

A Systemic Review of the Brain Mechanism of Humor Processing

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Abstract: As a universal linguistic phenomenon, humor has gradually become an interdisciplinary research topic. Domestic and international scholars have expanded the study of humor, yet there is a paucity of evaluations on the brain mechanisms underlying humor perception. This paper primarily introduces the concept of humor, the major theoretical frameworks of humor, and the key findings from domestic and international research on the neural mechanisms of humor. Furthermore, this paper synthesizes the existing issues in humor research in order to provide clues and guidance for future investigations of humor.

Keywords: Humor; Cognitive Processing of Humor; Brain Mechanism.

1. The Concept of Humor

Owing to its pervasive and enduring nature, the phenomenon of humor has been conceptualized through a diverse array of definitions. According to the Cambridge Dictionary, humor is simply defined as the capacity to be amused by something seen, heard, or thought of, which may cause you to smile or laugh, or the quality of something that inspires such enjoyment. Humor is complex and nuanced. In the field of psychology, there is no universally unified concept of humor, which can be understood from many angles. From the perspective of psychoanalysis, humor can be seen as a kind of defense mechanism to vent people's subconscious impulses and desires in a reasonable manner. Humor functions similarly to wit and comic, all of which can make people laugh. From an evolutionary point of view, humor serves as a pleasant emotional experience accompanied by laughter. It is particularly crucial to point out that the experience is not exactly consistent with pure laughter (Weisfield, 1993). From the perspective of explicit behavior, humor represents the frequency of laughing or being amused (Martin & Lefcourt, 1984). To understand humor from a cognitive perspective, two basic conditions need to be met. First of all, humorous events must be sudden and surprising. Secondly, there is a perceived inconsistency between the humorous background information and the surprise ending, namely the catch phrase. Particularly, it is the inconsistency between the consequence and the anticipated circumstance noticed by the receiver from the background information (Gierych et al., 2005). This paper would comprehend humor from the cognitive perspective.

In general, humor can be separated into two categories: wide and narrow. The broad sense of humor holds that all the phenomena that can make people laugh can be called humor. The viewpoint that humor can be ironic, sarcastic, witty, funny, or hilarious is in line with the view of western psychologists. The narrow sense of humor is mainly from the Dictionary of Psychology, where humor is implicit and witty, not just a smile, emphasizing the positive aspects of humor. We were unable to locate a word in Chinese that has the same meaning and connotation as western humor, since it is impossible to fully capture the entire phenomenon of laughing in a single word or sentence. According to Yue (2014), as a result of traditional Confucian culture, humor has long been

regarded as incompatible with orthodoxy. The narrow definition of humor inherits the euphemistic and implicit characteristics of Oriental traditional culture, so it is easier to be accepted.

In addition, the term "sense of humor" often appears in much literature, which is easily confused with the word "humor" by readers. Humor is a more general notion, whereas sense of humor differs greatly among people. In research, "sense of humor" is generally discussed from the perspective of personality traits or individual difference in appreciating and creating humor (Chen et al., 2011). Although a person's "sense of humor" is considerably more sophisticated than is commonly believed, it can be inferred from the way they convey their laughter. In broad categories, there are different types of stimuli that can be used to elicit humorous responses in all people. The stimuli cause an individual to have a hilarious reaction that may involve their physiological response to laughter, cognitive variations, and emotional changes. Nevertheless, neither the cognitive changes nor emotional changes are visible to the observer nor manifested externally.

2. Main Theories in Humor Research

Typical humor theories primarily consist of the Superior Theory (Disparagement Theory), the Incongruity Resolution Theory, the Semantic Script Theory of Humor (SSTH), the General Theory of Verbal Humor (GTVH), and the Social Theory.

2.1. Superiority Theory

The superiority theory, which is also called "the disparagement theory", was first put forward by Plato and Aristotle. It is the oldest of the humor theories, and it explains humor's purpose primarily through the expressing of emotions. On the basis of this theory, when we perceive that others are stupider, uglier, less fortunate or weaker than us, we will have a sense of relative superiority, which will lead us to the feeling of happiness and laughter (Liu & Zou, 2007). According to Plato, based on their better observation, knowledge, ability, and background, humorists often despise other people when they find ignorance, hypocrisy, and vanity in others. Therefore, humor is often directed at the abuser of power, the greedy or the alcoholic (Liu & Zou, 2007).

Hobbes may be the earliest founder of superiority theory.

Hobbes holds the belief that it is “unexpected honor” that makes people suddenly respect and admire themselves when they compare themselves with their former selves or see the shortcomings of others. Hobbes also pointed out that the purpose of mocking the weaknesses of others to gain an advantage is to improve self-esteem (Liu & Zou, 2007: 48). Levine has also suggested that laughter is derived from the inner joy of a sense of control in the formative process for the young child to grasp. As adults, when encountering situations that may lead to anxiety, individuals will employ a humorous way to evoke a sense of mastery and familiar environmental control (Zou, 2007). Therefore, Levine believes that humor is derived from mastery and self-reinforcing pleasure (Zou, 2007: 6). Moreover, Holland suggests that laughter is not always about superiority, but also about minimizing threats (Liu & Zou, 2007: 48). When it comes to personal risks, regardless of whether they are caused by oneself or by interpersonal relationships, humor can boost self-esteem and raise one’s inner strength, thus becoming a good adaptive way to protect personal health and sense of security. The superiority theory regards aggression as the driving force of humor, and holds that the more aggression there is in humor, the higher the degree of humor will be. It also emphasizes that individuals can release depression and pressure through humorous emotional expression to achieve internal and external state of mind balance. This humor theory from the perspective of emotional release can well explain many common humor phenomena, but it also has its own limitations, that is, it does not explain the internal mechanism of how humor expresses strong emotions (such as aggression and sexual desire) in a gamified way.

2.2. Incongruity Resolution Theory

The incongruity resolution theory has received more empirical support at present. Incongruity theory believes that inconsistency is a characteristic of humor. On the basis of incongruity theory, the incongruity resolution theory states that people need not only to perceive inconsistency in humor, but also to resolve it in order to have a happy experience. Suls (1972) has purified this theory and put forward a two-stage theory model of humor comprehension. The first stage is the phase of incongruity detection and the second stage is incongruity resolution, which can help us better understand the internal mechanism of humor. Suls also assumes that humor understanding is similar to the process of problem solving, and takes the humorous form of joke as an example to make a specific elaboration: the setting of the joke enables the listener to make an expectation of the possible result. If the punchline is inconsistent with the expectation, the listener will be surprised, so he tries to find cognitive rules to make the punchline consistent with the logical cognition of the joke setting. If the cognitive rules are discovered, the inconsistencies are resolved, and the listener senses the punchline of the joke and laughs accordingly. And if the cognitive rules are not discovered, jokes can cause confusion in the listener. This model emphasizes that humor arises from the removal and resolution of inconsistencies, rather than from the presentation of incongruities.

However, this theory also has its own restrictions. According to Nerhardt (1976), incongruity is a sufficient and necessary prerequisite of humor, and its resolution is superfluous. Nevertheless, incongruity theory cannot be used to explain the phenomenon of pointless statements. Although there are inconsistencies between background information

and catchy sentences in meaningless statements, individuals cannot gain humorous experience because they do not resolve the inconsistencies. Moreover, according to the incongruity resolution theory, incongruity is a necessary but insufficient prerequisite for humor, yet this theory cannot resolve all contradictions. For example, inconsistencies in the weight judgment paradigm. Before the emergence of the weight judgment paradigm, jokes and cartoons were usually employed as experimental materials for researchers to explore the cognitive process of humor. However, due to the immeasurable and uncontrollable linguistic and emotional components contained in these materials, it was difficult for researchers to identify the ingredients from which subjects rated the humor level of the materials. Furthermore, subjects’ own expectations of the materials would also affect their responses. The weight judgment paradigm arose to circumvent the constraints of prior experimental materials and paradigms. Incongruities in the weight judgment paradigm are defined as weight differences, and the operation flow of the paradigm is roughly as follows. The subjects were asked to assess the standard weight before being provided with weights that were either heavier or lighter than the standard. When the subjects raised a significant deviation from the standard weight, they grinned or laughed frequently. However, the incongruity here was not resolved before the humorous behavioral response was produced. Moreover, inconsistency lacks a clear solution, and the incongruity resolution theory cannot solve the inconsistency here.

2.3. Semantic Script Theory of Humor and General Theory of Verbal Humor

As an attractive expression, humor has also attracted the attention of linguists, who combine cognitive psychology and linguistics to explain humor from an interdisciplinary perspective. The Semantic Script Theory of Humor (SSTH), proposed by Raskin in 1979, is based on language. This theory holds that when individuals try to comprehend the events in the joke setting, the original mental script, frame or schema is activated. However, the components in the punchline are incompatible with the original mental script, which triggers the transformation of the original script. Only by backtracking and reinterpreting can the listener understand the meaning of joke. Semantic script theory posits that script opposition is the most important factor that affects jokes. The limitation of this theory is that it ignores the variables that influence the effect of jokes, and the theory is not completely applicable to explain jokes in social situations. On this premise, Attardo (1991) proposed the General Theory of Verbal Humor (GTVH). Based on the semantic script theory of humor, this approach introduces numerous variables called Knowledge Resources. In addition to the script opposition needed to produce jokes, it also introduces five other knowledge resources, namely: logical mechanism, goal, narrative strategy, language and situation. Attardo (1991) argues that script opposition explains the setup part of a joke, while logical mechanisms explain the punch line part of a joke. To analyze longer hilarious texts, the general theory of verbal humor expands the number of analysis variables derived from the semantic script theory. Both theories hold that the resolution of incongruity is a crucial aspect in the generation of humor, which is the study of cognitive theory on humor in the realm of language.

2.4. Social Theory

In contrast to previous theories, the social theory of humor focuses on the entertaining, interpersonal, and adaptive aspects of humor in social circumstances. Social theory points out that humor is essentially a social phenomenon and a thinking match that individuals employ to communicate with each other in the form of games (Li et al., 2009). People create humor to amuse each other, create laughter, and increase the chances of play (Li et al., 2009: 283). In the long process of evolution, the development of intelligence and language ability leads us to the appearance of colloquial forms and humorous oral language of play behavior, which gradually replaces other games such as chasing and kicking by children, thus making this adult game played frequently (Li et al., 2009: 283). When people play games, they don't take themselves seriously, whose goal is just to have fun. According to social theory and the roles of humor, some academics argue that humor can be interpreted in two different ways. First and foremost, humor is a way of interpersonal relationship. Secondly, humor is a manner of interpersonal communication, and it also has three functions of entertainment, communication and adaptation (Chen, 2010: 4). In interpersonal communication, people use humor to make laughter, amuse others, relieve the awkward and tense atmosphere through a relaxed, pleasant and euphemistic way of expression, so that people are enlightened in the laughter.

3. Studies on the Brain Mechanism of Humor

3.1. FMRI Studies

Humor consists of cognitive and emotional components; therefore, separating these two psychological processes is a key challenge in the study of humor's brain function. Goel and Dolan (2001) used semantic puns and homophonic puns similar to brain teasers as experimental materials to investigate the brain mechanism of cognitive and emotional components of humor. Though all jokes include a cognitive component, some jokes are rated as funny and some are rated as not funny. For example, the emotional component may not be consistent. By contrasting the brain areas that are stimulated by jokes that are rated as humorous and jokes that are not amusing, it is possible to distinguish between the cognitive and emotional aspects of humor. The results show that the cognitive processing required by different types of jokes is class-specific, while the affective processing of humor requires a number of common neural networks. To be specific, semantic puns dissonance and resolution mainly require the bilateral semantic processing network, while phonetic puns dissonance and resolution mainly require the left hemisphere language production area.

The affective processing of humor is primarily dependent on the reward-related activity of the ventromedial prefrontal lobe, indicating that the cognitive and affective components of humor engage distinct processing systems. Moran et al. (2004) separated the cognitive and emotional components of humor by using humorous TV series, and found that the posterior glume and left inferior frontal lobes were significantly activated in the stage of humor comprehension. The posterior glume may play a crucial role in forming expectations based on experience, while the inferior frontal gyrus may play an important role in resolving the incongruities with expectations. The insula and amygdala

were considerably engaged during the humor enjoyment stage. The insula may have an effect on "remaining still". Amygdala activation may be caused by surprise or emotion. Since the humorous material used in the study was funny video clips, it's possible that the emotions evoked were more than just humor. Moreover, participants were not asked to evaluate the event as humorous during the experiment. Therefore, it may not be considered to fully reflect the process of humor appreciation (Bartolo et al., 2006). Bartolo et al. (2006) believed that non-verbal humor materials can effectively avoid the interference caused by speech processing. They also proposed that cartoon pictures are more appropriate humor materials. In order to examine the brain mechanisms behind the comprehension and appreciation of humor, scientists utilized non-verbal humor elements. In the comprehension stage of humor, the left middle glume gyrus, right inferior frontal gyrus, left superior glume gyrus, and left cerebellum were strongly active.

The left amygdala was significantly activated when cartoons were assessed for funniness, indicating that the amygdala was involved in emotional processing of humor. Wild et al. (2006) also used cartoon pictures as experimental materials to intend to separate humor understanding from humor appreciation. The strategy used to distinguish between humor comprehension and humor enjoyment was consistent with that used by Goel et al. (2001). Studies have shown that humor comprehension greatly activates the glume-occipito-parietal association area and the left lateral prefrontal cortex. The glume-occipito-parietal association area plays an important role in dissonance detection and resolution, while the left lateral prefrontal cortex may have an important effect on semantic information search and dissonance resolution. Humor appreciation is associated with the amygdala. Chan et al. (2012) used non-funny garden path sentences to separate the cognitive and emotional components of humor and used non-funny sentences, garden path sentences, and hilarious sentences as experimental materials. Unlike the non-humorous sentences, the humorous garden route sentences contain the dissonance-resolution stage of the humor comprehension stage. In contrast to garden path sentences, funny sentences include humorous emotion-producing stages. In the stage of humor comprehension, both the bilateral inferior frontal gyrus and the left superior frontal gyrus were active. The ventromedial prefrontal lobe, bilateral amygdala, and parahippocampal gyrus were highly active during the humor appreciation stage.

In humor research, it is even more difficult to distinguish between the cognitive phases of humor (incongruity detection and incongruity resolution) because there is no clear behavioral indicator of the transition between processing stages. Samson et al. (2008) investigated brain networks that are solely involved in the phase of incongruity resolution, namely incongruity detection and resolution. Not only the non-humorous material was used as the baseline, but an additional baseline condition was also employed, that is, cartoons containing the detection phase of inconsistency but with unsolvable dissonance. The brain areas active during the stages of incongruity resolution and humor appreciation can be determined by comparing hilarious and unsolvable cartoons. Non-verbal cartoons having distinct logic mechanisms, such as visual puns, semantic cartoons, and theoretical cartoons of mind, are also employed as experimental materials. As a result, the cognitive processes of different logic mechanisms depended on different neural

networks, but all of them included incongruity resolution process, indicating that incongruity resolution, comparable to a problem-solving procedure, was the key component of humor processing. This study also found that the stage of incongruity resolution significantly activated brain regions such as the glume parietal associative area, left lateral prefrontal cortex and inferior frontal gyrus. Chan et al. (2013) further divided the cognitive components of humor and utilized an event-related fMRI paradigm to study the different brain areas involved in incongruity detection and resolution. Three experimental conditions were designed, including unfunny, nonsense and funny sentences. Unfunny conditions did not contain dissonance. Nonsense conditions contained unsolvable dissonance, and humor conditions contained solvable dissonance. Humor is composed of both cognitive and emotional components; consequently, separating these two psychological processes is a significant difficulty in the study of the brain function of humor. Incongruity detection significantly activated the right middle gyrus and the right middle frontal gyrus, whereas incongruity resolution significantly activated the left superior frontal gyrus and the left inferior parietal lobule. The findings supported a three-stage model of verbal humor processing, incongruity detection and resolution of humor comprehension, and the enjoyment caused by humor inference.

3.2. ERP Studies

ERP research provides more accurate outcomes for the dynamic changes of humor processing, and ERP technology can better separate the stages of humor processing. Coulson and Kutas (2001) presented subjects with jokes or non-jokes. Both joke sentences and non-joke sentences contained surprise elements, but the end of non-joke sentences was consistent with the context-induced category, that is, consistent with the context-activated frame. It did not require frame transformation processing, while jokes required frame transformation. It was found that joke endings evoked larger N400 amplitudes than non-joke endings. Du et al. (2013) invited participants to read a tale without a conclusion, then provided the story's ending and asked them to rate the ending as engaging or uninteresting. The behavioral results showed no significant difference in response to reading funny and unfunny stories, suggesting that subjects easily understood jokes and non-jokes. ERP results revealed that joke stories induced a more negative shift (N350-450) in the central frontal region. Dipole source analysis showed that N350-450 was located in the left facial gyrus and left middle frontal gyrus, indicating that these brain regions were involved in the detection of incongruity in humor comprehension. At 600-800ms, jokes induced a more negative shift (N600-800) in the central frontal region and a more positive shift (P600-800) in the posterior anterior cingulate gyrus, which are involved in breaking mental stereotypes and forming new associations. Jokes induced a positive shift in the anterior and posterior regions (P1250-1400), located in the middle frontal gyrus and fusiform gyrus, which are related with emotional enjoyment in joke understanding. This study provides support for a three-stage model of humor processing (humor detection, incongruity resolution, and humor appreciation).

In addition, Tu et al. (2014) used ERP techniques to examine ERP components at different stages of humor comprehension, and asked subjects to appreciate cartoon pictures, containing cartoons that are humorous, not humorous, and irrelevant. The results demonstrated that

hilarious and unrelated drawings generated a greater negative shift across 500-800ms (N500-800) than non-humorous images, perhaps representing the incongruity detection component of humor comprehension (the incongruity detection phase). A more positive shift over 800-1000ms (P800-1000) was caused by humorous and non-humorous cartoons than unrelated images, probably reflecting a classification process that initially assessed the ability of the images to establish textual and pictorial associations (the associative evaluation phase). During 1000-1600ms, humorous cartoons induced a more positive slow wave than non-humorous cartoons, but non-humorous cartoons induced a more positive slow wave than irrelevant cartoons. This factor may contribute to the establishment of novel associations (incongruity resolution stage). Finally, in 1600-2000ms, humor evoked a more positive component than non-humorous and irrelevant images (P1600-2000), which may reflect the emotional processing in the process of humor appreciation. On the basis of these findings, it may be stated that the second step of humor processing, the incongruity resolution stage, can be subdivided into two stages: the association evaluation stage and the incongruity resolution stage. Feng et al. (2014) employed ERP technology to disclose various ERP components caused by humor incongruity detection, incongruity resolution, and humor production stage, and asked participants to read jokes, non-jokes, and nonsensical words. In 350-500 milliseconds, nonsensical sentences elicited the biggest N400 component, which may reflect the incongruity detection stage of humor. Compared with nonsense sentences, jokes and non-jokes elicited a corrected P600 component at 500-700ms, which may reflect the reanalysis process in the step of incongruity resolution. Finally, jokes induced a maximum late positive component at 800-1500ms, which may be related to the production of emotions. Ku et al. (2017) investigated whether N400, P600, and LPP, which are involved in humor processing, are changed by readers' surprise, comprehension, and level of humor. Besides, they also investigated whether differences in readers' behavioral patterns would affect the corresponding neurotic electrophysiological activities. The results revealed that the high surprise level group elicited greater N400 amplitude, compared with the low surprise level group, reflecting the humor incongruity detection stage. Compared to the group with low comprehension, the P600 evoked by the group with strong comprehension was greater, reflecting the process of incongruity resolution. Compared with the low funny level group, the high funny level group induced a larger LPP amplitude, suggesting the humorous joy experience. This study again showed that N400, P600 and LPP are effective indicators, reflecting different processing stages of humor.

Left hemisphere semantic activation is more sophisticated. Encoding semantics is more precisely and activating information is directly associated to word meanings. Right hemisphere semantic activation is more coarse. Encoding semantics is more extensively. Previous studies suggested that the broader and more distant information activated by the right hemisphere may be more important for understanding jokes. Coulson and Wu (2005) measured the EEG components caused by probe words presented after jokes or non-jokes in order to determine whether the activation of pertinent information engaged in the right hemisphere in the processing of laughing is essential for the interpretation of jokes. It was found that correlated probe words caused smaller

N400 compared with non-correlated probe words, indicating that the semantic activation of joke-related information became easier after the presentation of jokes. And the left visual area generated a higher N400 correlation effect, which was consistent with the idea of coarse semantic coding. Joke-related information was more strongly activated in the right hemisphere, possibly because jokes required individuals to activate novel information to understand the association between an individual's initial expectations and the implied meaning of the punch line. It suggested that semantic activation in the right hemisphere was important for high-level speech comprehension tasks. Coulson and Williams (2005) further demonstrated the dominance of the right hemisphere in joke comprehension. This study took one-sentence jokes as material to investigate whether the difference in semantic activation between left and right hemispheres was related to joke comprehension. The N400 joke effect was shown to be smaller in the right hemisphere than in the left, indicating that the information triggered by coarse semantic coding in the right hemisphere was crucial for joke comprehension.

Li et al. (2019) investigated humor processing in relation to frequency. 36 Chinese participants were asked to take part in this experiment. The experimental stimuli were Chinese jokes, non-jokes, as well as nonsensical sentences. The data demonstrated that the P200 effect varied significantly among situations, indicating that the detection of incongruity was integrated at about 200 milliseconds, prior to the semantic synthesis at 400 milliseconds. The pre-processing of Chinese verbal jokes was unique due to the fact that processing Chinese characters simultaneously incorporated both the phonologic and orthographic components. According to the analysis of frequency dimension, the strength of beta reflected in particular the characteristics of different phases in the Chinese processing of verbal humor. At around 200 milliseconds, the relative power changes of jokes and nonsensical sentences were much greater than those of nonjokes, indicating that preprocessing of the incongruities may be more difficult. This demonstrated the importance of the beta frequency band in the processing of Chinese verbal jokes and the sequential relationship between the brain oscillation and event-related potential analysis.

Moreover, Sanada et al. (2022) investigated the relationship between detecting humor incongruity and resolving it, as well as the subjective perception of humor, utilizing event-related brain potentials (ERPs). Japanese nazokake puns, in contrast to conventional English puns, have a structure that separates the phases of incongruity detection and resolution, allowing this study to track the ERPs for each stage separately. Furthermore, the ERPs caused by funny puns and unfunny puns, classified based on participants' subjective ratings, were compared in order to examine how the cognitive stages functioned when people subjectively found a pun funny. In earlier literature, this irrational feeling has not gotten enough attention. The results revealed that N400 and P600 responses were triggered during the incongruity detection and resolution phases, respectively. The P600 amplitude was also increased in funny puns in comparison with unfunny puns, while the N400 amplitude did not differ significantly between the funniness categories. These findings showed that subjective sense of humor is related to the resolution step of humor processing rather than the incongruity detection stage.

By summarizing the existing brain imaging studies on humor, it can be found that the brain regions related to humor

comprehension are mainly concerned with the glume-occipito-parietal association area, inferior frontal gyrus, frontal earth gyrus, middle frontal gyrus and middle glume gyrus. And the brain regions related to humor emotional processing are mainly the mesencephalic limbic dopamine reward system. In summary, the electrophysiological studies of humor reveal that N400 is associated with the detection of humor incongruity. P600 is associated with the process of humor incongruity resolution, and LPP is associated with humor emotion processing.

4. Conclusion

Based on the literature mentioned above, it is clear that there are existing problems in humor research. Most of the papers on humor cite western humor theories, combined with a large number of examples, but there is fewer empirical research with a case study of humor. Currently, there is no single definition of humor that is satisfactory in China. The word "humor" is transplanted from the West, while currently there is not a specific word in Chinese that has the same connotation and extension as the Western word "humor", nor is there a word that can cover all the phenomena related to laughter. As for the theory of humor, there are great differences between Chinese and English, both in the form and method. Theories about humor in western countries are both rich and specific, while those in Chinese are much smaller in number, with only Lin Yutang and Lao She's view of humor.

The research on humor in teaching in China, according to the extant literature, focuses mostly on the summary of experience in teaching humor, and the discussion is mainly restricted to three aspects: what is teaching humor, the role and significance of teaching humor and humor techniques. It seldom refers to the mechanism, theoretical model and the relationship between teaching humor and age, gender, personality, way of thinking, creativity and other factors. Relevant empirical research has rarely been found. Compared with Westerners, Chinese people have a misunderstanding of the concept of humor and do not pay much attention to it. The level of theoretical research is relatively low, and domestic scholars generally attach importance to empirical and speculative research methods, which lack empirical research tools and methods. For instance, there is no scale of Chinese sense of humor in China. At the same time, due to the small number of domestic humor theories, most of them are supported by western theories, resulting in the situation that domestic academic humor research lags behind the West. In addition, the narrow denotation and a completely positive understanding of humor also limit the more in-depth study of humorous phenomena. On the basis of findings of the current research, future studies correlated with the humor processing should carefully consider the contribution of the entire set of ERP components, such as LAN or late LAN, LPC, N400 and P600, from the standpoint of individual differences. When other facets of humor are taken into consideration, such as the distinctions between various varieties of humor and the relationship between cognitive and emotional components, the research could become even more fruitful.

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