Identifying Emotions in Faces:

A Developmental Study

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Summary

This study was aimed at discovering the development of emotion recognition in children and the age at which children reach adult levels. The experiments included matching, identification, and detection tasks featuring faces expressing different emotions as well as objects. The pictures in each task became more difficult to see as the subject matched them correctly. It was found that the development of emotion recognition progressed consistently and that children reached adult levels at age 12.

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Abstract

We know that children are on a different level than adults when it comes to recognizing and understanding emotions. But it remains to be seen if there exists an age at which children are able to recognize emotions as well as adults. This developmental study set out to determine such an age and find how the ability to recognize emotions changes from birth through adulthood. The first task used a row of pictures of the same face expressing each of the following four emotions: happiness, sadness, fear and disgust. The same procedure was repeated with the second task, this time involving pictures of four different objects. The pictures were covered with an unchanging level of visual "noise" while the contrast of the stimuli uniformly decreased. The subjects, ranging in age from 2 to 78 years, matched the designated stimuli (without noise) with the identical stimuli (with noise) in each row. The contrast threshold of each subject equaled the contrast of the last face correctly matched. A third task with the same procedure was performed, which asked subjects to find the same happy face in a row that included the face (with noise) and three squares with just noise. An increase in emotion recognition was found in the toddler years, and the development progressed consistently until about age 12, signifying that children around this age are able to recognize emotions like adults. The younger children were able to recognize the objects far better than the emotive faces at first, but both abilities were about equal in adulthood. The third task showed that emotion played a factor in the first task because young children performed nearly as well as the adults. These results are significant in three ways. Knowing the level that a child can recognize emotions will affect the way parents talk to their children and help them understand the world around them. Also, the results tend to refute the theory that the visual system is fully developed by age one, since large increases are shown in this study. Finally, it can help parents, teachers, and doctors better treat children with disorders that damage their emotion recognition abilities, such as autism and child blindness, because they will be able to better determine the chance of the child developing the skills.

Introduction & Literature Search

When we view the human face, we see many interesting features. We see all of its parts and the details of each one. But possibly the most interesting aspect of the face is the emotion being expressed. The ability to look at people and understand how they are feeling is an amazing thing. For young children, their main opportunity to connect with the outside world is by trying to understand the emotions of the people around them. But as a child gets older, how does his or her ability to recognize emotions develop? Some other interesting questions include: At what age do children come to recognize emotions as well as adults do? These and other questions were the main points of investigation in this study.

For human beings, the value of interpreting emotions is unchallenged. It is a natural part of growing up through childhood to develop a better understanding of the feelings expressed by others. The importance of these changes is easily seen in children inflicted with illnesses or diseases that damage their visual system, such as autism or child blindness. Many of these children are not helped with the learning of emotions until they are much older, at a time when their ability to perceive emotions has greatly weakened. Scientists have noticed, through various types of experiments, that there exist several key steps in the early development of emotion recognition. While traditional reports have shown that infants discriminate and recognize facial expressions by 6 months of age (Ahrens, 1954; Charlesworth & Kreutzer, 1973), others show evidence supporting infants' abilities to discriminate simple expressions as early as 3 months (Maurer & Barrera, 1981). As for development, several studies have shown an increase in emotion recognition from 3 to 9 years of age (Izard, 1971; Wiggers, 1977). With more

advanced testing methods, some recent studies have differed from the older claims. One study found an improvement in the perception of facial expression between the ages of 6 and 8, little change until about 13 years, and then a second improvement to adult performance at about 14 years (Kolb, Wilson & Taylor, 1992). Unfortunately, these newer studies have not followed the development from very early childhood through adulthood, instead focusing on smaller age ranges. Without using the same method in a long-range study, making a conclusion concerning development has been impossible. This study, which is relatively long-range, should yield different results. It is predicted that the results will show a strong, consistent development that stops around age 10 or higher, and that the children will perform significantly better on the object recognition task than the face recognition task.

Methods

Participants

People from a wide range of ages participated in this study. Many of the younger subjects were recruited at an after-school program. All subjects were chosen on an availability basis. Of the 49 people who completed the study, six were between the ages of 1 and 3; twelve between 4 and 6; ten between 6 and 10; eleven between 11 and 18; and nine were 18 or older. Consent forms were signed by parents of all child participants under 18 years of age. All subjects were aware of the procedure and signed consent forms that were based on age (3 consent forms – under 12, 12-17, and 18 and older).

Stimuli

The stimuli included three different sets made using Adobe Photoshop. Each set was composed of 17 rows. The rows in the first set consisted of four Ekman face photographs expressing the following four emotions: happiness, sadness, fear and disgust. The second set consisted of four different objects – a book, a lamp, a teapot and an umbrella. The rows of the third set, called the detection task, were composed of only one happy face with noise and three panels with just noise. In the three sets, each picture appeared only once in every row, and the pictures were randomly arranged. All pictures were covered with a different block of noise with unchanging opacity. The noise background allows the subjects to isolate their visual processes and determine their visual sensitivity (Pelli & Farell, 1999). In addition, the contrast of the images within a certain row was equal. Each row, however, had lower contrast than the last. The contrast (opacity) of each row was the square root of 1.625 lower than the previous row. In each row, the varied order of the images was randomly determined.

Testing Conditions

All subjects were seated at a desk appropriate for their age and were a distance of 30 cm above the stimuli, which rested on a flat surface. The subjects were told to remain seated and not to handle the stimuli in any way. At no time were the subjects allowed to view the stimuli prior to their testing. All subjects, regardless of age, were given encouragement as the testing procedure increased in difficulty to help them remain focused on the tasks. The same conditions were used for all subjects and for all tasks.

Procedure

All subjects started with the face task and were instructed in the same verbal manner. First, they were asked to look at the designated picture (without a noise background), then to find the picture in the first row with a noise background. The designated picture remained in front of the subject for the duration of the test. The instructions were repeated until the subject fully understood the task. The subject was asked to match the same face for each row of pictures. After the subject correctly matched the selected emotive face, they moved on to the next row of faces, which was decreased in contrast. The contrast of the last correct row determined their score. The contrast sensitivities were calculated by using the reciprocal of the contrast thresholds. For the face task, the only emotive faces tested were the faces showing happiness and fear. Again, each one was tested separately. Following the face task, the object task was then administered. The same procedure was used for this task, and the objects tested were the lamp and the umbrella. For the detection task, the procedure remained very similar to the previous tasks. Each subject was aware that in each row, only one panel had a happy face with noise, and the rest were left with only noise. The results were plotted on a graph, and best-fit lines were drawn. The age at which each contrast sensitivity curve was seen to shift from being directly proportional to age to being independent of age was noted.

Figure 1

Emotion Recognition Task

(Note: The size of the actual test is 4.5” X 4.5” for each panel with 4.5” X .5” white gaps in between)

4 Paul Ekman Faces Demonstrating Fear, Sadness, Disgust, and Happiness. Contrast thresholds (rounded to the nearest whole number) noted to the right of the figure.

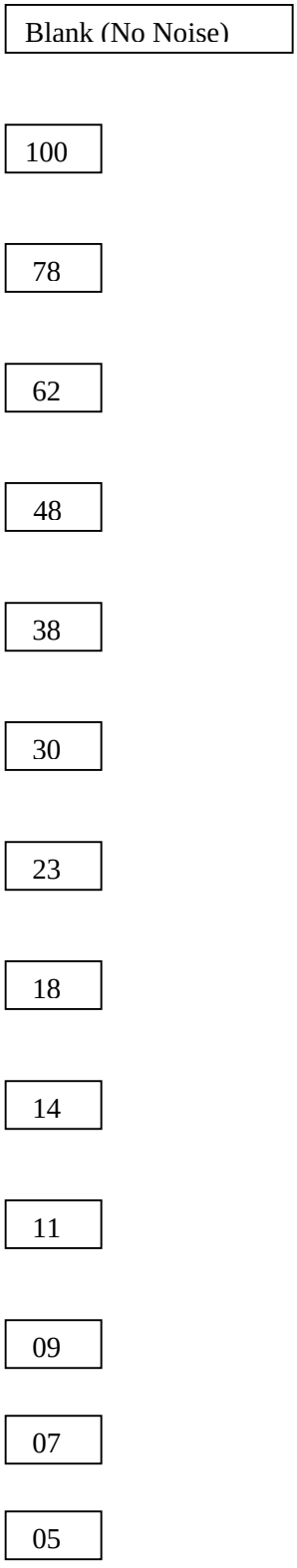


Figure 2

Object Recognition Task

(Note: The size of the actual test is 4.5” X 4.5” for each panel with 4.5” X .5” white gaps in between) 4 Object Drawings: A Book, Lamp, Teapot, and Umbrella. Contrast thresholds (rounded to the nearest whole number) noted to the right of the figure.

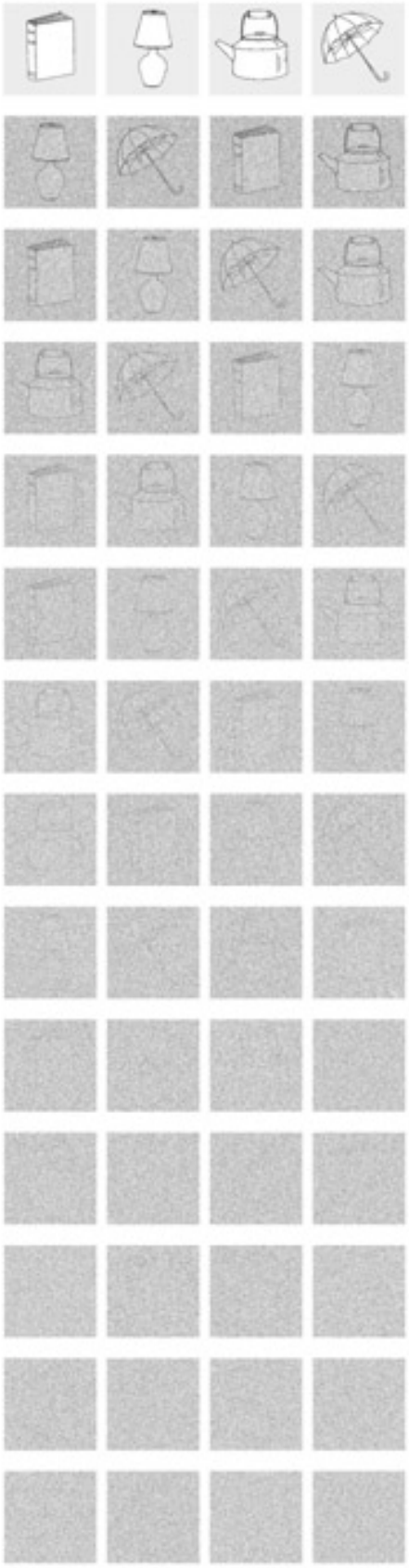
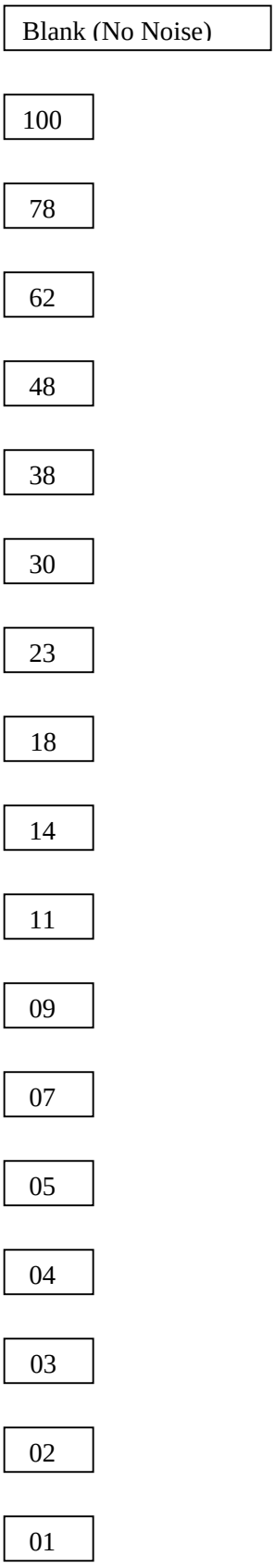


Figure 3

Face Detection Task

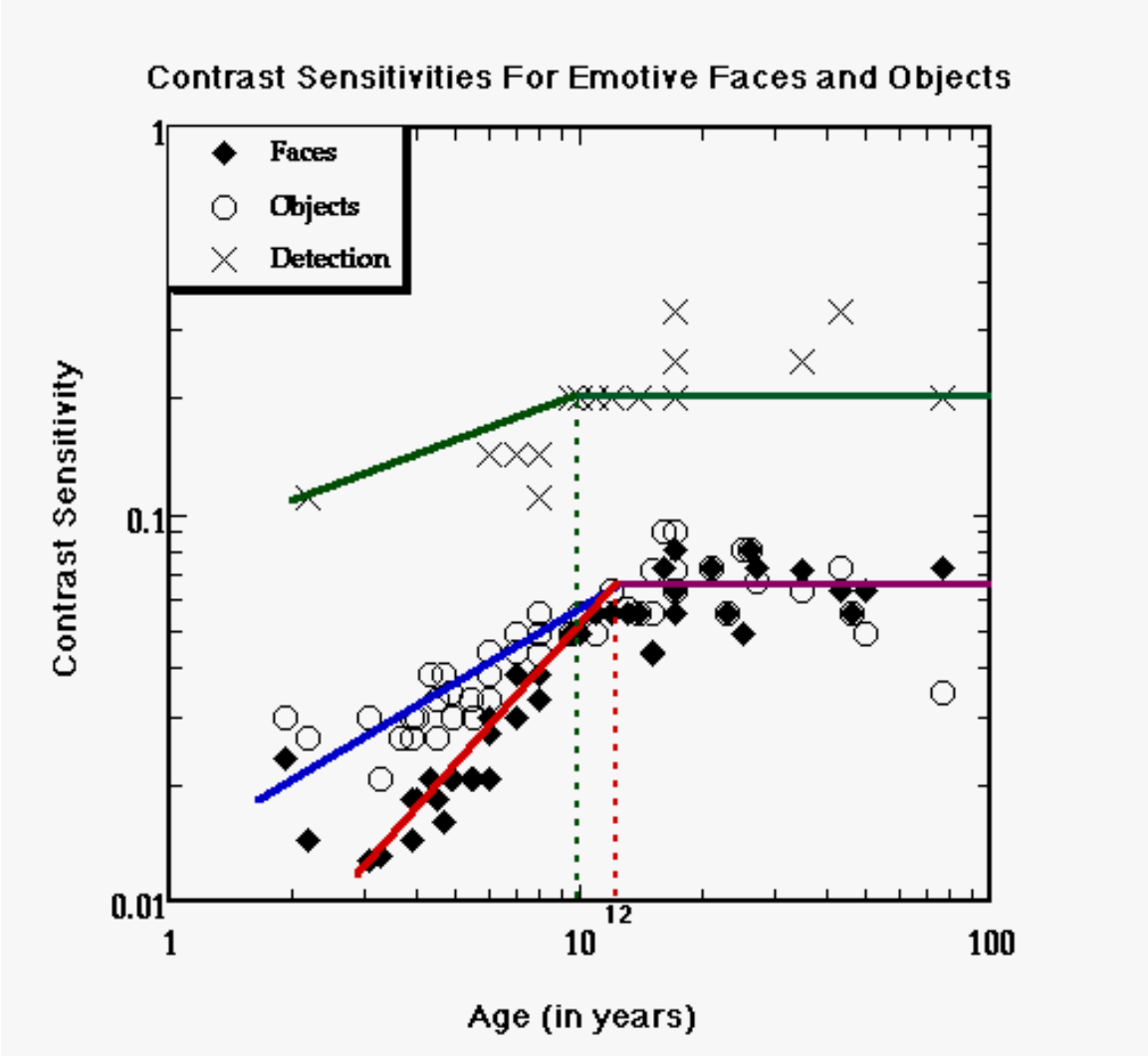
(Note: The size of the actual test is 4.5” X 4.5” for each panel with 4.5” X .5” white gaps in between)

Includes 1 face demonstrating happiness with 3 panels with only noise. Contrast thresholds (rounded to the nearest whole number) noted to the right of the figure.



Data and Results

After plotting the graph and drawing the best-fit lines, the age at which each contrast sensitivity curve was seen to shift from being directly proportional to age to being independent of age was found to be 12 for the “faces,” 12 for the “objects,” and 10 for the “detection.”



Graph 1
Contrast Sensitivities for Emotive Faces and Objects
“Faces” is an average of the results for the selection of the face expressing happiness and the results for the selection of the face expressing fear.
“Objects” is an average of the results for the selection of the lamp picture and the results for the selection of the umbrella picture.
“Detection” is the results of the entire detection task.

General Discussion

These results and graphs indicate several key trends. The first thing to pop out from Graph 1 is the detection task result, which indicates that detection is far more sensitive (needs less contrast) than identification. Child subjects reached a similar level to the adult subjects slightly faster, but show far less development than with the other two tasks. In fact, the detection sensitivity is 3 times higher than identification sensitivity. This shows that we need 3 times more contrast to differentiate between faces than we need to detect a face. When examining the relationship between the emotion and object recognition tasks, it is clear that all child subjects reached a higher level on the object task than on the emotion task. Also, it seems that very young children are better at recognizing objects than emotions from the beginning. The adults' performances, however, were almost equal on both emotion and object recognition tasks. The real breakthrough comes in the breakpoints, which are the ages at which children reach adult levels on the tasks. It appears that the breakpoint for the emotion task is equivalent to that of the object task. The breakpoint seems to fall around age 12 for both tasks and slightly earlier for the detection task at about age 10. Another key difference lies in the slopes of all three tasks. It is evident from Graph 1 that the slope is greater for the emotion task results than for the object results. This signifies a quicker development of the emotion recognition abilities of children. The improvement for sensitivity in the emotion recognition task is actually 7 fold, whereas the improvement for object sensitivity is 3 fold, and only 2 fold for the detection sensitivity. The consistency of the slope of the emotion results shows that the ability to recognize emotions increases at the same rate from age 2 to age 12, where it levels off.

The detection task results provide the smallest slope and increase in development. From observations during the experiments, it appeared that all subjects, children and adults, had similar ease in completing the detection task. The detection results show that there exists a significant difference between children's abilities to detect an emotive face and their abilities to identify one and differentiate between multiple emotive faces. This difference is much greater in children than it is in adults.

What explains why children have less ability to recognize emotions? Several hypotheses have been advanced addressing both the biological and psychological factors. One reason might be due to the fact that young children are still undergoing maturation processes in their nervous systems, which restrict their abilities to understand emotions. It is also possible that the right hemisphere and frontal lobe develop into the teenage years, which could impair emotion recognition abilities. It has been shown that children have superior recognition performance when emotions are presented to the left visual field, or the right hemisphere of the brains (McLaren & Bryson, 1984). Finally, it is possible that children are not as fully prepared to understand the emotions of others due to, basically, lack of experience.

Having now shown that a child's development of emotion recognition is fast but lasts until age 12, there are some very interesting ways to approach the significance of the results. First of all, the breakpoints found in this study do not agree with many of the points found in previous studies. The age of 12 actually falls in between the breakpoints of the two studies mentioned earlier (9 years – Wiggers & 14 years – Kolb, Wilson & Taylor). In addition, the results of this study showed a consistent development, unlike other studies that showed lapses in child development.

Another significant point involves the earlier discussion of children with difficulties of understanding emotions of others. From this study, it can be advised that any child showing difficulties recognizing emotions needs additional teaching as soon as possible since the development after the toddler years begins rapidly. Further analysis of the development of emotion recognition can help parents and doctors plan out a teaching system for their children with hopes of maximizing the development and time left before the breakpoint of 12 years of age.

Researchers have claimed that at 1 year of age, humans' visual systems are fully developed. The results of this study tend to refute that idea. All three task results show that children's abilities to recognize a visual drawing still develop after 1 and until 12.

The final point of significance is the one that has affected this researcher's own life the most. By observing the children participating in these tasks and by examining all the results showing development of emotion recognition, my interactions with my two year-old sister have changed. Over the past year, it has become clear to me that my sister's emotional development is changing. This has changed the way I express myself to her now, and as she gets older, it will give me a hint as to how much I have to express my emotions before she understands. When she has friends over, who may be either older or younger than her, I realize that I cannot express my feelings in the same way to each one. It would seem that the parents of children of different ages who review the results of this study might change in a like manner. By knowing that their children are not on the same level when it comes to understanding emotions and feelings, the parents would be more inclined to express themselves to their children individually, and in a way that gets their feelings across. This would allow every child to be fully aware of their parents' emotions.

Future Research

This study focused on the emotions as a whole. The data showed some promise that a study centered on the difference between the basic emotions would yield surprising results. In an interesting twist, the one elderly subject and other seniors who were not included in the data had far more trouble with the object recognition task than with the emotion recognition task. Would further investigation show that as we become much older, we lose our abilities to recognize objects, but not emotions?

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