Blink rate and imagined letters*

MICHAEL WEGMANN and ROBERT WEBER
Oklahoma State University, Stillwater, Okla. 74074

College Ss were required to imagine and report letters of the alphabet that were "traced" out in a 3 by 3 matrix by means of a series of messages, presented auditorially or visually. Also, each S's eyeblink was monitored before, during, and after each message. Results indicated that performance for the auditory presentation group was significantly better than that for the visual presentation group. It was found that letters associated with long messages were significantly more difficult to identify correctly than those letters associated with short messages. Finally, results indicated that blinking during the imagery task was suppressed significantly, relative to 10 sec before and after periods. Possible implications of the blink suppression were discussed.

Research involving the eyeblink has attempted to describe the nature of blinking as well as the conditions that will alter its rate. Findings indicate that blinking undergoes orderly phylogenetic and ontogenetic changes, in addition to being affected by various psychological, physiological, and environmental factors (Duke-Elder, 1968; Baumstimler & Parrot, 1971). The above, together with observations by Leask, Haber, & Haber (1969) on the erasure of eidetic imagery by blinking, suggests a possible functional relationship between blinking and visual modes of processing information.

In a recent study, Holland & Tarlow (1972) have suggested that increased blinking in a short-term memory task may be indicative of loss of information from memory. However, the observations by Leask et al (1969) and pilot data collected by the present authors suggested that blinking might serve an "erasure" function in the processing of visual information. In addition, the present study sought to investigate stimulus variables that might effect the formation of visual images. Variables selected for investigation were: presentation method (visual vs auditory), amount of information to be processed (message length), and the complexity of the material to be processed (overlapping vs nonoverlapping messages).

METHOD

Subjects

The Ss for the present study consisted of 32 undergraduate volunteers. All were enrolled in an introductory experimental psychology course at Oklahoma State University and received course credit for their participation.

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Apparatus

The eyeblinks of each S were recorded by means of an eye movement monitor (Biometrics Model SGH/V-2) on grid-line chart paper, using a Harvard apparatus chart mover, recorder, and event markers. A Ganzfeld was provided for Ss in the listening group by means of a sheet of white construction paper attached to a chinrest.

Procedure and Materials

The Ss were required to imagine a block capital letter being traced out in a 3 by 3 matrix, each cell of which had been given a label. The corner cells of the matrix were labeled upper and lower left and right, with the center cell designated as "center." The remaining cells, beginning at the top row, center cell and proceeding in a clockwise fashion, were labeled 12, 3, 6, and 9 o'clock. To trace out a letter, an S was presented with a sequence of cell names at about 1 cell/sec. The S was instructed to imagine drawing a line from the center of the first cell to the center of the next cell, until the sequence of cell names had ended. At that time S was required to call out the letter that had been traced out. An example of a cell sequence representing the letter "Y" would be "start at upper right," "next move is center," "move to upper left," "center is next move," "next move is six o'clock."

Prior to the beginning of the experiment and practice trials, Ss were allowed to study a sheet that illustrated how each letter of the alphabet would look if traced out in a 3 by 3 matrix. For the first two practice trials, Ss were provided with a blank matrix and instructed to trace along in accord with the messages. For the remaining two practice trials, Ss were required to imagine the matrix as well as the letter being traced out by the message. For the last two practice trials and all subsequent experimental trials, Ss either listened to the messages (presented over a tape recorder) or read the messages (from cards presented by E). The Ss were assigned randomly to either the visual or auditory presentation condition (between-Ss condition).

For experimental trials, the S's eyeblink was monitored for 10 sec prior to the beginning of a trial. At that time, Ss heard or read "ready." After a 2-sec delay, the starting cell in the matrix was presented. When another 2 sec had passed, the remaining cells of message were presented, embedded in short sentences, at a rate of 1/sec. The Ss then heard or read, "one, two, stop," and were expected to respond prior to the occurrence of "stop." The S's eyeblink was then monitored once again for 10 sec.

Letters utilized were classified according to length (e.g., the number of cell moves required to trace out the letter) and complexity (e.g., whether or not the letter had lines which crossed). The letters E, H, and I were classified as long overlapping letters, while G, O, and S were used as long nonoverlapping letters. Overlapping letters would have the same cell name reported more than once, as would occur by retracing a pathway if the letter were written. Nonoverlapping letters would not have the same cell repeated. Similarly, Y, T, and F were designated short overlapping letters, and L, J, and U were used as short nonoverlapping letters.

RESULTS

The analysis for the group performance data shown in Fig. 1 indicated that auditory presentation ($\bar{X}$ = 3.42 letters correct) was superior to visual presentation [$\bar{X}$ = 1.41, $F(1,30) = 16.47$, $p < .01$]. Further, it was concluded that short messages ($\bar{X}$ = 2.69) were significantly easier to process than long messages [$\bar{X}$ = 2.14, $F(1,30) = 6.42$, $p < .05$]; see Fig. 1, Panel 3.

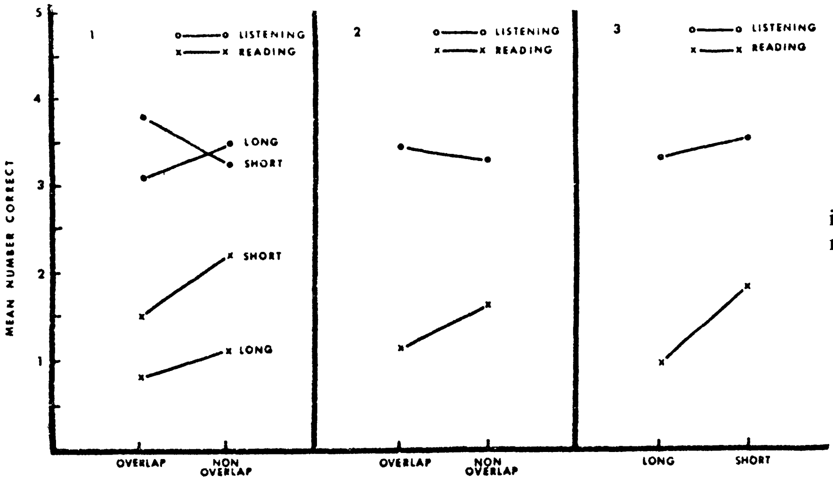

Fig. 1. Mean number of correct letter identifications as a function of presentation method, complexity, and overlap.

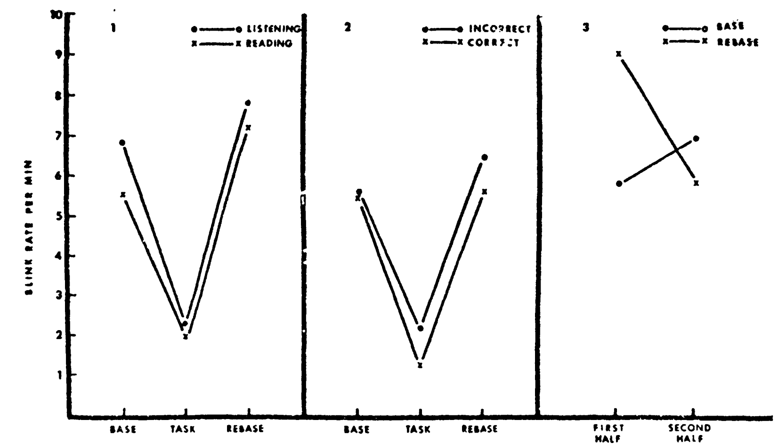

Fig. 2. Mean blink rates.

Lastly, the Presentation Method by Message Length by Complexity interaction was significant, $F(1,30) = 4.19$, $p < .05$. However, inspection of Fig. 1, Panel 1, indicated that the significant second-order interaction was due to a significant Message Length by Complexity interaction for the listening group, $F(1,15) = 9.30$, $p < .05$. A subsequent simple effects analysis for this interaction indicated that the only significant difference was between long and short overlapping messages for the listening group, $F(1,15) = 6.30$, $p < .05$. In addition, Fig. 1, Panel 2, indicated that messages associated with overlapping letters tended to be harder to process.

The analysis for the eyeblink data presented in Fig. 2 indicated that while the presentation method groups did not differ significantly with respect to blink rate, the blink rate of both groups was significantly different across the base, task, and rebase periods, $F(2,60) = 25.03$, $p < .01$. Multiple comparison procedures (Dunn's procedure) indicated that blink rates for the base ($\bar{X} = 6.21$) and rebase ($\bar{X} = 7.56$) were significantly different from that of the task period ($\bar{X} = 2.07$), but not from each other, $d = 2.86$, $X_3 - X_2 = 5.48$, $X_1 - X_2 = 6.25$, $p < .05$; see Fig. 2, Panel 1. Analysis of the blink rate data for incorrect vs correct trials (Fig. 2, Panel 2) indicated that blink rate activity did tend to be higher for incorrect trials, although the differences were not significant. Finally, it was found that for the pretask monitoring period, the blink rate tended to be higher in the latter half of the period (Fig. 2, Panel 3), while for the posttask period, the blink rate was significantly greater in the first half of the period, $F(1,30) = 13.43$, $p < .01$.

DISCUSSION

The results of the present study seem to confirm that listening was superior to reading and that long messages were more difficult to process than short. The former finding can be taken as confirmation of the finding by Brooks (1967) that reading causes a suppression of visualization. The last expectation, that overlapping messages should have been more difficult to process than nonoverlapping messages, while not confirmed, was in the expected direction.

The findings of the present study seem consistent with previous research (Holland & Tarlow, 1972) on the question of the effect of certain forms of cognitive activity on the human eyeblink. The next question would then seem to be, why is the blink rate altered? Could it be that a blink serves an erasure function in tasks requiring the processing of visual information? That is, after visual information has been taken in and processed, could a blink clear the visual registers in order that subsequent visual information might be taken in for processing? Further, could the tendency to blink more in the second half of the base period be due to the fact that the visual registers are being cleared of extraneous visual information taken in between trials? Also, the higher blink rate in the first half of the rebase period suggests that Ss are clearing out visual information accumulated in the trial just completed.

In summary, the results of the present study seem consistent with research previously reported (Holland & Tarlow, 1972; Baumstimler & Parrot, 1971). However, the data have been interpreted in different ways (see Holland & Tarlow, 1972). Therefore, with the effect of cognitive activity on blink rate established, it remains to investigate the reasons for the effect.

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Steep delay of reinforcement gradient in escape conditioning with altruistic reinforcement*

ROBERT FRANK WEISS, JOE SHELBY CECIL and MARCY J. FRANK

University of Oklahoma, Norman, Okla. 73069

Delay of altruistic reinforcement effects resemble those for conventional reinforcement in showing a decreasing monotonic gradient of response speed (100/latency) ($p < .001$). Results were obtained in a discrete-trials escape conditioning situation, employing the simulated suffering of another person as the noxious stimulus and his relief from suffering as the reinforcer.

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Five experiments now clearly establish that human Ss will learn an instrumental conditioned response, the reinforcement for which is the deliverance of another human being from suffering (Weiss, Boyer, Lombardo, & Stich, 1973; Weiss, Buchanan, Altstatt, & Lombardo, 1971). They employed discrete-trials instrumental escape conditioning in which the noxious stimulus was the simulated suffering of another person and, upon presentation of a CS, S made an instrumental button-pushing response which was altruistically reinforced by cessation of the *other* person's suffering.