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The Influence of Creativity on Incongruity-Resolution and Nonsense Humor Comprehension

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Both creativity and humor are high-level cognitive functions and complex concepts. Although creativity and humor are generally deemed positively correlated, it has been difficult to explicitly identify their relationship with each other. The cognitive process of creativity includes divergent thinking, insight, and remote association, whereas humor comprehension includes incongruity resolution and nonsense humor. The difference between the 2 types of humor is in whether individuals can understand the content of jokes through logical deduction. This study explored the relationship of the different dimensions of cognitive creativity and incongruity-resolution and nonsense humor comprehension. Furthermore, we examined the influence of divergent thinking, insight, and remote association on incongruity-resolution and nonsense humor comprehension. The scores from 103 participants on a divergent thinking questionnaire, an insight problem-solving task, and the Chinese compound remote associate problems test were used to analyze their comprehension of incongruity resolution and nonsense humor. The results showed a positive correlation between remote association and incongruity-resolution humor comprehension, as well as a positive correlation between insight and nonsense humor comprehension. These findings indicate that each dimension of cognitive creativity has a particular way of connecting to various types of humor comprehension.

Creativity and humor are high-level cognitive functions unique to human beings. Both play a crucial role in daily living and in scientific and technological development (Martin, Puhlik-Doris, Larsen, Gray, & Weir, 2003; Wei et al., 2014). For half a century, much attention has been devoted to understanding the relationship between creativity and humor. Currently, creativity and humor are generally considered to be positively correlated (Koestler, 1964; Rouff, 1975; Sitton & Pierce, 2004); however, because creativity and humor are complex and diverse concepts with various definitions provided by different academic researchers (O'Quin & Derks, 1997; Sternberg & Lubart, 1999), it is difficult to identify the similarities between

them. Defining the two concepts clearly before examining their relationship is therefore needed.

CREATIVITY: DIVERGENT THINKING, INSIGHT, AND REMOTE ASSOCIATION

The prevalence of research studies on creativity can be attributed to the advocacy of J. P. Guilford in the 1950s when he presided over the American Psychological Association. In Guilford's structure of intellect (SI) theory, creativity was part of the intellectual operation called divergent thinking (Guilford, 1959). Using factor analysis, Guilford divided divergent thinking into four dimensions of abilities: (a) fluency (the ability to produce a large number of ideas), (b) flexibility (the ability to propose a variety of ideas), (c) originality (the ability to produce unusual ideas), and (d) elaboration (the ability to develop or embellish ideas by describing and adding details). It can be inferred from the aforementioned four categories of

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abilities that divergent thinking moves in diverging directions, leading to different solutions or creations. Based on SI theory, Torrance (1974) deemed divergent thinking as a key factor in creativity and developed the widely used Torrance Tests of Creative Thinking (TTCT). A version of the TCCT, the Creative Thinking Questionnaire in the Chinese language and graphics, is a measurement scale comprising the following elements: (a) product improvement, (b) unusual uses, (c) questioning, and (d) circles. Individuals' creativity is scored based on fluency, flexibility, originality and elaboration. Wu et al. (1998) developed the Chinese version of the Creative Thinking Test (CVCTT), which includes two subtests, a verbal subtest and a graphics subtest. In the verbal subtest, the task is to associate and write down unusual or creative uses for chopsticks. In the graphics subtest, the task is to add detail to or embroider a picture, “人”. Scores on the verbal subtest reflect fluency, flexibility, and originality; scores on the graphics subtest reflect fluency, flexibility, originality, and elaboration.

Classified according to the two dimensions of creativity, “clarity in defining questions” and “openness of problem solving” (Wakefield, 1992, p. 28), the divergent thinking questionnaire is “closed-problem, open-solution,” whereas the insight problem is “open-problem, closed-solution.”

The concept “insight” originated from Gestalt psychology's theory of problem solving (Kohler, 1925, pp. 351–352). During the process of insight problem solving, individuals experience a sudden discovery of proper connections among parts within an overall situation and an *aha* moment follows (Fleck & Weisberg, 2004, 2013; Weisberg, 2015). Ohlsson (1984, 1992, 2011) has pointed out accordingly that *aha* moments are generated due to the restructuring of problems. This process involves impasses: the formation of a new and correct perspective other than the initial problem situation, reorganization of the existing relationships among the stimuli, and construction of a novel problem representation. Several studies have indicated that restructuring the initial problem representation is the key to insight problem solving (Knoblich, Ohlsson, Haider, & Rhenius, 1999; Knoblich, Ohlsson, & Raney, 2001).

Different from divergent thinking, which focuses on the creation of a wide variety of novel ideas or on the use of convergent insight problem solving by means of problem representation transfer, remote association focuses mainly on the simultaneous production of many novel concepts and the formation of connections between what were originally remote factors to form new relationships (Mednick, 1962). Mednick utilized the concept of associative hierarchies to illustrate why individuals differed greatly in creativity scores. According to his study, the semantic network of highly creative people, described as having the ability to produce more concepts and gradually connect these remote concepts with

each other, is a flat associative hierarchy, whereas the semantic network of people with low creativity, described as having the ability to associate adjacent concepts more readily than remote concepts, is a steep associative hierarchy. Mednick and Mednick (1967) developed the Remote Associates Test (RAT) to assess creativity potential. This test has since been used in numerous studies (Bowden & Jung-Beeman, 2003; Cerruti & Schlaug, 2009; Storm, Angello, & Bjork, 2011; Ward, Thompson-Lake, Ely, & Kaminski, 2008; Zhong, Dijksterhuis, & Galinsky, 2008). For Mandarin speakers, Jen, Chen, Lien, and Cho (2004) created a Chinese version of the RAT using Chinese orthography and called it the Chinese Remote Association Test (CRAT). Since then, different forms of the CRAT have been developed, such as the Chinese Word Remote Associative Test (CWRAT; Huang, Chen, & Liu, 2012), Chinese Radical Remote Associative Test (CRRAT; Chang, Wu, Chen, & Wu, 2016), and Chinese Compound Remote Associative Test (CCRAT; Wu & Chen, 2017). The RAT is characterized by the strengths of having a short testing time, limited solutions, and objective scoring. The RAT can effectively evaluate individuals' creative potential with relatively simple question programming and can also help in formulating bulk questions to prevent a practice effect.

The RAT, similar to insight problem solving, is “open-question, closed solution” (Huang, Chen, & Liu, 2012). Studies have indicated that individuals engaging in the RAT and insight problem solving show similar key characteristics (Bowden & Jung-Beeman, 2003), including (a) misguidance in the extraction process, (b) difficulty reporting the solution-exporting process (Ben-Zur, 1989), and (c) the occurrence of *aha* moments that took place during the problem-solving process. The operational process of remote association allows individuals to form free associations and then examine whether they could form associations among remote concepts (Mednick, 1962). The number of concepts created in an individual's association process and the fluency of divergent thinking are similar, wherein both (a) emphasize the quantity of concept output and remote concepts and (b) view originality as an ability to create innovative ideas that are difficult to generate. Therefore, individual scores on the RAT were positively correlated with scores reflecting fluency and originality of divergent thinking (Wu, Chang, & Chen, 2017).

Overall, the research reviewed suggests that the solutions produced during the RAT are based on the fluent associations formed from remote concepts to adjacent concepts. Furthermore, connections are made between the original remote concepts and *aha* moments occur when solutions to the problem emerge. Divergent thinking, insight, and remote association are all cognitive components of creativity and each reflects different creativity operational processes. Therefore, it is necessary to integrate these components into the exploration of the relationship between the different dimensions of cognitive creativity and humor comprehension.

HUMOR COMPREHENSION AND APPRECIATION

Humor comprehension and appreciation refers to the capacity of an individual to derive amusement from the meaning of a piece of information perceived as incoherent (Ruch & Hehl, 1998). Suls (1972) proposed the incongruity-resolution theory to further understand humor comprehension, arguing that readers, based on the clues provided, could predict the likely subsequent result. If the actual result of the story matched the readers' prediction, then the incongruity-resolution process did not take place. On the other hand, if the end result of the story was inconsistent with readers' prediction, they would feel surprised and try to find rules that could explain the end result from the clue provided. If individuals find the rules to be consistent, an approach to resolution occurs; failure to approach resolution results in individuals being stuck in perpetual confusion. The following story is a good example of this process:

An extremely beautiful girl had severe bromhidrosis; because of her condition, her boyfriend wanted to break up with her. This upset her very much, so she went to pray before the statue of Jesus, pledging her utmost loyalty and faith and pleading to Jesus to cure her. While she was praying intently, something dropped in front of her. She picked it up and nearly fainted. It was a nail!

In the last sentence, "It was a nail," the connotative meaning of "nail" can be puzzling for the readers; thus, they enter the stage of incongruity. Next, the readers will reinterpret the narrative until they infer the meaning behind the sentence, which is that *Jesus dropped the nail that prevented him from moving his hand on the cross to hold his nose because of the girl's strong body odor*. This is the process of resolution, which elicits the feeling of amusement or the response of laughter. On the other hand, if the readers are unable to infer the real meaning behind the nail, they will be perpetually puzzled.

Incongruity resolution, although an essential condition for humor, is not a sufficient condition to elicit humor (Michael, 2007) because problem solving or bridging inference also goes through the incongruity resolution process, but it does not necessarily provide amusement (Rothbart, 1976); therefore, Wyer and Collins (1992) proposed comprehension-elaboration theory. This theory holds that, once incongruity takes place, individuals will reinterpret the text to obtain solutions and derive delight from the refined process of obtaining solutions—the two stages of comprehension and appreciation. Using jokes in texts, Chan et al. (2013) used functional magnetic resonance imaging (fMRI) technology to distinguish between the two stages of comprehension and elaboration and thus further identified the cognitive and emotional components of humor. The cognitive component of humor was the comprehension of the

content of humor, and the emotional component was the delight derived from humor comprehension.

Not all humor comprehension proceeds through the incongruity-resolution process. Ruch (1992) divided humor into three categories: (a) incongruity-resolution humor, (b) nonsense humor, and (c) sexual humor. Incongruity-resolution humor is believed to be driven by *punch lines* that can be resolved through logical thinking during the postjoke narrative. Nonsense humor, on the other hand, implies that the surprise or incongruity factor in the text cannot be fully solved by means of logical thinking, but rather mostly through puns or harmonics, which aid comprehension of the joke and, therefore, results in amusement. For example: "Someone is called Xiao Cai, and then he is taken away." Because *Xiao Cai*, 小蔡 (Chinese pronunciation: Xiao Cai), has the same pronunciation as *side dish*, 小菜, the connection between the name and the meaning of *side dish* could be easily inferred; thus, the joke is comprehended. Finally, sexual humor can be characterized by the sexual elements contained in jokes. It follows that incongruity-resolution humor, like nonsense humor, may also elicit feelings of amusement in readers. The major difference lies in the logical narrative of the content of the jokes, which enables readers to obtain resolution through logical deduction. One brain imaging study found that activation occurs in different brain areas when individuals comprehend incongruity-resolution humor and nonsense humor (Samson, Hempelmann, Huber, & Zysset, 2009). This indicates that to comprehend the two types of humor, different cognitive operations are required. On the other hand, the main difference between sexual humor and the other two kinds of humor is the presence of sexual elements; there is no difference in structure. This study only considered incongruity-resolution and nonsense humor to explore the relationship between the different dimensions of cognitive creativity and humor comprehension of various structures.

THE ASSOCIATION BETWEEN CREATIVITY AND HUMOR

Both creativity and humor are diverse and complex concepts (Sternberg & Lubart, 1999); although many empirical studies have suggested that the two are closely correlated (Galloway, 1994), the findings have been relatively dissimilar and divergent. The following is a brief account of the association between divergent thinking, insight, and remote association and the various types of humor. This description provides a hypothetical basis for our study.

Research has pointed out that divergent thinking is correlated with humor production and humor styles (Cayirdag & Acar, 2010; Derks & Hervas, 1988). Derks and Hervas invited college students to create humorous subtitles for

movie pictures and discovered that the more humorous subtitles the students produced, the less repetitive the subtitle content was. This finding indicates that when individuals devise a greater amount of humorous work, they show higher levels of originality. In addition, Cayirdag and Acar analyzed the association between middle school students' humor styles and divergent thinking. They discovered a negative correlation between humor styles and divergent thinking; individuals who were more inclined to use positive humor styles had lower performance in fluency and originality. In addition, individuals who were more inclined to adopt self-deprecating humor obtained lower scores on fluency. However, there is no current empirical research that supports the proposition that divergent thinking and humor comprehension are directly related.

Furthermore, insight thinking is correlated with humor comprehension and humor production (Amir & Biederman, 2016; Amir, Biederman, Wang, & Xu, 2015). Amir and Biederman (2016) used two studies to analyze the connection between insight and humor comprehension, as well as the relationship between insight and humor production through understanding the different operations that occur in the brain. Their results showed that operations related to insight and humor comprehension collectively triggered brain activation in the temporal poles, temporo-occipital junction, and medial prefrontal cortex. When individuals were asked to give pictures humorous titles, the same significant activation in the medial prefrontal cortex was observed. The results showed that a physiological association between insight, humor comprehension, and humor creation exists.

Remote association and humor comprehension both contain elements of incongruity, surprise, and novelty (Mednick, 1962). Both require logical thinking and the connection of originally irrelevant things through fortuitous clues, eventually generating ideas or feelings of amusement. Empirical research suggests that there is a positive correlation between remote association and humor comprehension (Rouff, 1975). When individuals had higher remote association abilities, they were more capable of effectively comprehending the humor content. One notable thing is that after controlling for the factor of Chinese language proficiency, remote association and humor comprehension were still significantly positively correlated, which is indicative of a stable positive correlation between the two.

It follows that previous research has established an association among insight, remote association, and humor comprehension (Amir et al., 2015; Rouff, 1975). However, prior studies have failed to consider differences in cognitive approaches that could be used to comprehend different types of humor. Ruch (1992) proposed two types of humor: incongruity-resolution and nonsense humor. The major difference is whether the jokes are sufficiently logical that readers can obtain resolution through logical

deduction. Nonsense humor, therefore, does not rely on remote association to find the resolution to incongruity but rather relies on transferring the representation of the key joke elements to elicit the feeling of amusement.

When exploring the relationship between creativity and humor comprehension, one should take gender and age into account. Previous studies have argued that humor comprehension improves with age (Bergen, 1998), and many scholars have proposed that age is correlated with humor comprehension (Herzog, 1999; Martin et al., 2003).

THIS STUDY

Creativity and humor comprehension are generally considered to be positively correlated (Galloway, 1994; Rouff, 1975; Sitton & Pierce, 2004). Creativity, according to its operative mechanism, has been categorized into (a) divergent thinking, (b) insight, and (c) remote association, whereas humor comprehension has been divided into (a) incongruity-resolution humor and (b) nonsense humor, based on whether logical deduction is involved. Currently, there has been a lack of research on the influence of creativity on a certain type of humor comprehension. This study thus aimed to fully examine the association among the three dimensions of creativity and the two types of humor comprehension to provide a deeper understanding of the cognitive mechanisms of creativity and humor.

The hypothesis of this study was that a certain type of humor comprehension could obtain resolution from nonlogical content. Furthermore, this research also tested the idea that insight and remote association, which lead to convergent resolution, are positively correlated with each other and that divergent thinking, which continually produces associations, is not directly correlated with humor comprehension. In this study, remote association refers to the generation of remote and irrelevant concepts and the formation of weak connections in each concept. Incongruity-resolution humor reflects the incongruity driven by punch lines that can be resolved through logical thinking in the postjoke narrative. These definitions suggest that both types of humor require logical thinking in addition to fortuitous clues and the formation of connections between the originally irrelevant concepts to generate ideas or feelings of amusement. On the other hand, insight requires individuals to restructure the problem representation to seek resolution through initial problem representation transfer before the *aha* moment can occur. Although the incongruity elements of nonsense humor cannot be fully resolved through logical thinking, they can be resolved through representation transfer (such as use of phonetics and semantics) of key elements. This ability indicates that insight and nonsense humor comprehension both involve the process of problem representation restructuring. Accordingly, this study further

hypothesized that remote association would be positively correlated with incongruity-resolution humor comprehension and that insight would positively predict nonsense humor comprehension. By differentiating the respective influence of individuals' different cognitive creativity on the comprehension of various types of humor, an improved cognitive operation framework of creativity and humor could be established.

METHOD

Participants

One-hundred-and-three students volunteered to participate in this study. The participants were undergraduates or graduate students, 41 men and 62 women aged 18 to 30 years ($M = 21.25$, $SD = 1.91$). All participants spoke Mandarin, were right-handed, and had normal or corrected eyesight. All understood the content of the research and signed the informed consent form before the study started, earning 150 new Taiwanese dollars after completing the study.

Materials

Chinese compound remote associates problems

Chinese compound remote associate problems were taken from the Normative Data for Chinese Compound Remote Associate Problems" established by Wu and Chen (2017). This study used a short version, which included 30 problems. Each problem contained three stimulus characters, for example, 今, 輕, and 去. The participants' task was to find a target word to pair with the stimuli to create three actual two-character words. The target word of this example item was 年 (*nian*) because it can be combined with each of the character stimuli to form 今年 (this year), 年輕 (young), and 去年 (last year). Because this database is a *question bank*, it did not provide reliability and validity information.

Divergent thinking test

The CVCTT was compiled by Wu et al. (1998) and includes two subtests: a verbal subset and a graphics subset. The test requires participants to associate and write down unusual or innovative uses for chopsticks other than for eating and grasping food. Creativity was evaluated using the following three indices: fluency, flexibility, and originality. The raw scores were transformed and standardized into a *T*-score ($50 + 10 \times Z$). The total *T*-score of the three indices represented divergent thinking performance.

For the reliabilities, Kendall's coefficients of internal consistency were .96 for fluency, .97 for flexibility, and .94 for originality. After 3 to 4 months, retesting was conducted, and the following results were obtained: .46

for fluency, .44 for flexibility, and .34 for originality. For validity, TTCT was utilized as an external criterion. The correlation results of the CVCTT and TCCT were as follows: .52 ~ .75 for fluency; .47 ~ .62 for flexibility; .08 ~ .20 for originality of Chinese language; .09 ~ .57 for originality of Chinese graphics, respectively; and .39 for elaboration.

Insight problem solving

The insight problem solving test used in this study was a revision by Chiu (2005, pp. 197–199) based on the "six insight problems" by Ashcraft (2002), Perkins (2000), and Chen (2002). Before test administration, participants were asked whether they had already seen the problems in textbooks or elsewhere; if they acknowledged that they knew the answer to a problem, their response to this specific problem was recorded as a missing value and was not counted. One credit was given for each correct result; no credit was given for an incorrect result. The total score for the six problems was the participant's total score for the test. To prevent differences in total scores caused by unanswered problems or invalid responses, the passing rate was computed with the equation ($\frac{\text{correct items}}{\text{valid items}}$) to represent insight problem performance.

For validity and reliability testing, Chiu (2005) assembled 125 college students. The internal consistency coefficient, α , was .52, which was within the acceptable range according to the standards. For validity, the analytical results of the validation factors were as follows: $\chi^2(124) = 7.72$, $p > .05$, GFI = .98, SRMR = .048, PNFI = .51, and CFI = 1.00. All conformed to the overall suitability standards. This result indicated that insight problem solving was indeed formed by an element's potential construction.

Humor comprehension and appreciation questionnaire

The Chinese Humor Comprehension and Appreciation Questionnaire was sampled from the Normative Data for Chinese Jokes compiled by Cheng, Chen, Chan, Su, and Tseng (2013). Our study selected 10 items for nonsense humor and 10 items for incongruity-resolution humor. The participants' task was to evaluate the degree of their joke comprehension on a 9-point scale after reading each joke. The mean score of the 10 items represented the level of understanding for the corresponding types of humor. The higher the score was, the higher the level of joke comprehension was. Examples can be seen in Table 1.

Procedure

This study used group testing and a counterbalancing method to arrange the order of the tests to be taken. A quarter of the participants finished the test in this order: (a) Chinese compound remote associate problems, (b) divergent thinking test,

TABLE 1
Examples of incongruity-resolution and nonsense humor

Type of Humor	Example
Incongruity-resolution humor	Director of the psychiatric hospital: "Do you know what day is tomorrow?" All of the patients shook their heads. The director said, "The president is visiting tomorrow. When I cough, you clap your hands. If you all behave well, each of you will get a big meat bun." The next day when the president came, the director coughed, and every patient started to clap. Suddenly, one of the patients went up to the president, slapped him on the face, and said, "Don't you want a meat bun?"
Nonsense humor	A unicorn striving to fly north flew to the north pole and transformed into ice cream. Its two younger brothers wanted to follow their brother to the North Pole. Eventually, they turned into frost cream.

(c) insight problem solving, and (d) Chinese Humor Comprehension and Appreciation Questionnaire. Another quarter of the participants finished the test in this order: (a) divergent thinking test, (b) insight problem solving, (c) Chinese Humor Comprehension and Appreciation Questionnaire, and (d) Chinese compound remote associate problems. Another quarter of the participants finished the test in this order: (a) insight problem solving, (b) Chinese Humor Comprehension and Appreciation Questionnaire, (c) Chinese compound remote associate problems, and (d) divergent thinking test. The last quarter of the participants finished the test in this order: (a) Chinese Humor Comprehension and Appreciation Questionnaire, (b) Chinese compound remote associate problems, (c) divergent thinking test, and (d) insight problem solving.

RESULTS

Descriptive statistics

Table 2 presents the means, standard deviations, kurtosis, and skewness for creative performance. The results showed that participants attained relatively low passing rates ($M = .20$) on the Chinese compound remote associate problems. Furthermore, participants in the first quartile obtained the highest rate ($Q1 = 7.5$) in the evaluation of humor comprehension, indicating that they could mostly understand the content of the jokes.

Partial correlation analysis

As past studies have indicated that age and gender are related to humor comprehension (Bergen, 1998; Herzog, 1999; Martin et al., 2003), this study statistically controlled for the influence of gender and age and computed partial correlation coefficients between performances on the three creativity tasks

TABLE 2
Results of participants' performance on the creativity questionnaire and humor comprehension

	Mean	SD	Skewness	Kurtosis
Creativity performance				
Remote association	.20	.07	0.33	-0.15
Insight problem solving	.59	.24	-0.29	-0.32
Divergent thinking	151.44	28.57	2.46	10.50
Humor comprehension				
Incongruity-resolution joke	8.67	0.39	-1.36	1.24
Nonsense joke	8.75	0.45	-2.45	6.92

and comprehension of the two humor types. Table 3 lists these results. Remote association and incongruity-resolution humor comprehension were positively correlated ($r = .35, p < .001$), performance on the insight problems was positively correlated with nonsense humor comprehension ($r = .25, p = .010$), and divergent thinking had no significant association with either type of humor comprehension ($r_s < .10, p_s > .322$).

Hierarchical multiple regression analysis

Finally, to understand the respective influence of the three kinds of creativity on comprehension of incongruity-resolution humor and nonsense humor and to determine which of the creativity tasks had the strongest relation to humor comprehension, this study implemented hierarchical multiple regression analysis to investigate the individual influence of the three creativity tasks on humor comprehension, controlling for age and gender. The results in Table 4 showed that after controlling for the influence of gender and age, as well as for performance on divergent thinking and insight problem solving, remote association and incongruity-resolution humor comprehension were significantly positively correlated, $\beta = .32, t(97) = 3.34, p = .001$. Additionally, after controlling for the influence of gender, age, and divergent creativity, insight problem solving ability was positively correlated with nonsense humor comprehension, $\beta = .23, t(97) = 2.33, p = .022$.

TABLE 3
Partial correlations of three dimensions of creativity performance on incongruity-resolution and nonsense humor comprehension

	Humor Comprehension	
	Incongruity-Resolution Joke	Nonsense Joke
Remote association	.35**	.18
Insight problem solving	.18	.25*
Divergent thinking	.10	.06

Control variables: gender and age

* $p < .05$, ** $p < .01$

TABLE 4
Multiple regression analysis of the effect of creativity performance on incongruity-resolution and nonsense humor comprehension (N = 103)

	<i>Humor Comprehension</i>			
	<i>Incongruity-Resolution Joke</i>		<i>Nonsense Joke</i>	
	ΔR^2	β	ΔR^2	β
Step 1	.02		< .01	
Gender		.07		-.02
Age		-.12		-.03
Step 2	.14**		.08*	
Remote association		.32**		.14
Insight problem solving		.13		.23*
Divergent thinking		.03		.01
Total R^2	.15**		.08*	

* $p < .05$, ** $p < .01$

DISCUSSION

This study explored the connection between different dimensions of cognitive creativity and various types of humor comprehension. Additionally, the study analyzed the respective influences of divergent thinking, insight, and remote association on incongruity-resolution and nonsense humor comprehension. The results indicated that after controlling for the influence of age and gender, remote association was positively correlated with incongruity-resolution humor comprehension, performance on insight problem solving positively predicted nonsense humor comprehension, and divergent thinking had no direct connection to either type of humor comprehension. This result is indicative of the specific association between the different cognitive components of creativity and the different types of humor comprehension.

Based on the results of our study, remote association positively predicted incongruity-resolution humor comprehension and was not significantly correlated with nonsense humor comprehension. In the initial proposal of the concept of remote association, Mednick (1962) argued that both remote association and humor contained incongruity, surprise, and novelty and required logical thinking to connect originally irrelevant things with each other to generate ideas or feeling of amusement. Empirical research has supported the positive correlation between remote association and humor comprehension (Rouff, 1975). By further analyzing the relationship between remote association and certain types of humor comprehension, our study discovered that remote association and incongruity-resolution humor comprehension were positively correlated. The reason for this correlation is that incongruity-resolution humor comprehension relies on logical thinking to resolve the inconsistency within the text and to identify the remote connection between parts of the text. One example of this

need is shown in the incongruity-resolution joke in Table 1: when the participants tried to understand the statement “One of the patients went up to the president, slapped him on the face and said, ‘Don’t you want a meat bun?’”, readers must first connect this statement to the scene illustrated by the statement “only the president didn’t clap,” and must then connect the statement to the clue provided in the previous text, “the director said that only those who clap their hands will get meat buns.” The response of “smiling” indicated that the participants comprehended the reason that the patient hit the president, which was actually because the patient just wanted to remind the president. The process of humor comprehension involves connecting different clues in the joke and producing a novel and interesting interpretation, and the statistical results of the present study support this idea.

Insight, on the other hand, positively predicted nonsense humor comprehension and had no significant association with incongruity-resolution humor comprehension. Previous research has explored the connection between an individual’s insight and humor comprehension from the perspective of physiology by pointing out that both insight and humor comprehension trigger the activation of some of the same brain areas, indicating that insight and humor comprehension share common cognitive mechanisms. This study analyzed the association between insight and humor comprehension at the behavioral level. Further analysis of the relationship between insight and certain types of humor showed that insight was positively associated with nonsense humor comprehension. The key to solving insight problems is reconstructing the initial representation of the problem (Knoblich et al., 1999, 2001). For nonsense humor, the readers mostly adopted harmonics or puns to reinterpret the content of jokes. With the nonsense joke in Table 1 as an example, the semantics of “two unicorns” 雙麒麟 (Shuang Qi lin) and “frost cream” 霜淇淋 (Shuang Qi lin) are not related at all; they are just pronounced the same. Although two unicorns turning into frost cream seem illogical, there is an indirect relationship between these phrases. When the participants tried to understand the relationship between “two unicorns” 雙麒麟 (Shuang Qi lin) and “frost cream” 霜淇淋 (Shuang Qi lin), they had to convert 雙麒麟 to the homophone 霜淇淋 to understand the joke. This need means that individuals must transfer representation during the process of insight problem solving and nonsense humor comprehension.

It is interesting to note that, individually, remote association and insight positively predicted incongruity-resolution and nonsense humor comprehension, indicating that although remote association and insight are considered to share many common problem-solving processes (Bowden & Jung-Beeman, 2003), analysis of their connection to the different types of humor comprehension showed that they still differ in other aspects. Furthermore, both remote association and insight were

significantly correlated with only one type of humor comprehension. This finding reveals that an individual's comprehension of incongruity-resolution and nonsense humor may operate via different cognitive mechanisms.

Divergent thinking had no significant association with either incongruity-resolution or nonsense humor comprehension. A comparison of these operations revealed that the process of divergent thinking is different from that of humor comprehension. The former emphasizes the free generation of various types of novel products and is not about convergent thinking, whereas the latter focuses on deriving delight from finding inconsistent resolutions (Suls, 1972; Wyer & Collins, 1992), in which various reasons for the inconsistency converge into one answer. This study took an empirical approach, and the results of the analyses conformed to the expectation that divergent thinking is not directly correlated with humor comprehension. It is important to note that previous research suggested that divergent thinking is positively correlated with remote association (Wu et al., 2017). This study also supported the finding that remote association positively predicted humor comprehension, but this positive correlation was not reflected in the association between divergent thinking and humor comprehension. This finding indicates that remote association, divergent thinking, and humor comprehension are independently related to different components.

This study only utilized a self-reported questionnaire to investigate the different types of humor comprehension. The comprehension of the humor used in the study was relatively limited, suggesting that future research should further ask participants about the factors that make jokes entertaining and, based on the answers, examine whether the participants truly comprehended the content of the jokes. Moreover, the study only explored the influence of the different dimensions of cognitive creativity on humor comprehension. Previous studies have revealed that divergent thinking and insight are correlated with humor creation (Amir & Biederman, 2016; Derks & Hervas, 1988). Subsequent research should also explore the association between remote association and humor creation. Finally, this study focused on the relationship between creativity and humor at the level of cognitive processing. Creativity and humor both contain affective elements, such as creative tendency (Edwin, Emily, & John, 2005), creative self-efficacy (Tierney & Farmer, 2002), and humor styles (Martin et al., 2003). This characteristic suggests that an integrated model could be constructed to further analyze the relationship between creativity and humor through the interconnection of cognitive and affective factors.

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Data can be accessed by contacting the corresponding author.

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REFERENCES

- Amir, O., & Biederman, I. (2016). The neural correlates of humor creativity. *Frontiers in Human Neuroscience*, 10, 597. doi:10.3389/fnhum.2016.00597
- Amir, O., Biederman, I., Wang, Z., & Xu, X. (2015). Ha Ha! Versus Aha! A direct comparison of humor to nonhumorous insight for determining the neural correlates of mirth. *Cerebral Cortex*, 25, 1405–1413. doi:10.1093/cercor/bht343
- Ashcraft, M. H. (2002). *Cognition*. Upper Saddle River, NJ: Prentice Hall.
- Ben-Zur, H. (1989). Automatic and directed search processes in solving simple semantic memory problems. *Memory and Cognition*, 17, 617–626.
- Bergen, D. (1998). The sense of humor: Explorations of a personality characteristic. In W. Ruch (Ed.), *Development of the sense of humor* (pp. 329–358). Berlin, Germany: Walter de Gruyter.
- Bowden, E. M., & Jung-Beeman, M. (2003). Normative data for 144 compound remote associate problems. *Behavior Research Methods, Instruments, and Computers*, 35, 634–639. doi:10.3758/BF03195543
- Cayirdag, N., & Acar, S. (2010). Relationship between styles of humor and divergent thinking. *Procedia Social and Behavioral Sciences*, 2, 3236–3240. doi:10.1016/j.sbspro.2010.03.494
- Cerruti, C., & Schlaug, G. (2009). Anodal transcranial direct current stimulation of the prefrontal cortex enhances complex verbal associative thought. *Journal of Cognitive Neuroscience*, 21(10), 1980–1987. doi:10.1162/jocn.2008.21143
- Chan, Y. C., Chou, T. L., Chen, H. C., Yeh, Y. C., Lavallee, J. P., Liang, K. C., & Chang, K. E. (2013). Towards a neural circuit model of verbal humor processing: An fMRI study of the neural substrates of incongruity detection and resolution. *NeuroImage*, 66, 169–176. doi:10.1016/j.neuroimage.2012.10.019

- Chang, Y. L., Wu, J. Y., Chen, H. C., & Wu, C. L. (2016). The development of Chinese radical remote associates test. *Psychological Testing*, 63(1), 59–81.
- Chen, L. K. (2002). *Puzzles collection*. Taipei, Taiwan: Reader's Digest.
- Cheng, C. M., Chen, H. C., Chan, Y. C., Su, Y. C., & Tseng, C. C. (2013). Taiwan corpora of Chinese emotions and relevant psychophysiological data - Normative Data for Chinese Jokes. *Chinese Journal of Psychology*, 55(4), 555–569.
- Chiu, F. C. (2005). *The cognitive process of creativity* (Doctoral dissertation). Retrieved from <http://ir.lib.ntnu.edu.tw/>
- Derks, P., & Hervas, D. (1988). Creativity in humor production: Quantity and quality in divergent thinking. *Bulletin of the Psychonomic Society*, 26(1), 37–39. doi:10.3758/BF03334854
- Edwin, C. S., Emily, J. S., & John, C. H. (2005). The creative personality. *Gifted Child Quarterly*, 49, 300–314. doi:10.1177/001698620504900404
- Fleck, J. I., & Weisberg, R. W. (2004). The use of verbal protocols as data: An analysis of insight in the candle problem. *Memory & Cognition*, 32, 990–1006. doi:10.3758/BF03196876
- Fleck, J. S., & Weisberg, R. W. (2013). Insight versus analysis: Evidence for diverse methods in problem solving. *Journal of Cognitive Psychology*, 25, 436–463. doi:10.1080/20445911.2013.779248
- Galloway, G. (1994). Psychological studies of the relationship of sense of humor to creativity and intelligence: A review. *European Journal for High Ability*, 5, 133–144. doi:10.1080/0937445940050203
- Guilford, J. P. (1959). *Personality*. New York, NY: McGraw-Hill.
- Herzog, T. R. (1999). Gender differences in humor appreciation revisited. *Humor: International Journal of Humor Research*, 12(4), 411–423. doi:10.1515/humr.1999.12.4.411
- Huang, P. S., Chen, H. C., & Liu, C. H. (2012). The development of Chinese word remote associates test for college students. *Psychological Testing*, 59(4), 581–607.
- Jen, C. H., Chen, H. C., Lien, H. C., & Cho, S. L. (2004). The development of the Chinese remote association test. *Research in Applied Psychology*, 21, 195–217.
- Knoblich, G., Ohlsson, S., Haider, H., & Rhenius, D. (1999). Constraint relaxation and chunk decomposition in insight. *Journal of Experimental Psychology: Learning, Memory & Cognition*, 25, 1534–1555.
- Knoblich, G., Ohlsson, S., & Raney, G. E. (2001). An eye movement study of insight problem solving. *Memory & Cognition*, 29, 1000–1009. doi:10.3758/BF03195762
- Koestler, A. (1964). *The act of creation*. New York, NY: Macmillan.
- Kohler, W. (1925). The mentality of apes. *Nature*, 116, 351–352.
- Martin, R. A., Puhlik-Doris, P., Larsen, G., Gray, J., & Weir, K. (2003). Individual differences in uses of humor and their relation to psychological well-being: Development of the Humor Styles Questionnaire. *Journal of Research in Personality*, 37, 48–75. doi:10.1016/S0092-6566(02)00534-2
- Mednick, S. A. (1962). The associative basis of the creative process. *Psychological Review*, 44, 220–232. doi:10.1037/h0048850
- Mednick, S. A., & Mednick, M. T. (1967). *Examiner's manual, remote associates test*. Boston, MA: Houghton Mifflin.
- Michael, K. C. (2007). Humor and the limits of incongruity. *Creativity Research Journal*, 19(2–3), 203–211. doi:10.1080/10400410701397263
- O'Quin, K., & Derks, P. (1997). Humor and creativity: A review of the empirical literature. In M. A. Runco (Ed.), *Creativity research handbook* (Vol. 1, pp. 227–256). Cresskill, NJ: Hampton Press.
- Ohlsson, S. (1984). Restructuring revisited: A summary and critique of the gestalt theory of problem solving. *Scandinavian Journal of Psychology*, 25, 67–78. doi:10.1111/j.1467-9450.1984.tb01001.x
- Ohlsson, S. (1992). Information-processing explanations of insight and related phenomena. In M. Keane & K. Gilhooly (Eds.), *Advances in the psychology of thinking* (pp. 1–44). London, UK: Harvester-Wheatseaf.
- Ohlsson, S. (2011). *Deep learning: How the mind overrides experience*. Cambridge: Cambridge University Press.
- Perkins, D. (2000). *The art and logic of breakthrough thinking*. New York, NY: W.W. Norton & Company.
- Rothbart, M. K. (1976). Incongruity, problem-solving and laughter. In A. J. Chapman & H. C. Foot (Eds.), *Humour and laughter: Theory, research and applications* (pp. 37–54). Hoboken, NY: Wiley.
- Rouff, L. L. (1975). Creativity and sense of humor. *Psychological Reports*, 37(3), 1022. doi:10.2466/pr0.1975.37.3.1022
- Ruch, W. (1992). Assessment of appreciation of humor: Studies with the 3WD humor test. In C. D. Spielberger & J. N. Butcher (Eds.), *Advances in Personality Assessment* (Vol. 9, pp. 27–75). Hillsdale, NJ: Erlbaum.
- Ruch, W., & Hehl, F.-J. (1998). A two-mode model of humor appreciation: Its relation to aesthetic appreciation and simplicity-complexity of personality. In W. Ruch (Ed.), *The sense of humor: Explorations of a personality characteristic* (pp. 109–142). Berlin, Germany: Mouton de Gruyter.
- Samson, A. C., Hempelmann, C. F., Huber, O., & Zysset, S. (2009). Neural substrates of incongruity-resolution and nonsense humor. *Neuropsychologia*, 47(4), 1023–1033. doi:10.1016/j.neuropsychologia.2008.10.028
- Sitton, S. C., & Pierce, E. R. (2004). Synesthesia, creativity and puns. *Psychological Reports*, 95(2), 577–580. doi:10.2466/pr0.95.2.577-580
- Sternberg, R. J., & Lubart, T. I. (1999). The concept of creativity: Prospect and paradigms. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 3–15). Cambridge, England: Cambridge Press.
- Storm, B. C., Angello, G., & Bjork, E. L. (2011). Thinking can cause forgetting: Memory dynamics in creative problem solving. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 37(5), 1287–1293. doi:10.1037/a0023921
- Suls, J. M. (1972). A two-stage model for the appreciation of jokes and cartoons: An information-processing analysis. In J. H. Goldstein & P. E. McGhee (Eds.), *The psychology of humor: Theoretical perspectives and empirical issues* (pp. 81–100). New York, NY: Academic Press.
- Tierney, P., & Farmer, S. M. (2002). Creative self-efficacy: Its potential antecedents and relationship to creative performance. *Academy of Management Journal*, 45(6), 1137–1148.
- Torrance, E. P. (1974). *Torrance tests of creative thinking*. Baltimore, MD: Penguin.
- Wakefield, J. F. (1992). *Creative thinking: Problem solving skills and the art orientation*. Norwood, NJ: Ablex.
- Ward, J., Thompson-Lake, D., Ely, R., & Kaminski, F. (2008). Synaesthesia, creativity and art: What is the link? *British Journal of Psychology*, 99, 127–141. doi:10.1348/000712607X204164
- Wei, D., Yang, J., Li, W., Wang, K., Zhang, Q., & Qiu, J. (2014). Increased resting functional connectivity of the medial prefrontal cortex in creativity by means of cognitive stimulation. *Cortex*, 51, 92–102. doi:10.1016/j.cortex.2013.09.004
- Weisberg, R. W. (2015). Toward an integrated theory of insight in problem solving. *Thinking & Reasoning*, 21(1), 5–39. doi:10.1080/13546783.2014.886625
- Wu, C. C., Chen, F. Y., Kuo, C. T., Lin, W. W., Liu, T. H., & Chen, Y. H. (1998). Development of revised creative thinking test. *Journal of Student Counseling*, 62, 132–147.
- Wu, C. L., Chang, Y. L., & Chen, H. C. (2017). Enhancing the measurement of remote associative ability: A new approach to designing the Chinese Remote Associates Test. *Thinking Skills and Creativity*, 24, 29–38. doi:10.1016/j.tsc.2017.02.010
- Wu, C. L., & Chen, H. C. (2017). Normative data for Chinese compound remote associate problems. *Behavior Research Methods*, 49(6), 2163–2172. doi:10.3758/s13428-016-0849-3
- Wyer, R. S., Jr., & Collins, J. E. (1992). A theory of humor elicitation. *Psychological Review*, 99(4), 663–688.
- Zhong, C. B., Dijksterhuis, A., & Galinsky, A. D. (2008). The merits of unconscious thought in creativity. *Psychological Science*, 19(9), 912–918. doi:10.1111/j.1467-9280.2008.02176.x