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Cognitive control in belief-laden reasoning during conclusion processing: An ERP study

Junlong Luo[1,2], Xin Liu[2], Edward J. N. Stupple[3], Entao Zhang[4], Xiao Xiao[2], Lei Jia[2], Qun Yang[5], Haijiang Li[2], and Qinglin Zhang[2]

[1]Education College, Shanghai Normal University, Shanghai, China
[2]Department of Psychology, Southwest University, Chongqing, China
[3]Centre for Psychological Research, University of Derby, Derby, UK
[4]School of Psychology and Cognitive Science, East China Normal University, Shanghai, China
[5]School of Education Science, Hangzhou Normal University, Hangzhou, China

Belief bias is the tendency to accept conclusions that are compatible with existing beliefs more frequently than those that contradict beliefs. It is one of the most replicated behavioral findings in the reasoning literature. Recently, neuroimaging studies using functional magnetic resonance imaging (fMRI) and event-related potentials (ERPs) have provided a new perspective and have demonstrated neural correlates of belief bias that have been viewed as supportive of dual-process theories of belief bias. However, fMRI studies have tended to focus on conclusion processing, while ERPs studies have been concerned with the processing of premises. In the present research, the electrophysiological correlates of cognitive control were studied among 12 subjects using high-density ERPs. The analysis was focused on the conclusion presentation phase and was limited to normatively sanctioned responses to valid–believable and valid–unbelievable problems. Results showed that when participants gave normatively sanctioned responses to problems where belief and logic conflicted, a more positive ERP deflection was elicited than for normatively sanctioned responses to nonconflict problems. This was observed from −400 to −200 ms prior to the correct response being given. The positive component is argued to be analogous to the late positive component (LPC) involved in cognitive control processes. This is consistent with the inhibition of empirically anomalous information when conclusions are unbelievable. These data are important in elucidating the neural correlates of belief bias by providing evidence for electrophysiological correlates of conflict resolution during conclusion processing. Moreover, they are supportive of dual-process theories of belief bias that propose conflict detection and resolution processes as central to the explanation of belief bias.

Keywords: Belief-bias effect; Cognitive control; Dual processing; Event-related potentials (ERPs); Late positive component (LPC).

La croyance biaisée est la tendance à accepter des conclusions qui sont compatibles avec les croyances existantes plus souvent que celles qui contredisent les croyances. Il s'agit de l'un des résultats le plus souvent obtenu dans la documentation sur le raisonnement. Récemment, les études de la neuroimagerie utilisant l'imagerie par résonnance magnétique fonctionnelle (IRMf) et les potentiels cognitifs liés à un événement (PCE) ont fourni une nouvelle perspective et ont mis en évidence des corrélats neuraux du biais de croyance qui ont été interprétés comme appuyant les théories du traitement double de la croyance biaisée. Toutefois, les études d'IRMf ont surtout porté sur le traitement de la conclusion, alors que les études de PCE se sont intéressées au traitement des prémisses. Dans la présente recherche, les corrélats électrophysiologiques du contrôle cognitif ont été étudiés auprès de 12 sujets en utilisant les PCE à haute densité. L'analyse a été centrée sur la phase de la présentation de la conclusion et a été limitée aux réponses normativement sanctionnées à des problèmes croyables

Correspondence should be addressed to Qinglin Zhang, Department of Psychology, Southwest University, Chongqing, China, (E-mail: luo831023@163.com); and Edward J. N. Stupple, Centre for Psychological Research, University of Derby, Derby, UK, (E-mail: E.J.N.Stupple@derby.ac.uk).
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validides et incroyables valides. Les résultats montrent que lorsque les participants donnaient des réponses normativement sanctionnées à des problèmes où la croyance et la logique étaient en conflit, une déflexion du PCE plus positive était obtenue que pour les réponses normativement sanctionnées à des problèmes non conflictuels. Cela a été observé de −400 à −200 ms avant que la réponse correcte soit donnée. Nous soutenons que la composante positive est analogue à la composante positive tardive (CPT) impliquée dans les processus cognitifs de contrôle. Cela est cohérent avec l'inhibition de l'information empiriquement anormale lorsque les conclusions sont incroyables. Ces données sont importantes pour comprendre les corrélats neuraux de la croyance biaisée en fournissant la preuve de corrélats électrophysiologiques de résolution de conflit durant le traitement de la conclusion. De plus, elles confortent les théories du traitement double de la croyance biaisée qui soutient que les traitements de la détection du conflit et de la résolution sont au cœur de l'explication de la croyance biaisée.

El sesgo de la creencia es la tendencia a aceptar con más frecuencia las conclusiones que son compatibles con las creencias existentes que las que contradicen las creencias. Éste es uno de los hallazgos comportamentales más replicados en la literatura del razonamiento. Recientemente, los estudios de neuroimagen que utilizan las imágenes de resonancia magnética funcional (IRMf) y los potenciales relacionados con eventos (PREs) han proporcionado una nueva perspectiva y han demostrado correlatos neurales del sesgo de creencia que han sido vistos como un apoyo a las teorías de proceso dual del sesgo de creencia. Sin embargo, los estudios de IRMf han tendido a centrarse en el procesamiento de la conclusión, mientras que los estudios de PREs se han ocupado del procesamiento de las premisas. En la presente investigación, se estudiaron los correlatos electrofisiológicos del control cognitivo en 12 sujetos usando PREs de alta densidad. El análisis se centró en la fase de presentación de conclusiones y se limitó a las respuestas normativamente sancionadas a los problemas válidos creíbles y no creíbles. Los resultados mostraron que cuando los participantes daban respuestas normativamente sancionadas a los problemas donde la creencia y la lógica estaban en conflicto, se obtenía una desviación de ERP más positiva que para las respuestas normativamente sancionados a problemas no conflictivos. Esto se observó entre −400 y −200 ms antes de que la respuesta correcta fuera dada. Se argumenta que el componente positivo es análogo al componente positivo tardío (CPT) involucrado en los procesos de control cognitivo. Esto es consistente con la inhibición de la información empírica anómala cuando las conclusiones son increíbles. Estos datos son importantes en la aclaración de los correlatos neurales del sesgo de creencia, proporcionando evidencia de los correlatos electrofisiológicos de la resolución de conflictos durante el procesamiento de conclusiones. Por otra parte, son de apoyo a las teorías de proceso dual del sesgo de creencia que proponen la detección de conflictos y procesos de resolución como elemento central de la explicación del sesgo de creencia.

The belief-bias effect in syllogistic reasoning is the tendency of participants to accept more believable conclusions than unbelievable conclusions; the bias is more pronounced for invalid problems but is also observed for valid problems, such that the conclusion-endorsement rates display an interaction between logical status and the believability of the problems (e.g., Evans, 2003; Klauer, Musch, & Naumer, 2000). In the traditional belief-bias paradigm there are two types of syllogism: conflict problems, in which the logical conclusion is inconsistent with one's beliefs (valid–unbelievable and invalid–believable), and nonconflict problems, in which the logical conclusion is consistent with one's beliefs (valid–believable and invalid–unbelievable). Most accounts of belief bias attempt to explain the observed interaction in conclusion endorsement rates with dual-process theories. These accounts propose two types of cognitive process: Type 1 processing entails rapid belief-driven heuristics; Type 2 processing entails slower analytic responding (e.g., Evans, 2003, 2007). These differing processes come into conflict when their outcomes differ. Studies have demonstrated robust effects of response patterns, response times, and confidence ratings within the belief-bias paradigm (e.g., Evans, Barston, & Pollard, 1983; Stupple & Ball, 2008; Turner & Thompson, 2009) which are well explained by these dual-process accounts. For example, dual-process theories have gained support for the prediction of increased response times for conflict problems relative to nonconflict problems due to the cognitively demanding process of belief inhibition (e.g., Stupple & Ball, 2008). Furthermore, Evans and Curtis-Holmes (2005) demonstrated increased belief bias for speeded responses, which is consistent with limited time reducing the opportunity for Type 2 processing. Moreover, Stupple, Ball, Evans, and Kamal-Smith (2011) have shown that cognitive ability moderates the influence of belief bias, such that the most able participants on belief-bias tasks devote additional processing time to the most demanding conflict problems. These example studies are illustrative of the general literature, which is, for the most part, consistent with dual-process theories that place conflict detection and resolution as central to the explanation of belief bias.

Most recently, neuroscientific methods, such as functional magnetic resonance imaging (fMRI), functional near infrared spectroscopy (fNIRS), repetitive transcranial magnetic stimulation (rTMS), and event-related potentials (ERPs) have demonstrated the value of utilizing new measures to examine the belief-bias effect (Goel & Dolan, 2003; Luo, Yang, Du, & Zhang, 2011; Luo et al., 2008; Tsujii, Masuda, Akiyama, & Watanabe, 2010; Tsujii & Watanabe, 2010). This accumulating neuroscientific evidence has generally shown support for dual-process theories (see, e.g., De Neys, Moyens, & Vansteenwegen, 2010) and has added weight to the argument that belief bias is difficult to explain with a unitary cognitive process (but see Dube, Rotello, & Heit, 2010 for a challenge to dual-process theory from a single-process perspective).

Furthermore, dual-process accounts of belief bias posit cognitive control mechanisms such as belief inhibition, analytic inhibition, and conflict monitoring (e.g., Evans, 2007; Stupple et al., 2011) as central to explaining the phenomenon. For example, normative responses to valid–unbelievable problems require both the detection of the conflict between belief and logic, and the inhibition of the belief to avoid rejection of the valid conclusion. Invalid–believable problems require even greater cognitive control as they also require the inhibition of an analytic bias towards searching for models that are consistent with belief. This evidence from fMRI, rTMS and fNIRS studies demonstrates that the inhibition of belief-bias is associated with increased activation of the right lateral prefrontal cortex (PFC) (Goel & Dolan, 2003; Tsujii et al., 2010; Tsujii & Watanabe, 2010).

Although the fMRI and fNIRS techniques can provide accurate information about the location of the brain areas involved, these measures are limited in their capacity to inform us about the timing of activations. Event-related potentials (ERPs) provide a means to evaluate timing of cognitive processes prior to a response; with this technique, recordings are made of the electrical activity of the brain that are time-locked to the presentation of an external stimulus. ERP data allow for a precise examination of the time course of activation for different stages of reasoning. This approach has been successfully applied both to the reasoning domain and, more specifically, for conflict resolution. For example, studies (Luo et al., 2008, 2011) have found some ERP components associated with the belief-bias effect. However, since these studies only examined the temporal resolution of premise processing rather than the processing of conclusions, it remained unclear what happens to the ERP effects in the conclusion presentation phase after the presentation of the premises. This is important because, when ERP measures are time-locked to premise presentation, it is only possible to obtain an incomplete picture of the process as belief–logic conflicts may also emerge once the conclusion has been presented. Furthermore, there is evidence that belief-biased reasoning is conclusion-driven (e.g., Morley, Evans, & Handley, 2004), and as such the examination of ERPs time-locked to conclusion presentation would seem to be essential. In addition, Bonnefond and Van der Henst (2009) highlighted the fact that most fMRI studies have focused on conclusion processing and, in the interests of the comparability of studies, it is clear that the examination of conclusion processing is an important next step.

In the present study, the neural basis of inhibitory processing (before participants make a correct response on a logical conclusion) in belief-laden syllogistic reasoning was investigated using a high-density (64 channels) ERP recording system. Participants were asked to perform a syllogistic reasoning task, involving two types of belief-bias problems: conflict problems (with valid–unbelievable conclusions) and nonconflict problems (with valid–believable conclusions), and were required to make a normatively sanctioned logical response after conclusion presentation. Thus participants needed to inhibit their beliefs for the conflict condition but not in the nonconflict condition.

Previous studies (Luo et al., 2008, 2011) have provided evidence for electrophysiological correlates of belief-bias effect during premise processing. For example, a greater negativity was associated with the detection of conflict between empirical beliefs and logical rules in conditional reasoning (Luo et al., 2011). Similarly, it has been postulated that an increased N2 in conditional reasoning is related to perceptual conflict (Bonnefond & Van der Henst, 2009; Prado, Kaliuzhna, Cheylus, & Noveck, 2008). Conversely, a greater positivity was found in syllogistic reasoning when participants were faced with beliefs that are inconsistent with logical rules (Luo et al., 2008). The authors' interpretation of this finding was that the greater positivity (or LPC) may reflect the mental inhibition of conflict. Similarly, in the previous literature, LPC (which also is called the "P3"; see Polich, 2007) is an index of neural inhibition (Donchin, 1981; Polich, 2007). The available research, however, appears to be inconsistent, which may be due to the different reasoning paradigms (syllogistic reasoning vs. conditional reasoning) in these studies. In view of using syllogistic reasoning (consistent with Luo et al., 2008) in the present study, we hypothesized that the LPC would involved in inhibiting the belief-bias effect for the conflict problems. By recording and analyzing high-density ERPs elicited by making a logical response under different conditions, the ERP data will allow for a more precise examination of the time course of conflict resolution during conclusion processing.

MATERIALS AND METHODS

Participants

As paid volunteers, 12 undergraduate students (six women, six men) aged 21–24 years (mean age, 22.8 years) participated in the study. All participants were right-handed, and with no reported neurological disorders. This study was approved by the local Ethics Committee, and all participants signed an informed consent form for the experiment.

Materials

In order to avoid the influence of belief of the premises, we selected an atypical material to ensure the premises are empirically true. The specific format of reasoning is as follows: *All A are B (major premise). All C are B (minor premise). Therefore, the relation between A and C is indefinite (valid conclusion)/Therefore, all A are B (invalid conclusion)*. Two task conditions (conflict and nonconflict; see Table 1) were examined when this reasoning format was filled by empirically true premises. In order to exclude the influence of differing decisions (acceptance and rejection), only trials with correct response (i.e., acceptance) on valid conclusions of conflict/nonconflict conditions were taken into ERP analysis. To ensure that there were enough trials available for each subject and condition in a reasonable time frame, the ratio of valid to invalid conclusions (i.e., conflict and nonconflict) was 3:1. Furthermore, we selected other formats of reasoning with concrete content as additional materials; for example: (1) *All A are B; All B are C; Therefore, all A are C (valid conclusion)/the relation between A and C is indefinite (invalid conclusion)*. (2) *All B are C; All A are B; Therefore, all A are C (valid conclusion)/ the relation between A and C is indefinite (invalid conclusion)*. (3) *All A are B; All A are C; Therefore, some B are C (valid conclusion)/the relation between B and C is indefinite (invalid conclusion)*. The three reasoning formats were filled by empirically true premises too. Thus, the additional materials entail conflict and nonconflict problems, but the inhibition of belief bias in these problem types would not be investigated. These additional materials were used to ensure the effective inference during premise onset, in case participants judged the validity of the conclusions without inference. The ratio of valid to invalid additional conclusions was 1:3, which is a balance for whole ratio. And the numbers of conflict trials, nonconflict trials, and additional reasoning trials were 80, 80, and 160, respectively. A baseline condition was not devised in this study since the premises are all empirically true. Thus, it is difficult to find an ideal baseline in neural activations that are associated with inhibiting belief bias during conclusion processing. The presented words and sentences are familiar to people in their daily life (e.g., women, flowers, and animals). The length of each conclusion was eight to 13 Chinese characters, and the characters were high-frequency words. The present focus of analysis on the valid problems is driven by the desire to maximize the number of participants who respond correctly. As Stupple et al. (2011) demonstrated that only the most able subset of participants consistently provide the normatively sanctioned response to invalid–believable problems, it was deemed prudent to exclude these problems from analysis.

Procedure

The overall experiment was divided into two parts: a training phase and a test phase. The training phase consisted of at least three blocks in order to train participants to inhibit their belief bias. Each block (10 trials) contained one condition (i.e., the conflict condition, nonconflict condition, or additional condition). Participants were given feedback after each trial, and those whose accuracy rate in every condition was greater than 80% were allowed to begin the experiment. The formal test stage was composed of five blocks, with each block incorporating 64 trials (i.e., 16 conflict trials, 16 nonconflict trials, and 32 additional reasoning trials). The stimuli presented in the test blocks were randomized across the three categories of conflict condition, nonconflict condition, and additional condition.

Subjects were seated in a semidark room facing a monitor placed 60 cm away from the eye. Horizontal and vertical visual angles were below 5°. Each reasoning item was presented as shown in Figure 1. Each trial was initiated by a "+" in the center of the screen for 300 ms. Next, the major premise (six to eight Chinese characters at a visual

TABLE 1

Examples of task types with approximate literal translation: The premises for all tasks are empirically true

Task type	
The conflict trial	
Major premises	所有女人是动物 (All women are animals)
Minor premises	所有人是动物 (All humans are animals)
Valid conclusion	因此，女人和人的关系不确定 (Therefore, the relation between women and humans is uncertain)
Or	
Invalid conclusion	因此，所有女人是人 (Therefore, all women are humans)
The non-conflict trial	
Major premises	所有小狗是狗 (All small dogs are dogs)
Minor premises	所有黑狗是狗 (All black dogs are dogs)
Valid conclusion	因此，小狗和黑狗关系不确定 (Therefore, the relation between small dogs and black dogs is uncertain)
Or	
Invalid conclusion	因此，所有小狗是黑狗 (Therefore, all small dogs are black dogs)

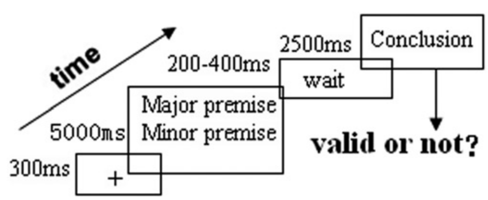

Figure 1. Stimulus paradigm presentation.

angle of $1.93^\circ \times 0.81^\circ$) and the minor premise (six to eight Chinese characters) were shown for 5000 ms, during which subjects were instructed to draw a logical conclusion based on the major and minor premises. Subsequently, the blank screen that lasted for 200–400 ms was followed by the presentation of a conclusion for 2500 ms. Finally, participants were asked to judge whether or not the conclusion was valid by pressing different keys ("1" if the conclusion is correct; "2" if the conclusion is incorrect) as quickly and as accurately as possible on a keypad. In addition, they were instructed to keep their eyes fixated on the center of the monitor during the experiment to avoid ocular artifacts.

Electrophysiological recording[1] and analysis

Electroencephalography (EEG) was recorded at 64 scalp sites using tin electrodes mounted in an elastic cap (Brain Product, Brain Products GmbH, Gilching, Germany), with the reference on the left and right mastoids. The vertical electrooculogram (EOG) was recorded with electrodes placed above and below the left eye. All interelectrode impedance was maintained below 5 kΩ. The EEG and EOG were amplified using a 0.05–100 Hz bandpass and continuously sampled at 500 Hz/channel for offline analysis. Eye movement artifacts were rejected offline. Trials with EOG artifacts (mean EOG voltage exceeding $\pm 80\,\mu V$) and those contaminated with artifacts due to amplifier clipping, bursts of electromyographic (EMG) activity, or peak-to-peak deflection exceeding $\pm 80\,\mu V$ were excluded from averaging.

The ERP waveforms were response-locked to the onset of the conclusions. Response-locked ERPs were calculated for a 900 ms epoch, extending from 700 ms before the response until 200 ms (baseline) after the response. The reason that the window of analysis is -700 ms is that the shortest RTs to the conclusions are 716 ± 121 ms (nonconflict condition). On the basis of the grand averaged ERPs and topographical map (see Figure 2), the following 33 electrode positions (including anterior, central, parietal, posterior, and occipital sites) were chosen for statistical analysis: Fz, F1, F2, F3, F4, FCz, FC1, FC2, FC3, FC4, Cz, C1, C2, C3, C4, CPz, CP1, CP2, CP3, CP4, Pz, P1, P2, P3, P4, POz, PO3, PO4, PO5, PO6, Oz, O1, and O2.

RESULTS

A significance level of .05 was set for all analyses. In case of violations of sphericity assumptions, degrees of freedom were corrected by means of the Greenhouse–Geisser method.

[1] We recorded our data mainly referring to relevant information from previous work (see Qiu et al., 2007).

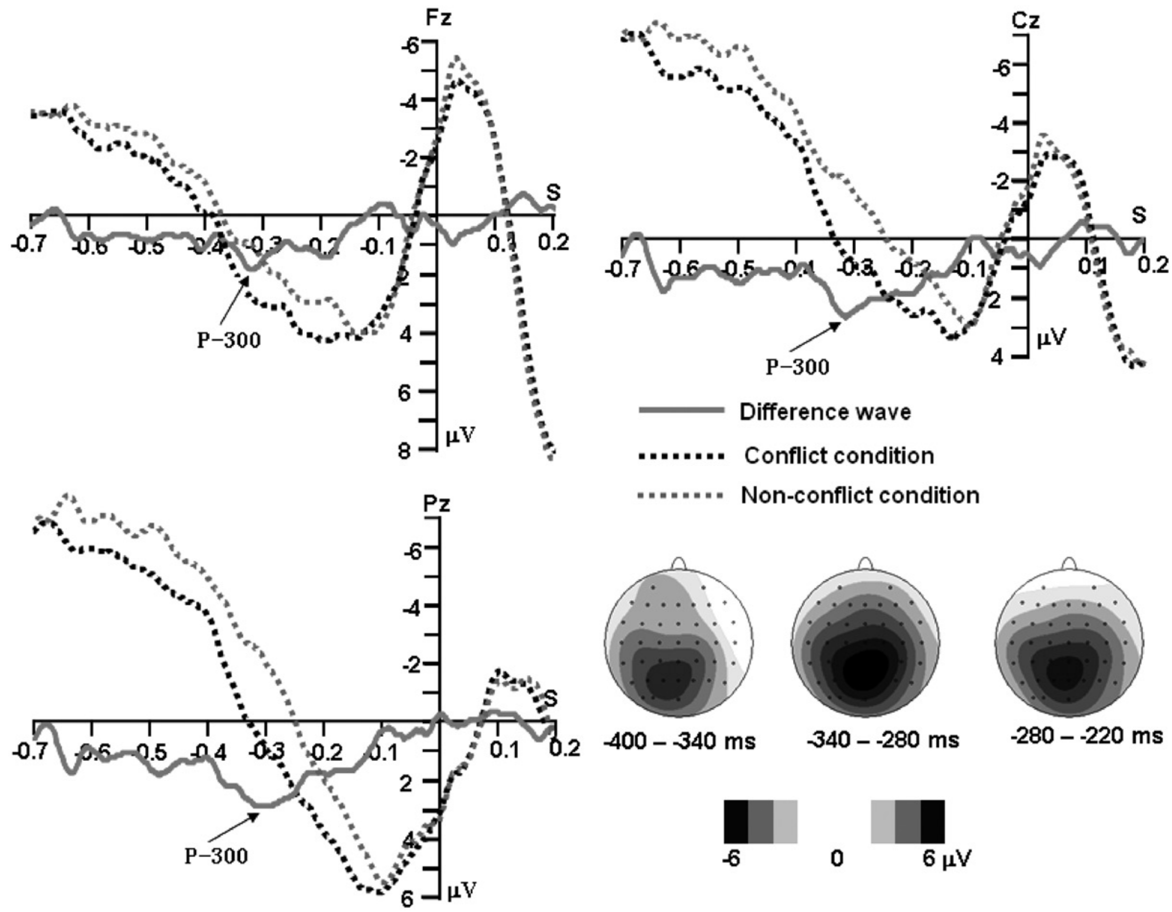

Figure 2. Grand average ERPs at Fz, Cz, and Pz for correct response for conflict condition, nonconflict condition, and the difference wave (conflict condition minus nonconflict condition). (Bottom right) Topographical maps of the voltage amplitudes for the difference wave from −400 to −340 ms, −340 to −280 ms, and −280 to −220 ms.

Behavioral data

Only trials with correct response on valid conclusions of conflict/nonconflict conditions were taken into analysis. The accuracy rates and mean reaction times (RTs) were analyzed using one-way repeated-measures analyses of variance (ANOVAs). The ANOVA factor was task type (two levels: conflict condition and nonconflict condition). The average numbers of conflict and nonconflict trials that participants responded to correctly were 53 ± 7 ($87.8 \pm 11.6\%$) and 58 ± 3 ($96.5 \pm 5.1\%$), respectively. Repeated-measures ANOVA on the accuracy rates showed that the effect of task type was significant, $F(1,11) = 10.172$, $p = .009$, $\eta_p^2 = .48$, accuracy being higher on nonconflict trials. Mean RTs for conflict condition and nonconflict condition were 747 ± 149 ms and 716 ± 121 ms, respectively. Repeated-measures ANOVA on the RTs showed that the effect of task type was approaching the threshold significance level in the predicted direction, $F(1,11) = 4.015$, $p = .070$, $\eta_p^2 = .27$); reaction times were nonsignificantly shorter on nonconflict trials.

ELECTROPHYSIOLOGICAL SCALP DATA

Mean amplitudes in the time windows of −700 to −600 ms, −600 to −500 ms, −500 to −400 ms, −400 to −300 ms, −300 to −200 ms and −200 to −100 ms were analyzed using two-way repeated-measures ANOVA. The ANOVA factors were task type (two levels: conflict condition and nonconflict condition) and electrode site (33 electrode sites). Two main effects of task type were found in the time windows of −400 to −300 ms and −300 to −200 ms respectively, $F(1,11) = 7.692$, $p = .018$, $\eta_p^2 = .71$ and $F(1,11) = 11.279$, $p = .006$, $\eta_p^2 = .86$. In each case, correct responses for conflict trials elicited a more positive ERP deflection (Figure 2) than for nonconflict trials. Neither the main effect of the electrode site nor the interaction of the task type and the electrode site was significant in any time window.

Discussion

In the present study, the participants were required to evaluate a logical conclusion based on empirically true premises and make a logical judgment after conclusion presentation. The electrophysiological data suggested that conflict problems elicited a more positive ERP deflection than the nonconflict problems at −400 to −200 ms prior to the correct response on valid conclusions. Behavioral data showed that mean accuracy rate was higher for the nonconflict condition than for the conflict condition, thus replicating the belief-bias effect to some extent using these atypical materials. However, the RT data did not show statistically significant support for the difference between the conflict and nonconflict conditions.

The finding on RTs runs counter to evidence presented by Stupple and Ball (2008) indicating that RTs for conflict condition are reliably higher than for nonconflict condition. This result is explicable for two reasons: First, smaller sample sizes in neuroimaging studies are common and the trend shown in the data suggests that a larger sample would be likely to show statistically significant support for the reaction time effect. Moreover, the present study focused on the less demanding valid–believable and valid–unbelievable problems, whereas Stupple and Ball found the largest differences between invalid–believable problems and nonconflict problems. As such these behavioral data are not inconsistent with the findings of Stupple and Ball or with theories that predict increased response times for conflict problems through an effortful process of belief inhibition.

In previous studies (e.g., Evans et al., 1983), where participants had not received logical training, the accuracy rate of logically correct answers for conflict condition was only 46%. In contrast, the present accuracy data demonstrated a high logical accuracy in the conflict condition, most likely due to logical training which was necessary to obtain a sufficient sample of correct responses for an ERP analysis.

In contrast to experiments where conclusions and premises are presented simultaneously, here the premises were presented prior to conclusions. From this it was reasonably inferred that an integrated model of the premises would formulate prior to the conclusion presentation phase. Previous evidence has shown conflict detection processing occurring during the premise processing (Luo et al., 2008, 2011) and the present study extends that finding to the conclusion processing phase. In order to resolve the conflict between belief and logic to endorse valid–unbelievable problems, participants needed to inhibit their beliefs, whereas this inhibition was absent during responses to nonconflict problems. Thus participants exerted greater cognitive effort in inhibiting the empirically anomalous information, to avoid a nonlogical response.

As shown in Figure 2, at the −400 to −200 ms time window, conflict condition elicited an increased positivity, compared to nonconflict condition, prior to the selection of the correct response. Together with the mean RTs, we can infer that the positive component peaks with a latency of 300–500 ms after the conclusion onset. Based on peak latency, the positive component is similar to the ERP component LPC (although it cannot definitively be described as LPC because the ERP analysis is time-locked to the response phase). The comparison of the positive component with LPC (or P3) is interesting because it is related to the inhibitive process. It has been widely accepted that P3 reflects neural inhibition of concomitant cognitive processes (Donchin, 1981; Polich, 2007). Previous research has generally found that more intense inhibitive processes evoke larger P3 amplitudes (Donkers & van Boxtel, 2004; Pfefferbaum, Ford, Weller, & Kopell, 1985). Therefore, we argue that the evident positive component elicited by conflict condition may be attributed to a belief inhibition process when conclusions were empirically false. This finding is therefore of particular interest to dual-process theorists as it shows that there are neural correlates of conflict resolution during conclusion processing in belief bias. These data are, moreover, inconsistent with single-process theories (e.g., Dube et al., 2010) as they provide evidence consistent with cognitive control or belief inhibition which was observed only for the belief–logic conflict condition.

The present study demonstrated that a greater positive component was elicited by the conflict condition than the nonconflict condition between −400 and −200 ms before correct response on logical conclusions, which, it is argued, is related to the cognitive control of empirically false information in the conflict condition. Further study is needed to test and verify the LPC-like component in this paradigm and to examine the contrast with previous ERP studies in this domain. Nonetheless, the presented data are parsimoniously explicable by dual-process theorists (e.g., Evans, 2007), and are problematic for those theorists who argue against dual-process theories of reasoning (e.g., Keren & Schul, 2009).

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