Development of Regulation of Emotional Expression in Young Children: The Relationship between Understanding of Real Emotions and Facial Expressions in a Card Game

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Abstract

There were two purposes in the present study. The first purpose was to examine how young children control emotional expression while playing a card game. The second purpose was to examine the relation between children's understanding of real and apparent emotion, and emotional expression. Subjects were 8 four-year-old and 7 five-year-old children in a nursery school. The facial expression control (FC) task, baba-nuki (old maid) and emotional understanding tasks, facial expression understanding (FU) task and intention understanding (IU) task, were examined. The main results were as follows: (1) There were no significant difference between the scores on the FC task and the emotion understanding tasks (FU and IU); (2) When using multiple indices (pulse rate change and children's self-report in addition to facial expression), there was significant difference in FC scores between a high IU group and a low IU group; (3) There remain problems to be addressed in using these indices while focusing on multiple aspects of emotion.

Key words: regulation of emotional expression, control of facial expression, emotional understanding, card game, young children.

Purpose

Emotion plays an important role in children's social development. Although emotion has a rapid onset and is a temporary phenomenon, it plays a role in providing information on the internal state through its expression, the detection of the others' emotions, and in controlling other people's behavior. Therefore, emotion influences individual adaptation in the long-term through regulating relationshipa between individuals (Campos, Campos, & Barrett, 1989). Recently, distortion of emotional development, such as difficulty in regulating negative emotions, is considered to be an important factor in behavioral problems such as bullying at school, and it is increasingly necessary to clarify the details of child emotional development. However, most previous studies on the emotional development of young children have been related to

understanding of emotion, including understanding of emotional regulation in imaginary situations. There have not been many studies to focus on children's emotion expression and regulation in real situations.

According to studies on the understanding of emotion, children at the age of 5 or 6 begin to distinguish between apparent emotion and real emotion and to understand that they can intentionally regulate their expressions of emotion (Harris, et al., 1986; Hirakawa, 2014; Nagahama & Takai, 2011). However, Masuda (2014) and Suzuki (2005) pointed out that understanding of emotion regulation and actual regulation of emotional expression are not necessarily the same. In addition to this view, it is important to consider that emotional understanding is a factor supporting the development of children's regulation of emotional expression. Saarni et al. (2006) stated that understanding emotion, for example "discerning others' emotions" and "understanding the difference between real and apparent emotions," was important for children to regulate their emotional expression. Therefore, it is important to focus on, and measure, the "actual regulation of emotional expression in young children.

Many researchers define emotion in terms of three aspects: emotional experience (to be conscious of sadness, happiness etc.), emotional state (changes in emotional arousal such as sweating hands and increased heart rate), and emotional expression (observable behavior such as smiling, escape, or language expression). In late childhood, emotional experience and expressive behaviors do not always coincide with each other, such as when children become able to control their behavior when they feel anger. As such, it becomes more difficult to determine their ability to regulate emotion through only observation (Eisenberg & Morris, 2002). According to Eisenberg & Morris (2002), it is important to focus on multiple aspects of emotion. For example, it has been shown that physiological changes such as variations in heart rate due to specific emotional changes are difficult to intentionally control, and physiological changes could be objective indices of evoked emotion. In fact, there have been many studies on emotional arousal and heart rate change in laboratory contexts (Nakazawa, 2009). It is still difficult to apply the measurement of these physiological changes to daily or naturalistic contexts because this often requires large equipment. However, it is increasingly possible to measure some physiological indices in daily contexts owing to the availability of wearable and light devices.

There were two purposes in this study. The first purpose was to examine the development of control of emotional expression in early childhood while focusing on "emotional expression and regulation." The second purpose was to examine the relation between children's understanding of emotion, and emotional expression, in the context of controlling their emotionally expressive behavior.

Method

1. Participants

Participants included 8 four-year old children (3 boys and 5 girls) and 7 five-year old children (4 boys and 3 girls) in a nursery school.

2. Investigation Period

Two days in October 2017.

3. Measures

(1) Facial expression control (FC) task

As a facial expression control (FC) task, three children played "baba-nuki (old maid)" at the nursery school which they usually attend. "Baba-nuki" was played with 11 cards (5 pairs and a joker), and played three times per child. Owing to the rules of the game, it is generally possible to assume that negative emotion is evoked when children pick a joker. As a main index, change in facial expression—whether children could control facial expression—was measured when the children picked a joker. The children's facial expression was recorded using a PIXPRO SP360 4K system which has a 360° spherical lens.

In addition, as a supplementary measurement, pulse rate was recorded using a wearable pulse meter (PULSENSE PS-100), which was a wristwatch type and lightweight. Furthermore, after finishing "Baba-nuki," each child was asked "How do you feel when picking a joker?" and "What kind of face do you try to make when picking a joker?"

The FC task score was calculated by the following method. When there was a change in facial expression, the extent of expression varied. Therefore, facial expression change was scored on a three point scale: "none: 0," "small change (e.g. brief moment of bitter smile): 0.5," and "large change (change of several seconds): 1." The degree of facial expression change was evaluated separately by two graduate students, and the agreement rate was 90 %. The FC score was then calculated using the following formula:

$$\text{FC score} = 1 - \frac{(\text{(Sum of "facial expression change score" when joker picked))}}{(\text{(Number of times joker picked))}}$$

(2) Emotion understanding tasks

Facial expression understanding (FU) task: In this task, children listened to four stories of interpersonal conflict situations (Table 1). Each story contained two pieces of information. One described a situation to provoke a negative emotion in the story protagonist. The other described a reason for the protagonist to conceal his or her emotion from other characters in the story. The children then chose a facial expression (apparent emotion) for the protagonist. Each story and the

facial expressions were printed on cards (Figures 1 and 2). The score for this task, the FU score, was calculated as the number of correct answers divided by four (the number of tasks).

Table 1. Facial expression understanding (FU) tasks.

|	Card 1	Card 2	Card 3
Story 1	When Jun returned home, his father bought him a birthday present.	When Jun opened the present, it was not what he wanted.	Jun got sad because the gift was not what he wanted. But he thought his father would be sad if he told him his feeling.
Story 2	Yumi was making a house with blocks by herself	A small boy came and said that he wanted to do it together.	Yumi worried about whether he would break the house she made. But she thought the boy was sad when she said no.
Story 3	Jun was racing at the athletic meet.	Jun ran as hard as he could, but he fell down and lost.	Jun felt very sad. But he thought it was embarrassing to cry in front of everyone.
Story 4	Yumi was waiting for her turn next on the swing.	A big elementary school boy came and cut in front of her.	Yumi got angry and wanted to say "Do not cut in," but was afraid to say that feeling to him.
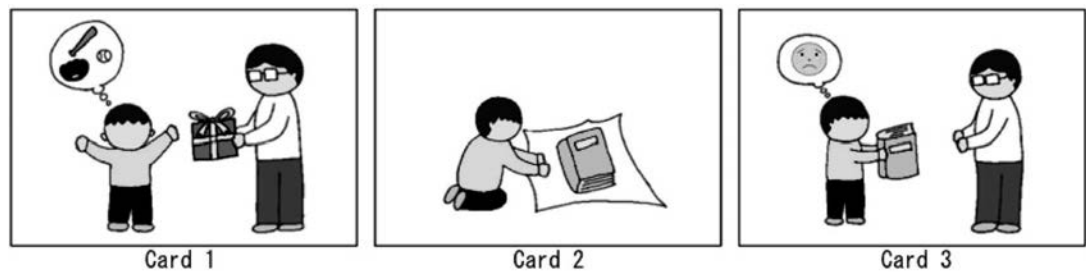
Figure 1. Examples of cards used in FU tasks.

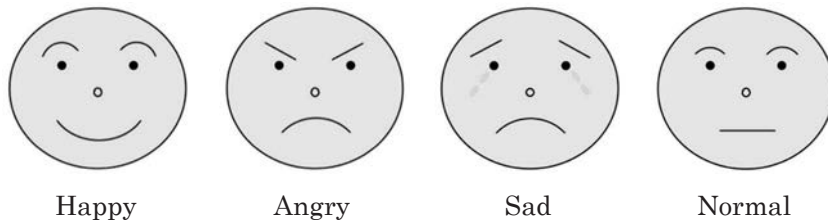Happy   Angry   Sad   Normal

Figure 2. Illustration of facial expressions used for answers.

Intention understanding (IU) task: In this task, children listened to four stories of interpersonal conflict situations (Table 2). Each story contained two pieces of information. One described a situation to provoke a negative emotion in the story protagonist. The other described the facial expression (apparent emotion) of the protagonist. Then the children chose "the reason to conceal real emotion / express apparent emotion" for the protagonist (Table 3). Each story and the reasons were printed on cards (Figures 3 and 4). The score for this task, the IU score, was calculated as the number of correct answers divided by four (the number of tasks).

Table 2. Intention understanding (IU) tasks.

|	Card 1	Card 2	Card 3
Story 1	On Jun's birthday, his father said "I will make a curry."	His father finished cooking. When Jun lookd at the dish, there was a green pepper that he disliked.	Jun became very sad because the curry had green peppers. But he ate the curry with a smile.
Story 2	Yumi was going out for a walk with everyone in the nursery school. Her teacher told everyone, "Please hold hands with your friends."	Yumi tried to hold hands with the friend she liked, but a small boty came and said "Yumi, let's hold hands."	Yumi felt sad because she wanted to hold hand with her friend. But she gave her hand to the little boy with a smile.
Story 3	A teacher was giving out origami to each child at a nursery school. Jun wanted to origami with a golden color.	His friend said he wanted gold too. They decided by scissors–paper–stone, and Jun lost.	Jun became very sad because he did not get golden origami. But he received a red origami with a normal face.
Story 4	Yumi was enjoying making things with building blocks with her friends.	When they were nearly finishedl, her teacher came and said, "It's time to clean up."	Yumi got angry and thought "Why do I have to clean up now? I want to play more! " But she started cleaning up with a normal face.
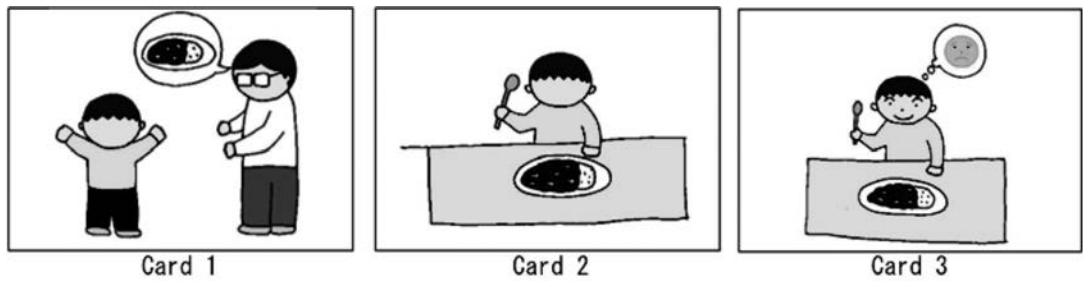
Figure 3. Example of cards used in IU tasks.

Table 3. Answers for IU tasks.

|	Answer 1	Answer 2	Answer 3	Answer 4
Story 1	Because Jun thought his father would be sad if he expressed a sad face	Because the dessert was Jun's favorite pudding.	Because Jun felt happy when he got a birthday gift.	Because it is fun to play with friends.
Story 2	Because Yumi thought the little girl would cry when she said no.	Because Yumi wanted to go to the park as soon as possible.	Because Yumi ate her favorite chocolate bread in the morning.	Because it is good to get up early and be praised by mother.
Story 3	Because Jun thought it was embarrassing to get angry or cry.	Because Jun also likes the red origami a little.	Jun did not like origami so much.	Because he is drowsy when sleepy.
Story 4	Because Yumi thought she did not want to be angry with her teacher.	Because it was time for lunch after cleaning up.	Yumi did not like playing with blocks so much.	Because she is tired when running a lot.
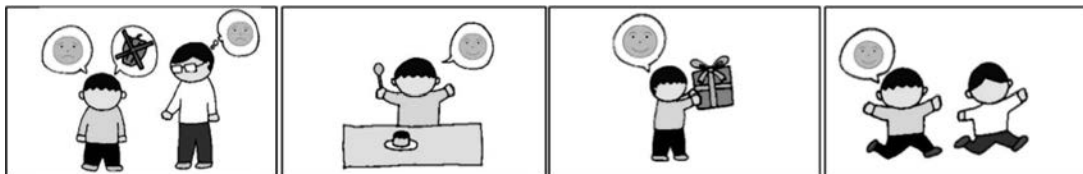
Figure 4. Example of cards used for answers in IU tasks.

Results

1. Scores on each task by age

Table 4 shows the scores on the FC task by age. The scores were examined using a t-test, and there was no significant difference in FC score between four and five-year-old children.

Table 4. FC score by age.

		4-year old (N=8)	5-year old (N=7)	Total (N=15)
Number of times Joker was picked	Total	21	20	41
	Mean	2.63	2.86	2.73
	SD	1.19	1.01	1.10
Number of times facial expression changed	Total	18	16	34
	Mean	2.25	2.29	2.27
	SD	1.58	1.25	1.39
FC score	Mean	0.35	0.37	0.36
	SD	0.37	0.27	0.32

Table 5 shows the scores by age for EU tasks. The mean score of FU task was lower than that of IU task. For each task, the mean score for five-year old children was higher than the mean score for a four-year old children. However, there was no significant difference of FC score in four and five-year-old children when the scores were examined using a t-test.

Table 5. Emotion understanding score by age.

		4-year old (N=8)	5-year old (N=7)	Total (N=15)
Facial expression understanding score	Mean	0.25	0.32	0.28
	SD	0.24	0.32	0.27
Intention understanding score	Mean	0.53	0.71	0.62
	SD	0.24	0.24	0.24

2. Relation between emotion understanding and facial expression control.

(1) FU score and FC score

In order to examine the relation between FU score and FC score, those scoring lower than the mean FU score (0.28) were defined as the FU low group, and those scoring higher than the mean FU score were defined as the FU high group. For each group, FC score was calculated (Table 6). FC scores were examined using a t-test, and there was no significant difference in FC scores between the FU high group and the FU low group.

Table 6. FC scores of FU low and high groups.

	FU Low group (N=9)	FU High group (N=6)	Total (N=15)
FU score			
Mean	0.10	0.56	0.28
Max	0.25	0.75	0.75
Min	0.00	0.38	0.00
SD	0.12	0.17	0.27
FC score (Mean)	0.35	0.36	0.36
SD	0.33	0.32	0.32

(2) IU score and FC score

In order to examine the relation between IU score and FC score, those scoring lower than the mean IU score (0.62) were defined as the IU low group, and those scoring higher than the mean IU score were defined as the IU high group. For each group, FC score was calculated (Table 7). FC scores were examined using a t-test, and there was no significant difference in FC scores between the IU high group and the IU low group.

Table 7. FC score of IU low and high groups.

	IU Low group (N=7)	IU High group (N=8)	Total (N=15)
IU score			
Mean	0.32	0.88	0.62
Max	0.50	1.00	1.00
Min	0.00	0.75	0.00
SD	0.24	0.13	0.34
FC score (Mean)	0.25	0.45	0.36
SD	0.24	0.35	0.32

3. Analysis using other supplementary indicators

(1) Pulse rate measurement

The mean value of the pulse rate of all the participants in the FC task was 110.5. When picking the joker, it was 112.5. Based on this difference, a change was defined as when the difference in measured pulse rate from before to after picking a joker was +2 or more. In this analysis, FC score was calculated using the same formula as described above, but assuming that when picking a joker negative emotion is evoked and the pulse rate rises by two or more (Table 8). One child, whose pulse rate had not changed when he picked a joker, was excluded and we analyzed the data with 14 children to calculate FC score using pulse rate.

Table 8. FC score (pulse rate change) by age.

		4-year old（N=8）	5-year old（N=7）	Total（N=15）
Number of times Joker was picked (pulse rate change)	Total	11	9	20
	Mean	1.38	1.50	1.43
	SD	0.52	0.84	0.65
Number of times facial expression was changed (pulse rate change)	Total	8	6	14
	Mean	1.00	1.00	1.00
	SD	0.93	0.63	0.78
FC score (pulse rate change)	Mean	0.47	0.45	0.46
	SD	0.47	0.39	0.42

In order to examine the relation between FU score and FC score using pulse rate, those scoring lower than the mean FU score (0.28) were defined as the FU low group, and those scoring higher than the mean FU score were defined as the FU high group. For each group, FC score was calculated (Table 9). FC scores were examined using a t-test, and there was no significant difference in FC scores between the FU high group and the FU low group.

Table 9. FC score (pulse rate change) of FU low and high group.

	FU Low group (N=8)	FU High group (N=6)	Total (N=15)
FU score			
Mean	0.08	0.56	0.29
Max	0.25	0.75	0.75
Min	0.00	0.38	0.00
SD	0.11	0.17	0.28
FC score (pulse rate change)	0.55	0.33	0.46
SD	0.43	0.41	0.42

In order to examine the relation between IU score and FC score using pulse rate, those scoring group lower than the mean IU score (0.62) were defined as the IU low group, and those scoring higher than the mean IU score were defined as the IU high group. For each group, FC score was calculated (Table 10). FC scores were examined using a t-test, and there was no significant difference in FC scores between the IU high group and the IU low group. However, there was a marginally significant difference ($t(11.99)=2.07$, $p<.10$).

Table 10. FC score (pulse rate change) of IU low and high group.

	IU Low group (N=7)	IU High group (N=7)	Total (N=14)
IU score			
Mean	0.32	0.89	0.61
Max	0.50	1.00	1.00
Min	0.00	0.75	0.00
SD	0.24	0.13	0.35
FC score (pulse rate change)	0.25	0.67	0.36
SD	0.38	0.37	0.42

(2) Using children's self-report on emotion and expression

FC score was calculated on the assumptions that negative emotions are always evoked and facial expressions are always controlled when picking a joker. However, it may be that these assumptions are not always valid. Therefore, we additionally assumed negative emotions are always evoked at the time of pulse rise for the analysis. In addition, another supplementary analysis was carried out based on the children's self-report of emotion and facial expression when picking a joker.

First, we analyzed the data after excluding 4 children who reported "I felt happy when I picked a joker." FC score using pulse rate of the IU high group (N = 7; M = 0.67, SD = 0.37) becomes higher than the score of the IU low group (N = 3; M = 0.17, SD = 0.29) (Figure 5). FC scores using pulse rate were examined using a t-test, and there was no significant difference in FC scores between the IU high group and the IU low group. However, there was marginally a significant difference (t(8)=2.05, p<.10).
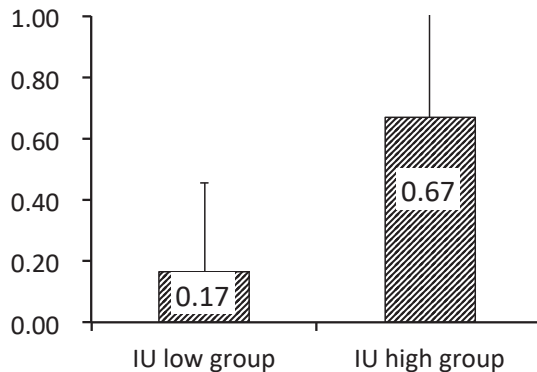

Figure 5. FC score (pulse rate change) of IU low and high group other than those who answered "I felt happy when I picked a joker."

Second, we analyzed data from eight children who reported "I tried to keep a normal face when picking a joker." FC score using pulse rate of the IU high group (N = 5; M = 0.80, SD = 0.27) becomes higher than the score of the IU low group (N = 3; M = 0.25, SD = 0.25) (Figure 6). FC scores using pulse rate were examined using a t-test, and there was a significant difference in FC scores between the IU high group and the IU low group (t(6)=2.83, p<.05).
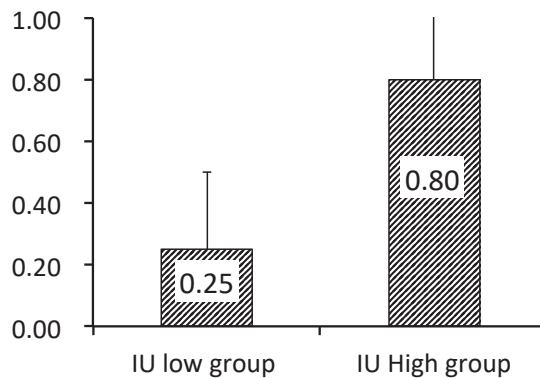
Figure 6. FC score (pulse rate change) of IU low and high group who answered "I tried to keep a normal face when picking a joker."

Discussion

1. Relation between facial expression control and age

There was no difference in the FC task between the four- and five-year old children. Regarding this task, Baba-nuki, it could be suggested that the ability to control facial expression exists to the same degree in four- and five-year old children. However, there were not enough participants in this research and it is therefore difficult to generalize the results. In addition, there were some aspects of the task that could be improved. In this research, the FC task made the assumptions that negative emotion is evoked when a joker is picked and that facial expression is controlled when a joker is picked. However, it is difficult to confirm the validity of these assumptions. In this task, four of the eight four-year old children answered "I feel happy as a result of picking a joker." Therefore, it could be too difficult a task for four-year old children to fully understand.

2. Relation between facial expression control and emotion understanding

(1) Facial expression control and facial expression understanding

There was no relationship between FC scores and FU scores. However, the mean score of the FU task, 0.28, was quite low, and the result is contrary to a previous study that suggests the

distinction between real and apparent emotion exists from about four years of age (Harris et al., 1986). In addition, because the scores of five-year old children were still low, it could be that the task was not only the difficult in terms of emotional understanding but also in some other aspect, such as language difficulties relating to explanations and instructions for the task.

(2) Facial expression control and intention understanding

There was no relationship between FC scores and IU scores. The intention understanding task used in this research included two kinds of intention. One is intention to protect others, such as "smiling because I do not want to make my father sad." Another is intention to protect oneself, such as "cleaning up because I do not want to be scolded." On the other hand, in the FC task, Baba-nuki, the intention to control facial expression is "to protect myself (so that others do not notice that I picked a joker, because I do not want to be the loser)." The intention to control facial expressions is not always the same, and it is necessary to examine in detail the relationship between understanding of intention and control of facial expressions in various real situations.

3. Possibilities of other supplementary indicators

As a supplementary analysis, pulse rate measurement was used as a physiological index of emotional arousal when a joker is picked. Pulse rate changed (increased) 20 out of 41 times when a joker was picked. When looking at the change in facial expression while picking a joker, and rising pulse rate, it could be shown that there was a slight relationship between IU score and FC score. In addition, the relationship became clearer when using children's self-report as well as pulse rate measurement. Even if the pulse rate is rising, it cannot always be assumed that the emotion is evoked. Also, children's self-report may sometimes not be very reliable because of limitations in their concentration, understanding, and memory. However, the results showed that the combination of various indices—focusing on multiple aspects of emotion—makes it possible to more clearly measure emotional arousal and control of emotional expression.

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