Face age modulates gaze following in young adults

Francesca Ciardo[1], Barbara F.M. Marino[1], Rossana Actis-Grosso[1], Angela Rossetti[1], and Paola Ricciardelli[1]*

[(1)]Department of Psychology, University of Milano-Bicocca, Edificio U6, Piazza dell'Ateneo Nuovo 1, 20126 Milan, Italy

Correspondence to:
Paola Ricciardelli, PhD
Dipartimento di Psicologia, Università di Milano-Bicocca, Edificio U6, Piazza dell'Ateneo Nuovo 1, 20126 Milano, Italy. Tel. ++39-02-64483734, Fax: ++39-02-64483706
Email: paola.ricciardelli@unimib.it Correspondence and requests for materials

S.1 Data correction criteria

The trials that showed Saccadic Reaction Time (SRT) latencies of less than 80 ms (anticipations) or greater than 800 ms (delays), and trials in which saccades were not performed (trial time-out) were discarded (main Experiment: .19 % of the administered trials; control Experiment: Middle-aged group = .16 %; Elderly group = .69 %). For the remaining trials, we focused on the landing point of the first horizontal saccadic eye movement following the instruction cue. These movements were defined as correct if landing within ± 2 degrees of visual angle of the instructed target (Main experiment: 82.84 %; Control experiment: Middle-aged group = 83.21 %; Elderly group = 82.69 %). Saccadic eye movements landing outside ± 2 degrees of visual angle of the instructed target were defined as "not reached" (Main experiment: 9.32 %; Control experiment: Middle-aged group = 9.70 %; Elderly group = 10.98 %) and were discarded from the analyses. Four participants in the main experiment were removed from the analysis because their "not reached" trial percentage exceeded 10%. Two participants in the control experiment (both from the Elderly group) were excluded due to eye tracking signal loss. Saccadic eye movements made in the opposite direction to that indicated by the instruction cue (i.e., antisaccades) were considered errors (Main experiment: 7.65 %; Control experiment: Middle-aged group = 6.93 %; Elderly group = 5.64 %). No amplitude criterion was applied to these movements, as long as they were > 2 degrees of visual angle.

S.2 Age manipulation Check

The perceived age ratings given by the experimental groups (i.e., young, middle-aged and elderly adults) to each distracting face were compared with ratings given by the manipulation check control group. A one-way ANOVA showed that there were no significant differences in the perceived age ratings between the manipulation check control group and the three experimental groups, with the exception of two distracting faces [i.e., 6-10.m2: $F(3,61) = 4.50$, $p < .008$, ; 18-25.m2: $F(3,61) = 5.68$, $p < .003$]. Bonferroni Post-hoc comparisons (alpha level = .05) revealed differences across the groups. Specifically, the elderly rated the age face age of one male distracter (i.e., 18-25.m2) differently from both young and middle-aged adults (21.0 ± 3.2 vs. 22.4 ± 3.6, $p < .02$; 21.0 ± 3.2 vs. 25.3 ± 2.6, $p < .02$); whereas young and middle-aged adults rate one distracter (i.e., 6-10.m2) as younger compare to the control group (9.8 ± 1.6 vs. 22.4 ± 3.6, $p < .05$; 8.3 ± 1.6 vs. 7.5± 1.5, $p < .02$). Nevertheless, our age manipulation was confirmed as these differences were not

large enough to determine exclusion of the two critical distracting faces from their original age range (see Table 1 below).

Table 1. Mean (m) and Standard Deviation (s.d.) of perceived age ratings given to each distracter face by the control and experimental groups.

Distracter	Control group		Young adults		Middle-aged adults		Elderly			
	m	d.s.	m	d.s.	m	d.s.	m	d.s.	F	*p*
6-10.f1	8.3	1.9	9.1	2.4	9.9	2.6	10.4	1.1	2.60	0.061
6-10.f2	9.6	2.1	8.7	1.9	9.8	2.3	10.5	1.6	2.40	0.077
6-10.m1	6.9	2.3	6.4	1.9	6.3	1.5	7.3	1.0	0.71	0.549
6-10.m2	9.8	1.6	8.3	1.6	7.5	2.2	9.0	1.3	4.50	0.007*
18-25.f1	23.3	5.1	23.3	4.3	23.2	4.2	22.5	4.2	0.47	0.944
18-25.f2	23.7	4.7	27.3	10.2	25.5	2.9	25.3	5.3	0.33	0.907
18-25.m1	21.8	3.0	22.4	3.4	24.5	3.5	22.3	4.1	1.20	0.317
18-25.m2	22.0	3.5	22.4	3.6	25.3	2.6	21.0	3.2	5.68	0.002*
35-45.f1	44.8	6.1	43.1	5.0	41.9	6.1	42.8	8.1	0.47	0.802
35-45.f2	43.3	4.7	40.0	4.3	42.5	5.9	40.7	7.2	0.33	0.147
35-45.m1	42.7	6.3	41.4	4.4	42.4	5.9	38.2	8.2	2.02	0.122
35-45.m2	41.1	6.0	40.4	4.2	41.4	6.1	43.8	4.7	0.98	0.407
over70.f1	83.6	6.5	81.7	5.5	78.0	6.4	81.0	5.0	1.82	0.153
over70.f2	82.3	5.6	78.2	6.2	78.8	6.9	78.2	8.1	1.07	0.369
over70.m1	82.8	5.4	79.4	4.4	78.2	4.9	79.1	6.6	2.07	0.114
over70.m2	82.8	4.7	81.7	5.0	79.6	4.5	81.3	7.4	0.76	0.519

S.3 Gaze direction task control experiment

Participants

Forty-five right-handed adults belonging to three different age groups (Young adults group: 11 female and 4 males, mean age= 23.1 ± 2.1 years; Middle-aged group: 8 females and 7 males, mean age: 40.9 ± 4.1 years; Elderly group: 8 females and 7 males, mean age = 70.7 ± 3.9 years) participated as volunteers in the study.

Twelve participants belonging to the middle aged group and eleven participants belonging to the elderly group took also part in the gaze following control experiment, whereas none of the young adult participants took part in the main gaze following experiment. All participants had normal or corrected-to normal vision and were unaware of the purpose of the experiment. All gave their

written informed consent. The study was conducted in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and fulfilled the ethical standard procedure recommended by the Italian Association of Psychology (AIP). All experimental protocols were also approved by the ethical committee of the University of Milano-Bicocca.

Procedure

In order to exclude the possibility that the perceptual properties of the distracter stimuli affect the perception of the gaze shift in the gaze following experiments (in particular in the main experiment), the perception of the direction of the distracters' gaze shift were evaluated. Stimulus presentation and data collection were controlled by E-Prime2 (Psychology Software Tools, Inc). The experimental session comprised 128 trials, divided into four blocks of 32 trials each, with the 8 conditions (4 Distracter Age x 2 Gaze Direction) being equally probable, and repeated randomly 16 times. A practice session of 12 trials was given prior to the beginning of the first block. Each trial began with the presentation of a black fixation cross (0.828 °) in the centre of a white screen for 500 ms, followed by a central neutral face with straight gaze with a black central fixation circle (diameter: 0.51 degrees of visual angle) presented on the distracter's nose. After 1000 ms, the same face appeared with averted gaze. Participants were instructed to maintain fixation at the centre of the screen and to respond using their right and left index fingers to indicate if the face shifted his/her gaze toward the right or the left. Instructions emphasized both response speed and accuracy.

Results

The trials that showed Response Time (RT) latencies of less than 80 ms (anticipations) or greater than 800 ms (delays), and trials in which no response was given (trial time-out) were discarded from the analyses (18-25 years Group = 0.47 % of the administered trials; 35-45 years Group = 1.61 %; over 65 years Group = 3.07 %). Errors were not analyzed separately given they were extremely rare (< 5 %). A participant from the over 65 years Group was excluded from the analysis since his accuracy was less than 90%. Mean values of the RTs of the remaining participants were calculated for each combination of gaze direction and face age. These data were entered in a mixed ANOVA with Gaze Direction (left, right) and Face Age (06-10 years, 18-25 years, 35-45 years and over 70 years) as within-subject factors, and Subject Age (Group 1: young adults, Group 2: middle-

aged adults and Group 3: elderly) as a between-subject factor. Post-hoc comparisons were performed using the Duncan's test (alpha level = .05) and the partial eta squared values (η_p^2) were reported.

Differences in latency of response to the gaze shift of distracters' faces of different ages were our variable of interest since they provide a measure of a possible effect of the perceptual age properties of the distracter faces (e.g., gaze width) on gaze shift perception. Indeed, if the ability to perceive a gaze shift is affected by the gaze width, then one might predict that latency in detecting a change in gaze direction increases as the face age increases, since skin excess, wrinkles, and bags around the eyes make the gaze width smaller.

The analysis revealed only a significant main effect of Participants' Age [$F(2,41) = 24.11$, MSE = 370950, $p < .0001$, $\eta_p^2 = .54$] and a significant main effect of Gaze Direction [$F(1,41) = 5.48$, MSE = 5776, $p < .03$, $\eta_p^2 = .12$]. The former reflected the fact that responses were slower in the elderly group (427.20 ± 11.72 ms), intermediate in the middle-aged group (361.32 ± 11.32 ms), and faster in the young group (314.38 ± 11.31 ms, all ps < .007). The latter was due to faster responses to gaze shifts to the right (363.58 ± 6.32 ms) than to the left (371.69 ± 7.32 ms). Given that only right-handed individuals were tested in the gaze-direction task and that the right hand was used to respond to right gaze aversion, the effect of Gaze Direction likely reflects the fine motor skills of the dominant hand compared to the other hand. More importantly, no significant effect of the distracters age was found ($p = .80$), thus ruling out the possibility that perceptual age properties of the distracter faces might have affected the effects found in the gaze following experiments.