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ABSENCE OF AVOIDANCE RESPONSE TO IMPENDING COLLISION IN CHILDREN

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INTRODUCTION

The development of avoidance response to impending collision in human infants was investigated by several researchers during the 1970's (Bower, Broughton, & More, 1970; Ball & Tronick, 1971; Yonas, Bechtold, Frankel, Gordon, McRoberts, Norcia, & Sternfels, 1977; 1977). One of the main issues of these studies was the onset age of the avoidance response. The avoidance response in question was the backward movement of the subject's head, and the onset age depends on the interpretation given to this response. That is, whether as a result of visually tracking the visual stimulus, as argued by Yonas *et al.*, (1977), or as an avoidance response, as argued by Bower *et al.*, 1970, 1977). This paper does not try to make a judgement on this issue, it suffices to say that in any case, these researchers seemed to agree that infant older than 4 or 6 months should show avoidance response in face of impending collision. Although the onset age issue can have great implications on the view of the nature of behaviour development (i. e., innate vs. learned etc.), its solution does not seem to inform us much about the development aspect of perception and action coupling. Furthermore, the issue as such does not lead to the formulation of question about what older subjects might or might not respond, because common sense suggests that as a competence observable in 6 months old infants, subjects a few years older can normally be assumed to have it. The authors would not have given a second thought to this view, had the first author not been puzzled by his failure in observing any response in young children when presented with a video clip which he had tested successfully with adult viewers in another experiment. This paper reports on an experiment to confirm that first observation.

EXPERIMENT

Subjects. 76 subjects whose age ranged from 3 to 24 years were tested.

Apparatus. Visual displays were presented by video monitor. The video monitor measuring 29 inch (73.66cm) diagonally, mounted on a table 60cm above ground, was

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placed 1.35m away from the subject who was seated on a stool 30cm (children) or 41 cm (adults) high, so that the subject's eye hight was about the middle of the monitor.

Behind the monitor, a high sensitivity black and white video camera (A) with a zoom lense, mounted on a tripod 125cm above ground, was used to observe the subject's response. Another camera (B) at the side of the subject focused on the video monitor. A composit image consisting of the subject's full face, from camera A, and an inset of the video display presented to the subject, from camera B, was tape-recorded through out the experiment using a video recorder kept in a separate corner invisible to the subjects.

Two sets of video clips were presented to the subjects. (a) Base Ball: depicting a ball, being pitched by the pitcher, moveing toward the viewer, missing the batter and hitting on the net in front of the camera. The clip lasted 3 seconds. The speed of the ball was estimated to be about 30m/sec (or 3000cm/sec). (b) Doll: depicting a doll falling from 6m above and landing on the camera. The clip lasted 12 seconds. These clips were in black and white, and were inserted into a popular colour animation. All subjects were presented with the same material.

Procedure. The subjects were brought invidually to the laboratory by a research assistant. Subjects were told that two events in black and white would be presented in the middle of a short animation and the task was to identify the events after viewing. Subjects viewed each set of clip only once. Eye blinking and dodging of head (abrupt movements of head backward or sideway) about 100 msec before and after the collisions were analysed and counted by the experimenter and two research assistants. Whenever disagreement occurred, the analysis and counting were reexamined by the three until satisfactory result was reached. Because of low frequency of occurrence in all types of "dodging of head", only data concerning eye blinking will be reported here. Some occurrences of eye blinking were also accompanied by dodging of head.

Subjects were prompted to watch carefuly just before the start of the intended clip and asked what the event was after each viewing. Aswers were considered correct when "base ball", "ball game", "ball collided", or "doll falling", "doll collided" "something falling" or their equivalents were mentioned.

Results

Development of avoidance response. Table 1 shows the development of avoidant response (eye blinking) to the two video clips containing impending collision events. The children subjects (N=60) were divided into 3 groups and the adult subjects, age ranged from 20 to 24, formed one group. Due to technical failure, the Doll clip condition suffered the loss of one subject each for the ages of 5 and 6. The two conditions (i.e., the Base Ball and the Doll) elicited different patterns of eye blinking. While Base Ball elicited an increasing frequency across ages; a decreasing frequency across ages was observed in the Doll condition. Furthermore, the Base Ball failed to elicited any eye blinking at all among subjects of the youngest group (0%), and only one out of 20 subjects in the next youngest group (5%). In contrast, the Doll clip elicited eye blinking in 36.8% of the subjects of the youngest group, and 26.3% in the next youngest group (Figure 1). An ANOVA showed that there was a significant interaction

TABLE 1

Occurrence of Eve Blinking

Age	[BASE BALL] No. of S Tested	%	Sum %	[DOLL] No. of S Tested	%	Sum %
3	1	0		1	1	
4	7	0		7	4	
5	12	0		11	2	
	(20)	(0)	0 %	(19)	(7)	36.84%
6	10	0		9	1	
7	5	1		5	2	
8	5	0		5	2	
	(20)	(1)	5 %	(19)	(5)	26.3%
9	6	1		6	0	
10	8	2		8	1	
11	6	3		6	1	
	(20)	(6)	30 %	(20)	(2)	10 %
20	1	1		1	0	
21	2	2		2	0	
22	9	4		9	1	
23	3	1		3	0	
24	1	1		1	0	
	(16)	(9)	56.3%	(16)	(1)	6.25%

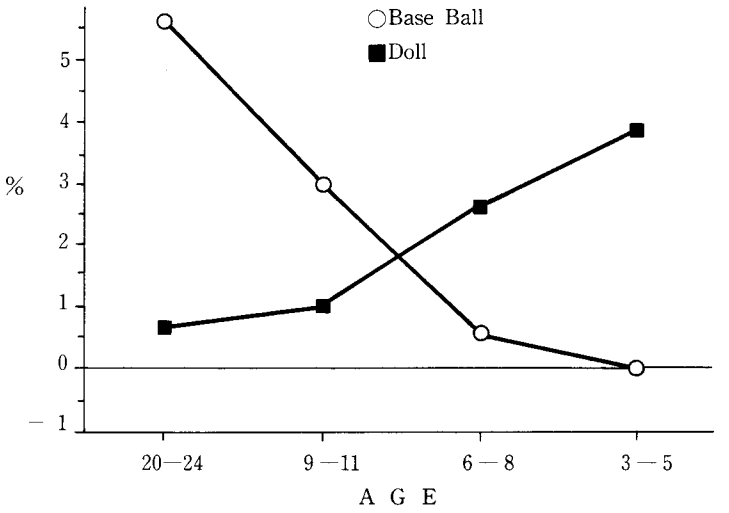

FIG. 1 Avoidance Response (Eye Blinking) to Two Types or Impending Collision Events.

between age of subjects and the type of video clip shown ($F=9.3074$ $df=3$, $P<.001$). *Identification of event and avoidance response.* Table 2 and Figure 2 show the result of an analysis of the developmental trend of the relation between the correctness in event identification and the occurrence of eye blinking. Partly because of difficulty in under-

TABLE 2

Eye Blinking and Event Identification

Age group	N=	Base Ball				N=	Doll			
		Correct		Incorrect			Correct		Incorrect	
		+	−	+	−		+	−	+	−
4− 5	16	1	(6.3%)	15	(93.7%)	16	3	(18.8%)	13	(81.2%)
		0 0%	1 100%	0 0%	15 100%		0 0%	3 100%	4 30.8%	9 69.2%
6− 8	19	2	(10.5%)	17	(89.5%)	18	10	(55.6%)	8	(44.4%)
		0 0%	2 100%	1 5.9%	16 94.1%		2 20%	8 80%	2 25%	6 75%
9−11	20	17	(85%)	3	(15%)	20	17	(85%)	3	(15%)
		7 41.2%	10 58.8%	0 0%	3 100%		2 11.8%	15 88.2%	0 0%	3 100%
20−24	16	16	(100%)	0	(0%)	16	16	(100%)	0	(0%)
		9 56.3%	7 43.7%	0 0%	0 0%		1 6.3%	15 93.7%	0 0%	0 0%

+/− represent presence and absence of eye blinking respectively.

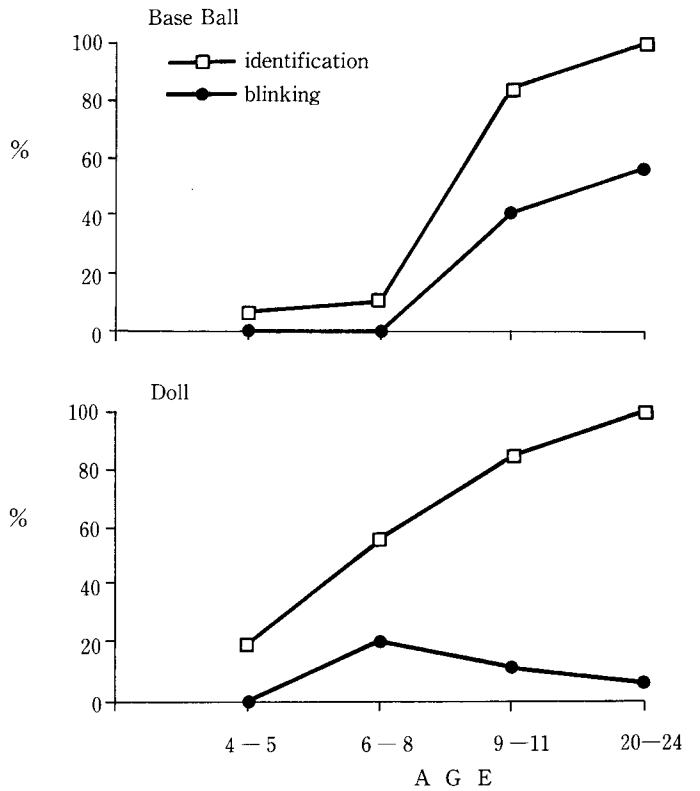

FIG. 2 Relationship Between Correctness in Event Identification and the Occuirence of Eye Blinking.

standing the experimenter's questions, the younger groups suffered a loss of 1 to 4 subjects. The majority of the youngest groups failed to identify correctly the events shown. While the Base Ball was hardly correctly identified at all (10.5%) by the next youngest group (6 to 8 years), the Doll was correctly identified by 10 out of 18 (55.6%) of the subjects in the same group. The oldest group of the children subjects showed greater increase in correct identification of both events (both at 85%).

Figure 2 shows the relationship between correctness of event identification and the frequency of eye blinking. In the case of Base Ball, the low percentages of correct identification in the two younger groups (6.3%, 10.5%) were accompanied by 0% of eye blinking, and the higher percentages of correct identification of event of the oldest group of children and the adult (85%, 100%) were accompanied by only moderate frequencies of eye blinking (41.2%, 56.3% respectively). In contrast, the Doll event was correctly identified by increasingly larger percentages of subjects (18.8%, 55.6%, 85%, and 100%), but the frequencies of eye blinking remained low (between 0% and 20%) for all groups.

Discussion

A general conclusion that can be drawn from previous studies on impending collision is that although the exact onset time of avoidance response depends on how one interprets the backward movement of the young infant's head (i. e., either as eye tracking or as avoiding backing), the appearance of avoidance response after 6 months is considered established. However, the result of this experiment showed that under the same conditions, the video clip that elicited eye blinking from adult subjects failed to do so entirely in children from 3 to 5, and only in one out of 20 children from 6 to 8 years of age. The result of this experiment suggested that the Base Ball event which contained object moving at about 30m/sec was effective (convincing enough in spite of the possibility of an awareness that the event was just a virtual one and not a real one) for the adult subjects but was not detected by the younger subjects. On the other hand, the Doll event which contained a falling object at the speed of about 8m/sec was effective for the younger subjects but not convincing enough for the adult subjects. The different effect of the two video clips was further evidenced by the result concerning correctness of event identification. The analysis showed that for both events, the percentage of correct identification reached 85% in the oldest children group (9 to 11) and 100% in the adult group, the frequency of eye blinking showed greater difference. This indicates that as the event was correctly identified, the Base Ball event became more effective but the Doll event became progressively less so. Similarly, with the two younger children groups, the Doll event was corretly identified by more subjects and elicited more eye blinking than the Base Ball event.

An analysis of the difference between the two video clips used in this experiment showed that they differed in at least three aspects: (a) length of event, (b) speed of approaching objects, and (c) velocity (acceleration vs. deceleration).

It has been shown that looming effect does ont involve the identification of the approaching object such as shape or nature of the object (Ball & Tronick, 1971; Schiff, 1965). However, what was in question in this experiment was avoidance response.

In previous studies on impending collision, no interest has been shown on the conditions of occurrence of avoidance in particular. Previous authors focussed on such issues as the onset age of eye blinking, or different effect of virtual and actual approaching objects.

When viewing virtual impending collision, the fact that avoidance response is not elicited all the time suggests that looming offect is not the only necessary and sufficient condition for the occurrence of avoidance response. It seems possible for a visual stimulus to generate perfect looming effect but to elicite no avoidance at all. Why? Because the stimulus is not convincing enough. In order for avoidance response to occur when viewing an impending collision event on a monitor or screen, the visual stimulus has to be convincing enough that the subject's ability to inhibit avoidance response from occurring is rendered inactive. Look at it in this light, the 'convincingness (or effectiveness)' of a certain visual stimulus in eliciting avoidance response can be seen as dependent on factors pertaining to both the subject (e. g., age and gender) and to the event (e. g., speed and nature of the object such as size, harmfulness, etc.).

The result of this experiment suggested that the Base Ball event, with the approaching object moving at 30m/sec, was convincing enough for the adult subjects but too fast for the younger children subjects even to identify. On the other hand, the Doll event, with the doll falling at the speed of 8m/sec was vonvincing enough for the young children but too slow to be convincing enough for the adult subjects.

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