Vertical position of Chinese power words influences power judgments: Evidence from spatial compatibility task and event-related Potentials

Xiangci Wu, Huibin Jia, Enguo Wang, Chenguang Du, Xianghua Wu, Caiping Dang

Abstract

The present study used event-related potentials (ERPs) to explore the influence of vertical position on power judgments. Participants were asked to identify whether a Chinese word represented a powerful or powerless group (e.g., “king” or “servant”), which was presented in the top or bottom of the screen. The behavioral analysis showed that judging the power of powerful words were significantly faster when they were presented at the top position, compared with when they were presented at the bottom position. The ERP analysis showed enhanced N1 amplitude for congruent trials (i.e., the powerful words in the top and the powerless words in the bottom of the screen) and larger P300 and LPC amplitude for incongruent trials (i.e., the powerful words in the bottom and the powerless words in the top of the screen). The present findings provide further electrophysiological evidence that thinking about power can automatically activate the underlying spatial up-down (verticality) image schema and that the influence of vertical position on the power judgments not only occurs at the early perceptual stage of power word processing, but also at the higher cognitive stage (i.e., allocation of attention resources, conflict solving and response selection). This study revealed the neural underpinnings of metaphor congruent effect which have great significance to our understanding of the abstract concept power.

1. Introduction

The mental representation of abstract concept is an important domain of cognitive psychology research. Barsalou (2008) integrated the conclusions of former researches and put forward the grounded cognition theory of concept representation. The grounded cognition theory rejected traditional views that cognition is computation on amodal symbols in modular system, independent of the brain’s modal systems for perception, action and introspection. The mental representations of abstract concepts not only depend on the proposition of abstract symbols, but also are carried out in a variety of mediums. In the grounded cognition framework, Conceptual Metaphor Theory is an important theory that explains the concept representation, and the core view of this theory is that abstract concepts are represented by metaphors. According to this theory, metaphors provide grounding for abstract concepts by connecting them to more concrete representations. Evidence for this idea originates from metaphorical expressions. By means of such metaphorical connection, the structure inherently present in a concrete concept (the source domain) is mapped onto the abstract concept (the target domain). The concrete concepts in turn take their structure from image schemas (e.g., Hampe and Grady, 2005; Johnson, 1987), which are dynamic patterns of multi-modal activation that emerge from recurring perceptual and action experiences.

Lakoff and Johnson (1999) proposed that abstract concepts are grounded metaphorically in embodied and situated knowledge. Specifically, they argued that the familiar concrete concepts were used to understand the unfamiliar abstract concepts, and our extensive knowledge about our bodies and the interaction of body with the environment provide the most primitive concepts to understand the world (Ren, 2012; Yin et al., 2013). Among all, spatial concepts provide the first and most familiar concepts to human beings, as spatial experience is the basic and early developed experience in our growth. Lakoff and Johnson (2003) proposed that spatial metaphor plays a crucial role in the formation of abstract concept. The upper and lower spatial positions, known as the “vertical spatial metaphor”, are the most basic metaphor in spatial metaphors. They could be mapped onto abstract concepts of the target domain using the up-down spatial concepts. The researchers showed that the basic experience of vertical space could cause orientational metaphor, which provide grounding for abstract concepts by connecting them to vertical experience. For example, affective experience can be understood as verticality, “good is up” and “bad is down”, which help us construct abstract concepts such as “promotion” and “demotion” (e.g., Bergen et al., 2007; Casasanto, 2009; Giessner and...
In the perspective of Embodied Cognition Theory, metaphor is not merely a linguistic phenomenon but also a thinking mode of human beings (Lakoff and Johnson, 1999; Yin et al., 2012). Through metaphor, we are able to map abstract concepts which can’t be perceived by body experiences to specific conceptual fields which are directly associated with perceived motion system of the body (Lakoff and Johnson, 1999).

From the perspective of neural activity, Galles and Lakoff (2005) believed that if a metaphor (e.g., ideas are food) is frequently used in daily life, a stable contact between abstract concepts (e.g., ideas) and concrete experience (e.g., food) could be formed. In addition, they proposed that, if the abstract concepts can form stable contact with concrete experience one-to-one, the concrete information of perceptual experience can be automatically activated during the processing of abstract concepts. The “Metaphor Congruent Effect” is the key evidence that supports this view, which has been found in a series of studies. “Metaphor Congruent Effect” refers to the conclusion that the cognitive processing of abstract concepts can be promoted if the spatial position that these abstract concepts mapped onto is congruent with the position that they were visually presented. For example, Schubert (2005) showed that participants made faster and more accurate responses when powerful words (e.g., “leader”) were presented at the top of the screen or powerless words (e.g., “subordinate”) were presented in the bottom of the screen, compared with when they were presented in the bottom and top of screen respectively. Researchers proposed that these results indicated a stable relationship between the vertical position (“top”, “bottom”) and powerful/powerless words, which could be automatically activated. Similar results were found by Chinese researchers (Deng, 2013; Wang, 2013; Xu, 2010).

Although previous behavioral studies have found that the processing of the abstract concept power could activate an underlying vertical spatial image schema, little is known about the underlying neural mechanism which becomes the first aim of the current study. In addition, ideas diverge as to the stage of cognitive processing at which the vertical position actually influences the power judgments. Some researchers assume that spatial information is automatically activated at the early perceptual stage of word processing, with the “automatic activation” in the Conceptual Metaphor Theory as powerful evidence (Zanolie et al., 2012). However, the activation of spatial information implied by these words might also occurs at the response-selection stage, since the response coding of up and down may be more stable than the automatic activation of spatial up-down (verticality) image schema associated with powerful/powerless words. Therefore, the second aim of this study is to investigate at which stage the vertical space positions influence power judgements.

To achieve these two aims, we investigated the time course of power judgment using spatial compatibility paradigm and the ERP technology. Here, we studied the early ERP components P1 and N1 which were related with early visual spatial attention, and the late components P300 and late positive component (LPC) related with higher cognitive processes. The visual P1 component occurred at 80–130 ms after the onset of stimuli and the visual N1 component occurred at 160–200 ms after the onset of stimuli were enhanced as a function of attention allocated to the visual target. Targets presented at locations allocated with more attentional resources elicited larger P1/N1 amplitude than targets presented at locations allocated with less attentional resources (Doallo et al., 2004; Hillyard et al., 1995; Luck et al., 1994; Luck and Hillyard, 1995; Mangun, 1995; Mangun and Hillyard, 1991; Mangun et al., 1998; Vogel and Luck, 2000). The P300 component is often associated with the identification, evaluation or categorization of the stimuli and context, and reflects the allocation of cognitive resources in these mental processes. Its amplitude is associated with the amount of resources invested in the stimulus and its latency is proportional to the evaluation time (Peng et al., 2004; Wang, 2011; Wei and Luo, 2002). And the LPC component in the Stroop task was found to be related with conflict solving or response selection, which was highly debated (Coderre et al., 2011; Fehr et al., 2006). Based on previous studies, we hypothesized that (1) the RTs (reaction times) should be significantly shorter in the congruent condition (i.e., the position where the power words were presented was congruent with the image schema activated), compared to those in the incongruent condition (i.e., the position where the power words were presented was incongruent with the image schema activated); (2) if the perception of powerful/powerless words presented on the top/bottom position of screen could automatically reallocate the attentional resources between spatial locations, the amplitude of the early ERP component (P1 and/or N1) should be enhanced in the congruent condition. Additionally, the task difficulty and the cognitive conflict level may be higher in the incongruent condition, thus the amplitudes of P300 and LPC should be larger in this condition.

2. Methods

2.1. Participants

Eighteen right-handed undergraduate students recruited from Henan University in Kaifeng, China participated in this study. Three participants were excluded from further data analysis due to high error rate (i.e., more than 15%) and abnormal ERP waveforms, leaving a total of 15 participants (8 females; mean age = 22 years, aged from 20 to 23 years). All these participants, with no history of neurological or psychiatric illness and normal or corrected-to-normal vision, gave their written informed consent and were paid for their participation. The local ethics committee approved the experimental procedures.

2.2. Material

In a pilot study before the experiment, 130 power-related two-character Chinese words were collected by experimenters. All these words referred to different types of people, professions or social classes. Then, 10 undergraduate students were recruited to rate the power level of each word. The words were rated on a 6-point scale ranging from 1 (Extremely powerless) to 6 (Very powerful). Finally, 30 powerful words with relative high scores (M = 4.42, SD = 0.74), which refer to powerful people (e.g., 皇帝, means emperor) and another 30 powerless words with relative low scores (M = 1.94, SD = 0.60), which refer to powerless people (e.g., 囚犯, means prisoner), were selected as the materials for the formal experiment (see Appendix A). It found that the scores of powerful words were significantly higher than those of the powerless words (F(1,19) = 67.58, p < 0.001). In addition, no significant difference between powerful words and powerless words with regard to word frequency was found.

2.3. Design and procedure

All participants were required to sit on a comfortable chair at about 60 cm from the monitor in a silent, temperature-controlled room, and were instructed to keep their eyes fixed on the black fixation point which was presented in the middle of the screen throughout the experiment.

At the beginning of each trial, a black fixation point appeared in the middle of the screen and lasted for 500 ms (see Fig. 1). Shortly thereafter, one of the 60 selected Chinese words, either powerful word or powerless word, was displayed above or below the middle of the screen. All the Chinese characters had a font size of 18 (Song Ti font), and were presented in black on a white background using the E-Prime software (Psychology Software Tools, Inc., Pittsburgh, PA). The participants were instructed to decide whether the stimulus was powerful or powerless as quickly and accurately as possible, once it appeared in the screen. One half of the participants were asked to respond by pressing key ‘1’ with right index finger if the stimulus was a powerful word, and pressing
(key ‘2’ with right middle finger if the stimulus was a powerless word. And the assignment of response keys was reversed for the other half of the participants. The presentation of powerful or powerless words was terminated by a key pressing, or was terminated when the words elapsed for 3000 ms. Therefore, they were informed that their responses must be made within 3000 ms. Each response was followed by 500 ms of a blank screen with a black fixation point presented in the middle of the screen.

Twenty practice trials were used before formal experiment in order to familiarize subjects with the procedure. The procedure of each trial in pre-training was the same as that of the subsequent formal experiment.

The formal experiment was consisted of 240 stimuli, including 60 powerful words presented on the top of the screen, 60 powerless words presented on the top of the screen, 60 powerful words presented on the bottom of the screen and 60 powerless words presented on the bottom of the screen. Since the number of each kind of stimuli was too low to obtain reliable ERP components, all these 240 trials were divided into 2 conditions: congruent and incongruent. In congruent trials, powerful words were presented on the top of the screen and powerless words were presented on the bottom of the screen. In incongruent trials, powerful words were presented on the bottom of the screen and powerless words were presented on the top of the screen. The reaction times (RTs) were recorded, and the error rate for each condition was calculated.

2.4. EEG data recording and analysis

EEG data were recorded using a 32-channel Brain Products system (pass band: 0.05–100 Hz; sampling rate: 500 Hz; physical reference channel: the left mastoid) with a standard EEG cap based on the extended 10–20 system. All channel impedances were kept lower than 5 kΩ. In order to monitor ocular movements and eye blinks, the vertical electrooculograms (VEOGs) were recorded with electrodes placed above and below the right eye and the horizontal electrooculograms (HEOGs) were recorded with electrodes placed by the outer canthi of each eye.

In the offline EEG data preprocessing, EEG data were re-referenced to the mean of the left and right mastoids (i.e., average mastoid reference), and low-pass filtered at 50 Hz. Epochs to the congruent condition and the incongruent condition were extracted using a time window of 1200 ms (200 ms pre-stimulus and 1000 ms post-stimulus), and baseline-corrected by demeaning the EEG data within the pre-stimulus interval. Epochs contaminated by blinks, eye movements, excessive muscle activity or peak-to-peak deflection exceeding ±100 μV were excluded from the following averaging. In order to assess the influences of vertical position on power judgment, EEG epochs with correct responses in each condition was averaged separately, which yielded the single subject ERP waveforms of each condition. Finally, the grand average ERP waveforms of each condition were obtained by averaging the single subject ERP waveforms across all participants.

Through the inspection of grand average ERP waveforms, four ERP components were identified, which were P1, N1, P300, and LPC (Fig. 2). The amplitude of P1, N1 and P300 was defined as the peak amplitude within time window 80–130 ms, 160–200 ms, and 250–400 ms respectively. And the amplitude of LPC was calculated as the mean amplitude within time window 400–800 ms.

It was observed that (1) P1 and N1 were mainly distributed over parietal-occipital electrodes; (2) P300 and LPC could be clearly seen on frontal, central and parietal electrodes (Fig. 3). Based on the scalp distribution of these ERP components, six anteroposterior sites were selected for statistical analysis, which were frontal (electrode Fz, F3 and F4), frontocentral (electrode FC1, FC5 and FC6), central (electrode Cz, C3 and C4), centroparietal (electrode CP1, CP5 and CP6), parietal (electrode Pz, P3 and P4) and occipital (electrode Oz, O1 and O2). The amplitude of each ERP component in each scalp site was obtained through averaging the peak amplitudes or mean amplitudes of the three electrodes located in this scalp site. For P1 and N1, two-way repeated measures ANOVAs were conducted, with congruency (2 levels: congruent and incongruent) and anteroposterior sites (2 levels: parietal and occipital) as independent variables. For P300 and LPC, similar two-way repeated measures ANOVAs were conducted, with congruency (2 levels: congruent and incongruent) and anteroposterior sites (5 levels: frontal, frontocentral, central, centroparietal and parietal) as independent variables.

3. Results

3.1. Behavioral results

Table 1 shows both the RTs and error rates in the power judgment task. Only trials in which the responses were correct were included in the analysis of results for the power judgment task. Trials were further excluded from analyses when the RTs deviated by 3 or more SDs from an individual participant’s overall mean RT.

Two-way within-subjects repeated-measures ANOVAs were performed on RTs and error rates in the power judgment task as a function of power (powerful, powerless) and position (top, bottom).

For RTs, the main effect of power was not significant \(F(1, 14) = 0.63, p > 0.05, \eta^2_p = 0.04\). The main effect of position was marginally significant \(F(1, 14) = 3.80, p = 0.07, \eta^2_p = 0.21\), and participants responded faster to words presented in the top position of the screen compared to words displayed in the bottom position of the screen. The interaction between power and position was also found significant \(F(1, 14) = 9.09, p < 0.01, \eta^2_p = 0.39\). The next simple effect analyses revealed that judging the power of powerful words was significantly faster when the words were presented in the top position of the screen.
compared with when they were displayed in the bottom position of the screen. Judging the power of powerless words were also faster when they appeared at the bottom position compared with when they appeared at the top position, however this difference did not reach significance level.

No main effect of power, position or interaction effect between these two factors was found for error rates ($F_{sb1}$).

### 3.2. ERP results

The grand-average ERP waveforms of the congruent and incongruent condition on electrode Fz, Cz, Pz and Oz can been seen in Fig. 2. And Fig. 3 shows the topographical maps of the mean amplitudes for the congruent condition, the incongruent condition and the difference wave (incongruent condition minus congruent condition) in the windows of P1(80–130 ms), N1(160–200 ms), P300(250–400 ms) and LPC(400–800 ms).

Firstly, the two-way repeated-measures ANOVA on the P1 peak amplitude demonstrated that the main effects of congruency, anteroposterior sites and the interaction effect between these two factors were not significant ($F_{sb1}$).

Secondly, for the peak amplitude of N1 component, the two-way repeated-measures ANOVA found that the main effect of congruency was significant ($F(1, 14) = 5.91, p < 0.05, \eta^2_p = 0.30$), and the amplitude was significantly larger in incongruent trials ($M = 1.71 \mu V, SD = 0.78 \mu V$) than that in congruent trials ($M = 2.28 \mu V, SD = 0.78 \mu V$). In addition, the main effect of anteroposterior sites was significant ($F(4, 56) = 5.27, p < 0.01, \eta^2_p = 0.27$) reflecting that the amplitude of LPC was not uniformly distributed over different anteroposterior locations. The post hoc comparisons revealed that the LPC component was largest at frontal and frontocentral locations. Moreover, the interaction between these two factors was not significant.

Thirdly, the repeated-measures ANOVA on P300 peak amplitude showed a significant main effect of congruency ($F(1, 14) = 11.27, p < 0.01, \eta^2_p = 0.45$), and the P300 amplitude in congruent trials ($M = 9.78 \mu V, SD = 1.01 \mu V$) was significantly smaller than the amplitude in incongruent trials ($M = 8.34 \mu V, SD = 1.11 \mu V$). The main effect of anteroposterior sites was also significant ($F(4, 56) = 9.15, p < 0.01, \eta^2_p = 0.39$). The post hoc comparisons revealed that the P300 component was largest at parietal locations. However, the interaction between these two factors was not significant.

Lastly, in order to explore more accurate time course of the influences of vertical position of powerful/powerless words on the ERP waveforms of the power-judgment stage, we also analyzed the amplitude of LPC. For this component, significant main effect of congruency was found ($F(1, 14) = 5.91, p < 0.05, \eta^2_p = 0.30$), and the amplitude was significantly larger in incongruent trials ($M = 2.28 \mu V, SD = 0.78 \mu V$) than that in congruent trials ($M = 1.71 \mu V, SD = 0.78 \mu V$). In addition, the main effect of anteroposterior sites was significant ($F(4, 56) = 5.27, p < 0.01, \eta^2_p = 0.27$) reflecting that the amplitude of LPC was not uniformly distributed over different anteroposterior locations. The post hoc comparisons revealed that the LPC component was largest at frontal and frontocentral locations. Moreover, the interaction between these two factors was not significant ($F(4, 56) = 2.56, p > 0.05, \eta^2_p = 0.15$).

### 4. Discussion

In this experiment, we found that the vertical spatial position of a Chinese word which represented a powerful or powerless person...
could influence the judgment whether the named entity was powerful or powerless. From the behavioral data, participants responded significantly faster to powerful words when they were presented at top position of the screen (i.e., the congruent condition) than when they were presented at the bottom position of the screen (i.e., the incongruent condition). Some interesting results from the ERP data were also revealed, which could be the neural underpinnings of the association between verticality and power. We found that the N1 amplitude was significant larger in congruent trials (i.e., the powerful words were presented in the top of the screen or the powerless words were presented in the bottom of the screen) than the N1 amplitude in incongruent trials (i.e., the powerful words were presented in the bottom of the screen or the powerless words were presented in the top of the screen). On the other hand, the amplitudes of P300 and LPC were significantly larger in incongruent trials compared to those in congruent trials.

From the behavioral data, the reaction times were significantly shorter when powerful words were presented in the top position of the screen (i.e., the congruent condition) than when they were presented in the bottom position of the screen (i.e., the incongruent condition). This result showed that the vertical spatial position of powerful words could influence the judgment whether the powerful words were powerful or powerless, which were consistent with those studies showing the metaphor congruency effect (Meier and Robinson, 2004; Schubert, 2005). Our results suggest that the metaphor congruency effect has its repeatability and cross-cultural consistency. On the other hand, judging the power of powerless words was also faster when they

Table 1
Mean reaction times (in ms) and Mean error rates (and SDs) for the power judgments task, depending on power level of Chinese power word (powerful/powerless) and its position on screen (top/bottom).

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<th>Powerless</th>
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<tr>
<td></td>
<td>Top</td>
<td>Bottom</td>
<td>Top</td>
<td>Bottom</td>
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<tr>
<td>Reaction time (ms)</td>
<td>728.98 ± 86.19</td>
<td>768.07 ± 108.85</td>
<td>765.59 ± 95.56</td>
<td>750.48 ± 88.74</td>
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<td>Error rate (%)</td>
<td>1.17 ± 1.40</td>
<td>1.33 ± 1.42</td>
<td>0.94 ± 1.68</td>
<td>1.08 ± 1.02</td>
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Fig. 3. Topographical maps of the mean amplitudes for the congruent condition, the incongruent condition and the difference wave (incongruent condition minus congruent condition) in the windows of P1 (80–130 ms), N1 (160–200 ms), P300 (250–400 ms) and LPC (400–800 ms). It’s observed that (1) P1 and N1 are mainly distributed over parietal-occipital electrodes; (2) P300 and LPC can be clearly seen on frontal, central and parietal electrodes. These two late components are maximal on parietal electrodes and frontal electrodes respectively.
appeared in the bottom position of screen compared with when they appeared in the top position, however this difference did not reach significance level. It may be caused by the reading habit or attention biases that people always respond to the stimuli presented at the top position of screen more quickly. However, we can’t rule out that the perceptual association between powerful and upper position of the visual field is stronger than that between powerless and lower position of the visual field. In the current study, we only compared powerful/powerless words presented in the top and bottom position of the screen. Adding a baseline condition in which these words are displayed in the middle of the screen may help us solve this question which deserves further study.

From the ERP data, some interesting findings were detected, which can be seen from Figs. 2 and 3. The present study got some expected ERP components in both the congruent condition and the incongruent condition.

Firstly, the results of the present study found that congruency between the concept of power and the spatial up-down location could not modulate the amplitude of P1, whereas the amplitude of N1 could be modulated. This result was consistent with Wu and Wang (2014) and Zanolie et al. (2012) using a distinct experimental paradigm, which showed a higher N1 amplitude for congruent spatial position, without any significant results for P1 revealed. Differential modulations of the P1 and N1 components have also been reported in other studies using distinct experimental paradigms, which may be due to the fact that the P1 and N1 components reflect differential visual and attentional processes (Luck, 1995). The P1 and N1 components which are related to early processing of visuospatial information and the allocation of visuospatial attention are enhanced as a function of attention allocated to the visual target. Thus, the significantly enhanced N1 amplitude in congruent condition may indicate that some early visual identification of mismatch between the power of the named entities and verticality occurred. Furthermore, it has been suggested that such early ERP components do not just reflect the sensory processing, but also the orienting or engaging of visual attention. Thus, the N1 result observed in this study may imply that more resources of visual attention were allocated to the powerful/powerless words if their spatial position was congruent with their perceived power. These results support the view of the Conceptual Metaphor Theory, which predicts that the spatial up-down image schema (powerful up; powerless down) is inherent in the concept power’s representation, and it should affect spatial attention in an automatic manner.

Secondly, in consistent with other related researches, we found that the amplitude of P300 component, which was mainly located in a time window from 250 to 400 ms, was significantly larger in the incongruent trials compared to that in congruent trials. Previous studies have showed that the emergence of P300 is often associated with the identification, evaluation or categorization of the stimuli and context, and reflects the allocation of cognitive resources in these mental processes. Its amplitude is associated with the amount of resources invested in the stimulus and its latency is proportional to the evaluation time (Peng et al., 2004; Wang, 2011; Wei and Luo, 2002). The result that the P300 amplitude was significantly larger in incongruent trials compared to the congruent trials, was also clearly observed in previous ERP experiments, although a different paradigm may be used (Cheng, 2010; Zhang et al., 2013). In the present study, a larger P300 amplitude was observed in the incongruent condition, which could be interpreted as follows: in incongruent condition (e.g., “emperor” at the bottom of the screen, “prisoner” at the top position of the screen), participants not only need more attention resources in order to ensure the effective processing of the stimuli presented in the screen, but also need more mental effort in order to inhibit the activation of the interference characteristics of stimuli (i.e., the visual position of powerful/powerless words).

Lastly, we also found significantly larger LPC amplitude in the incongruent condition compared to that in the congruent condition, which was consistent with previous studies using the Stroop task (e.g., Codereaa et al., 2011; Fehr et al., 2006). The LPC component is found maximal on centro-parietal electrodes or right frontal electrodes, depending on the paradigm used. Previous studies found it was originated from the middle or inferior frontal gyrus and left extrastriate region, which suggests that this component is involved in conflict resolution (West, 2003). However, another study found it may be related with response selection, since its amplitude is correlated with RT and accuracy rate (West et al., 2005). Thus though it is frequently reported in Stroop ERP studies, the underlying cognitive processes involved in generating the LPC remain unclear (Codereaa et al., 2011). Significant higher LPC amplitude in the incongruent condition suggests that higher conflicts or higher difficulty should exist in the incongruent condition of this study, which supports our hypothesis that the “power” is partially understood in terms of vertical space (i.e., powerful up; powerless down). These results were not detected in Zanolie et al. (2012), which may be caused by the distinct experimental paradigms used in the present study and Zanolie et al. (2012).

From the ERP results, we could find that not only the P1 and N1 components were evoked, but some late ERP components (i.e., P300 and LPC) commonly observed in the Stroop tasks were also evoked. Besides, we found that congruency between the concept of power and the spatial up-down location could modulate the amplitudes of N1, P300 and LPC. The significantly enhanced N1 amplitude in congruent condition may indicate that some early visual identification of mismatch between the power of the named entities and verticality occurred, and may also imply that more resources of visual attention were automatically allocated to the powerful/powerless words if their spatial position was congruent with their perceived power. These results support the view that the spatial congruency should affect spatial attention in an automatic manner. Besides the N1 effect, we also found that the P300 and LPC amplitudes, which were associated with evaluation of the stimuli, conflict solving or response selection respectively, were significant higher in the incongruent condition.

Above all, the present study suggests not only that the presentation of powerful/powerless words could automatically activate the spatial up-down image schema (powerful up; powerless down), but also that the influence of vertical position on the power judgments occurs at both the earlier perceptual stage of word processing and the higher-level cognitive processes (e.g., allocation of attention resources, conflict solving and response selection). The current study could have important significance in exploring the neural mechanism of the representation of the abstract concept power. At the same time, we need pay attention to the following several problems in future research. Firstly, although the ERP technology has obtained the brain functional data of power concept representation from the time course, but the spatial resolution of ERPs is relatively low. Therefore, we could combine the ERP technology with fMRI technology together in future and explore the problem of abstract concept power representation both from temporal and spatial aspects. Secondly, words and pictures are the two major ways for human to understand the world. There are a lot of researches discussing the abstract concept power representation with powerful/powerless words. However, whether pictures represented powerful or powerless person will produce the same effect merits a further study.

5. Conclusion

In this study, we used ERP technology to investigate the neural mechanism of conceptual representation of power in spatial compatibility paradigm and found some useful results. The present findings provide further electrophysiological evidence that thinking about power can automatically activate the underlying spatial up-down (verticality) image schema and that the influence of vertical position on the power judgments not only occurs at the earlier perceptual stage of power word processing, but also at the higher cognitive stage (i.e., allocation of attention resources, conflict solving and response selection), which
demonstrate significant metaphor congruent effect. This study revealed the neural underpinnings of metaphor congruent effect which have great significance to our understanding of the abstract concept power.

Acknowledgments

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Appendix A

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<tr>
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<th>Title</th>
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<td>Wang X.</td>
<td>An Experimental Research on Spatial Metaphor of Social Status Modern Chinese (Unpublished Master Thesis)</td>
<td>2013</td>
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