Validation of the Body Posture Expression Test Battery in Chinese Adults and Children

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Abstract

Purpose: The body posture expression stimulus set provides standardized stimuli for emotion research. While the consistency of this stimulus set has been validated in Western adults, its consistency in Chinese populations remains unclear. Therefore, this study selected 42 images each of happiness, sadness, fear, and anger from the original set of 254 images to validate the applicability of this stimulus set in Chinese populations.

Methods: Thirty-one Chinese university students and forty-one Chinese preschool children participated in this study. All participants were required to complete emotion recognition and judgment tasks.

Results: The results indicated that adults demonstrated high rating consistency, whereas children exhibited moderate consistency. For adults, sadness was the easiest to identify, followed by fear, while anger and happiness were the most difficult to identify. For children, fear was the easiest to identify, followed by anger and sadness, with happiness being the most difficult to identify. Additionally, adults' accuracy for happiness and sadness was higher than that of children. Regarding adults, they were more prone to confusing positive emotions with negative emotions; they tended to misidentify sadness, fear, and anger as happiness. For children, they were more likely to identify sadness as fear and happiness. They also tended to identify anger as fear.

Limitations: The fear and anger emotion images are suitable for 5-year-old children, whereas the applicability of sadness and happiness emotion images, particularly happiness, is not ideal. In the future, body posture images conveying happiness and sadness emotions could be re-photographed by incorporating real-life contexts of Chinese people, and younger children could be selected to investigate the applicability of the improved images.

Conclusion: These results suggest that Chinese and Western adults exhibit broadly similar recognition patterns for the body posture expression stimulus set.

However, within the same cultural context, the recognition patterns between adults and children differ substantially, and adults'recognition accuracy is higher than that of children.

Full Text

Preamble

Validation of the Bodily Expressive Action Stimulus Test Among Chinese Adults and Children

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Abstract

Objective: The Bodily Expressive Action Stimulus Test (BEAST) was developed to provide standardized emotional stimuli for experimental investigations of emotion and attention, and its consistency has been validated in adult populations abroad. However, the reliability of this test within Chinese populations remains unclear. To address this gap, we selected 42 images from each emotional category (happiness, sadness, fear, and anger) from the original set of 254 images to examine the consistency of the BEAST among Chinese participants.

Methods: Thirty-one Chinese college students and 41 Chinese preschool children participated in this study. All participants completed an emotion recognition and judgment task.

Results: Adults demonstrated high consistency in rating these pictures, while children' s consistency was at a moderate level. For adults, sadness was the easiest emotion to recognize, followed by fear; happiness and anger were the most difficult to recognize. For children, fear was the easiest to recognize, followed by anger and sadness, while happiness was again the most difficult. Adults were more accurate than children in identifying happiness and sadness. Adults were more likely to confuse positive emotions with negative emotions, tending to misidentify sadness, fear, and anger as happiness. Children, in contrast, were more likely to misidentify sadness as fear or happiness, and also tended to recognize anger as fear.

Limitations: Fear and anger pictures are suitable for children around age 5, whereas the applicability of sadness and happiness pictures—particularly happy emotional pictures—is not ideal. The picture materials could be improved by reshooting body posture pictures conveying happiness and sadness in contexts

that reflect actual Chinese life situations. Future research should also explore these materials with children in the lower primary school grades.

Conclusions: These results indicate that the recognition performance of BEAST images for Chinese and Western adults is roughly comparable. However, under the same cultural context, the recognition performance of adults and children differs substantially, with adults generally showing higher recognition accuracy than children.

Keywords: Body expression; Adults; Children; Emotion; China

Introduction

Human development is a continuous process of understanding, transforming, and adapting to the world. Emotions serve as crucial adaptive mechanisms, enabling infants without independent survival or language abilities to convey information and reflecting the psychological activities of adults. Individuals transmit attitudes and thoughts through emotional expressions, including facial expressions, vocal intonation, and body expressions (Sauter, McDonald, Gangi, & Messinger, 2014; Van den Stock, Righart, & de Gelder, 2007).

Although facial expressions are commonly used to convey emotional information and are frequently employed in emotion research, in daily life and social interactions, facial expressions typically work in conjunction with sensory stimuli such as sight, hearing, smell, taste, and somatosensation. Among these, body expressions constitute one of the primary visual stimuli related to facial expressions (Frijda, 1986, 1988). Individuals can recognize not only facial expressions but also emotional information conveyed through body posture, primarily because the mechanisms for processing and recognizing body expressions share similarities with those for facial expressions (Hadjikhani & de Gelder, 2003; van de Riet, Grezes, & de Gelder, 2009; Ding, Kang, Zhao, & Fu, 2018; Zhang, Zhao, Liu, & Chen, 2015). Moreover, these two expression types do not exist in isolation but rather influence each other substantially (Civile & Obhi, 2016). The recognition of body expressions affects facial expression recognition, particularly when the two are inconsistent (Mondloch, Nelson, & Horner, 2013; Van den Stock & de Gelder, 2014; Van den Stock, Righart, & de Gelder, 2007).

A recent study explored whether body posture or face better promotes emotion recognition in social interactions. The findings revealed that when body posture (with or without a face) conveyed emotional information, it facilitated emotional recognition, whereas faces alone did not (Abramson, Petranker, Marom, & Aviezer, 2020). Therefore, studying emotions through body posture is more effective, particularly for specific populations such as individuals with prosopagnosia or autism. Research has found that patients with prosopagnosia exhibit impairments not only in face perception but also in body posture perception (Biotti, Gray, & Cook, 2017; Righart & de Gelder, 2007). However, this deficit is not as pervasive as the core feature of face perception impairment, and the body perception abilities of patients with acquired prosopagnosia remain intact

(Susilo, Yovel, Barton, & Duchaine, 2013). Furthermore, studies have found that patients with autism also show atypical facial gaze patterns (Nyström, Bölte, & Falck-Ytter, 2017; Yamashiro et al., 2018). High-risk infants pay less attention to faces than low-risk infants (Nyström et al., 2017), and children later diagnosed with autism show reduced attention to facial areas as early as six months after birth (Shic, Macari, & Chawarska, 2014), while simultaneously showing increased fixation on non-facial areas (for example, increased attention to body parts) (Jones & Klin, 2013). Therefore, using body expression materials is more effective than facial expression materials in visual emotion research involving prosopagnosia and autism patients.

In summary, studying body expressions can not only expand the visual stimuli used in emotion research but also facilitate the study of special populations. Unlike facial expression materials that have become mature and standardized (Langner et al., 2010; Limbrecht-Ecklundt, Hoffmann, Scheck, Walter, & Traue, 2013; Young, Perrett, Calder, Sprengelmeyer, & Ekman, 2002), body expression research began relatively recently, and the unification and standardization of stimulus materials remain incomplete. Currently, developed stimulus sets include body expressions presented through point-light displays (Atkinson, Dittrich, Gemmell, & Young, 2004) and real body expressions (Aviezer, Trope, & Todorov, 2012; Bänziger, Mortillaro, & Scherer, 2012; de Gelder & Van den Stock, 2011; Thoma, Soria Bauser, & Suchan, 2013). Although point-light displays of body posture can convey rich emotional information, their ecological validity may not be as strong as that of real body postures. However, real body expression stimuli sometimes include the face, which may cause distraction (Civile & Obhi, 2016). To address this, de Gelder et al. developed and evaluated the Bodily Expressive Action Stimulus Test (BEAST) in 2011, which blurs faces to avoid their influence on body expression perception. The database comprises 254 whole-body expressions from 46 non-professional actors expressing happiness, sadness, fear, and anger based on real-life situations. These body postures not only express inner emotional feelings but also emphasize the action dimension of entire body postures, making them suitable for emotion research (de Gelder & Van den Stock, 2011; Watson & de Gelder, 2020). The original study selected 19 Western adults to conduct a standardized assessment of the stimulus set and found that Western adults showed high consistency in their evaluations, with higher accuracy for identifying negative emotions than positive emotions (de Gelder & Van den Stock, 2011). Subsequent studies have confirmed the utility of this database (Bannerman, Milders, & Sahraie, 2010; Hajduk, Klein, Bass, Springfield, & Pinkham, 2019; Ross & Flack, 2019; Watson & de Gelder, 2020).

Although the usability of this database has been confirmed, its applicability in Eastern cultural contexts has not been well verified. While emotional experience is an internal phenomenon, the expression of emotions is influenced by multiple factors, including culture, which affects both emotional expression (Jack, Garrod, Yu, Caldara, & Schyns, 2012) and judgments of external emotional intensity and internal subjective experience (Engelmann & Pogosyan, 2013).

Cross-cultural research on facial expressions has revealed cultural differences, particularly in negative emotions, with Western individuals showing better emotion recognition (Elfenbein & Ambady, 2003). Given the correlation between facial and body expressions, standardized assessment of body expressions in Chinese populations can help expand the application scope of body posture expression stimulus sets and facilitate their use as stimulus materials in Chinese body expression research. Therefore, this study selected Chinese adults to evaluate BEAST images to explore the database' s applicability among Chinese adults.

Adults and children differ in their ability to recognize emotions (de Sonneville et al., 2002; Morton & Trehub, 2001; Nelson & Mondloch, 2018; Segal, Reyes, Gobin, & Moulson, 2019). Two perspectives exist regarding adults' and children' s ability to recognize body expressions. One view holds that both adults and children can recognize body expressions well (Atkinson, Dittrich, Gemmell, & Young, 2004; de Gelder & Van den Stock, 2011). Another view suggests that children differ from adults when recognizing body postures with blurred faces (Nelson & Mondloch, 2018) and that even adolescents remain less accurate than adults in recognizing basic emotions (Heck, Chroust, White, Jubran, & Bhatt, 2018). Therefore, this study selected 5-year-old preschoolers to evaluate the BEAST and compared their performance with adults to explore differences between the two groups. We chose preschoolers for two main reasons. First, early childhood represents a critical period for developing emotion recognition abilities (Parkman & Gottman, 1989; Malatesta-Magai & Haviland, 1992). Second, by age 5, most children can accurately recognize facial expressions of basic emotions (Heck et al., 2018; Widen & Russell, 2008). Additionally, children at this age can understand and use symbolic gestures and appear able to express emotions through body gestures while understanding the emotional significance of body postures (Boyatzis & Satyaprasad, 1994).

In summary, this study has two main purposes: (1) to evaluate localized BEAST materials and explore the applicability of the stimulus set among Chinese adults and children, and (2) to investigate differences between adults and children in recognizing body expressions.

2.1 Participants

The adult sample consisted of 31 students from a university in Beijing (16 males, 15 females; mean age = 22.77 years, SD = 1.78 years). The child sample comprised 41 children from a kindergarten in Beijing (20 boys, 21 girls; mean age = 5.65 years, SD = 0.58 years). All participants had normal color vision and normal or corrected-to-normal visual acuity. Before the experiment, participants were informed about the study content; adult participants signed informed consent forms themselves, while parental consent was obtained for child participants. The experimental procedures and protocols were approved by the Institutional Review Board of the Institute of Psychology, Chinese Academy of Sciences.

2.2 Procedure

The picture materials were downloaded from www.beatricedegelder.com/beast.html. The average recognition accuracy for all pictures by Western subjects was 92.5%, with highly consistent overall scores (de Gelder & Van den Stock, 2011). To maximize applicability, we selected 42 pictures for each emotion (happiness, sadness, fear, and anger) from the 254 available pictures, ensuring the overall recognition accuracy of these selected pictures exceeded 90% (see Fig 1 for examples). Eight pictures (two for each emotion) were randomly selected for the practice phase, with each picture practiced twice. The remaining 160 pictures were used in the formal experiment.

The experimental program was presented using E-Prime software, with pictures displayed randomly during the experiment. Participants practiced with eight pictures after receiving instructions. Each trial began with a 500ms fixation point to alert participants to the upcoming task. Next, a picture was presented, and participants pressed a key to indicate the emotion recognized from the body posture. The "A," "D," "J," and "L" keys represented happiness, sadness, fear, and anger, respectively. There was no time limit for key-press responses. After completing one trial, participants automatically proceeded to the next trial, and after the practice phase, they entered the formal experiment. Each participant completed 176 trials, including 16 practice trials. Participants received compensation after completing the experiment.

For child participants, instructions were simplified for better comprehension, and keyboard buttons were replaced with more child-friendly emoticons. Before the experiment, the experimenter explained the task and rules to the children and tested their understanding using the buttons. Children who failed to understand the experimental content and button rules after three explanations were considered to have withdrawn from the study; ultimately, two children withdrew. After confirming that children understood the experimental procedure, the experiment began. The experimental process was identical to the adult version. After the experiment, children received small gifts as rewards.

2.3 Data Analysis

Statistical analyses were conducted using SPSS 24.0. Overall rater agreement was calculated using Fleiss' Generalized Kappa. Recognition accuracy and the proportion of incorrect emotion recognitions (e.g., when the target emotion was happiness, the proportion misidentified as sadness, fear, or anger) were compared between adults and children using ANOVA.

3.1 Comparison of Emotion Recognition Accuracy Between Adults and Children

The emotion recognition data for adults and children were visualized as heat maps (Fig 2 and Fig 3, respectively). Larger color patch areas indicate that the target emotion was more frequently recognized as its corresponding emotion.

Adults' average recognition accuracy for all images was 85.30%, with sadness showing the highest recognition accuracy and anger the lowest (see Fig 2). Fleiss' Generalized Kappa was calculated as the measure of overall rater agreement, yielding a value of 0.66, indicating high consistency among adult raters. Children's average recognition accuracy for all images was 74.66%, with fear showing the highest accuracy, followed by anger and sadness, and happiness the lowest (see Fig 3). Fleiss' Generalized Kappa was 0.47, indicating moderate consistency among child raters.

Recognition accuracy was analyzed using a 2 (group: adults vs. children) × 4 (emotion: happiness, sadness, fear, and anger) repeated measures ANOVA. Results revealed a significant main effect of group, $F(1, 280) = 16.28$, $p < .001$, $2 = .06$; a significant main effect of emotion, $F(3, 280) = 11.33$, $p < .001$, $2 = .11$; and a significant group × emotion interaction, $F(3, 280) = 5.09$, $p < .01$, $2 = .05$. Further analysis showed that adults' recognition accuracy for sadness ($p < .01$) and fear ($p < .05$) was significantly higher than for happiness and anger (see Fig 4). For children, recognition accuracy for sadness ($p < .05$), fear ($p < .001$), and anger ($p < .01$) was higher than for happiness; additionally, recognition accuracy for fear was higher than for sadness ($p < .01$) and anger ($p < .05$) (see Fig 5). Adults showed significantly higher recognition accuracy than children for happiness ($p < .001$) and sadness ($p < .001$), while the two groups did not differ significantly in recognition accuracy for fear and anger (see Fig 6).

3.2 Comparison of the Proportion of Incorrect Emotion Recognitions Between Adults and Children

We conducted a 2 × 3 ANOVA with group and target emotion misidentification (e.g., when the target emotion was happiness, it could be misidentified as sadness, fear, or anger) as independent variables and the proportion of incorrect recognitions as the dependent variable.

Misclassification analysis for happiness revealed a significant main effect of group, $F(1, 210) = 14.88$, $p < .001$, $2 = .067$; a non-significant main effect of target emotion misidentification, $F(2, 210) = .49$, $p = .62$, $2 = .01$; and a significant interaction between group and target emotion misidentification, $F(2, 210) = 5.34$, $p < .01$, $2 = .05$. Further analysis indicated that adults were more likely to misidentify happiness as sadness ($p < .05$) and anger ($p < .05$). Among children, there were no significant differences in the proportion of incorrect recognitions of happiness, but children were more likely than adults to misidentify happiness as fear ($p < .001$).

Misclassification analysis for sadness showed a significant main effect of group, $F(1, 210) = 22.62$, $p < .001$, $2 = 1.00$; a significant main effect of target emotion misidentification, $F(2, 210) = 13.78$, $p < .001$, $2 = .12$; and a significant interaction between group and target emotion misidentification, $F(2, 210) = 4.14$,

$p < .05$, $2 = .04$. Further analysis revealed that children tended to misidentify sadness as happiness ($p < .001$) and fear ($p < .001$), while adults easily misidentified sadness as happiness ($p < .05$). Compared with adults, children were more likely to misrecognize sadness as happiness ($p < .05$) and fear ($p < .001$).

Misclassification analysis for fear found a non-significant main effect of group, $F(1, 210) = .57$, $p = .45$, $2 = .003$; a non-significant main effect of target emotion misidentification, $F(2, 210) = 1.61$, $p = .20$, $2 = .02$; and a significant interaction between group and target emotion misidentification, $F(2, 210) = 3.44$, $p < .05$, $2 = .03$. Further analysis showed that adults tended to misidentify fear as happiness ($p < .05$). Among children, there were no significant differences in the proportion of incorrect recognitions of fear, but compared with adults, children were more likely to misidentify fear as anger ($p < .05$).

Misclassification analysis for anger revealed a non-significant main effect of group, $F(1, 210) = .07$, $p = .80$, $2 < .001$; a significant main effect of target emotion misidentification, $F(2, 210) = 7.7$, $p < .01$, $2 = .07$; and a marginally significant interaction between group and target emotion misidentification, $F(2, 210) = 2.55$, $p = .08$, $2 = .02$. Further analysis indicated that both adults and children were more likely to misidentify anger as fear ($p < .05$), and adults tended to misidentify anger as happiness ($p < .001$).

4. Discussion

The results demonstrated that Chinese adults showed high consistency in evaluating BEAST picture materials. For Chinese adults, sadness was easiest to identify, followed by fear, while happiness and anger were more difficult to recognize. This pattern is roughly consistent with that of Western adults (de Gelder & Van den Stock, 2011), as both Chinese and Western adults were adept at recognizing negative emotions, particularly sadness and fear. Evidence suggests that negative events have greater impact than positive events, and individuals pay more attention to negative emotions, which may explain the superior recognition of negative emotions (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001; Gross, Crane, & Fredrickson, 2010). However, significant differences emerged between Chinese and Western adults. Chinese adults' overall accuracy and their accuracy for sadness, fear, and anger were significantly lower than those of Western adults. Although happiness recognition accuracy was also lower than that of Western adults, the difference was not significant. Previous research has found that when emotion expressers and recognizers share the same cultural background, cultural familiarity improves emotion recognition accuracy—an in-group advantage in cross-cultural emotion recognition (Elfenbein & Ambady, 2002). Greater cultural differences between emotion expressers and recognizers correspond to larger differences in emotion recognition accuracy. Since the emotional images used in this study were photographed and evaluated by Western adults, cultural familiarity likely contributed to higher recognition accuracy among Western adults. Chinese and Western cultures differ substantially, with

Western individuals emphasizing individualism more strongly, while traditional Chinese culture is deeply influenced by collectivism. These cultural differences may explain why Chinese adults performed worse than Western adults in recognizing emotional pictures expressed and photographed by Western adults.

Comparing identification errors between Chinese and Western adults reveals that Chinese adults tend to confuse negative emotions with positive emotions, whereas Western adults do not show significant emotional confusion. This may be because Westerners' body postures when expressing emotions are more free, open, and direct than those of Chinese people, who are more restrained (Markus & Kitayama, 1991). Consequently, Chinese individuals show relatively lower accuracy when identifying pictures taken by Western people, while cultural sensitivity makes Western individuals' accuracy higher (Elfenbein & Ambady, 2003a). Additionally, the selected pictures had high recognition accuracy among Western adults.

In contrast, children showed only moderate agreement with all images. For children, fear was easiest to recognize, followed by anger and sadness, while happiness was most difficult. This emotion recognition pattern in children differed significantly from that of adults. Children could hardly recognize happy body expressions but performed better in recognizing fear and anger. This finding contradicts prior studies suggesting that happiness and sadness are more easily recognized by children and that sadness is the first emotion children recognize (Izard, 1971; Oleszkiewicz, Frackowiak, Sorokowska, & Sorokowski, 2017). The embodied emotion perspective has found that brain regions activated during emotional expression and recognition are similar (Jackson, Meltzoff, & Decety, 2005; Mclntosh, Reichman-Decker, Winkielamn, & Wilbarger, 2006). Through verbal questioning, we learned that children would imitate the body posture in the picture to recognize the expressed emotion. Results from oral questioning revealed that children often placed body postures expressing sadness into happy situations, which may explain the lower recognition accuracy for sadness. Additionally, body expressions reveal the close relationship between emotions and adaptive behaviors. Body postures expressing fear and anger are related to environmental threats, and even when facial information is blurred or removed, we can still recognize threatening body postures effectively (Bannerman, Milders, de Gelder, & Sahraie, 2009). From an evolutionary perspective, the ability to quickly identify body postures conveying fear or anger helps humans respond appropriately (by fleeing or fighting) (Bannerman et al., 2009). Better recognition of fear and anger in children may facilitate adaptation to threatening environments and timely reactions.

This study found that adults were significantly better than children at recognizing happiness and sadness, but their performance in recognizing fear and anger was similar. Compared with faces expressing anger and fear, children paid more attention to body posture, and this attention reached adult levels, enabling them to perform similarly to adults in recognizing these two emotions (Nelson & Mondloch, 2017). Strong ability to recognize negative emotions is important for species survival and development because faster and more accurate recognition of threat-signaling emotions helps individuals prepare timely responses (Bannerman et al., 2009). Therefore, identifying negative emotions (such as anger) is more meaningful for adaptive survival than identifying positive emotions (such as happiness) (Aronoff, Woike, & Hyman, 1992; Hansen & Hansen, 1988), especially for children with limited viability. Accurately identifying negative emotions like fear and anger may help reduce their likelihood of encountering potential dangers.

Analysis of incorrect recognition proportions indicated that adults were more likely to confuse positive emotions with negative emotions, confirming previous findings (Atkinson et al., 2004; Dittrich, Troscianko, Lea, & Morgan, 1996; Gross et al., 2010). This confusion may be explained by similarities in body posture, such as expressing emotions accompanied by clenched fists and raised arms (Dittrich et al., 1996; Ross & Flack, 2019)—features present in our selected pictures. Children not only tended to confuse negative emotions but were also more likely than adults to confuse positive emotions with negative emotions. Children tended to mistake sadness and anger for fear, perhaps because 5-year-old children cannot use reliable cues to distinguish sadness from fear as adults do (Boone & Cunningham, 2001). Confusion among happiness, anger, and fear may stem from similarities between anger and happiness expressions, such as the tendency for arms to lean forward (Ross & Flack, 2019).

In summary, the BEAST images validated in this study are more suitable for Chinese adults. Although culture leads to differences in recognition accuracy between Chinese and Western adults, the overall recognition pattern is similar. Fear and anger pictures are suitable for children around age 5, whereas the applicability of sadness and happiness pictures—particularly happy emotional pictures—is not ideal. Future research should improve the picture materials by reshooting body posture pictures conveying happiness and sadness in contexts reflecting actual Chinese life situations, and should also explore these materials with children in lower primary school grades. Chinese adults and children show very different recognition patterns for the four emotions, with adults performing better than children. Future research could use the selected picture materials to train children and explore whether emotional identification accuracy can be improved.

5. Conclusion

In summary, the BEAST images selected in this study are more suitable for Chinese adults. Sadness is the easiest to identify, followed by fear, while happiness and anger are the most difficult to identify. The applicability in children is moderate: fear is easiest to identify, followed by anger and sadness, while happiness is most difficult to identify. Chinese adults and children show different recognition patterns for the four emotions, with adults demonstrating higher recognition accuracy than children.

Author Contribution Statement
Jing Li: Designed the research.
Wenwen Hou: Prepared the experimental procedure.
Yunmei Yang: Collected the data and wrote the first draft of the manuscript.
Jing Li: Proposed the research question and modified the manuscript.
Wenwen Hou: Prepared the experimental procedure and modified the manuscript.
Yunmei Yang: Collected and analyzed the experimental data and wrote the manuscript.

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Figure Legends

Fig. 1 Examples of stimuli for female and male actors. From left to right: happiness, sadness, fear and anger
Fig. 2 Heat map of body gesture recognition in adults (A-happiness recognition, B-sadness recognition, C-fear recognition, D-anger recognition, the same below)
Fig. 3 Heat map of body gesture recognition in children
Figure 4. Proportion correct recognitions of four body expressions in adults. (*p* $< .05$, ***p* < .01,** p $< .001$, the same below)
Figure 5. Proportion correct recognitions of four body expressions in children
Figure 6. Proportion correct recognitions of four body expressions in adults and children

Note: Figure translations are in progress. See original paper for figures.

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