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The Effect of Expectation on the Identification of Known and Unknown Persons

JOSÉ H. KERSTHOLT, JEROEN G. W. RAAIJMAKERS AND J. MATHIEU VALETON

TNO Institute for Perception, PO Box 23, 3769 ZG Soesterberg, The Netherlands

SUMMARY

In this experiment we investigated the influence of expectation, exposure time and jacket hood positioning on person identification. Thirty subjects, all employees of the TNO Institute for Perception, participated in the experiment. They were presented with slides showing known and unknown persons who were photographed under bad lighting conditions. Limited viewing conditions considerably deteriorated subjects' performance and under these circumstances all experimental manipulations significantly affected identification accuracy. Contrary to what was expected longer exposure times impaired performance. The results are discussed in light of recent research on face recognition (Bruce and Young, 1986; Read, Vokey, and Hammersley, 1990).

INTRODUCTION

Recently, several theoretical models have been proposed to account for the perceptual and cognitive processes underlying face recognition (Bruce and Young, 1986; Hay and Young, 1982). According to Bruce and Young (1986) people can derive several 'codes' from faces, providing different types of information about the perceived person. For the identification of familiar persons they distinguish three codes: structural, identity-specific semantic and name codes. The abstract, structural codes emphasize the more informative parts of the face such as the distance between the eyes, the form of the nose and the configuration of features. These codes specify the characteristic aspects of a face distinguishing it from others. When these codes are activated one knows that the perceived face is familiar. However, for a successful identification to occur more specific information is needed such as where the person lives, his or her occupation and where he or she is usually encountered. This kind of information is provided by the identity-specific semantic codes. On retrieving this information the person is identified, and the name code may also become available.

A person will be recognized when the information that is derived from his or her face corresponds with the structural codes stored in memory. Several lines of research indicate that this matching process is affected by context. Priming studies show that a face will be recognized faster when it is preceded by a semantically related face (e.g. Laurel–Hardy). This context effect is greater when the stimulus

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quality is deteriorated (Bruce and Valentine, 1985, 1986). An interaction between stimulus quality and expectation was also found in a study by Young, Hay and Ellis (1985) in which subjects kept records of the difficulties they encountered in everyday recognition. Unfamiliar persons were more often identified as familiar persons under bad viewing conditions and when a known person was expected.

In this paper we report the results of an experiment in which we induced for half of the subjects the expectation to see only known target persons. In fact, both known and unknown target persons were presented who were all photographed under bad lighting conditions. In line with the model of Bruce and Young we predicted that subjects in the expectation condition would employ a more lenient criterion in identification, resulting in both higher false alarm and hit rates.

In addition to its theoretical relevance, the effect of context on the accuracy of person identification may have serious consequences in legal testimony. The practical relevance of the theoretical framework described above is indeed exemplified by the particular lawsuit for which the present experiment was designed. In this case of attempted murder two persons were injured. The main evidence against the accused was based on a testimony from one of the victims, who said that she had immediately recognized the perpetrator as her stepfather. However, viewing conditions were bad at the time of the shoot-out and their family circumstances made it plausible that in the context of the shoot-out the stepdaughter would expect the perpetrator to be her stepfather.

In addition to expectation, exposure time and visibility of the face were indicated as factors that might have affected the quality of the testimonies. A reconstruction of the shoot-out pointed out that the victims were exposed to the perpetrator for maximally 5 seconds. However, presumably only a small proportion of this time will have been spent looking at the face of the perpetrator. In order to investigate the effect of exposure time on identification accuracy the slides showing the target persons were presented for either 2 or 5 seconds. With regard to the visibility of the face the victims declared they had seen a hat or a hood on the head of the perpetrator, but without knowing the exact position. Considering the lighting conditions at the time of the shoot-out the positioning of the hat or the hood may have dramatically affected the amount of shadowing on the face of the perpetrator, leaving it more or less visible. For this reason we manipulated hood positioning as well.

METHOD

Subjects

Thirty subjects, all working at the TNO Institute for Perception, participated in the experiment. The group consisted of 26 men and four women. Their mean age was 40 years (range 26–57 years). An important selection criterion was the familiarity of the subjects with their colleagues. We therefore recruited subjects who had worked at least 2 years at the institute (mean 13 years, range 2–33 years) and who were, in the opinion of the investigators, reasonably familiar with their colleagues. The group varied greatly with regard to the subjects' background, and included techni-

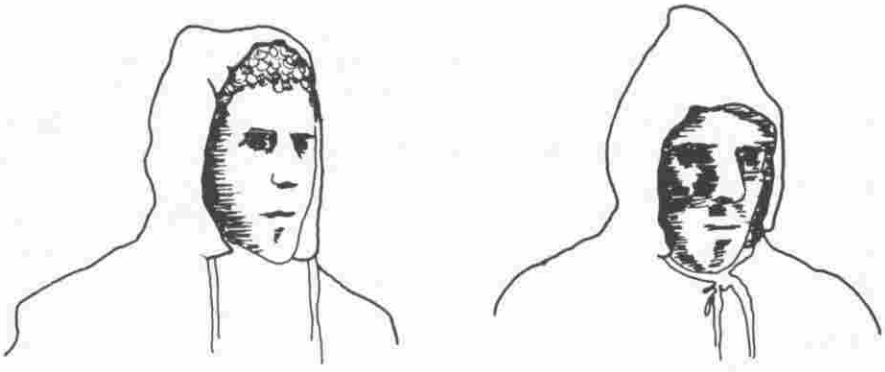

Figure 1. A schematic drawing exemplifying the position of the hood in the '¾ hood' and in the 'hood full' condition

cians, physicists, assistants and psychologists. None of the four psychologists who participated in the experiment had particular knowledge of eyewitness research.

Material

The experimental material consisted of colour slides of known and unknown target persons. The known target persons were employees at the TNO Institute for Perception for at least 5 years (mean 21 years, range 5–37 years). The unknown target persons were recruited from outside the Institute and were unknown to the subjects. In order to test for familiarity with the target persons a trial block was included showing slides of all target persons under optimal viewing conditions.

Care was taken to ensure that the identification of known target persons could not be initiated by distinct features such as beard, dark face, extreme height or posture. Each person wore the same jacket with a hood.

A major factor in shoot-outs is that a good deal of attention is captured by the weapon, leaving less capacity for the identification of the perpetrator (Loftus, 1979). In the experiment we simulated the effect of a reduction in attentional resources available for person identification, by presenting an additional name identification task. For this purpose, the target persons were asked to hold a card in front of them on which a four- or five-letter word was printed. Five pictures were taken of each target person in a three-quarters pose. Two pictures showed the target person with a hood covering the head for approximately three-quarters and two pictures showed the target person with a hood covering the head completely. In this last condition the degree of shadowing on the face of the target person was increased (see Figure 1). The fifth picture was taken under optimal lighting conditions, i.e. with a flashlight and without wearing the hood.

The same lighting conditions as at the time of the shoot-out were simulated. In a shed without windows the actual situation was reconstructed. The same street lighting was installed as at the time and place of the crime. The mean luminance of the target persons' faces was .24 cd/m^2 (range .16–.46 cd/m^2).

Design

In addition to expectation, exposure time and head covering were manipulated. The design of the experiment was a $2 \times 2 \times 2$ factorial with expectation (present or not) as a between-subjects variable and hood (partly or completely covering the head) and time (2 or 5 seconds) as within-subjects variables. Expectation was induced by informing subjects that the slides would only present known persons. Furthermore, in order to strengthen this expectation all trial blocks were preceded by an extra set of six slides showing only known target persons. In the 'no-expectation' condition subjects were told that the target persons would either be known or unknown. The word 'expectation' therefore refers specifically to the expectation of seeing only known target persons. The four conditions (time × hood) were presented in blocks, which means that subjects had to evaluate successively each of the four combinations of time by hood. The order in which blocks were presented was balanced across subjects. Within blocks the slides were shown in random order. The subjects were randomly assigned to either the 'expectation' condition or the 'no-expectation' condition.

Twenty-four persons were photographed: 16 known and eight unknown target persons. Subjects in the 'expectation' condition were first presented with six slides of known persons, followed by the resulting 10 known and eight unknown target persons in random order. In the 'no-expectation' condition people had to judge only the 10 known and eight unknown target persons in each experimental condition.

At the end of the experimental session 24 slides were presented showing all known and unknown target persons under optimal viewing conditions. These slides were presented for 5 seconds. Subjects in the 'expectation' condition therefore judged 120 slides ($4 \times 24 + 24$) and subjects in the 'no-expectation' condition 96 slides ($4 \times 18 + 24$).

Procedure

Two or three subjects were tested in parallel. They were seated at a distance of 5 metres from the screen on which the slides were projected in real-life format. They first read an instruction form on which the task was explained, and in which subjects in the 'expectation' condition were told that they had to identify colleagues whereas in the 'no-expectation' condition subjects were told that both colleagues and unknown persons would be shown. After each slide subjects were required to fill in a form posing the following questions:

Which word was on the card?
Did you recognize the person on the slide? yes/no
Who is this person?

In case the subjects knew the target person but could not retrieve his name, they had to characterize the person as well as possible, by for example naming his function and the group he worked in. From this information the experimenter would be able to infer whether identification was accurate.

During the presentation of a slide the experimental room was dark. After each presentation a few lamps were minimally lighted, just enough to fill in the question form, but to avoid light adaptation of the subjects.

RESULTS

Accuracy under optimal viewing conditions

Target persons who were photographed with flashlight and without hood were identified correctly in 98.8 per cent of the cases. Identification accuracy is therefore nearly perfect under good viewing conditions.

Secondary task

Subjects wrote down 94.5 per cent ($\sigma = 9.6$) of the words shown on the slides correctly. From this result it can be inferred that sufficient attention has been allocated to the word-naming task.

Test conditions

In the 'expectation' condition subjects were presented with six extra slides of known target persons preceding each trial block. In order to make the 'expectation' condition comparable to the 'no-expectation' condition these responses were discarded, after which 72 (4 conditions $\times$ 18 target persons) slides remained, which were judged by all subjects. Table 1 shows the overall results. Using concepts from signal detection theory, we distinguished the following response categories: hits, incorrect identifications, misses, false alarms and correct rejections. When a target person is known to the subject he can be identified correctly (hit), misidentified for another known person (incorrect identification), or not recognized at all (miss). Unknown target persons can either be misidentified for a known person (false alarm) or not recognized at all (correct rejection). Table 1 shows that over all test conditions 56 per cent (± 2.2 per cent) of the known persons were identified correctly. Of the unknown persons 22 per cent (± 1.5 per cent) were incorrectly identified as a colleague.

Table 1. Percentage hits, incorrect identifications, misses, false alarms and correct rejections over all conditions

		Response category				
Condition	Target	Hits	Incorrect identifications	Misses	False alarms	Correct rejections
	Known	56 (672)	13 (153)	31 (375)		
	Unknown				22 (208)	78 (752)

Figures between parenthesis give absolute number of trials.

In order to determine the effects of time, hood and expectation, analyses of variance were carried out over the absolute numbers of correct identifications and false alarms with 'time' and 'hood' as 'within-subjects' factors and 'expectation' as a 'between-subjects' factor. The results for known and unknown target persons were analysed separately.

Table 2 presents the number of responses falling into the different response categories for the two expectation conditions. If a known person is expected, subjects identified known target persons in 62 per cent of all cases correctly. With no such

Table 2. Percentage hits, incorrect identifications, misses, false alarms and correct rejections for the 'expectation' and 'no expectation' condition

		Response category				
Condition	Target	Hits	Incorrect identifications	Misses	False alarms	Correct rejections
Expectation	Known	62 (373)	11 (65)	27 (162)		
	Unknown				26 (124)	74 (356)
No expectation	Known	50 (299)	15 (88)	35 (213)		
	Unknown				18 (84)	82 (396)

Figures between parenthesis give absolute number of trials.

expectation this percentage drops to 50. However, this decrease in hit rate is only marginally significant ($F(1,28) = 3,4$; $p < .1$). On the other hand, expectation significantly affected the number of false alarms: if subjects expect to see a known person they more often identify an unknown target person as a known person ($F(1,28 = 4,1$; $p < .05$). On average these misidentifications increased from 18 per cent to 26 per cent. Table 3 gives the responses for an exposure time of 2 and 5 seconds. A remarkable finding is that more errors were made with increased presentation time. A higher presentation time caused a reduction in hit rate of 5 per cent ($F(1,28) = 4,4$; $p < .05$). The same holds for false alarm rates: 19 per cent of the slides showing unknown persons were incorrectly judged with a presentation time of 2 seconds and 25 per cent of the unknown target persons were identified incorrectly with a presentation time of 5 seconds ($F(1,28) = 9,1$; $p < .01$). Therefore, rather than enhancing performance, increased exposure times led to more errors.

Table 4 gives the identification scores for the two 'hood' conditions. 'Hood ¾' means that approximately three-quarters of the head was covered by the hood and that the face and part of the hair could be seen. In the condition 'hood full', the hood covered all of the person's hair and resulted in more shadowing on the face. Hood positioning had a significant effect on the correct recognition of known target persons ($F(1,28) = 53,4$; $p < .0001$). The hit rate declined from 65 to 47 per cent when more shadowing fell into the face of the target person. Thus, known subjects were recognized significantly better when the face could be seen more clearly. Hood positioning had only a marginal effect on the number of false alarms ($F(1,28) = 3,3$; $p < .1$). In the 'hood ¾' condition 19 per cent of the unknown target persons were

Table 3. Percentage hits, incorrect identifications, misses, false alarms and correct rejections for a presentation time of 2 and 5 seconds

		Response category				
Condition	Target	Hits	Incorrect identifications	Misses	False alarms	Correct rejections
2 seconds	Known	59 (351)	10 (61)	31 (188)		
	Unknown				19 (89)	81 (391)
5 seconds	Known	54 (321)	15 (92)	31 (187)		
	Unknown				25 (119)	75 (361)

Figures between parenthesis give absolute number of trials.

Table 4. Percentage hits, incorrect identifications, misses, false alarms and correct rejections for the 'hood ¾' condition and the 'hood full' condition

		Response category				
Condition	Target	Hits	Incorrect identifications	Misses	False alarms	Correct rejections
Hood ¾	Known	65 (392)	11 (65)	24 (143)		
	Unknown				19 (93)	81 (387)
Hood full	Known	47 (280)	15 (88)	38 (232)		
	Unknown				24 (115)	76 (365)

Figures between parenthesis give absolute number of trials.

identified as known persons and in the 'hood full' condition this percentage was 24. There were no significant interactions between experimental factors.

DISCUSSION

The results of this study show that the identification accuracy for both known and unknown target persons deteriorates considerably under inferior viewing conditions. Furthermore, under these circumstances performance is significantly affected by expectation, exposure time and hood positioning. However, a note of caution regarding the generalizability of the present result is required. Subjects identified persons from colour slides, which implies a static pose. On the other hand, we have no reason to question the relevance of these findings to 'real-world' situations.

Expectation significantly affected the number of false alarms, providing experimental support for the diary study of Young *et al.* (1985) in which it was reported that misidentifications of unfamiliar as familiar persons especially occurred under bad viewing conditions and when a known person was expected. According to Bruce and Young (1986) expectation raises the basic activation level of the face recognition unit, which will cause subjects to respond at a lower level of correspondence with the structural codes derived from the perceived face. As far as the accuracy of identifications is concerned this would imply both higher hit and false alarm rates. However, even though the percentage correct identifications of known target persons (hits) increased with 12 per cent in the 'expectation' condition, this effect was only marginally significant. Two reasons may account for this result. First, expectation was manipulated as a between-subjects variable and individual differences within a group may have been large, possibly obscuring any systematic between-group difference. Second, expectation was induced through instruction and an extra set of slides of known target persons at the beginning of each trial block. However, as soon as subjects find out that unknown target persons are also presented, their expectation to see only known target persons will disappear. This may well result in a smaller overall effect.

For both known and unknown target persons the number of misidentifications increased with longer exposure times. At first sight this result may seem rather counterintuitive, since in most recognition studies accuracy is positively related to exposure time (Laughery, Alexander, and Lane, 1971; Shapiro and Penrod, 1986). However, in order to observe the effect of exposure time on recognition performance many

studies included the same set of photographs in the test phase as was used in the study phase. A disadvantage of this method is that subjects can rely on pictorial rather than on structural information. Pictorial information captures the static pose or the expression of the perceived face or details of flaws or lighting in a photograph, but not the characteristic information that distinguishes the face from other faces (Bruce and Young, 1986). In a recent study by Read *et al.* (1990) it was indeed shown that picture similarity interacted with exposure time. With great dissimilarities between pictures used at study and at test exposure, time may impair accuracy rather than enhance it. In the present study, persons were photographed under bad viewing conditions, reducing the similarity between the encoded information and the presented pictures. Under these circumstances increased exposure times reduced performance.

In line with what would be expected from the model of Bruce and Young (1986), head covering significantly affected recognition accuracy of known target persons. When more shadowing is falling on the face of the target person the probability of deriving structural codes is lowered, and as a result the correspondence with encoded structural information is reduced. This will decrease the number of hits as compared with the condition in which the face would be seen more clearly.

To summarize, in line with recent developments in research on face recognition these results provide further support for the effect of context on identification accuracy. Moreover, the rather surprising effect of exposure time on performance implies that task environments in which subjects respond to structural rather than pictorial information need more attention in future research.

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