. The target remained visible until a response was made. The next trial began 1000 ms after a response. There were 288 experimental trials.

2.4. Procedure: Experiment 2

To initiate each trial, participants were required to press the spacebar while fixating a central fixation point (black, 1.0° in diameter), after which two square flanking placeholders were presented. Placeholders were outlined in black and filled with white, each subtending 2° of visual angle. After 500 ms, a cue (Republican/Democrat) replaced the central fixation point. The center-to-center distance between cue and placeholder was 6°. Participants were instructed to freely view the cue as they normally would and then to simply direct their gaze at one of the square placeholders whenever they saw fit. Though the direction of the saccade was up to the participant, everyone was instructed to avoid always making the same response (e.g., always directed rightward) and to avoid any specific pattern of response (e.g., continually alternating left/right). The end of the trial was triggered by the first saccade landing within a 175 × 175 pixel invisible boundary surrounding each placeholder. There were 240 experimental trials.

3. Results

Considering that political figure cues were intended to trigger spatial biases associated with the concept of ideology, it was important that participants actually had knowledge of the political figures and their respective affiliation. Therefore, after completing the experimental task, participants were asked to identify each of the eight political figures by name. Responses were recorded as correct/incorrect, with total number correct serving as a proxy of political knowledge. In Experiment 1, 45 participants (63%) correctly identified six or more political figures whereas 27 participants (37%) correctly identified three or less, a clear bimodal distribution. In Experiment 2, the total number of correct responses was far more evenly distributed (Fig. 2). This difference is likely due

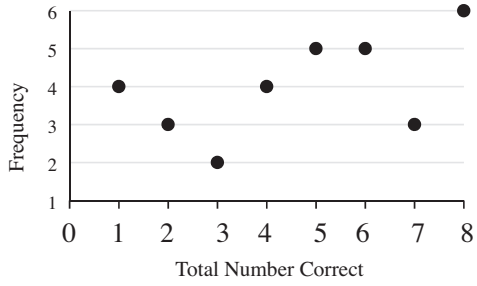


Fig. 2. Frequency distribution of political knowledge in Experiment 2.

to recency/frequency effects on recall induced by the timing of data collection: Experiment 1 was collected Winter-2009, just months removed from the 2008 Presidential election, whereas Experiment 2 was collected Fall-2014, over 2 years removed from the 2012 Presidential election. In any case, as the distribution of political knowledge in Experiment 1 suggested that knowledge naturally clustered into two groups (knowledgeable and unknowledgeable), only knowledgeable participants (i.e., those able to identify at least six figures) were included in the analysis reported for Experiment 1. As the distinction between knowledgeable and unknowledgeable was not apparent in Experiment 2, political knowledge was submitted as a covariate (centered at 6).

3.1. Experiment 1

Person mean RT was analyzed with a 2 (Cue: Democrat/Republican) × 2 (Target: left/right) × 3 (SOA: 100, 500, 800 ms) repeated measures ANOVA. RTs less than 100 ms or greater than 1000 ms were excluded from analysis (0.8%). Mean RT in each condition is shown in Fig. 1d. Overall, RTs decreased monotonically with increasing SOA, as evidenced by a significant main effect of SOA, $F(2,88) = 65.12$, $p < .001$. The critical Cue × Target interaction was significant overall, $F(1,44) = 13.17$, $p < .001$. The three-way interaction was marginally significant, $F(2,88) = 2.62$, $p = .07$, attributable to the Cue × Target interaction being significant at the 500 ms SOA, $t(44) = -3.88$, $p < .001$, $SE = 5.21$, but not at the 100 or 800 ms SOAs ($p > .10$). At the 500 ms SOA, the critical Cue × Target interaction indicates that when the cue was a Democrat, RTs were faster to left versus right targets, $t(44) = 2.54$, $p = .01$, $SE = 4.16$, $d = .38$, whereas when the cue was a Republican, RTs were faster to right versus left targets, $t(44) = -2.33$, $p = .02$, $SE = 4.16$, $d = .38$. Thus, target detection following presentation of a Democrat was facilitated for targets appearing to the left whereas target detection following presentation of a Republican was facilitated for targets appearing to the right, despite the fact that Democrat/Republican cues were spatially non-predictive of target location.

3.2. Experiment 2

As gaze direction was a dichotomous outcome (leftward or rightward saccade), a generalized linear function modeling the logit of the probability of a rightward saccade was selected for analysis. Parameter estimates, therefore, are presented on the logit scale, which is unbounded and symmetric around zero. A logit of zero means that first-saccade direction was equally likely to be directed rightward as leftward. Note that a logit of 0 is equivalent to a probability p of .50—i.e., $p = \exp(\text{logit})/[1 + \exp(\text{logit})]$. When the logit is positive, a rightward saccade is more likely to occur than not ($p > .50$); when the logit is negative, a rightward saccade is less likely to occur than not ($p < .50$). Analyses were performed on the full data matrix, with dependency among observations controlled

Table 1
Intercept estimates, standard errors, and 95% confidence intervals for Democrat and Republican political figures as a function of political knowledge, as well as the slope parameter estimate, standard error, and 95% confidence intervals for the mean difference between Democrat and Republican political figures as a function of political temperament. Note that values are given on the logit scale.

Political knowledge	Democrat			Republican			Diff. (Dem – Rep)		
	Est.	*SE*	95% CI	Est.	*SE*	95% CI	Est.	*SE*	95% CI
3	0.52	0.29	[−.05, 1.08]	−0.01	0.25	[−.52, .50]	0.53	0.31	[−.08, 1.14]
4	0.31	0.21	[−.11, .73]	0.21	0.19	[−.18, .59]	0.10	0.22	[−.36, .56]
5	0.10	0.16	[−.23, .42]	**0.42**	0.15	[.13, .72]	−0.33	0.17	[−.68, .03]
6	−0.11	0.16	[−.44, .21]	**0.64**	0.15	[.35, .94]	**−0.76**	0.17	[−1.11, −.40]
7	−0.33	0.20	[−.74, .09]	**0.86**	0.19	[.48, 1.24]	**−1.18**	0.22	[−1.64, −.73]
8	**−0.54**	0.26	[.02, .37]	**1.08**	0.25	[.57, 1.58]	**−1.61**	0.29	[−2.22, −1.01]

Note: Bold values indicate significance ($p < .05$).

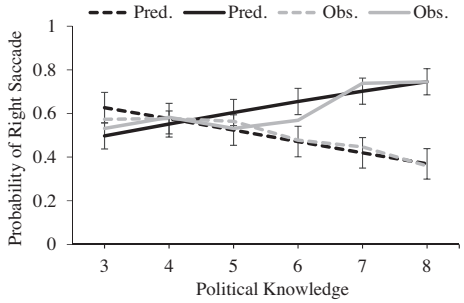


Fig. 3. Model predicted mean probability of a rightward saccade for Democrat and Republican cues (black lines). Observed proportion of rightward saccades for Democrat and Republican cues (gray lines).

directly through inclusion of random effects [12]. Point biserial correlations, r_{pb}, are reported as estimates of effect size. Trials with three or more saccades on the stimulus were omitted from analysis (1.4%). Two subjects were removed from analysis because >99% of saccades were directed in the same direction. As can be seen in Fig. 3, in which the observed proportion of left/right saccades is plotted against model fits, it is evident that the model adequately captured the overall trends in the data.

Estimates of the intercept for each Cue, as well as the slope term for the mean difference between them, are presented in Table 1 as a function of Political Knowledge. Overall, the grand mean of the logit of the probability of a rightward saccade ($M = .26$, $SE = .13$) was significantly greater than zero, $t(29.9) = 2.10$, $p = .04$, $r_{pb} = .01$, indicating that rightward saccades were more likely to occur than leftward saccades, indicative of a general rightward bias. The main effect of Cue, $F(1,27.5) = 19.15$, $p < .001$, indicates that rightward saccades were more likely to occur following a Republican ($M = .64$, $SE = .15$) versus Democrat ($M = -.11$, $SE = .16$). The main effect of Political Knowledge was not significant, $F(1,29.7) = .01$, $p = .97$; however, there was a significant interaction of Cue and Political Knowledge, $F(1,27.2) = 18.74$, $p < .001$. The pattern of this interaction can be seen in Fig. 3, which shows that the likelihood of a rightward saccade increased with Political Knowledge for Republican cues, $t(29.8) = 2.61$, $p = .01$, $r_{pb} = -.19$, but decreased with Political Knowledge for Democrat cues, $t(28.4) = -2.32$, $p = .03$, $r_{pb} = .19$. In other words, as Political Knowledge increased, saccades tended to be directed rightward following a Republican and leftward following a Democrat.

4. Discussion

In Experiment 1, target detection following presentation of a Democrat (Republican) political figure was facilitated for targets appearing to the left (right) of the figure. Thus, merely perceiving an image of a political figure induced a covert shift of attention to a specific region in the visual field consistent with the ideology of the political figure. These results demonstrate that abstract conceptual stimuli influence attentional allocation even when not directly associated with physical space. Similarly, Experiment 2 showed that participants were more likely to look left (right) following the presentation of a Democrat (Republican), demonstrating that perception of an image of a political figure causally biased the choice of gaze direction in a manner consistent with the ideology of the political figure. These results demonstrate that abstract conceptual stimuli influence free-choice of response even when not directly associated with physical space.

Importantly, the present study demonstrates that the link between abstract conceptual processing and spatial attention can be totally arbitrary, with no reference to physical or symbolic spatial information. Previous studies examining the influence of conceptual thinking on spatial processing have used conceptual stimuli that have a relatively direct association with a 'physical' spatial location. For example, the concept of number [8] and divinity [4] have relational associations in that a given item occupies a particular location relative to another item (e.g., "1" is before "2"; "God" is above "Devil"). This is not the case for political figures (e.g., perceptual aspects of Obama do not "place" him before/after or above/below Bush). The present study, therefore, provides strong evidence supporting the idea that spatial information deeply permeates abstract concepts.

The fact that political figures make no reference to physical or symbolic spatial information is relevant to the current debate regarding whether conceptual cueing effects may be accounted for by polarity benefits (default asymmetries in the way people process categorical dimensions). Specifically, it has been suggested that task-induced associations between categories and target locations may explain conceptual cueing effects (e.g., [13–15]). Though this account cannot entirely be ruled out, it is difficult to see how it could account for the present results given that (a) participants simply viewed political figures without evaluation, making it unlikely that participants treated the figures as a single binary variable [16], and (b) there were multiple categories to which a figure potentially belonged (e.g., gender, race, age), which likely reduced the extent to which polarity benefits could have emerged [5]. Similarly, it has also been suggested that an association between abstract concepts and locations might be grounded in terms of the co-occurrence of these concepts in language (e.g., Goodhew et al., 2014). This alone, though, cannot account for why merely perceiving an image of a political figure is sufficient to activate shifts of spatial attention.

The present results are in line with the pre-motor theory of attention [6], which holds that covert spatial attention activates motor routines in oculomotor brain regions (e.g., superior colliculus) that execute saccades to the attended location. Given that Experiment 1 demonstrated that cue ideology shifts spatial attention, the effect of cue ideology on gaze direction in Experiment 2 is likely mediated by such an attentional shift. An important implication is that the oculomotor system may be especially useful in

uncovering the mechanisms that relate the concept of ideology and spatial attention.

The fact that stimuli that are not inherently directional can bias attention by evoking learned spatial associations has implications both in terms of how these biases are generated and for the relationship between attention and action. For instance, in a neurophysiological study investigating the influence of evaluation on action, McCall et al. [17] demonstrated a link between affectively-valenced attitudes and motor responses, such that spatially-specific premotor activity (namely in dorsal premotor cortex and posterior superior parietal areas) was triggered by the mere appearance of a stimulus that evoked an attitude that had been previously associated with a particular response. As these areas have also been implicated in arbitrary sensorimotor mappings between sensory stimuli and motor responses, McCall et al. concluded that attitudes trigger action through learned stimulus-response associations instantiated by neural mechanisms responsible for arbitrary sensorimotor mechanisms. The present results extend McCall et al. by suggesting that spatial attention may play a role in contributing to these processes.

Spatial metaphors such as the left/right distinction in politics are useful because they provide a common metric, physical space, to which abstract information can be grounded and therefore communicated to others [18]. The present findings show that abstract conceptual stimuli affect attentional allocation and the choice of gaze direction even when not directly associated with physical space. Thus, the relationship between perception of abstract concepts and spatial attention may offer a framework that grounds abstract thinking in spatial processing.

References

[1] Freeden M. Ideology: a very short introduction. New York: Oxford University Press; 2003.
[2] Heywood A. Political ideologies. New York: St. Martin's Press; 1992.
[3] Fischer MH, Castel AD, Dodd MD, Pratt J. Perceiving numbers causes spatial shifts of attention. Nat Neurosci 2003;6:555–6.
[4] Chasteen AL, Burdzy DC, Pratt J. Thinking of god moves attention. Neuropsychologia 2010;48:627–30.
[5] Gozli DG, Chasteen AL, Pratt J. The cost and benefit of implicit spatial cues for visual attention. J Exp Psychol: Gen 2013;142:1028–46.
[6] Rizzolatti G, Riggio L, Dascola I, Umiltà C. Reorienting attention across the horizontal and vertical meridians: evidence in favor of a premotor theory of attention. Neuropsychologia 1987;25:31–40.
[7] Deubel H, Schneider WX. Saccade target selection and object recognition: Evidence for a common attentional mechanism. Visual Cognit 1996;5:81–107.
[8] Ruiz-Fernàndez S, Rahona JJ, Hervàs G, Vàzquez C, Ulrich R. Number magnitude determines gaze direction: spatial-numerical association in a free-choice task. Cortex 2011;47:617–20.
[9] Daar M, Pratt J. Digits affect actions: the SNARC effect and response selection. Cortex 2008;44:400–5.
[10] Loetscher T, Bockisch CJ, Nicholls MER, Brugger P. Eye position predicts what number you have in mind. Curr Biol 2010;20:R264–5.
[11] Wilson D, Pratt J. Evidence from a response choice task reveals selection bias in the attentional cueing paradigm. Acta Psychol 2007;126:216–25.
[12] Raudenbush SW, Bryk AS. Hierarchical linear models: applications and data analysis methods. 2nd ed. Thousand Oaks, CA: Sage; 2002.
[13] Lakens D. High skies and oceans deep: Polarity benefits or mental simulation? Frontiers in Cognition 2011;2. Article 21.
[14] Proctor RW, Cho YS. Polarity correspondence: a general principle for performance of speeded binary classification tasks. Psychol Bull 2006;132:416–42.
[15] Santiago J, Ouellet M, Romàn A, Valenzuela J. Attentional factors in conceptual congruency. Cognit Sci 2012;36:1051–77.
[16] Estes Z, Verges M, Barsalou LW. Head up, foot down: object words orient attention to the objects' typical location. Psychol Sci 2008;19:93–7.
[17] McCall C, Tipper CM, Blascovich J, Grafton ST. Attitudes trigger motor behavior through conditioned associations: neural and behavioral evidence. Social Cognit Affective Neurosci 2012;7:841–9.
[18] Barsalou LW. Perceptual symbol systems. Behav Brain Sci 1999;22:577–600.