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Hemispheric asymmetry and pun comprehension: When cowboys have sore calves

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Abstract

Event-related potentials (ERPs) were recorded as healthy participants listened to puns such as "During branding, cowboys have sore calves." To assess hemispheric differences in pun comprehension, visually presented probes that were either highly related (COW), moderately related (LEG), or unrelated, were presented in either the left or right visual half field (LVF/RVF). The sensitivity of each hemisphere to the different meanings evoked by the pun was assessed by ERP relatedness effects with presentation to the LVF and the RVF. In Experiment 1, the inter-stimulus interval between the pun and the onset of the visual probe was 0 ms; in Experiment 2, this value was 500 ms. In Experiment 1, both highly and moderately related probes elicited similar priming effects with RVF presentation. Relative to their unrelated counterparts, related probes elicited less negative ERPs in the N400 interval (300–600 ms post-onset), and more positive ERPs 600–900 ms post-onset, suggesting both meanings of the pun were equally active in the left hemisphere. LVF presentation yielded similar priming effects (less negative N400 and a larger positivity thereafter) for the highly related probes, but no effects for moderately related probes. In Experiment 2, similar N400 priming effects were observed for highly and moderately related probes presented to both visual fields. Compared to unrelated probes 600–900 ms post-onset, related probes elicited a centro-parietal positivity with RVF presentation, but a fronto-polar positivity with LVF presentation. Results suggest that initially, the different meanings evoked by a pun are both active in the left hemisphere, but only the most highly related meaning is active in the right hemisphere. By 500 ms, both meanings are active in both hemispheres.

Keywords: Jokes; Puns; Humor; Laterality; Ambiguity; ERP; N400; Hemifield presentation; Word play

1. Introduction

Though anatomical differences between the left and right cerebral hemispheres are fairly minimal, functionally the two hemispheres differ markedly in their importance for language processing. The study of brain damaged patients suggests that the left hemisphere is crucial for basic aspects of language production and comprehension, while the right hemisphere is important for language tasks that require the listener to strategically recruit background knowledge, or to appreciate the relationship between an utterance and its context. One example of a high-level language phenomenon that underscores the functional asymmetry in the two hemispheres is joke comprehension because it presupposes the speaker's ability to interpret language against background knowledge.

For example, in "Nothing ages a woman faster than identification," the first part of the sentence suggests the topic is the physical causes of the aging process, and prompts the listener to activate background knowledge relevant to this topic. The word "identification," however, is inconsistent with this interpretation and requires the listener to activate background knowledge about women's often dishonest representation of their age. A critical aspect

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of this sort of joke, then, is a process known as frame-shifting, in which existing information in the discourse model is reorganized into a new frame extracted from long-term memory (Coulson, 2001; Vaid, Hull, Heredia, Gerkens, & Martina, 2003).

Researchers in neuropsychology have long noted that joke comprehension is compromised in patients with RH lesions, especially when there is damage to the anterior portion of the frontal lobe (Brownell, Michel, Powelson, & Gardner, 1983; Shammi & Stuss, 1999). In one classic study, right hemisphere damaged (RHD) patients were given the set-up part for a number of jokes and asked to pick the punch-line from an array of three choices: straightforward endings, non-sequitur endings, and the correct punch-line. While age-matched controls had no trouble choosing the punch-lines, RHD patients tended to choose the non-sequitur endings, suggesting the patients understood that jokes involve a surprise ending, but were impaired on the frame-shifting process required to re-establish coherence (Brownell et al., 1983).

The pattern of deficits in RHD patients differs dramatically from those evidenced by LHD patients whose communicative difficulties are seemingly more severe. To compare the performance of LHD and RHD patients on joke comprehension, Bihrle and colleagues used both verbal (jokes) and nonverbal (cartoons) materials with the same narrative structure (Bihrle, Brownell, & Gardner, 1986). Whether patients received verbal or nonverbal materials, they were asked to pick the punch-line (or punch frame) from an array of four choices: a straightforward ending, a neutral non-sequitur, a humorous non-sequitur, or the correct punch-line. Though both patient groups were impaired on this task, their errors were qualitatively different. In both verbal and non-verbal materials, RHD patients showed a consistent preference for non-sequitur endings over straightforward endings and correct punch-lines (Bihrle et al., 1986). In contrast, LHD patients (who participated only in the nonverbal task) more often chose the straightforward endings than either of the non-sequitur endings (Bihrle et al., 1986). These data suggest the deficits RHD patients experience in the comprehension and production of humor is not attributable to the emotional problems associated with some kinds of RHD, as the RHD patients displayed preserved appreciation of the slapstick depicted in the humorous non-sequitur endings.

One attempt to link the deficits observed in RHD patients to hemispheric asymmetries evident in healthy adults is Beeman's coarse coding hypothesis (Beeman & Chiarello, 1998; Beeman et al., 1994). According to this hypothesis, words in the RH are represented by means of wide semantic fields, while words in the LH are represented via a narrow range of features relevant to the immediate discourse context. Although coarse RH semantic activations would predictably include contextually irrelevant information, they might nonetheless be important for the comprehension of figurative language such as that needed to understand jokes. Because jokes frequently require the integration of novel information, the reinterpretation of a word or phrase, and the reinterpretation of the scenario depicted by the preceding context, diffuse RH activation might provide additional information that makes joke processing easier. Similarly, reduced access to these diffuse semantic activations in RH damaged patients could result in joke comprehension deficits.

Several studies in our laboratory have addressed whether hemispheric differences in semantic activation are relevant for joke comprehension. In one study, we recorded event-related potentials (ERPs) as healthy adults read laterally presented "punch words" to one-line jokes (Coulson & Williams, 2005). Parafoveal presentation of probe words was intended to affect which cerebral hemisphere received the initial information from the stimulus, and to increase the participation of that hemisphere in the processing of the stimulus. The N400 component, a negative-going deflection in the ERPs associated with the processing of meaningful stimuli, was of particular interest, as its amplitude can be interpreted as an index of how hard it is to integrate the meaning of a given word into one's model of the discourse context (Kutas & Hillyard, 1980; Kutas & Van Petten, 1994). Typically, the larger the N400, the more difficult the task of lexical integration. Previous ERP research on joke comprehension has shown that the critical word in a joke often elicits a larger N400 than a similarly unexpected "straight" ending for the same sentence: the N400 joke effect (Coulson & Kutas, 2001).

We reasoned that if hemispheric differences in semantic activation are relevant for joke comprehension, lateral presentation of joke (GIRL) versus straight (BALL) endings for sentences such as "A replacement player hit a home run with my" would result in different N400 joke effects as a function of visual field of presentation. In this sentence comprehension paradigm, the difficulty of joke comprehension is indexed by the size of the N400 joke effect with larger effects pointing to relatively more processing difficulty. In fact, N400 joke effects were smaller when the critical words were presented to the LVF/RH than the RVF/LH, suggesting joke comprehension was easier with LVF presentation and consistent with the claim that coarse coding in the RH facilitates joke comprehension (Coulson & Williams, 2005).

In a similarly motivated study, we measured ERPs elicited by laterally presented probe words that were preceded either by a joke, or by a non-funny control (Coulson & Wu, 2005). Since all jokes turned on the last word of the sentence, control sentences were formed by replacing the sentence final word with a "straight" ending. For example, the straight ending for "Everyone had so much fun diving from the tree into the swimming pool, we decided to put in a little water," was "platform." Probes (such as CRAZY) were designed to be related to the meaning of the joke, but unrelated to the meaning of the straight control. In this sentence prime paradigm, the activation of information relevant to joke comprehension was signaled by differences in the size of the N400 elicited by related versus unrelated probes. The more active joke-related information was, the larger the N400 relatedness effect could be expected to be. Consistent with the coarse coding hypothesis, we found larger N400 relatedness effects with LVF/RH presentation suggesting joke-related information was more active in the RH (see also (Hull, Chen, Vaid, & Martinez, 2005) for comparable evidence using behavioral measures).

2. Pun comprehension and ambiguity resolution

While the neural basis of joke comprehension has received some attention in the literature, the neural basis of pun comprehension has received comparatively little (see (Wild, Rodden, Grodd, & Ruch, 2003) for a review of the neural basis of humor). A pun, of course, is a rhetorical technique in which the speaker deliberately invokes multiple meanings via a single word or phrase. For example, in "Old programmers never die, they just lose their memory," the word "memory" can refer either to a human ability or to an electronic device, and both meanings are contextually appropriate. Although serious puns can be found in various literary works, most puns today are humorous—or at least intended to be so. The present study addressed the relevance of hemispheric differences for cognitive aspects of pun comprehension.

A number of factors suggest hemispheric differences in semantic activation might be relevant to the comprehension of puns, just as they are relevant to the comprehension of other sorts of jokes. First, various investigators have suggested that the RH involves more peripheral, and the LH more central aspects of semantic structure (Beeman & Chiarello, 1998; Beeman et al., 1994; Chiarello, Burgess, Richards, & Pollock, 1990; Chiarello, Liu, & Faust, 2001). In a hemifield priming study with two primes followed by a laterally presented target word, Faust & Lavidor found that the LH benefited more from semantically convergent primes (e.g., story, book, NOVEL), while the RH benefited more from divergent primes (new, book, NOVEL) (Faust & Lavidor, 2003). The finding that semantic activation in the RH is less specific than that in the LH has also been seen in studies that utilized spoken sentences that biased either central or peripheral features of an ambiguous word's meaning (Titone, 1998).

Second, evidence suggests semantic activation in the RH is slower than that in the LH (Burgess & Lund, 1998; Burgess & Simpson, 1988), and the RH may maintain contextually irrelevant meanings for longer. For example, Faust & Gernsbacher presented participants with sentences that ended either with a homograph (e.g., spade) or with an unambiguous equivalent (e.g., shovel). All sentences were presented centrally and followed either 100 or 1000 ms later by a laterally presented probe word (e.g., ACE), related to the contextually irrelevant sense of the ambiguous word. Participants' task was to decide whether the probe was related to the overall meaning of the sentence. For words presented to the RVF/LH, interference produced by the contextually irrelevant probes was less severe after 1000 ms than it was after 100 ms, suggesting the irrelevant meaning of the ambiguous word had been suppressed. However, for words presented to the LVF/RH, interference effects were the same size whether the probe was presented at the short SOA or the long one (Mark Faust & Gernsbacher, 1996).

Differences in each hemisphere's ability to select contextually relevant meanings and suppress irrelevant ones have been argued to be especially important for the processing of ambiguous words. In a priming study comparing LHD patients with healthy controls, the patients showed a preserved ability to activate multiple meanings, but were impaired on so-called discordant triplets such as river-bank-money where responding required them to inhibit a contextually inappropriate meaning (Copland, Chenery, & Murdoch, 2002). Similarly, hemifield priming paradigms conducted with healthy adults have shown that when ambiguous words are presented in biasing sentence contexts, the LH activates only the contextually relevant meaning, while the RH activates both the sentence congruent and incongruent meanings (Coney & Evans, 2000; Faust & Chiarello, 1998).

In fact, hemispheric differences in the speed and scope of semantic activation, as well as differences in contextual sensitivity may all be relevant for the way the two hemispheres work together in understanding naturalistic language phenomena such as that in jokes and puns. One suggestion is that while rapid, focused, and contextually sensitive LH semantic activations are conducive to many instances of language comprehension, the slower rise time and/or the lack of suppression for RH semantic activations might be particularly important in language phenomena such as jokes that require semantic reanalysis (Beeman & Chiarello, 1998; Faust, 1998). Further, the broader array of meanings activated in the RH might be useful in cases of language such as puns where access to alternative word meanings is important.

Puns, however, differ both from other sorts of jokes and from other instances of ambiguity in language. In most instances of language comprehension, the listener's task is to activate the contextually appropriate meaning of an ambiguous stimulus and suppress its other meanings. This latter task is particularly difficult in jokes because the joke teller issues deliberately misleading cues that support an erroneous interpretation of ambiguities in the joke set-up. In a pun, by contrast, *both* meanings of an ambiguity are relevant for getting the joke. Indeed, the humorous nature of a pun derives from the listener's ability to simultaneously maintain two, possibly conflicting, meanings for the same word or phrase. Thus, previously observed hemispheric differences relevant for joke comprehension, may not be equally important for the comprehension of puns.

3. The present study

The present study addressed hemispheric sensitivity to the different meanings of a pun using a sentence prime paradigm with puns and pun-related probe words. We recorded ERPs as healthy adults listened to puns and read probe words presented in either participants' left or right visual hemifields. Probe words were either *highly related* to the pun that preceded them, *moderately related* to the pun that preceded them, or were *unrelated* to the pun that preceded them. Because ERPs are known to be sensitive to lexical variables such as word length and frequency, each probe served as its own control by occurring once after a pun to which it was related, and once after a pun to which it was unrelated.

Lexical integration of the probes was predicted to be easier when they were related to the puns that preceded them than when they were unrelated, and consequently to elicit smaller (less negative) N400s in the ERPs. N400 relatedness effects can thus be seen as an index of the facilitative effect of the puns on the processing of the probes, with larger relatedness effects indicating a greater degree of priming. As the related probes would predictably elicit smaller N400s than the controls, the question of interest was whether the relatedness effect would be bigger for highly- than moderately-related probes, and whether these effects would be conditioned by the visual field of presentation.

To address potential differences in the time course of semantic activation, we also varied the amount of time that intervened between the pun and the visually presented probe word. In Experiment 1, the onset of the probe word coincided with the offset of the pun. In Experiment 2, probe onset was 500 ms after the end of the pun.

4. Experiment 1

Neuropsychologists have suggested that one reason patients with RHD experience difficulty understanding jokes, sarcastic comments, and other sorts of high-level language is an inability to simultaneously maintain multiple meanings. To assess whether both hemispheres were equally sensitive to both meanings evoked by a pun, we adopted a cross-modal variant of the hemifield priming paradigm. The pun, presented in the auditory modality, served as the prime, and it was followed by a written probe word presented in either the left or the right visual hemifield. As noted above, there were two sorts of related probe words, a highly related probe and a moderately related probe. Each probe word served as its own control by occurring after a different, unrelated, pun. Experiment 1 was intended to address the immediate semantic activations associated with pun comprehension, and thus the interstimulus interval (ISI) between the offset of the pun and the onset of the visual probe was 0 ms.

5. Methods

5.1. Participants

Sixteen healthy native English speakers (7 women) participated either for cash or in fulfillment of a course requirement. All had normal or corrected-to-normal vision and none had any history of psychiatric or neurological disorder. Participants' age was between 18 and 23 (mean = 19.6 years). Handedness was assessed via the Edinburgh inventory (Oldfield, 1971), which yields a laterality quotient ranging from +1 (strongly right-handed) to −1. Participants were all right-handed as suggested by the average laterality quotient of +0.87 (SE = 0.08).

5.2. Materials

Stimuli consisted of 320 puns, each followed by a probe word which was potentially related to the ambiguity in the pun. Half of the puns, referred to below as *experimental puns*, were always followed by a related probe word, and half, referred to as *control puns*, were followed by an unrelated probe. The puns were gathered from a large number of websites. All puns were a single sentence, though they varied somewhat in both length and syntactic structure. Most (151/160) experimental puns were homographic (as in "The inventor of a hay baling machine made a bundle,"), or puns that exploit the multiple meanings of the same word form ("bundle"). There were also a few (9/160) ideophonic puns ("Coal mines that aren't deep enough will be undermined," "The promise of some tailors are pure fabrication,") where meanings evoked by a pun are related to similar, but not identical word forms. All puns were chosen such that the ambiguous word or phrase occurred in the final and/or penultimate word in the sentence. All experimental puns can be found in the Appendix A.

Relatedness of the probes was established in a separate normative study in which 96 participants read each pun and rated a probe word on a scale from 1 (very unrelated) to 7 (very related). Based on these ratings, we selected 160 experimental puns and two related probe words for each. A probe was deemed "related" if its average relatedness score was greater than 4. In addition, for any given pun, the probe that elicited the higher relatedness score was deemed the highly related probe, and the probe that elicited a slightly lower relatedness score was deemed a moderately related probe. For example, the highly related probe for "During branding cowboys have sore calves," was "cow" and the moderately related probe was "leg". Each probe word was also paired with another (control) pun to which it was unrelated. For example, the highly related probe "cow" was paired with "I could have been a swimmer if I had a stroke," and classified as highly unrelated. Highly- and moderately-related probes were matched for average word length in characters (Highly related: 6.17, SE = 1.9; Moderately related: 5.96, SE = 1.57) and word frequency (Kucera & Francis, 1967) in occurrences per million words (Highly related: 82, SE = 75; Moderately related: 66, SE = 65).

Final pairings between puns and probes were tested in another normative study with 20 participants. As in the prior study, participants read each pun and probe and rated their relatedness on a scale from 1 (very unrelated) to 7 (very related). Analysis of these ratings suggested highly related probes (5.4) were rated higher than moderately related probes (4.9) ($p < .01$), but ratings for "highly" (1.8) and "moderately" (1.7) unrelated probes did not differ ($F = 1.15$, n.s.). Thus, the relatedness manipulation refers to the comparison of ERPs elicited by each probe when primed by its related (experimental) versus unrelated (control) pun. The probe type manipulation refers to which probe (e.g., "cow" versus "leg") participants viewed as being more related to the experimental pun ("During branding season cowboys have sore calves,").

Puns were spoken by a male speaker of American English and digitally recorded at a sampling rate of 44.1 KHz and 16 bit resolution. Each audio file was edited to ensure that there were no clicks at the beginning or end of the file. Probes were presented in a customized 20-point Helvetica font. Although the puns themselves were not repeated, each probe word occurred once as a related probe and once as an unrelated probe.

As noted above 160 experimental puns were always followed by a related probe (half by the highly related probe and half by the moderately related probe), and 160 control puns were always followed by an unrelated probe (half of which were highly related probes for other puns and half moderately related probes for other puns). Four lists were formed so that while no participant ever heard the same pun twice, across participants each experimental pun was followed by both a highly- and moderately-related probe in both the left and the right visual fields.

Each list had 80 experimental puns followed by a highly related probe, 80 experimental puns followed by a moderately related probe, 80 control puns followed by a "highly" unrelated probe, and 80 control puns followed by a "moderately" unrelated probe. Half of the probe words (40) in each experimental category were presented in the participants' left visual field, and half in the right visual field so that visual field (left vs. right), relatedness (related vs. unrelated), and probe type (high vs. moderate) were counterbalanced within-participants.

5.3. Procedure

Each trial began with the appearance of a fixation dot in the middle of the screen. Participants were told to fixate on the dot before and during the presentation of the pun, and to read the word that appeared afterwards. The initial fixation was for 2 seconds, followed by the presentation of the pun via an audio file. Immediately after the offset of the final word in the pun (ISI = 0 ms) the probe word appeared so that its inner edge (the first letter of words presented in the right visual field, and the last letter of words presented in the left visual field) was 2 degrees from the fixation point. To discourage eye movements towards these laterally presented words, probes were presented for only 200 ms. The probe word was followed by the fixation dot for 1800 ms, which was replaced by a yes–no comprehension question about the preceding pun.

The experiment began with a practice session in which participants were familiarized with the hemifield priming paradigm. Participants were instructed to fixate a small dot in the center of their gaze during the presentation of the auditory stimulus, and to continue to fixate during the appearance of the visual stimulus (the probe word) in either their left or right visual field. Eye movements were assessed on-line via the electro-oculogram and participants were chastised whenever they made a saccade to the lateralized stimulus. Experimental trials began once the participant was able to perform the practice trials correctly.

Participants had three tasks. During the presentation of the stimuli, they had to listen attentively and fixate the dot in the center of the screen. After the presentation of the lateralized stimulus, participants pushed the "no" button on the response box if they were unable to read the word. Participants were told that one of the goals of the experiment was to determine how difficult it was to read peripherally presented words, and that they should not hesitate to indicate their inability to read stimuli presented in this way.[1] Participants' third task was to answer the comprehension question that followed each probe with a button press. For example, the comprehension question that followed "College-bred is a four-year loaf made out of the old man's dough," was followed by the comprehension question "Parents pay for their children's tuition," to which the participant should have responded with the "yes" button. Half of the questions had the correct response of "yes", and half "no".

5.4. Electroencephalographic and electrooculographic recording

Participants' electroencephalogram (EEG) was monitored with a commercial electrode cap with 29 scalp sites arranged according to the International 10–20 system. Scalp electrodes were referenced to the left mastoid, and re-referenced off-line to the average signal from the left and right mastoid electrodes. Horizontal eye movements were measured with a bipolar derivation of electrodes placed at the outer canthi. Vertical eye movements and blinks were monitored with an electrode under the right eye and referenced to the left mastoid electrode. The EEG at a band pass of 0.01 and 40 Hz was amplified with SA Instruments 32-channel bioamplifiers, digitized at 250 Hz, and stored on a computer hard disk for later averaging.

5.5. Analysis of ERPs

ERPs were timelocked to the onset of the visual probe, and signals were epoched with a time window of −100–920 ms around an event. The 100 ms preceding the stimulus

[1] Note that this task differs from the naming task used in some previous work that combined ERPs with the hemifield priming paradigm. Besides eliminating the long sessions and lengthy inter-stimulus intervals necessitated by the combination of ERPs and the delayed naming task, the task of signaling one's inability to read the stimulus avoids the known hemispheric asymmetry in speech production which might serve to underestimate the lexical competence of the right hemisphere.

served as the baseline. Epochs containing blinks, eye movements, amplifier drift or blocking were rejected prior to averaging (approximately 18.7% of trials). Unless noted otherwise, analysis involved mean amplitude measurements of each participant's ERPs elicited between 300 and 600 ms post-probe onset (intended to capture the N400 component), and between 600 and 900 ms post-probe onset (intended to capture any post-N400 positivities such as the late positive complex (LPC)). Measurements were subjected to repeated measures ANOVA with factors Relatedness (related/unrelated), Probe Type (high/moderate), Visual Field (RVF/LVF), and Electrodes (29 levels). Although the original degrees of freedom have been maintained for clarity, the p values have been corrected where appropriate (Huynh & Feldt, 1978).

Because the visual field manipulation affects the topography, or relative amplitude of ERPs over the scalp, ERP amplitude at lateral electrodes can differ markedly with RVF versus LVF presentation, and to a lesser degree over midline electrodes that measure activity in both hemispheres. Consequently, interactions between Visual Field and other experimental variables were followed up with analyses within each VF. Within-VF comparison enabled us to control for topographic differences and focus on the size and reliability of the different relatedness (priming) effects for the highly and moderately related probes.

6. Results and discussion

6.1. Behavioral data

Participants' first behavioral task was to indicate with a button press whether or not they were able to read the lateralized probe word. Readability scores, assessed as the percentage of words in each experimental category the participant was able to read, were analyzed with repeated measures ANOVA with factors Visual field (left/right), Relatedness (related/unrelated), and Probe type (high/moderate). Participants were marginally less likely to be able to read probes presented to the LVF (76.6%) than the RVF (85.8%) ($F(1,15) = 4.05$, $p = .06$), and marginally less likely to be able to read the unrelated (78.5%) than the related (83.9%) probes ($F(1,15) = 3.95$, $p = .07$). No other effects or interactions approached significance. The trend towards the relatedness effect suggests the preceding puns facilitated the processing of related probes more than the unrelated probes. The trend towards a RVF advantage in this task is consistent with a known left hemisphere advantage for word reading (Neville, Kutas, & Schmidt, 1982), and suggests the hemifield presentation paradigm worked as intended to shift the balance of processing to the contra-lateral hemisphere.

Participants' second behavioral task was to answer a true/false comprehension question about the pun. Because instructions to participants stressed accuracy on this task over speed, reaction times were not analyzed. Accuracy scores for the comprehension questions were analyzed with repeated measures ANOVA with factors Visual Field (left/right), Relatedness (related/unrelated), and Probe Type (high/moderate). This analysis indicated a reliable effect of Relatedness ($F(1,15) = 13.08$, $p < .01$) as well as an interaction between Relatedness and Visual Field ($F(1,15) = 6.63$, $p < .05$). Post hoc analyses performed separately in each Visual Field revealed no effects with LVF presentation, but a reliable effect of Relatedness with presentation to the RVF ($F(1,15) = 23.83$, $p < .01$), due to worse performance on questions that followed unrelated than related probes. These findings suggest that while pun comprehension was equivalent with left and right visual field presentation of probes, the presentation of unrelated probes to the RVF had a detrimental effect on comprehension.

6.2. ERP effects

6.2.1. Hemifield presentation effects

The amplitude of the N1 component of the ERP was measured to assess whether the hemifield presentation of the probes succeeded in shifting the balance of processing to the opposite hemisphere. Mean amplitude of ERPs measured 100–200 ms post-probe onset at electrode sites T5 (over the LH) and T6 (over the RH) where the N1 component is largest. These values were subjected to repeated measures ANOVA with factors Visual Field (left/right) and Electrode (T5, T6). Reliable effects of Visual Field ($F(1,15)3.59$, $p < .05$), and interaction between Visual Field and Electrode ($F(1,15) = 11.03$, $p < .01$) indicate the hemifield presentation paradigm successfully shifted the balance of processing to the hemisphere contra-lateral to the visual field of presentation.

In addition to lateral asymmetry in the amplitude of the N1 component elicited by parafoveally presented words, the hemifield presentation paradigm has also been shown to result in a lasting asymmetry over temporal sites known as the selection negativity (Coulson, Federmeier, Van Petten, & Kutas, 2005; Federmeier & Kutas, 1999). This negativity over posterior scalp is a component of the visual evoked potential and signals attentional selection of the stimulus for further processing. Its asymmetry in this paradigm points to the greater participation of one hemisphere than the other in the processing of the stimulus.

To test whether probes elicited selection negativities larger over the hemisphere contra-lateral to the visual field of presentation, we measured the mean amplitude of ERPs at T5 and T6 measured between 300 and 900 ms post-probe onset. Repeated measures ANOVA with factors Visual Field and Electrode (T5, T6) revealed a reliable interaction between these factors ($F(1,15) = 32.06$, $p < .01$), reflecting the presence of less positive (more negative) ERPs over the hemisphere opposite the visual field of presentation.

6.2.2. N400 Effects measured 300–600

Consistent with analyses of the N1 component and selection negativity, analysis of ERPs measured 300–600 ms post-probe onset revealed an interaction between VF and

Electrode site ($F(28,420)=7.31$, $p<.0001$, $\varepsilon=.22$), suggesting the VF manipulation affected the neural generators active in the latency range of the N400. Analysis of the N400 effect suggested ERPs were less positive (more negative) to unrelated than to related probes (Relatedness $F(1,15)=6.48$, $p<.05$), especially over fronto-central sites (Relatedness × Electrode $F(28,420)=2.59$, $p<.05$, $\varepsilon=.14$). Relatedness effects were qualified by marginal interactions with Probe Type ($F(1,15)=4.19$, $p=.06$) and VF ($F(1,15)=3.97$, $p=.06$). Probe type also interacted reliably with VF ($F(1,15)=4.48$, $p=.05$). Interactions between experimental variables and VF motivated separate analyses of effects in each visual field. Results of these analyses can be found in Table 1.

As seen in Table 1, presentation to the RVF (LH) yielded effects of Relatedness and Probe Type, but no interaction between these variables. ERPs to related probes were more positive (less negative) than unrelated probes, and ERPs to highly related or unrelated probes were more positive (less negative) than the moderately related or unrelated probes. However, relatedness effects were similar for both highly and moderately related probes, suggesting both meanings evoked by the pun were equally available to the LH. The RVF relatedness effect can be seen in Fig. 1.

In contrast, presentation to the LVF (RH) yielded an interaction between Relatedness and Probe Type (see Table 1). Highly related probes tended to be more positive (less negative) when they followed experimental (related) than control (unrelated) puns, while moderate probes tended to be less positive (more negative) when they were related than unrelated (see Fig. 1). However, neither effect reached conventional significance levels (Highly related/Unrelated: $F(1,15)=3.77$, $p=.07$; Moderately related/Unrelated $F(1,15)=2.33$, $p=.15$).

6.2.3. Positivity measured 600–900

As in the N400 interval, analysis of ERPs measured 600–900 ms post-probe onset revealed a reliable interaction between VF and electrode site ($F(28,420)=2.87$, $p<.05$, $\varepsilon=.12$), indicating a difference in the neural generators contributing to the ERPs 600–900 ms as a function of visual field of presentation. Further, analysis of ERPs in this interval also yielded a main effect of Relatedness ($F(1,15)=5.9$, $p<.05$), qualified by interactions with Electrode Site ($F(28,420)=2.73$, $p<.05$, $\varepsilon=.24$), and Visual Field ($F(1,15)=5.0$, $p<.05$).

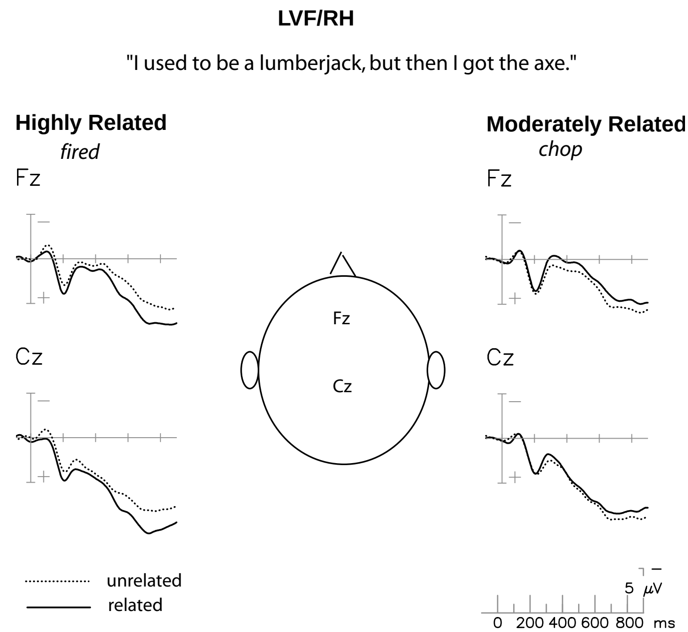

Fig. 1. Relatedness effect with LVF/RH presentation (ISI = 0 ms). Larger LPC to related stimuli evident in highly related probes (left) but not moderately related probes (right).

The interaction between Relatedness and Visual Field motivated separate analyses of effects in each visual field. Results of these analyses can be found in Table 1. With RVF (LH) presentation, related probes elicited more positive ERPs than unrelated, especially over centro-parietal electrode sites (see Fig. 2). Relatedness effects were similar for highly and moderately related probes. With LVF (RH) presentation, however, relatedness effects were evident in highly but not in moderately related probes (see Fig. 1).

6.3. Summary

Behavioral data suggested participants encountered less difficulty reading the probes presented in the RVF (LH) than the LVF (RH), consistent with a known LH advantage for reading. Participants also had less trouble reading probes that were related to the pun that preceded them than probes that were unrelated, indicating they were sensitive to the semantic relationship between the probe words and the puns. Performance on the comprehension questions suggested participants understood

Table 1
Visual field analyses for Experiment 1 (ISI = 0 ms)

	300–600 ms		600–900 ms	
	RVF	LVF	RVF	LVF
Relatedness	$F(1,15)=10.07$, $p<.01$	n.s.	$F(1,15)=7.20$ $p<.05$	n.s.
Relatedness × Electrodes	$F(28,420)=2.24$, $p<.05$, $\varepsilon=.2$	n.s.	$F(28,420)=2.84$, $p<.01$, $\varepsilon=.31$	n.s.
Probe type	$F(1,15)=9.53$, $p<.01$	n.s.	n.s.	n.s.
Probe type × Electrodes	$F(28,420)=2.53$, $p<.05$, $\varepsilon=.16$	n.s.	n.s.	n.s.
Relatedness × Probe type	n.s.	$F(1,15)=5.75$, $p<.05$	n.s.	$F(1,15)=5.51$, $p<.05$

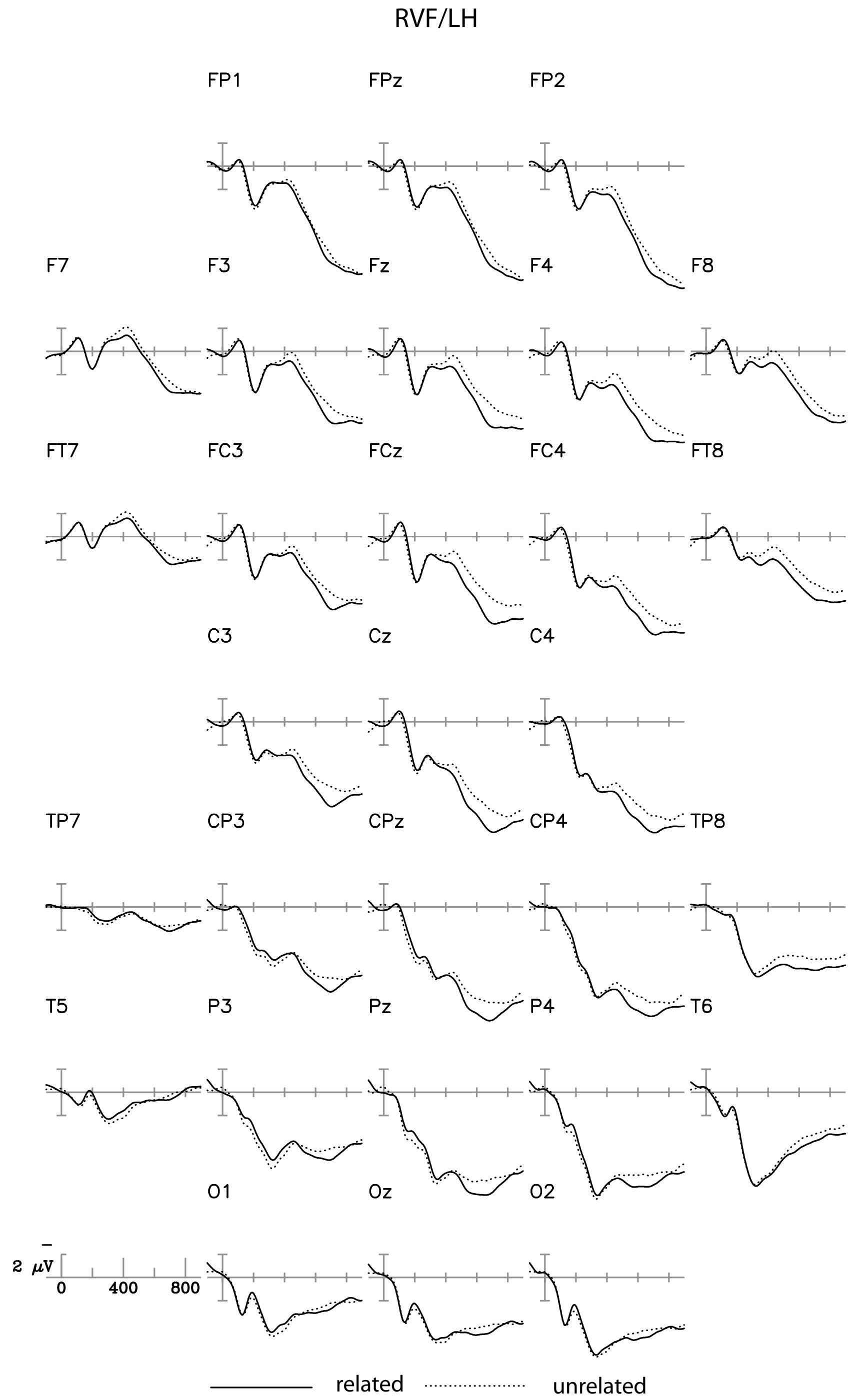

Fig. 2. Relatedness effect with RVF/LH presentation (ISI = 0 ms). The anterior-posterior dimension on the scalp is laid out from the top to the bottom of the page, and plots on the left-hand side of the page correspond to ERPs recorded over left hemisphere electrode sites. Negative polarity is plotted up in this an all subsequent figures.

most of the puns, though the presentation of unrelated probe words to the RVF (LH) appears to have disrupted the comprehension process. Interestingly, participants did worse on questions about puns followed by unrelated RVF probes than any other category (puns followed by related RVF probes, puns followed by related LVF probes, or puns followed by unrelated LVF probes).

ERP data also revealed participants' sensitivity to the relationship between the puns and the probe words, as well as pointing to interesting hemispheric differences in pun comprehension. With RVF (LH) presentation, related probes elicited less negative N400 than unrelated probes, suggesting they were primed by the context, and more positive LPC, an effect that may index the brain's tacit categorization of the probes as being related to recently encountered information in the pun. The LPC is often elicited in memory paradigms and is larger when participants categorize a stimulus as being "old" (i.e., studied previously) than when it is classed as "new". In any case, similar relatedness effects for highly and moderately related probes suggest that both meanings of the pun were available to the left hemisphere.

This was not the case for the right hemisphere. While RVF relatedness effects were similar for both the highly related probes and the moderately related probes, LVF relatedness effects were largely confined to the former. With LVF (RH) presentation, highly related probes exhibited a trend towards less negative N400 than unrelated probes, and reliably more positive LPC. While RH priming effects for the highly related probes were similar to those observed with RVF (LH) presentation, we observed no RH priming effects for the moderately related probes. Contrary to the claim that semantic activation in the RH is more wide-ranging than that in the LH, these data suggest that the RH is less sensitive than the LH to the multiple meanings evoked by puns.

7. Experiment 2

One potential explanation of the unexpected results observed in Experiment 1 is that they are related to the short inter-stimulus interval (0 ms) between the offset of the pun and the onset of the visually presented probe. One criticism of this paradigm is that the sudden presentation of the probe word can interfere with and even alter the processing of the material that precedes it (Koriat, 1981; Van Petten, 1995). This interference might be more profound for the RH than the LH, given the known LH advantage for reading, leading to an underestimation of RH sensitivity to the meanings evoked by puns. Alternatively, results observed with the short ISI in Experiment 1 may simply reflect the semantic activations that are available immediately at the offset of the pun, consistent with the suggestion that the rise time for semantic activation is slower in the RH than in the LH (Burgess & Lund, 1998; Burgess & Simpson, 1988). The absence in Experiment 1 of RH priming effects for moderately related probes, then, might reflect the fact that those meanings were not yet activated.

To clarify these issues, we repeated the previous experiment with a longer ISI of 500 ms. Because 500 ms is presumably sufficient to attenuate any interference between the pun and the probe, replication of our previous results at the longer ISI would argue against the interference hypothesis and point to true hemispheric differences in pun-related semantic activations. Differences between the results of Experiment 1 and Experiment 2, however, would be suggestive in hemispheric differences in the time course of semantic activations.

8. Methods

Twelve healthy right-handed English speakers (5 women) participated either for cash or in fulfillment of a course requirement. All had normal or corrected-to-normal vision and none had any history of psychiatric or neurological disorder. Participants' age was between 18 and 22 (mean = 20.4 years). Handedness was assessed via the Edinburgh inventory (Oldfield, 1971), yielding a laterality quotient ranging from +1 (strongly right-handed) to −1. Participants' average laterality quotient was .82 (SE = .06).

Materials in Experiment 2 were the same as those used in Experiment 1, as were the details of stimulus presentation and procedure, with the exception of the inter-stimulus interval (ISI) between the offset of the pun and the onset of the visually presented probe. In Experiment 1, the ISI was 0 ms. In Experiment 2, the ISI was 500 ms. All other details of EEG recording and ERP analysis were the same as in Experiment 1.

9. Results and discussion

9.1. Behavioral data

As in Experiment 1, readability scores were assessed as the percentage of words in each experimental category the participant was able to read, and analyzed as in Experiment 1. This analysis suggested participants were less likely to be able to read probes presented to the LVF (81%) than the RVF (90%) ($F(1,11) = 11.29$, $p < .01$), and marginally less likely to be able to read unrelated (83%) than related (88%) probes ($F(1,11) = 4.12$, $p = .07$). No other effects or interactions approached significance. The trend towards the relatedness effect suggests the participants were sensitive to the contextual congruity between the puns and both sorts of related probes. The observed RVF advantage for reading the laterally presented probes suggests the hemifield presentation paradigm served to shift the balance of processing to the hemisphere opposite the visual field in which the stimulus was presented.

Accuracy scores for the comprehension questions were also analyzed with repeated measures ANOVA with factors Visual Field (left/right), Relatedness (related/unrelated), and Probe Type (high/moderate). This analysis indicated a reliable effect of Relatedness ($F(1,11) = 10.14$, $p < .01$), as participants performed better on the comprehension questions that followed related (78% correct) than unrelated (74%) probes. No other main effects or interactions approached significance. Although the presentation of an unrelated probe may have had a negative impact on pun comprehension, there is no reason to suspect that participants' comprehension was differentially affected by the presentation of probes to either the left or the right visual field.

9.2. ERP effects

9.2.1. Hemifield presentation effects

As in Experiment 1, the efficacy of the hemifield presentation paradigm was tested via analysis of the N1 component, measured 100–200 ms post-probe onset at T5 and T6, and the selection negativity, measured 300–900 ms

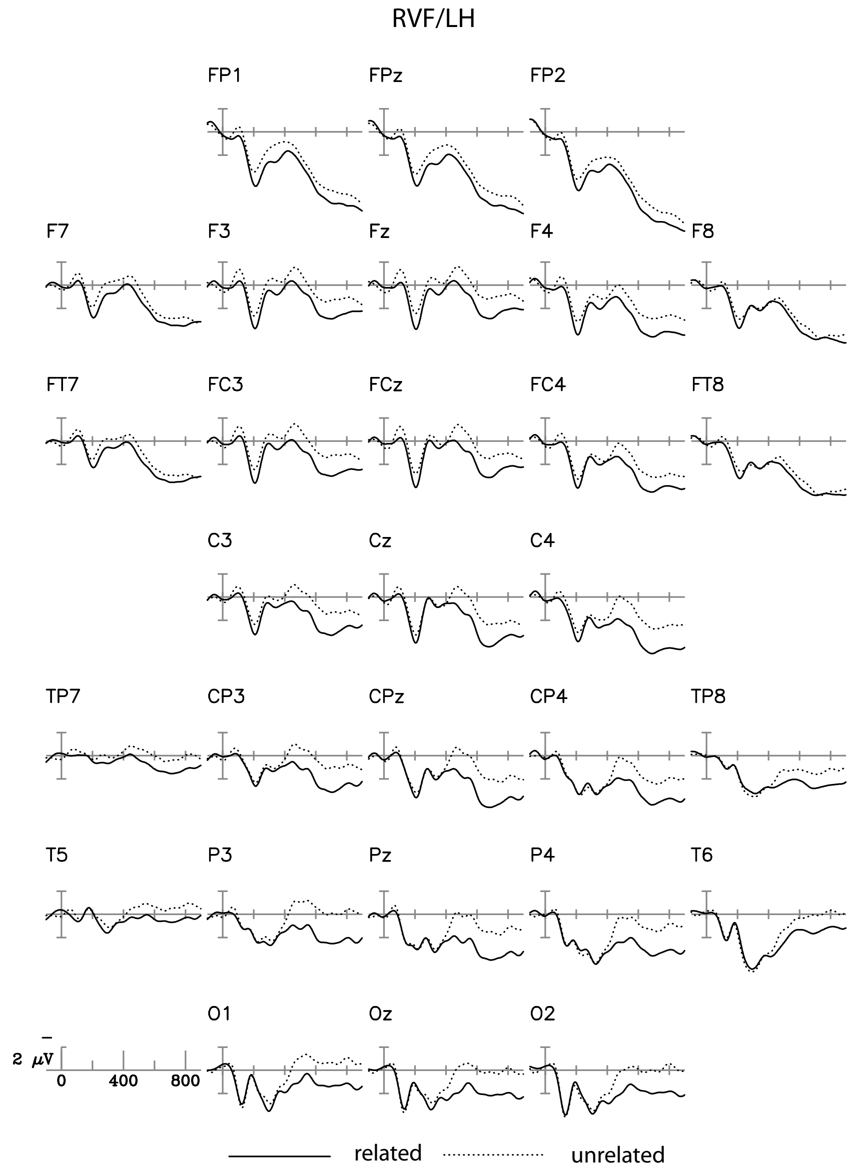

Fig. 3. Relatedness effect with RVF/LH presentation (ISI = 500 ms). Both N400 and LPC effects evident at electrode sites such as Cz and CPz.

post-probe onset (also at T5 and T6). Analysis of the N1 revealed a reliable interaction between Visual Field and Electrode ($F(1,11) = 9.55$, $p < .05$), as did analysis of the selection negativity ($F(1,11) = 9.13$, $p < .05$). These effects suggest the paradigm successfully shifted the balance of processing to the hemisphere contra-lateral to the visual field of presentation.

9.2.2. N400 Effects measured 300–600 ms post-probe onset

ERPs measured 300–600 ms post-onset revealed a small (0.9 μV) but reliable effect of Relatedness ($F(1,11) = 10.99$, $p < .01$), as related probes elicited more positive (less negative) ERPs than unrelated. Unlike the results of Experiment 1, the relatedness effect did not differ as a function of either Probe Type or Visual Field (all Fs < 1.28), suggesting both meanings evoked by the pun were equally active in the two hemispheres. Relatedness effects with RVF presentation can be seen in Fig. 3, and relatedness effects with LVF presentation can be seen in Fig. 4.

9.2.3. Positivity measured 600–900 ms post-probe onset

Measured 600–900 ms post-onset, ERPs to related probes were more positive than unrelated ($F(1,11) = 5.06$, $p < .05$). This relatedness effect did not differ as a function of probe type, but did differ as a function of visual field of presentation (Relatedness × VF × Electrodes $F(28, 308) = 3.15$, $p < .01$, $\varepsilon = 0.24$). With RVF presentation (Fig. 3), related probes elicited a centro-parietal positivity (Relatedness $F(1,11) = 5.34$, $p < .05$; Relatedness × Electrodes $F(28, 308) = 2.44$, $p < .05$, $\varepsilon = .28$). Analysis of LVF data revealed no significant relatedness effects (all Fs < 2), though Fig. 4 suggests a spatially restricted positivity over fronto-polar electrode sites, Fp1, Fpz, and Fp2. Post hoc analysis of LVF ERPs measured 600–900 ms at these 3 electrode sites

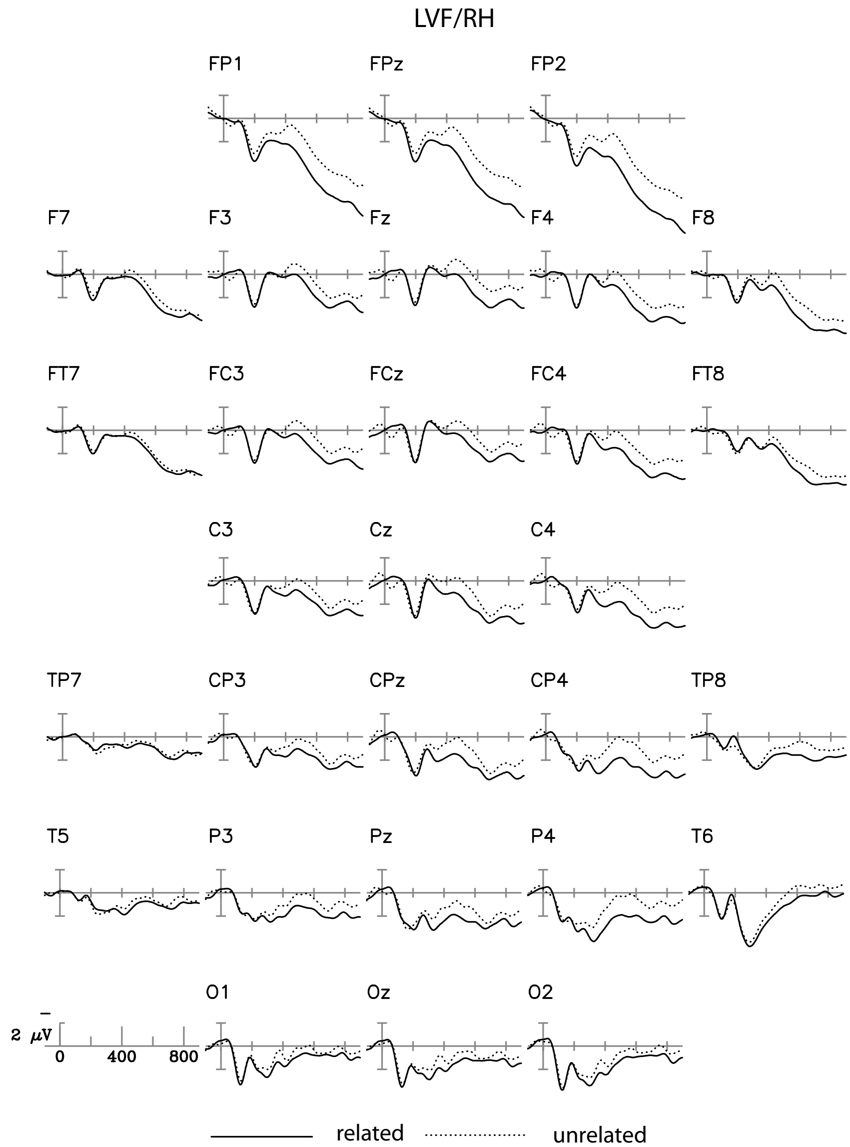

Fig. 4. Relatedness effect with LVF/RH presentation (ISI = 500 ms). N400 effect evident at CPz. Late positivity visible at fronto-polar electrodes Fp1, Fpz, and Fp2.

revealed reliable effects of Relatedness ($F(1,11) = 8.66$, $p < .05$), as related probes were more positive than unrelated. In contrast, comparable analysis of RVF data recorded from Fp1, Fpz, and Fp2 revealed neither a main effect of Relatedness ($F(1,11) = 1.53$, n.s.), nor any interactions with the Relatedness factor (all Fs < 1).

9.3. Summary

Related probes thus elicited less negative ERPs than unrelated in the N400 interval, and more positive ERPs thereafter. Relatedness effects were similar for both the Highly and the Moderately Related probe types, and while VF did not affect ERPs in the N400 interval, it did modulate the late positivity. With RVF presentation, related probes elicited a larger centro-parietal positivity than did unrelated probes. The topography of this effect resembles that of the Late Positive Complex (LPC). With LVF presentation, related probes elicited a larger positivity over fronto-polar electrode sites. Similar N400 effects for highly and moderately related probes with RVF and LVF presentation suggest that by 500 ms after the offset of the pun, both relevant meanings were available in each hemisphere. However, differences in the subsequent positivities elicited with left versus right visual field presentation point to hemispheric differences in the processing of pun-related probes.

10. General discussion

Two experiments tested for hemispheric differences in sensitivity to the different meanings evoked by a pun. We recorded ERPs as healthy adults listened to puns and read laterally presented probe words that were either highly related, moderately related, or were unrelated. The activation of pun-related information was assessed by the presence of relatedness effects on the N400 component of the ERP and on positive waveforms that frequently follow the N400 such as the LPC. Experiment 1 was intended to assess the immediate activation of information in pun comprehension, and thus utilized an ISI of 0 ms between the offset of the pun and the onset of the probe. With RVF (LH) presentation, we observed similarly sized priming effects for both the highly and moderately related probes. With LVF (RH) presentation, we observed priming for the highly but not the moderately related probes.

To see whether this same pattern of results would obtain when participants had more time to process the pun, in Experiment 2 we increased the ISI between the pun and the probe to 500 ms. This resulted in similarly sized N400 relatedness effects for highly and moderately related probes with presentation to the RVF (LH) as well as the LVF (RH). Further, while relatedness effects on the N400 did not vary as a function of visual field in Experiment 2, the relatedness effects on the subsequent positivity did. RVF (LH) presentation resulted in a larger centro-parietally distributed LPC for related probes. This effect was absent with LVF (RH) presentation, although post hoc testing suggested related probes elicited more positive ERPs over fronto-polar sites.

10.1. Positive-going ERP Effects

The LPC is a positive-going deflection in the waveform observed 500–900 ms post-stimulus onset that has typically been linked to memory processes. LPC priming effects similar to those observed in the present study have often been reported in studies of episodic retrieval utilizing the old/new paradigm. In this paradigm, participants first perform a study task that helps them encode a list of words, and ERPs are recorded in a subsequent memory test in which participants classify each word as either old (previously studied) or new. The previously studied "old" words typically elicit smaller N400 and larger LPC components than do the "new" words on the memory test. Although the N400 and LPC priming effects often co-occur, they have been experimentally dissociated in a way that suggests each component indexes different aspects of memory (Van Petten, Kutas, Kluender, Mitchiner, & McIsaac, 1991). The N400 has been argued to be sensitive to implicit memory processes (Rugg et al., 1998), while the LPC is thought to reflect cognitive processes underlying explicit recognition (Paller & Kutas, 1992; Rugg, Cox, Doyle, & Wells, 1995).

Frontal positivities similar to that observed in the LVF relatedness effect in Experiment 2 (500 ms ISI between pun offset and probe onset) have also been observed in studies of episodic memory. Although the functional significance of this frontal ERP component is controversial, it is clearly dissociable from posterior positivities such as the LPC (Rugg & Yonelinas, 2003). One suggestion, consistent with neuroimaging research on prefrontal versus temporoparietal activation is that posterior positivities reflect the reactivation of stored information and anterior positivities reflect the monitoring and evaluation of retrieved information (Ranganath & Paller, 2000).

Observed ERP effects on the probes may reflect the result of recently encountering the relevant concepts in the context of the pun. Although the similar N400 effects in Experiment 2 suggest that both of the pun's meanings were available to both hemispheres, the differences in the subsequent late positivities indicate that the semantic activations in the left and the right hemisphere did differ. We suggest that the LPC elicited with RVF presentation may reflect the left hemisphere's explicit recognition of the relevance of the probe words to the preceding pun. The anterior positivity elicited with LVF presentation, by contrast, may reflect a more effortful attempt to relate the probe to the preceding pun.

10.2. Time course of semantic activation

One question raised by these results is whether the short ISI used in Experiment 1 disrupted the processing of the puns in such a way as to produce artifactual results. Although a number of factors suggest that probe presentation did disrupt pun comprehension, we do not believe this invalidates the results of Experiment 1. Limited disruption of pun processing, for example, was clearly indicated by participants' performance on the comprehension questions in this experiment. With RVF (LH) presentation, participants were less accurate in answering comprehension questions for puns followed by unrelated than related probes, suggesting that at least the unrelated probes interfered with the comprehension process. As comparable effects were not observed with LVF presentation, however, this does not explain the absence of LVF priming effects for moderately related probes. The disruptive nature of probe presentation in Experiment 1 is also suggested by the difference in the morphology of the waveforms in Experiments 1 and 2 (compare Figs. 2 and 3, especially at posterior scalp sites). However, given that the early onset of the probes was disruptive with presentation to the RVF and the LVF alike, it is unclear why this factor would differentially affect the brain response to the moderately related probes presented to the LVF (RH)—unless those probes were less active than the highly related probes.

In sum, these results suggest that initially both meanings of a pun were equally active in the LH while only the highly related probes were active in the RH. By 500 ms after the offset of the pun, both meanings were available in both hemispheres. These results contrast with prior studies of hemispheric differences in the processing of ambiguous words, that have typically indicated that the less frequent and/or the contextually irrelevant meanings are active longer in the RH than the LH. Studies of ambiguous words presented in isolation, for example, indicate the dominant meanings of ambiguous words are initially active in both hemispheres at short intervals (SOA = 100 ms), while the subordinate meanings were active only at short intervals in the LH and only at long intervals (SOA = 750 ms) in the

RH (Burgess & Simpson, 1988). When ambiguous words are presented in sentence contexts, the contextually irrelevant sense has been shown to be active in the LH only at short intervals, but active in the RH at both short and long intervals (Mark Faust & Gernsbacher, 1996).

10.3. Selection and suppression

Differences between results of the present study and previous research on ambiguity are probably due to the fact that puns provide contextual support for both meanings of the ambiguity they contain. One suggestion for the hemispheric differences that have been observed in the processing of ambiguity is that the RH has suppression mechanisms that are less efficient than those in the LH, so that contextually irrelevant information is active longer in the RH. Because both meanings of a pun are relevant for getting the joke, neither needs to be suppressed—in either hemisphere. In the present study, the main hemispheric difference was that the moderately related probes were initially primed in the LH but not the RH, and primed in both hemispheres at the later interval. These findings might best be accounted for by the processing hypothesis that less salient meanings have a slower rise time in the RH than the LH. Our finding that both relevant meanings remained active in the LH also support the suppression and retention hypothesis that suppression mechanisms are not automatic, and operate in a context-sensitive fashion (Giora, 2003).

10.4. Hemispheric differences and jokes versus puns

Results of the present study also differ from earlier research on hemispheric differences in joke comprehension that suggest a right hemisphere advantage in understanding the critical word in a joke (Coulson & Williams, 2005), and in the activation of joke-related information (Coulson & Wu, 2005). By contrast, the present study suggests that while pun-related information is eventually available to both hemispheres, the left hemisphere shows an initial advantage. That is, priming effects at the short ISI were larger and more robust with RVF/LH presentation. In fact, with LVF/RH presentation, the moderately related probes were not primed at all at the short ISI.

However, just as metaphors are not a homogeneous category of figurative language whose comprehension is subserved by a single cortical 'metaphor network' (Ahrens et al., 2005, Mashal, Faust, Hendler, & Jung-Beeman,2005, this volume; Mashal et al., 2005, this volume), jokes too must be viewed as a heterogeneous language phenomenon. Crucially, the word play in puns differs from that in more semantically based jokes, such as those studied by Coulson and colleagues (Coulson & Kutas, 2001; Coulson & Lovett, 2004). This difference lies chiefly in its reliance on the retrieval of word meanings over the more inferential demands of semantic jokes. While semantic jokes begin by suggesting one interpretation of the discourse situation only to replace it with another at the punch line (Giora, 1991, 2003), the point of puns is simply to promote both meanings of an ambiguous word or phrase.

Observed findings are thus consistent with research that suggests patients with unilateral brain damage (both LHD and RHD) are sensitive to multiple meanings of ambiguous words presented out of context (Klepousniotou & Baum, 2005). Moreover, neurologists report that callosotomy patents whose speech is exclusively controlled by the left hemisphere often react appropriately to word play in everyday humor, and themselves produce puns (Zaidel, 1994). Another population in which speech is controlled almost exclusively with the left hemisphere is individuals with agenesis of the corpus callosum (ACC). In a recent study of this population, individuals with ACC but normal IQ were tested on a battery of humor comprehension tests. Though the comprehension of narrative jokes was impaired in the ACC group, their comprehension of puns was normal (Brown, Paul, Symington, & Dietrich, 2005).

The LH advantage observed in the present study, then, may reflect the importance of this hemisphere (especially the left frontal lobe) in coding the association between a word's form and its meaning. In fact, a neuroimaging study that compared semantic jokes with non-funny controls revealed bilateral temporal lobe activations, while an analogous comparison using puns revealed left frontal activations (Goel & Dolan, 2001). Whereas the temporal lobe activation presumably reflects memory processes necessary for the inferential demands of jokes, the frontal activations to puns were consistent with the need to retrieve word meanings. Results of the present study are also consistent with recent findings that point to the importance of the intact LH for understanding figurative language, such as conventional metaphors (Rapp, Leube, Erb, Grodd, & Kircher, 2005, submitted; Stringaris, Medford, Brammar, & Giampetro, 2005, this volume; Stringaris et al., 2005, this volume) and idioms (Papagno & Caporali, submitted), that involves a well-learned mapping between a word form and a conventional meaning.

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Appendix A. Experimental puns

The inventor of a hay baling machine made a bundle.
Skipping school to bungee jump will get you suspended.
An archaeologist's career ended in ruins.
A psychiatrist on a hike fell into a depression.
News of a coming flood was leaked.
Noteworthy musicians are very composed.
A dog that played baseball always got walked.
Golfers hate cake because they might get a slice.

Suicide at sea is definitely going overboard.
To some, marriage is a word; to others, a sentence.
Old lawyers never die they just lose their appeal.
You shouldn't interrupt a judge in the middle of a sentence.
When ancient wall sculptors were finished, it was a relief.
Lawyers have to like alcohol because they're always being called to the bar.
Those who work on reducing auto emissions go home exhausted.
A guy who used to sell boomerangs is trying for a comeback.
I know a lingerie buyer who gave his wife the slip.
A reporter was at the ice cream store getting the scoop.
Weather forecasters have to have lots of degrees.
A bad shoemaker's assistant was given the boot.
People who make motor oil are very refined.
Lumberjacks have to keep problem logs.
Coal mines that aren't deep enough will be undermined.
The calendar maker's days were numbered.
On a long trek, nomads used camels to get them over the hump.
In England, dog food is sold by the pound.
The clam's relationship was on the rocks.
Lightning storms can be very striking.
The pilot's career choice was up in the air.
Every so often, railroad conductors have to go for retraining.
The lonely chess player had his mail order bride wrapped in plastic because he was tired of stalemates.
The story about the missing tract of land would never sell because there was no plot.
My submarine business was doomed to go under.
I thought I was financially set, but then my candle-lighting gigs began to taper off.
Long boxer films never sell because people prefer boxer shorts.
The progressive neurosurgeon had an open mind.
Two banks with different rates have a conflict of interest.
Old bankers never die, they just pass the buck.
Everyone in the town had low IQ's; the population was dense.
If you leave a banana on a plane you could see a fruit fly.
Selling coffee has it's perks.
I got fired from the grocery section of the store because I couldn't produce.
For Thanksgiving, Saddam Hussein demanded Turkey.
The atom was sure it lost an electron; it said it was positive.
The soda called its dad Pop.
I could have been an accountant but I did not get an entry.
I could have been a billiard player but nobody gave me a break.
I could have been a balloonist but the idea didn't get off the ground.
I could have been a carpenter but it went against the grain.
I could have been a magician but it didn't materialize.
I could have been a milkman but everything turned sour.
I could have been a mountaineer but I couldn't make the grade.
I could have been a palmist but that wasn't my line.
I could have been a sprinter but I was on the wrong track.
I could have been a statistician but I didn't have the figure.
When the red and blue ships collided, the crew was marooned.
Someone should try to cheer up that space bar; it looks depressed.
At the time, installing an air-conditioning unit didn't seem like such a hot idea.
College-bred is a four-year loaf made out of the old man's dough.
Mathematics teachers call retirement the "aftermath."
When the human cannonball retired, they couldn't find a replacement of the right caliber.
Old teachers never die, they just lose their class.
An experienced waiter has a lot of good tips.
Those who play team sports usually have a ball.
Old skiers never die, they just go downhill.
She was only a whiskey maker, but he loved her still.
Taxidermists really know their stuff.
Drilling for oil is boring.
Drink wet cement, and get completely stoned.
Income tax time is when you test your powers of deduction.
When the first eyeglasses were made, it was quite a spectacle.
A restaurant accountant has to make sure the books aren't cooked.
If you are what you eat, I'm staying away from the nuts.
Have an optometrist run for president; they are people with good vision.
The sign on the music store said, 'Come in, pick out a drum, then beat it.'
If the mint makes 25 cent pieces it should expect quarterly profits.
Some commands given by the Army are specific, others are General.
When a boxer practices in winter, he may be out cold.
The Olympic swimming program has a large talent pool.
Wrestlers don't like to be put on hold.
If you don't pay your exorcist you get repossessed.
The man who fell into an upholstery machine is fully recovered.
He had a photographic memory that was never developed.
Those who get too big for their britches will be exposed in the end.
When the artist tried to draw a cube he had a mental block.
A ham walked out of the hospital and said "I'm cured".
When neon lights were perfected the inventor was positively glowing.

To golf at your favorite course may require a long drive.
Miners with illuminated helmets say it makes them feel lightheaded.
I got fired from the orange juice factory because I couldn't concentrate.
Musical mechanics always sing in parts.
A mailman has many problems to address.
The promises of some tailors are pure fabrication.
Astronauts work in a nice atmosphere.
During branding, cowboys have sore calves.
Math teachers have lots of problems.
The basketball-playing lawyer always went to court.
Those who like fishing can really get hooked.
A waiter who played tennis was great at serving.
A boiled egg in the morning is hard to beat.
This beverage says it is non-alcoholic, but I want to see the proof.
When attorneys dress for fun cases, they have leisure suits.
The enthusiastic rubber manufacturer will never tire.
Averages make no sense to someone who doesn't understand what they mean.
Always write your music notes clearly for good measure.
We couldn't eat the cake we made to celebrate our baseball victory because we lacked a good batter.
People who like yogurt are well cultured.
The prince with a bad tooth got a crown.
In medical matters it's nurses who call the shots.
That anatomy book is no good because it has no appendix.
When tires are up, it's due to inflation.
The old carpenter knew the drill.
The man opened a bakery using his father's dough.
The math teacher bored his students because he always went off on tangents.
I got fired from the computer shop because I didn't have the drive.
I could have been an actor but my father created a scene.
I could have been an athlete but there were too many hurdles.
I could have been an electrical engineer but I had no connections.
I could have been a farmer but it wasn't my field.
I could have been a gravel merchant but I didn't have the grit.
I could have been a geologist but I disliked finding faults.
I could have been a librarian but they were fully booked.
I could have been a musician but I wasn't noteworthy.
I could have been a nuclear scientist but I didn't have the energy.
I could have been a photographer but things didn't click.
I could have been a printer but I wasn't the type.
I could have been a psychiatrist but the thought made me shrink.
I could have been a witch doctor, but only for a spell.
I could have been a yachtsman but I didn't know the ropes.
He said he would jump off the cliff, but I thought it was a bluff.
The hair stylist was fired for making waves.
A backwards poet writes inverse.
I did not want to spill jelly on my mattress because it was too hot to sleep with a bed spread.
My lawyer carried the evidence in a leather box, as he knew this would be a briefcase.
Teachers who take class attendance are absent-minded.
I used to be a lumberjack, but then I got the axe.
When the television set got married, it had a good reception.
Dermatologists are often rash.
An essay can be about anything but a king, because a king isn't a subject.
The cook's speech was very stirring.
If you give some managers an inch, they think they're rulers.
A radical segment of the woodworker's union broke off and formed a splinter group.
An unemployed jester is nobody's fool.
Golfers don't get mad, they just get teed off.
Every time I go near the bank, I get withdrawal symptoms.
I used to work at a pillow factory, but I left because I always felt down.
Boxers stand up for other people's rights.
I could have been a plumber, but the work is too draining.
I used to work at a casino, but then I was offered a better deal.
I was arrested for stealing adhesive tape, but the charges didn't stick.
The crew on the boat whose engine froze had a hardship.
Stealing someone's coffee is called mugging.
Old programmers never die, they just lose their memory.
Whether you use a keyboard or a knife, be careful with your back slash.
The cowboy artist was a fast draw.
Ballet dancers are kept on their toes.
The conductor who didn't pay his orchestra had to face the music.
Sports are refereed by people of many stripes.
A marathon on a scorching day ended in a dead heat.
Monorail enthusiasts have a one track mind.

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