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MATCHING FACES BY EXPRESSION AND IDENTITY IN 6-TO 9-YEAR-OLD CHILDREN

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Research Article

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ABSTRACT

The research questions addressed are: 1. Do children tend to match unfamiliar faces by face expression or by identity, and 2. Is this tendency age-related? A total of 60 school pupils of both sexes, aged 6 to 9 years, participated in the experiment. Photograph triads were presented to participants, one at a time. Two of the three photographs showed two different people (A and B) with the same emotional expression, while the third was the same as person A with a neutral facial expression. Participants were requested to match photographs and to choose the odd one out. Children aged 6 to 7 years tended to match faces by facial expression, while 8 to 9 year olds tended to match faces by identity. Presumably preference to match faces rather by identity than by facial expression in older children may be ascribed to the age-related development of the ability to attend selectively to face identity, without paying attention to emotional facial expression. As for the biological significance of this phenomenon, development of the ability to identify people is suggested to increase in importance with age in parallel to the increase in the level of socialization and contacts with larger community.

INTRODUCTION

The human face represents one of the most important categories of objects to which we are exposed. The ability to quickly, and accurately interpret the emotional or motivational state of other humans and to distinguish between particular individuals has high value within the context of human social culture and is likely to represent a cognitive skill that is part of our early evolutionary legacy [1-5].

Human ability to retrieve important information from faces is suggested to be based on cognitive processes such as perception and consequent recognition of face identity and face emotional expression [6].

Types of information specific for face identity perception are internal features such as mouth, nose, eyes and a distance between them as well as external features such as hair and jaw line [7-9]. Joy, disgust, sadness, fear, anger, surprise, contempt belong to universally recognized facial expressions of emotion [1, 2].

Classical models of face perception postulate separate sub-systems for identity and expression processing [10,11]. Lateral fusiform gyrus is suggested responsible for perception of face identity when one is exposed to the novel face [12,13], While superior temporal cortex and amygdala are believed crucial for perception of face emotional expressions [14]. We focused on face perception in children.

Several studies provide clear evidence of face processing in infants [15,16]. Newborns track face-like stimuli in preference to

non-face-like stimuli just in first minutes of birth, showing preference to the mother's face as well as to attractive faces. By the age of three or four months, infants exhibit differential visual fixation to a smiling face in relation to certain other non-smiling expressions [17] , at the age of four month they can discriminate smiling and sad faces [18] and 3-to 7-month-olds are able to discriminate between some face emotional expressions [19,20]. Two and a half-year-olds understand the meaning of words, such as happy, sad, and afraid and can indicate the photographs, representing the appropriate facial expression [21], while 5-to 6- years-olds are capable of identifying which of two faces is demonstrating a particular facial expression [22]. Six and seven months old infants can discriminate the pictures by sex and age as well as different views of the same face [23,24]. Children reach the adult level performance in face identification by the age of 10 or 11 year old [25,26]. However, even 14-year-olds make more errors than adults and in fact, it takes a time for children to reach the level of adult expertise in face recognition ability [27,28].

The current study represents the efforts to further clarify face processing in children and to test the hypothesis [29], that perception of face expression predominates over the perception of face identity when a child is exposed to unfamiliar faces. Much of the prior work with children, that is relevant to this hypothesis, has been subject to certain methodological confounds. At the same time, experimental data concerning the developmental aspects of face perception is controversial. Bormann-Kischkel [29] conducted study on children preference to match human faces either by identity or by emotional expression. Participants were presented with three photographs. Two of the three photographs showed the same person with two different expressions while the third was of a different person but showing one of the emotions seen in the first individual. Participants were asked to select two photographs that go together. It was shown, that there were more participants sorting the photographs by the same facial expression. However, in our opinion, there are several shortcomings in this study, such as relatively small number of participants (19 children of both sexes) and not homogenous contingent, as long as experimental group consisted of participants aging 5 and 7 years. Gilbert [30] examined 102 children aged 4-6. Stimuli included the front-face head and shoulders of a boy, girl, man, and woman. Using one picture as a standard, participants were requested to choose from among the three others the "one that is most like this one". Clear trends in age preferences in sorting human faces have been shown. Children aged 4 sorted by age or size, 5-year-olds sorted by sex and 6-year-olds sorted by facial expression. In contrast, Levy-Shoen [31] found, that children under the age of 8 years tend to sort pictures of people on the basis of clothes, whereas sorting by emotions is more characteristic for children older than 11 years. However, Johnston [32] found that among 8 to 15 years old children, older children were significantly less accurate at face emotion discrimination task than they were at the face identity discrimination tasks. Consistent to these findings, De Sonneville et al. [33] found that older children, adolescents in particular, are better at face identity matching as compared to face emotion matching. However, authors studied the face identity matching and face emotion matching in two independent tasks, and it is not clear, what happens when participants have a free choice of sorting faces either by identity, or by emotional expression.

Research questions addressed in the current study are: 1. Do children tend to match unfamiliar faces by face expression or by identity and 2. Is this tendency age-related?

MATERIALS AND METHODS

Sample selection: A total of 60 school pupils of both sexes, 30 participants aging 6 to 7 years, and the rest 30 – 8 to 9 years, were recruited by the written permission of parents, school psychologist and school officials. The experiment was approved by the Ethic Committee of Child Psychologists.

Instrument: A total of 24 photographs of adult female faces, not familiar to the participants, were selected from the Karolinska Directed Emotional Faces (KDEF) database [34]. Photographs were cropped to remove the details of clothes and neck. Hair was not removed from the photographs to maintain natural conditions of face perception. The size of each photograph was 8x8 cm. Photographs were arranged in triads, in a horizontal line. Two of the three photographs showed two different people (A and B) with the same emotional expressions, while the third was the same as Person A displaying a neutral face expression. Eight photograph triads were used in the experiment, each triad in one experimental trial (ET). Emotional expressions in the eight consecutive ET were fear, joy, anger, sadness, joy, sadness, fear and anger respectively. The position of A (emotional and neutral) and B in the line was changed randomly in consecutive trials. Photographs used in the one ET, were not replicated in other trials.

Procedure: Participants were seated in front of the computer monitor. The distance between the monitor screen and a participant was approximately 50 cm. Photograph triads were presented to participants, one at a time, for 8 seconds, in the eight consecutive ET. Each ET was followed by the blank slide. There was 1 minute pause between the experimental trials. Participants were requested to watch the photograph triads, to choose one photograph (by pointing to the target stimulus), that does not fit the other two and to explain their choice. Responses referring to the difference in face external and internal features was considered a choice in favor of face identity, while response referring to the difference in emotion, was considered a choice in favor of face expression.

SPSS software was used to analyze the data obtained.

RESULTS

From the output of SPSS 20 Cronbach's alpha equaled to 0.949 **(Table 1)** indicates the high level of internal consistency for the given scale with this specific sample.

Table 1. The Item-Total Statistics: "Cronbach's Alpha if Item Deleted".

ET	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
ET1	11.10	9.075	.738	.614	.947
ET2	11.02	9.000	.774	.720	.944
ET3	11.00	8.746	.876	.869	.938
ET4	10.92	8.857	.879	.826	.938
ET5	11.07	9.080	.736	.708	.947
ET6	10.98	8.796	.863	.851	.939
ET7	10.95	8.964	.814	.807	.942
ET8	11.05	8.862	.819	.875	.941

ET-Experimental Trial

Choices in favor of both face expression and face identity have been registered. Explaining choice in favor of identity, participants qualified the faces that “do not fit”, as “another person” and referred to the specific hairstyle and hairline, as well as to the specific shape of mouth, nose and eyes. Explaining choice in favor of face expression, participants reported the faces that “do not fit” as smiling, sad, scared, surprised, or as most sad, most happy and very annoyed. Participants correctly distinguished between sadness, joy and anger.

The total number and percentage of choices in favor of face identity and face expression were calculated **(Table 2).** In each ET participants made one choice, meaning that each participant made 8 choices in the eight ET and the total number of choices made by 60 participants was 480.

Table 2. Total number and percentage of choices in favor of face identity and face expression.

Total number of choices	Total number of choices in favor of identity	Percentage of choices in favor of identity	Total number of choices in favor of expression	Percentage of choices in favor of expression
480	217	45,2	263	54,8

Participants displayed a tendency to make the choice in favor of face expression. For further data analysis, the results of the face matching task performance in 6 to 7 years old participants (Group 1) were compared to the results of the face matching task performance in participants aging 8 to 9 (Group 2). Percentage of choices in favor of face identity and face expression made by the participants in the Groups 1 and 2 in the each of eight ET was calculated. In the each ET participants made one choice, meaning that 30 participants in the each age group made 30 choices in total in the each ET.

The percentage of choices in favor of face expression was higher than the percentage of choices in favor of identity in all the eight ET-s in Group 1 **(Table 3)** . The percentage of choices in favor of face identity was higher than the percentage of choices in favor of expression in the Group 2 in all the ET-s with exception of ET4, where the percentage of choices in favor of face expression was higher than the percentage of choices in favor of face identity.

Table 3. The percentage of choices in favor of identity and expression in the age groups.

ET	Group 1		Group 2	
	Percentage of choices in favor of identity	Percentage of choices in favor of expression	Percentage of choices in favor of identity	Percentage of choices in favor of expression
1	40	60	63,3	36,7
2	40	60	53,3	46,7
3	33,3	66,7	60	40
4	23,3	76,4	46,6	53,4
5	20	80	66,6	33,4
6	23,3	76,4	56,6	43,4
7	23,3	76,4	53,3	46,7
8	20	80	66,6	33,4
Total	26,7	73,3	63,8	36,2

ET-Experimental Trial

Two-sample one tail t-test was conducted to compare the means of the cumulative responses in two different groups of participants, Group 1 and Group 2. The null hypothesis was that there is no difference in the number of choices in favor of face identity and face expression between the age groups. There was a difference between the means of the aggregated responses of participants in Group 1 (M1=13.87, SD1=2.945) and Group 2 (M2=11.30, SD2=3.385). This difference was statistically significant with $t(58) = 3.13$, $p < .05$. Therefore the null hypothesis was rejected.

DISCUSSION

Results of the study demonstrate that 6-to 9-year-old children are capable of perceiving face emotion and to identify the

particular facial expression. Participants were also capable of perceiving face identity. In case of the choice in favor of identity participants referred to the hair style and hair color, as well as to the hair line - the data consistent with the reports, that matching of unfamiliar faces in children is guided by external features [35, 36]. However, participants in the current study were shown capable of identifying faces by the shape of eyes, nose and mouth – the data suggesting, that face matching in 6-to 9-year-old children may be guided not only by face external features, but by internal features as well.

Comparison of the results of face matching task performance in Group 1 and 2 makes clear, that the tendency to match faces by expression is characteristic of 6-to 7-year-old children, while by the age, 8-to 9-year-olds give preference to face identity.

Data obtained are consistent with the results of the experiments [30,37] demonstrating the tendency of sorting human faces by face emotional expression in 4 –to 6-year-olds. At the same time, results of the study presented confirm the suggestion, that the older is child, the better he/she are at face identity matching [32,33].

It is not clear, whether identity and emotional expressions in faces interact or whether they are processed by strictly separated routes. Several studies support the hypothesis about the separate and parallel processing of face expression and identity. At the same time, some evidences point to the close interaction between the expression and identity processing mechanisms [38,39]. The facilitating effect of happy expressions on face identity memory [40,41], as well as the influence of facial expressions on the conscious recollection of facial identity even when participants' attention is not directed towards expressions [42] speaks in favor of the close interaction of face expression and identity processing mechanisms.

The results of the studies of the face recognition ability in children at early ages (6 – 10 years) convince, that face identity processing is developing slowly [26,8]. Authors [43] suggest that development in face processing ability rests on the development of the ability to attend selectively to face identity, without paying attention to emotional facial expression. Selective attention is a function of frontal lobes of the brain hemispheres, that mature slowly [44,45] and that is why face emotion processing interferes with face identity processing in children in the first decade of their life [43]. With this respect, priority of matching faces rather by expression than by identity in 6-7 years old participants in the study presented, may be ascribed to inability to pay due attention to face identity.

At the same time, there is another explanation that takes into account the social meaning of emotional expressions for the self. As it was mentioned earlier, perception of face expression is suggested to predominate over the perception of face identity when child is exposed to unfamiliar face [29]. The hypothesis is based on the assumption, that in childhood the ability to discriminate between unknown persons is of less importance for a child than the ability to recognize an expressed emotion.

Data obtained in the current study suggests the hypothesis to be relevant to children aged 6 to 7 years, but not to older children. At the same time, results of the current study suggest discrimination of unknown persons by face identity to get more importance at the age of 8 to 9 as compared to younger children. Development of the ability to process faces by their identity may have adaptive function. Older children become more socialized, they expand contacts with mates as well as with adults and ability to identify individuals by their face may help child to better discriminate between novel persons.

At the same time, in our opinion, a follow up study is desirable to come to final decision about the age related features of face processing in children. In particular, we plan to follow up participants aging 6-7 and displaying preference to match faces by the expression and to examine them again after one year. We hypothesize, that in the age of 8-9, these subjects should display the change in their preferences and shift to the matching faces rather by identity, than by expression, as it was revealed in the Group II of 8 to 9 years old participants in the study presented. Study of correlation between the face matching preferences and the level of child socialization is of special interest as well.

CONCLUSION

The manner in which faces are perceived and processed is a subject to developmental changes. In particular, younger children, aged 6 to 7 years, display tendency to match unfamiliar faces by face emotional expression, while 8-to 9-year-olds pay more attention to information specific to face identity perception, such as hairstyle and hairline, shape of mouth, nose and eyes. The age related change in the manner of face processing is suggested due to the developmental changes in brain functional systems, responsible for face processing. At the same time, shifting to the predomination of face identity processing over the face expression processing in older children, may have adaptive significance helping child to better discriminate between novel persons in parallel to the increase of the level of socialization and establishing active contacts with larger community.

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