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(出版者 / Publisher)
法政大学文学部
(雑誌名 / Journal or Publication Title)
法政大学文学部紀要 / Bulletin of the Faculty of Letters, Hosei University
(巻 / Volume)
88
(開始ページ / Start Page)
79
(終了ページ / End Page)
98
(発行年 / Year)
2024-03-03
(URL)
https://doi.org/10.15002/00030893

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Abstract

Preschool years constitute a crucial period for the development of emotional prosody recognition, which is a fundamental skill necessary for establishing positive interpersonal relationships. However, there is a dearth of research examining the development of emotional prosody recognition and gender differences among Japanese preschool children of various ages. To address this gap, this study aimed to investigate emotional prosody recognition in 69 Japanese children aged four and five. The findings revealed that both four- and five-year-old Japanese children demonstrated accurate recognition of happy prosody. Moreover, there was a significant improvement in the recognition of angry and sad prosody between the ages of four and five, with Japanese girls exhibiting higher accuracy in recognizing happy and sad prosody. Consequently, Japanese boys under the age of five may exhibit limited proficiency in recognizing happy and sad prosody, highlighting the potential benefits of additional support for their social-emotional development.

Keywords：emotional prosody, emotional recognition, children, development, social-emotional skill.

Introduction

Emotional literacy, encompassing the abilities to perceive, understand, and appropriately respond to one's own emotions and those of others, is a crucial social-emotional skill that has been linked to children's school adjustment (Domitrovich et al., 2017), academic achievement (Oberle et al., 2014), delinquency (Chong et al., 2015), and mental health (Davis & Humphrey, 2012). Within emotional literacy, emotional recognition skills play a fundamental role in establishing positive interpersonal relationships and regulating emotions (Di Maggio et al., 2016). These skills involve the recognition of emotional cues conveyed through verbal and non-verbal channels. Verbal cues entail comprehending the emotional language used by others, such as expressions like "I feel sad." Non-verbal cues, on the other hand, encompass the recognition of facial expressions (e.g., anger), affective bursts (e.g., laughter

and crying), and emotional prosody (e.g., vocal pitch, loudness, tempo, rhythm, and timbre) (Nygaard & Tzeng, 2021).

Children who lack emotional recognition skills are at a heightened risk of encountering interpersonal challenges, including bullying and difficulties in collaborative settings. As a result, it is crucial for parents and educators to offer targeted support to children who demonstrate delayed development in emotional recognition skills. However, in order to provide effective assistance, it is essential to grasp the typical developmental trajectory of children's emotional recognition skills. Numerous studies have explored the development of emotional recognition skills from various angles, with a particular focus on the Western context.

Development of emotional recognition skills in the Western context

Regarding the development of emotional language usage, children in the Western context typically begin using simple emotional terms around the age of two, and they start naming basic emotions such as happy, angry, and sad between the ages of three and five (Widen & Russell, 2008). Between the ages of four and 11, children's emotion vocabulary tends to double every two years and then reaches a plateau between 12 and 16 years of age (Nook et al., 2020). Children tend to learn the emotional language commonly used by their caregivers, such as happy, angry, and sad, more quickly compared to other emotional terms like fear, surprise, and disgust (Grosse et al., 2021). While children begin using emotional language around the age of two, they develop emotional recognition skills through non-verbal channels earlier, even during infancy.

Facial emotion processing is one of the earliest non-verbal emotional recognition skills that infants develop. Even in the first year of life, infants are capable of recognizing emotions from facial expressions and adjust their social behavior accordingly based on the emotional message conveyed (Hertenstein & Campos, 2004). By four months of age, infants can differentiate between anger and happiness and demonstrate a preference for positive faces, such as those displaying happiness, over negative faces, like those displaying sadness (McClure, 2000). At the age of two, infants begin to comprehend the relationship between other people's facial emotional expressions and their corresponding actions (Hepach & Westermann, 2013). The development of facial emotion processing continues throughout childhood and reaches an adult-like level in early adolescence (Batty & Taylor, 2006). Between the ages of four and 16 years, children and adolescents may exhibit faster development in the facial recognition of happiness, fear, and disgust compared to sadness and anger (Montirosso et al., 2010).

The development of vocal emotion processing, which involves recognizing emotions from affective bursts and prosody, tends to be slower compared to facial emotional processing. Facial emotional cues are generally easier for both adults and children to recognize, as they often provide more distinct emotional information compared to vocal cues from affective bursts and prosody (Pell, 2002). However, infants begin to discriminate whether an emotion expressed through affective bursts and prosody is positive or negative by the age of five months, although they may not have the exact ability to recognize specific emotions like happiness, sadness, or anger (Grossmann et al., 2010). By seven months of age, infants demonstrate an understanding of the congruence between the emotional message conveyed by facial expressions, affective bursts, and prosody (Grossmann et al., 2006). Around the age of five, children become predominantly proficient at recognizing simple emotions such as sadness, anger, and happiness from affective bursts, although they may still struggle with recognizing complex emotions like surprise from affective bursts (Sauter et al., 2013). Children's skills for recognizing both basic and complex emotions from affective bursts continue to develop and reach an adult-like level around 14-15 years old (Grosbras et al., 2018).

The development of emotional prosody recognition skills progresses at a slower rate compared to the recognition of affective bursts. Children between the ages of three and five possess some ability to recognize happiness from emotional prosody, but they encounter difficulties in accurately identifying other emotions like anger and sadness (Chronaki et al., 2015; Morton & Trehub, 2001). The recognition of sadness from prosody, in particular, may be significantly delayed, as it is often more ambiguous and challenging to comprehend, especially for younger children (Stifter & Fox, 1986). However, between the ages of five and 10, there is a significant improvement in the recognition of emotional prosody for both basic and complex emotions, including happiness, anger, contentment, disgust, and sadness. By around 10-11 years of age, children reach adult-like levels of proficiency in emotional prosody recognition (Sauter et al., 2013).

There are gender differences in the development of emotional recognition skills. In general, girls tend to develop various types of emotional recognition skills, including facial and vocal emotional processing, at a faster rate compared to boys (McClure, 2000). This difference may be partially explained by disparities in neurobiological development. The female brain, for instance, exhibits a larger grey matter volume in the temporal lobe region, which can facilitate quicker and more accurate processing of emotional information during language processing tasks, compared to the male brain (Ethofer et al., 2006; Schirmer et al., 2002). Additionally, differences in parenting practices may contribute to this gender difference. Due to societal expectations and child-rearing responsibilities, parents may socialize girls to be more prosocial, nurturing, and attuned to others' emotions, fostering their responsiveness and accuracy in judging emotions (Schirmer, 2013).

While predominant studies on emotional recognition have been conducted in the Western context, there are also studies that investigated the development of emotional recognition skills in a non-Western context, as a culture-specific understanding of developmental trajectories is necessary for providing the most appropriate support to children in different cultural contexts. There is a growing number of studies that investigate emotional recognition skills in the Japanese context, as social-emotional skills (including emotional recognition skills) are becoming more recognized as critical for children's development (Watanabe, 2020).

Development of emotional recognition among Japanese children

Emotional recognition skills hold particular significance for Japanese children due to the cultural emphasis on collectivism and valuing individuals who demonstrate sensitivity to others' feelings and thoughts, as well as conformity to social norms, in contrast to the Western context (Azuma, 2014; Ikeda et al., 2021). In line with trends in the Western context, there is a growing recognition within Japanese society of the importance of emotional recognition skills. This recognition is driven by the rise in incidents of classroom disruption and bullying in Japanese schools, which are believed to be linked to students' insufficient emotional recognition skills (Watanabe, 2020). Consequently, there is an increasing awareness of the need to cultivate emotional recognition skills among Japanese children to foster positive social interactions and address these societal challenges.

Despite socio-cultural differences, the development of emotional language in Japanese children shows similarities to that observed in Western contexts. Japanese infants begin using negative emotional terms, such as iya ('no'), by the age of 12 months (Matsunaga et al., 1996). Between 12 and 18 months, they employ negative terms like iya and kowai ('scary'), positive terms like omoshiroi ('fun') and ii ('good'), as well as the neutral term gomen ('sorry'/'excuse me'). By the age of two, the range of emotional language expands. At three or four years old, Japanese children utilize approximately 25 emotional terms, including dame ('anger'), kitanai ('disgust'), kowai ('fear'), and dō shiyō ('perplexity'). The diversity of emotional terms employed by Japanese children increases to around 30 by the age of five, influenced by heightened social interactions in preschool settings (Kubo, 2007).

In the development of emotional recognition based on non-verbal cues, studies have revealed that Japanese infants as young as six months old possess the ability to differentiate between certain pleasant and unpleasant emotions based on non-verbal cues, and by the age of two, they become proficient in this skill (Shimura et al., 2002; Watanabe, 2016). This can be attributed to the emphasis in Japanese culture on social conformity and group harmony, which leads caregivers to strongly encourage children to be sensitive to others' feelings (Azuma, 2014).

As consistent with studies in the Western context (Chronaki et al., 2015; Morton & Trehub, 2001), Wakamatsu (2011) found that Japanese five-year-olds already have some skills in recognising happy emotional prosody, although they still struggle to recognize other emotions, such as anger, aversion, sadness and surprise. Japanese children may develop the skill to recognize positive emotions faster, compared with negative emotions, as the explicit verbal and non-verbal communication of emotion—especially negative emotions (e.g. anger and sadness)—is not socially desirable in Japanese culture, given the influence of Buddhism, which emphasizes patience and self-regulation (Azuma, 2014). Japanese parents also bring up children to both consciously and subconsciously inhibit the communication of negative emotions to others, which could also potentially inhibit children's accurate response to prosody with negative emotion (Matsumoto & Kishimoto, 1983).

By the age of seven, Japanese children demonstrate improved accuracy in recognizing positive or negative emotional prosody, although they may still misinterpret the specific type of emotion being conveyed (Kondo & Hayashi, 2015). Consistent with findings in Western contexts, Japanese studies indicate that around the age of 10 or 11, children's abilities to recognize emotional prosody across various emotions reach a level comparable to that of adults. However, they tend to exhibit higher accuracy in recognizing happy emotional prosody compared to other emotional expressions such as anger and sadness (Fujisawa & Shinohara, 2011).

Consistent with studies in the Western context (Filippa et al., 2022), certain Japanese studies have found gender differences in children's emotional prosody recognition. Wakamatsu (2011) found that Japanese girls aged between five and six years recognized sad emotional prosody more accurately, while they recognized angry emotional prosody less accurately, compared with boys. Other studies found that gender differences in emotional prosody recognition among Japanese children may continue into adolescence. Another study conducted by Fujisawa and Shinohara (2011) found that Japanese girls aged 13–15 years are more capable of recognizing happy and sad emotional prosody, compared with boys. These findings suggest that Japanese girls may have better skills in recognizing sad emotional prosody than Japanese boys throughout childhood and adolescence while Japanese girls less accurately recognize angry prosody than Japanese boys during early childhood and Japanese girls more accurately recognize happy prosody than Japanese boys during adolescence. While past studies provided useful insights regarding the normal developmental trajectories of emotional prosody recognition among Japanese children, they have also had some limitations.

Limitations of existing studies

While many studies investigated the development of emotion recognition from a variety of verbal and

non-verbal cues, a limited number of studies investigated emotional prosody recognition, especially, among Japanese children. In particular, no study has investigated Japanese children's ability to recognize happy, angry and sad emotional prosody before the age of five. A previous study conducted by Horie and Tamai (2017) investigated children's ability to recognize prosody among four-year-old Japanese children. However, said study only investigated children's ability to recognize the attitudes of the speaker (acceptance, bluffing, rejection and fooling) from prosody. Even though said study showed that four-year-old Japanese children may already be somewhat capable of recognizing positive intention from others, it did not provide evidence for their ability to recognize emotional prosody.

Moreover, no prior study investigated gender differences in emotional prosody recognition among Japanese children before the age of five. However, understanding the different developmental patterns between boys and girls at a younger age could be critical for providing appropriate support to children. Wakamatsu (2011) investigated gender differences in emotional prosody recognition among Japanese preschool students and found that Japanese girls more accurately recognize sad emotional prosody and less accurately recognize angry emotional prosody than Japanese boys. However, said study only studied Japanese children between the ages of five and six. Thus, investigating emotional prosody recognition among children younger than five years old would be particularly important, as preschool years comprise a critical period for the development of emotional prosody recognition, which may vary between boys and girls, as well across age groups.

Objectives of the present study

To fill the gap in existing research, the present study aimed to investigate the normative development of emotional prosody recognition skills among Japanese preschool students of different ages, and to examine gender differences. The knowledge gained from such investigation could be useful for researchers, parents and educators, and could enable them to more accurately assess children's development of emotional prosody recognition to provide children with more developmentally appropriate support for improving their emotional prosody recognition and preventing unnecessary interpersonal conflicts. Five hypotheses were tested in the present study.

(1) Both four- and five-year-old Japanese children are competent recognizing happy emotional prosody.

(2) Both four- and five-year-old Japanese children are better at recognizing happy prosody, compared with angry and sad prosody.

(3) Five-year-old Japanese children are more capable of recognizing happy, sad and angry emotional prosody, compared with four-year-olds.

(4) There is no difference in the accuracy of recognizing happy emotional prosody between Japanese

boys and girls aged four and five.

(5) Japanese girls between the ages of four and five are more capable of recognizing sad emotional prosody and less capable of recognizing angry emotional prosody, compared with boys.

Materials and methods

Participants

The participants were 68 Japanese preschool students between the ages of four and five (M = 36; F = 32) from a private preschool in an urban area, including 33 four-year-olds (M = 18: F = 15) and 35 five-year-olds (M = 18; F = 17). Most children were from families of mid-to-high socio-economic status. Parents and children's consent was obtained before participation, which was fully voluntary. None of the participants had an existing diagnosis of developmental or mental disorders. The study was approved by the Ethics Committee of the researcher's university.

Materials

Emotional Prosody Stimuli

For conducting an emotional prosody recognition test, emotional prosody stimuli were created in reference to the procedure employed by Wakamatsu (2011), who previously tested emotional prosody recognition among five-year-old Japanese children. The researcher hired a professional Japanese actress who produced 18 recordings in total, using six phrases with neutral meanings that are familiar to Japanese children, including *ohayō* ('good morning'), *baibai* ('bye'), *ittekimasu* (a stock phrase uttered when heading out), *itterasshai* (a stock response to *ittekimasu*), *tadaima* (a stock phrase uttered after returning home), and *okaeri* (a stock response to *tadaima*). An actress was specifically hired for recording emotional prosody, as Japanese preschool teachers are predominantly female and students are most familiarized with female voices.

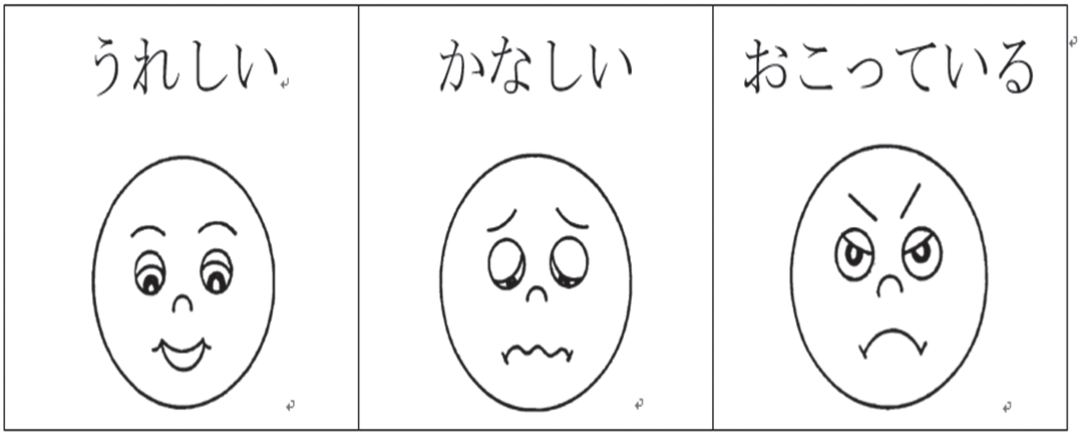
The actress was instructed to record each phrase using three types of emotional prosody (happy, sad, and angry) multiple times. Each recording was three seconds in duration. After the recording, the researcher, a graduate student in educational psychology, and the actress checked all the recordings, had a discussion, and selected the 18 recordings that most clearly presented the six phrases with the three types of emotional prosody. The selected 18 recordings were used as emotional prosody stimuli in the experiment.

Response sheet for the emotional prosody test

The researcher prepared a response sheet which contained illustrations of three different facial

expressions (happiness, anger and sadness) that children could point out and refer to when responding to the emotional prosody stimuli (Figure 1). The illustration was adapted from Watanabe and Takiguchi's (1986) research. Each illustration depicted an emotional face and was labelled as either *ureshii* ('happy'), *okotteiru* ('angry') or *kanashii* ('sad'). Hamana and Haryu (2015) confirmed that these phrases are easy to understand for Japanese preschool children aged between four and five years old.

Figure 1 Children's response sheet



Note. うれしい = Happy; かなしい = Sad; おこってる =Angry.

Procedure

After obtaining ethical approval, the researcher contacted and described the purpose of the study to the school principal of a private preschool in the researcher's contact list. After obtaining approval from the principal, the purpose of the study was described to the schoolteachers, students and caregivers. Written consent was obtained from the caregivers and verbal consent was obtained from the children. The experiment was performed by the researcher and a graduate student who followed a standardized procedure.

With approval from the principal, the experiment was conducted at the preschool over two days, using a spare classroom with minimum distraction. In the spare room, the experimenter positioned two chairs facing each other, on each side of a table, for the researcher and child. An audio player was placed on the table for playing the 18 emotional prosody stimuli. On the table, the experimenter also placed the response sheet for children and a sheet for the researcher to record children's responses. The entire testing process for each child took 15 minutes. Each child was separately guided by a teacher into the spare classroom from the regular classroom during classroom hours. After the arrival

of the child, the researcher confirmed the child's name, age, and gender, and engaged in small talk (e.g. asking children what things they like) to develop rapport before commencing the test.

The experimenter performed the emotional prosody recognition test by playing 18 stimuli and asking children to identify the emotion of each stimulus by pointing to one of three facial expressions (happiness, anger and sadness). Before playing the emotional prosody stimulus, the researcher presented the response sheet (Figure 1) and described the task to the children, stating, 'Here you can see three faces. One is a happy face, one is a sad face and one is an angry face. I am going to play a short speech in either a happy, sad or angry voice. Please tell me the emotion of each speech by pointing to one of three faces'. Before playing the stimuli, the experimenter conducted one practice session to ensure that children understood the instructions. After playing each stimulus, the researcher briefly paused for 10 seconds to ensure that children had sufficient time to think and respond to each stimulus. The children's response to each stimulus was recorded on the corresponding sheet.

Data analysis

The participants' average accuracy for each type of emotional prosody (happy, sad and angry) and their average accuracy for all three emotional prosodies were calculated. A one-way repeated-measure analysis of variance (ANOVA) was performed to compare the differences in participants' accuracy recognizing happy, sad and angry prosodies. A two-way independent group ANOVA was performed to examine age and gender differences in participants' accuracy recognizing emotional prosody. The data were analysed using IBM SPSS Statistics predictive analytics software (version 26).

Results

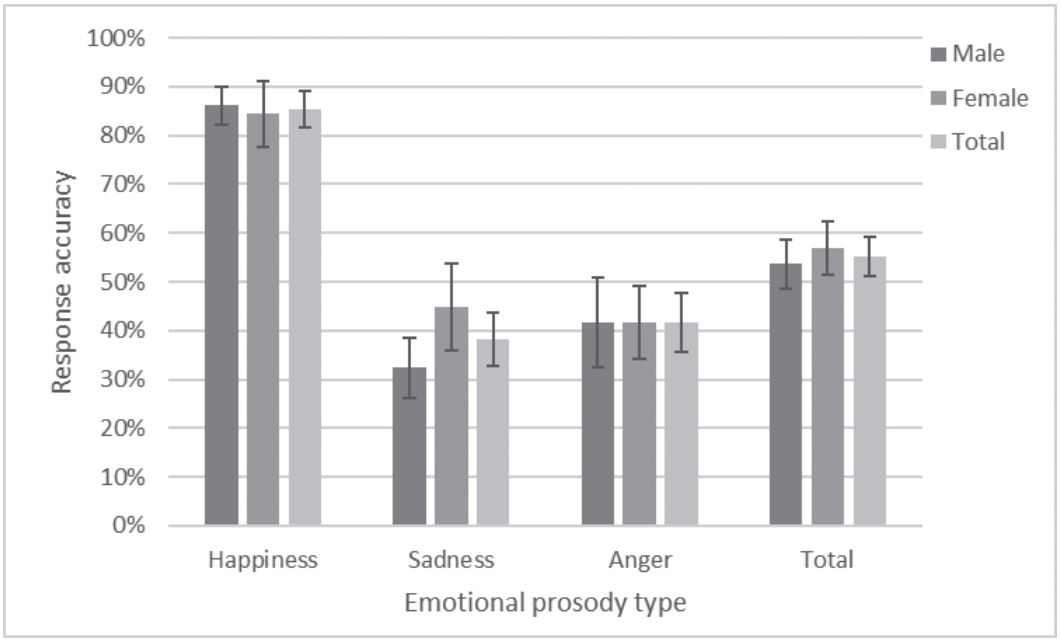
Overview

The results of the emotional prosody recognition test are presented in Table 1. Separate results for four- and five-year-old children are presented in Figures 2 and 3, respectively.

Table 1 Results of emotional prosody test among 4-5-year-old Japanese children

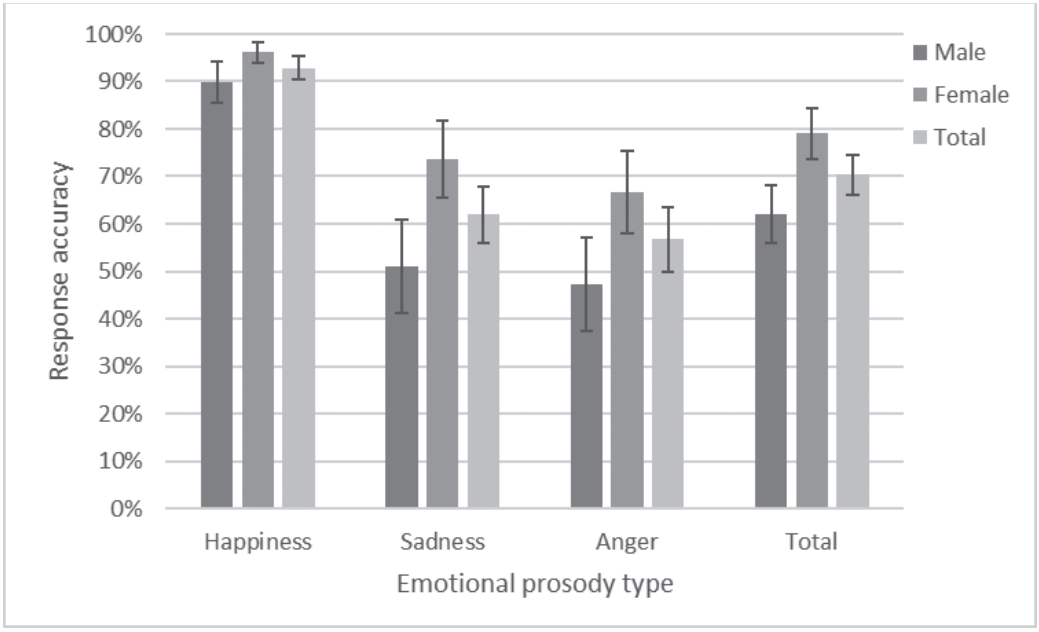
		Happiness		Sadness		Anger		Total	
		Accuracy rate (%)	*SE*	Accuracy rate (%)	*SE*	Accuracy rate (%)	*SE*	Accuracy rate (%)	*SE*
4-year-old	Male	86.11%	3.87	32.41%	6.24	41.67%	9.16	53.70%	5.00
	Female	84.38%	6.88	44.79%	8.83	41.67%	7.51	56.94%	5.43
	Total	85.29%	3.78	38.24%	5.34	41.67%	6.02	55.23%	3.94
5-year-old	Male	89.81%	4.29	50.93%	9.85	47.22%	9.74	62.04%	6.10
	Female	96.08%	2.27	73.53%	8.09	66.67%	8.81	79.08%	5.32
	Total	92.86%	2.49	61.90%	6.02	56.67%	6.70	70.32%	4.22
Total		89.13%	2.28	50.24%	4.47	49.28%	4.57	62.88%	2.93

Figure 2 Accuracy of emotional prosody recognition among 4-year-old children



Note. error bars represent the standard errors

Figure 3 Accuracy of emotional prosody recognition among 5-year-old children



Note. error bars represent the standard errors

Accuracy of emotional prosody recognition

The results supported Hypothesis 1 (namely, that both four- and five-year-old participants would be competent recognizing happy emotional prosody). Further, the results revealed that participants' accuracy recognizing sad and angry prosody was between 38.24% and 61.90%. This indicates that the participants had difficulties in recognizing sad and angry prosody. However, the results also revealed that four- and five-year-old Japanese children could recognize happy prosody with an accuracy of 85.29% and 92.86%, respectively. This indicates that participants recognized happy prosody above chance level.

Difference in the accuracy of emotional prosody recognition among happiness, sadness, and anger

The results supported Hypothesis 2 (namely, that four- and five-year-old participants would more accurately recognize happy prosody, compared with sad and angry prosody). The results of a one-way repeated-measure ANOVA revealed that emotion type had a significant main effect on the accuracy of emotional prosody recognition (Wilks' lambda = 0.44, F [2, 64] = 41.51, $p < .01$). Post-hoc paired samples t-tests revealed that participants' accuracy recognizing happiness was significantly higher than that for recognizing sadness (t [68] = 7.81, $p < .01$) and anger (t [68] = 8.67, $p < .01$). There was no difference between the accuracy recognizing sadness and anger (t [68] = 0.23, *ns*). There were no

interactions between emotion type and grade (Wilks' lambda = 0.96, F [2, 64] = 1.32, *ns*), between emotion type and gender (Wilks' lambda = 0.96, F [2, 64] = 1.20, *ns*), or a three-way interaction among emotion type, grade and gender (Wilks' lambda = 0.99, F [2, 64] = 0.24, *ns*). These results indicate that, regardless of age and gender, Japanese children aged between four and five had higher accuracy recognizing happy prosody, compared with sad and angry prosody, while there was no difference in their accuracy recognizing sad and angry prosody.

Age and gender differences in emotional prosody recognition

The results mostly supported Hypothesis 3 (namely, that five-year-olds would be better at recognizing happy, sad and angry emotional prosody, compared with four-year-olds) However, the results partly rejected Hypothesis 4 (namely, that there is no difference in the accuracy of recognizing happy emotional prosody between Japanese boys and girls aged four and five) and Hypothesis 5 (namely, that girls would be better at recognizing sad emotional prosody and worse at recognizing angry emotional prosody, compared with boys) . The results of a two-way ANOVA revealed that age had a significant main effect (F [1, 65] = 7.69, p <.01), while gender had a near-significant main effect (F [1, 65] = 3.41, p <.07) on the total accuracy of emotional prosody recognition. There was no interaction between age and gender on accuracy (F [1, 65] = 1.58, *ns*). These findings indicate five-year-olds had significantly higher accuracy recognizing emotional prosody, compared with four-year-olds, while girls had higher accuracy than boys.

The results of a two-way ANOVA revealed that gender had a near-significant main effect on the accuracy of happy prosody recognition (F [1, 65] = 2.89, p = .09). However, there was no main effect of age (F [1, 65] = 0.25, *ns*) or an interaction between age and gender on the accuracy of happy prosody recognition (F [1, 65] = 0.78, *ns*). These results indicate that girls could more accurately recognize happy emotional prosody, compared with boys, while there was no difference in the accuracy recognizing happy prosody between four- and five-year-old children.

The results of a two-way ANOVA revealed that there was a significant main effect of age (F [1, 65] = 7.99, p < .01) and gender (F [1, 65] = 4.38, p < .05); however, there was no interaction of age and gender (F [1, 65] = 0.37, *ns*) on the accuracy recognizing sad emotional prosody. These results indicate that five-year-olds could recognize sad prosody more accurately than four-year-olds, while girls could more accurately recognize sad prosody, compared with boys.

The results of a two-way ANOVA revealed that there was near-significant main effect of age (F [1, 65] = 2.87, p < .10) on the accuracy recognizing angry emotional prosody. However, there was no main effect of gender (F [1, 65] = 1.16, *ns*) or an interaction between grade and gender (F [1, 65] = 1.16, *ns*). These results indicate that five-year-olds had higher accuracy recognizing angry emotional

prosody, compared with four-year-olds, while there was no difference in the recognition of angry prosody between boys and girls.

Discussion

Emotional prosody recognition

The present study's findings supported Hypothesis 1. Consistent with a previous study conducted by Wakamatsu (2011), the present study found that five-year-old Japanese children are competent recognizing happy prosody, although they have a limited ability to recognize sad and angry prosody. In addition, the present study provided the novel insight that, regardless of gender, four-year-old Japanese children may be as competent as five-year-olds recognizing happy prosody, but not sad and angry prosody. As consistent with findings in the Western context (Chronaki et al., 2015), these findings indicate that Japanese children aged four and five may be competent recognizing at least happy prosody.

The development of Japanese children's ability to recognize happy emotional prosody during early childhood may be partly promoted by social expectations and parenting styles in Japanese society. In Japan, there is a widely held social expectation for people to understand other people's feelings and thoughts and proactively meet others' expectations by observing non-verbal cues (i.e. without listening to other people's explicit statements regarding their feelings and thoughts) (Azuma, 2014). Accordingly, Japanese parents focus on training their children to be sensitive to other people's feelings and thoughts by carefully observing non-verbal cues and conforming to others, rather being individualistic and explicitly communicating their unique thoughts and behaviours to others, which could partly contribute to the development of happy emotional prosody recognition among Japanese preschool children during early childhood (Ikeda et al., 2021).

The present study's findings have important implications for the assessment of Japanese children's emotional recognition skills. To provide early interventions to children who lack emotional recognition skills, it would be important for parents and educators to provide assessments to four- and five-year-old children and confirm if they have emotional recognition skills by accurately recognizing happy prosody. If some children are found to have poor skills recognizing happy emotional prosody, it may be important for parents and educators to provide extra support and training to these children as to promote the development of adequate skills to recognize happy prosody and reduce children's future risk of interpersonal problems.

Differences in the accuracy of emotional prosody recognition among happiness, sadness, and anger

The present study's findings supported Hypothesis 2 and provided the novel insight that Japanese children between four and five years old are more capable of recognizing happy prosody, rather than sad and angry prosody. These findings are consistent with previous studies in which Japanese children aged five years old and older exhibited better skills for recognizing happy prosody, compared with other types of emotional prosody (Wakamatsu, 2011).

Happy prosody may be the easiest to recognize for children because negative emotions (e.g. sadness) may be more complex and more difficult to understand (Stifter & Fox, 1986). Moreover, in Japanese culture, the explicit verbal and non-verbal presentation of emotion (especially negative emotions such as anger and sadness) is not socially desirable, given the influence of Buddhism, which emphasizes patience and self-regulation (Azuma, 2014). Hence, Japanese children may have more frequent exposure to and familiarity with happy prosody, rather than angry and sad prosody, from a young age. Japanese parents also bring up children to both consciously and subconsciously inhibit the communication of negative emotions to others, which could potentially inhibit children's accurate recognition of angry and sad prosody (Matsumoto & Kishimoto, 1983).

Development of emotional prosody recognition between the ages of four and five

Consistent with Western studies, the present study found that the preschool years are a critical period for the development of emotional prosody recognition. The present study also presented the novel finding that the development of emotional prosody recognition among Japanese children between the ages of four and five may vary between different emotion types. The present study also found that Japanese children's emotional prosody recognition, especially for negative (e.g. sad or angry) prosody, improved significantly between the ages of four and five, while that for happy prosody may have limited improvement during the same period. However, these findings may be partly attributed to the emotional prosody stimuli used in the present study.

While many Western studies used emotional prosody with multiple levels of intensity (Chronaki et al., 2015), the present study only used emotional prosody stimuli with one level of emotional intensity due to the concern that stimuli with multiple levels of intensity could increase the duration of the experiment, making it more difficult for children to maintain attention, and negatively influencing the validity of results, especially for preschool children with a limited attention span. However, the use of emotional prosody with only one level of intensity could also limit the sensitivity of the present study for detecting the improvement in emotional prosody recognition skills among Japanese children. If the present study used stimuli with multiple levels of intensity, the study might have detected an

improvement in happy prosody recognition among the participants. To confirm the findings from the present study, future study will need to replicate the present study by using emotional prosody stimulus with multiple levels of intensity.

Gender differences in the development of emotional prosody recognition

Consistent with Western studies, the present study found gender differences in the development of emotional prosody recognition among Japanese children. The present study presented the novel finding that gender differences are already present among four-year-old Japanese children, while prior studies identifying gender differences among Japanese children only included subjects no younger than five years old (Wakamatsu, 2011). Japanese girls may develop emotional prosody recognition skills faster than boys due to the combination of gender differences in neurobiological development and gender roles in Japanese society. Further, studies have found that girls' brains exhibit a larger grey matter volume in the temporal lobe, which enables them to process emotional prosody faster and more accurately than boys during language processing (Ethofer et al., 2006; Schirmer et al., 2002). Furthermore, Japanese parents traditionally teach young girls to become good caregivers and be more sensitive and empathic to other people's feelings and thoughts, which could also contribute to girls' faster development in emotional prosody recognition (Azuma, 2014).

Consistent with the trend found among five-year-old Japanese children (Wakamatsu, 2011), the present study found that gender differences in emotional prosody recognition may vary across different types of emotional prosody; by the age of four, Japanese girls may develop better skills for recognizing sad prosody, compared with boys. However, while Wakamatsu (2011) found that girls less accurately recognize angry emotional prosody than boys, the present study found that four- and five-year-old boys and girls may have similar skills for recognizing angry emotional prosody. While Wakamatsu (2011) also found there is no difference in the accuracy of recognizing happy emotional prosody between boys and girls, the present study found that girls more accurately recognize happy emotional prosody than boys.

The discrepancies in findings may be partly attributed to the gender of voice used to record emotional prosody stimulus. While the present study used emotional prosody stimulus only with female voice, Wakamatsu (2011) used emotional prosody stimulus with both male and female voices and demonstrated that the accuracy of the recognition of angry prosody expressed in a female voice was significantly lower than that for stimuli recorded in a male voice, in a sample of Japanese boys between the ages of five and six. Hence, Japanese boys in the present study might have demonstrated higher accuracy in recognizing angry emotional prosody than girls if the present study used emotional prosody stimulus with both male and female voices. The discrepancies in findings may also be partly attributed

to the small sample size of study conducted by Wakamatsu (2011). Wakamatsu (2011) employed only 25 students from a single preschool. Hence, the findings from the study conducted by Wakamatsu (2011) could be distorted.

To accurately confirm gender difference in different types of emotional prosody recognition among Japanese preschool students, future study will need to replicate the present study by employing a larger sample of Japanese preschool students from multiple preschools in diverse regions and by using emotional prosody stimulus with both male and female voices. Nevertheless, this study's findings still highlight that it is important for parents and educators to recognize the delay in Japanese boys' development of emotional prosody recognition skills (especially for happiness and sadness), as it may increase boys' risk of having interpersonal problems in preschool. To ensure that Japanese boys in preschools can effectively establish positive interpersonal relationships, it may be useful for parents and educators to provide them with extra support and promote their emotional prosody recognition skills.

Limitations

Children who participated in the present study were exclusively recruited from a single preschool in an urban area and most belonged to mid-to-high socioeconomic level households. Hence, the results of the present study may not be generalizable to a larger population of Japanese children. Another limitation of the present study is that it only used emotional prosody stimuli recorded in a female voice.

A previous study found that the accuracy of emotional prosody recognition among Japanese children can vary depending on the gender of the voice used to record the stimuli. For example, Wakamatsu (2011) demonstrated that the accuracy of the recognition of angry prosody expressed in a female voice was significantly lower than that for stimuli recorded in a male voice, in a sample of Japanese boys between the ages of five and six. Hence, the results of the present study may be partly distorted due to the gender of the voice used to record the stimuli. Unlike many Western studies (e.g. Chronaki et al., 2015), the present study did not employ emotional prosody stimuli with varying levels of intensity. Hence, the present study was unable to examine age and gender differences in emotional prosody recognition according to different levels of emotional intensity.

Conclusions

The present study is the first to demonstrate that four-year-old Japanese children can accurately recognize happy prosody. Further, it showed that Japanese children between the ages of four and five exhibit a significant improvement in emotional prosody recognition skills for angry and sad stimuli. Additionally, it showed that there are gender differences in Japanese children's development of

emotional prosody recognition, especially for recognizing angry and sad prosody, even among four-year-olds. However, a future study with a larger sample of Japanese children from a wider geographical area and from various socioeconomic strata would be necessary to verify the present study's findings with a larger Japanese population. Researchers may also replicate the present study by using a larger variety of emotional prosody stimuli recorded in both male and female voices with multiple levels of intensity. Such research could provide even deeper insights into age and gender differences in the development of emotional prosody recognition among Japanese children.

Acknowledgements

The authors would like to thank the school children, parents, and schoolteachers who participated in this study.

Declaration of interest statement

The authors have no conflicts of interest to declare.

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日本の幼児における音声を通しての感情認知の発達

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要旨

感情のリテラシーの発達研究に関心が寄せられているが，言葉や表情を通しての感情理解が中心で，発話のリズムやイントネーションなどを含む音声のプロソディの発達はほとんど検討されていない。しかし，こうした声を通して相手の気持ちを理解することは，幼児期において円滑な対人関係を築く上において大変重要である。ただし，日本の幼児を対象とした音声による感情の理解についての研究は，性差を含めて発達的に明らかにされていることが少ない。したがって，本研究では，４－５歳の６９名の幼児を対象に音声を聞かせることによって感情理解について検討した。その結果，４－５歳の幼児は，「嬉しい」については正確に理解していることが明らかとなった。怒りや悲しみの感情については，４歳から５歳にかけて聞き分けることができるようになっていることが示唆された。さらには，嬉しいと悲しい感情については女児が男児に比べて理解力が上回っていた。こうした性差の理由についてはこの研究から十分な考察は難しいが，さらに大規模な研究を重ね，こうした感情理解の発達過程を明らかにするとともに，こうした社会情動的なスキルを育てる支援のあり方につなげていきたい。

Keywords: 感情プロソディ，感情理解，幼児，発達，社会情動的スキル