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PERSON REPETITION NEGLECT WHILE VIEWING CONTINUOUS PICTORIAL NARRATIVES

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ABSTRACT

Continuous pictorial narratives (CPN) present protagonists repeatedly, yet adult viewers report seeing different persons instead. We presented 12 CPNs to 16 adults, whose oculomotor and verbal responses were continuously recorded. We addressed (a) the capability of instructions to compensate for lacking aesthetic fluency (Smith & Smith, 2006); (b) perceptual-cognitive processes accompanying Person Repetition Detection (PRD); (c) formal stimulus properties related with PRD. The results demonstrated that (a) search for presented persons especially similar to each other yielded more PRD than estimation of average age or aesthetic evaluation; (b) saccades between picture regions with repeated persons and PRDs were positively correlated; and (c) formal properties and PRD are not reliably correlated.

This study is concerned with a phenomenon which occurs when adult naïve observers view some curious artistic examples of stories told through pictures. In such a story (here specified as continuous pictorial narrative) the artist represents the passage of time by repeating the same character within a single frame. When viewing pictures like this, adult naïve observers mostly report seeing different characters coexisting in time, instead of the same person in successive moments (as is the intention of the artist).

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Our concern with this neglect phenomenon originated in an unusually long visit to the Campo Santo museum in Pisa in 1984. After repeated examinations of the reproductions of paintings by Benozzo Gozzoli (15th century), the thus far neglected triple appearance of Cain and Abel in *La morte di Abele* suddenly became apparent to the senior author. Twenty-five years later, participants in an introductory course in social psychology inspected a large-scale screen projection of Botticelli's *Temptation of Christ* for 60 seconds; this mural depicts four entrances of Christ and three appearances of the tempter. The students had been asked to look out for conspicuous features and to write them down afterwards on distributed pieces of paper. Looking out for conspicuous features scarcely averted the neglect: Only 1 out of the 95 answers collected contained (in form of labeling the painting as "Temptations of Jesus") a potential indication that person repetitions (at least of Christ) had been perceived. How come?

CONTINUOUS PICTORIAL NARRATIVES

Pictures are more or less pleasing (Fechner, 1865, 1876). They may be uninteresting or interesting (Berlyne, 1974), abstract or representational (Locher, Krupinski, Mello-Thoms, & Nodine, 2007; Massironi, 2002). Representational pictures may be still-lifes or landscapes and thus depict what is called *settings* in Seymour Chatman's narratology (Chatman, 1978). Settings are *permanences* in Massironi's sense. They may be individual or group portraits and then present what Chatman terms *characters*. Characters are origins of modifications within the meaning of Massironi, with regard to which he differentiates between transformations and movements. Characters are thus unlike settings, which can hardly be modified. The narratological setting/character distinction has its neurophysiological counterpart in the discernment of two cortical regions (Yi, Kelley, Marois, & Chun, 2006), i.e., a scene-sensitive cortical region known as the *parahippocampal place area*, and a face-sensitive region known as the *fusiform face area*.

Representational pictures may represent characters and settings in combination. The members of a particular subset of pictures like that are termed *visual narratives* (Brilliant, 1984), or, since verbal texts are visual, too, *pictorial narratives*. A pictorial narrative may consist of multiple pictures within their respective frames (e.g., a comic strip) or in a single picture in its single frame (Brilliant, 1984; Massironi, 2002). Single frame pictorial narratives may show their characters once or repeatedly (Brilliant, 1984). The non-repeating ones exemplify either the *complementary style* (the *komplettierende Darstellungsweise* of Wickhoff [1912, p. 14]) or the *isolating style* (Wickhoff's *distinguierende Darstellungsweise*). Single frame pictorial narratives that show their characters repeatedly exemplify the *continuous style* (Wickhoff's *kontinuierende Darstellungsweise*). The latter superseded the isolating style in Europe since the 2nd century A.D. and prevailed through one and a half millennia until the sixteenth century (Wickhoff, 1912, p. 13). Critically, "The comprehension of a continuous

[pictorial] narrative . . . requires an awareness that more than one moment is represented within a single frame and that multiple appearances of a character in a single setting indicate successive states of action" (Brilliant, 1984, p. 29). In other words, although Person Repetition Detection (PRD) is necessary for narrative comprehension, it is not sufficient.

PICTORIAL NARRATION AND COGNITIVE DEVELOPMENT

Interested in how children comprehend continuous pictorial narratives, Actis-Grosso and Zavagno (2008) presented reproductions of two medieval paintings to 20 kindergarteners and 20 first-graders: *Miracle of the Child Falling from the Balcony* by Simone Martini, 1324, *The Drowning and Salvage of Saints Cosma and Damiano* by Fra Beato Angelico, 1438-1440, and the respective line-drawing cartoon versions of the paintings in which the characters were impersonated by Disney-like animals. These paintings represent, according to Massironi (2002), an intermediate stage in the evolution of art. Visual representations of the passage of time like those shown in the *Tabula Iliaca Capitolina*, originating in the late 1st century B.C., are examples of a primary stage, whereas comics stand for a more developed stage in the artistic evolution. These stages are believed to correspond to Piaget's cognitive Stages I, II, and III in the development of the notion of time. The authors hypothesized that neither children at Stage I nor children at Stage III should be able to understand the medieval narratives presented to them; Stage I children would not, because they have not yet developed a notion of time passage at all. Stage III children would not, because they would need a more advanced technique of time representation, that is, comic strips. The children at the intermediate cognitive Stage II, however, should be able to understand the continuous pictorial narratives presented to them. This hypothesis was confirmed in that the three school-children and the single kindergartener, who belonged to Piaget-Stage II, saw in both paintings the same person in different moments (as did one Stage I kindergartener, too). The majority of the kindergarteners and the school-children, however, "saw the different representations of the key characters as different people" (Actis-Grosso & Zavagno, 2008, p. 327). This finding suggests that the comprehension of continuous pictorial narratives reflects a transitional stage in the development of the notion of time.

ENHANCING THE PROBABILITY OF PERSON REPETITION DETECTION

Person repetition, Wickhoff's *persönliche Wiederholung*, deserves aesthetic interest in the role of the distinctive feature of the continuous style, whereas person repetition neglect concerns social cognition, as well. Although awareness of a person's appearance is certainly a matter of face recognition, it also depends

on depth of processing (Craik & Lockhart, 1972). The complex visual stimuli to which the *fusiform face area* responds are socially meaningful patterns that may signify variables other than the personal identity of their bearers exclusively (e.g., species, age, gender, emotional state, etc.). Bruce and Young (1998) argue that there are at least seven distinct types of information that can be derived from faces, and that everyday recognition of familiar faces can be described, to a certain extent, in terms of the sequential access of different codes. The authors maintained that recognition of expression and identity, an so forth, can all be achieved independently (cf. Haberman & Whitney, 2007) and that therefore one does not need, for instance, to determine a person's gender in order to recognize his/her identity and so on. The lowest level of face categorizing stands for the recognition of some visual pattern as a human face, the highest level for the apprehension of its personal identity. These levels find electrophysiological correlates in the form of *Event Related Potentials* (ERP): The N170, "a prominent response over occipito-temporal areas which is prominent for faces but is much smaller for most other visual stimuli," and the N250r, a component which "refers to a relatively more negative ERP for repeated as compared to unrepeated faces, a difference which peaks between 230 and 330 ms over right inferior temporal regions" (Neumann & Schweinberger, 2008, p. 182). The level extremes are thus neurophysiologically grounded. Our first hypothesis is that the higher the level of face processing, the greater is the probability of PRD in a continuous pictorial narrative. Different processing levels would be operationalized by pertinent instructions.

Aesthetic fluency, a concept introduced by Smith and Smith in 2001, has been defined as "the knowledge that a person has about art and aspects closely related to art" (Smith & Smith, 2006, p. 50). Heightening the probability of PRD by means of pertinent instructions would not necessarily promote aesthetic fluency. Conversely, a viewer sufficiently endowed with aesthetic fluency should know what a continuous pictorial narrative is. The probability of PRD depends, on the other hand, on stimulus conditions such as the number of a protagonist person's entrances and, apart from characteristics of the scene, the total number of persons depicted. Our second hypothesis is that the higher the (relative) number of non-repeated persons, the less conspicuous are occurring repetitions. The *type token ratio* (TTR), as it is called, is in our case the proportion of the number of different persons depicted (*types*) to the total number of person depictions (*tokens*). The TTR, which originated in the linguistic domain, has been used by Kalkofen, Müller, and Strack (1988) in an examination of the aesthetic evaluations of frequency proportions in tessellations.

SELECTING CONTINUOUS PICTORIAL NARRATIVES

Aiming at conceivable precursors of Wertheimer's stroboscopic motion devices, Actis-Grosso and Zavagno resorted to stimulus pictures with two

character appearances within a short period of narrative time. A controlled sampling (Brunswik, 1956) of continuous pictorial narratives, as is required for an examination of the conditions for PRD, should also include exemplars that embody more than two appearances and longer periods of time. A suitable collection needs constraint, on the other hand, since instances of the continuous style are numerous. In order to reduce that multitude, we excluded the instances of plastic art and concentrated on pictures, both paintings and drawings, of Central European provenance and on landscape as well as vertical formats that do not violate the rules of linear perspective too much. Despite these restrictions, a maximum spread of times of origin should be attained and various styles be exemplified. Assuming that the probability of PRD depends inversely on the TTR, that is, the proportion of the number of individuals to the total number of persons depicted (see second hypothesis), we fixed the lower limit of the TTR in our stimulus sample at .70. The linear perspective restriction follows Wickhoff's view that the unfolded continuous method be inseparable from the illusionistic style that already employed most of the pictorial depth cues that proper linear perspective provides.

HOW TO ASSESS PERSON REPETITION DETECTION

PRD is a mental event, comparable in a way to the aha-experience, as it has been called by Karl Bühler (1909, p. 117). Mental events may, when transfigured into verbal responses, be assessed by means of think-aloud protocols. They are accompanied by covert and overt somatic processes. Locher, Krupinski, Mello-Thoms, and Nodine (2007) instructed subjects to verbalize their thoughts as they formulated their evaluative judgments of a work's pleasingness. Concurrently with the verbalizations oculomotor responses were registered, since "the study of eye movements has proven to be a very useful tool to investigate how the pictorial composition of artworks affects the viewing behavior during an aesthetic experience" (p. 56). Three areas within each artwork had previously been identified by experts as containing the work's major compositional aspects. The results demonstrated that these

> major compositional elements of the art stimuli drew viewers' interest at the earliest stage of exploration and presumably contributed to their global impressions of the art stimuli. By the time participants completed viewing each composition, they had directed their gaze to all three regions of each composition designated as containing key aspects of its structural skeleton. (p. 73)

This finding is, according to the authors, consistent with Locher's (2003) visual rightness theory of picture perception: The artworks that served as stimuli in the study were created by renowned artists of recognized talent and are, therefore,

presumably visually right. It is therefore not surprising that participants' scanpaths include the major aspects of the structural organizations of the artworks during both initial and later stages of processing (p. 74). Defining pictorial areas that contain hypothesis-relevant aspects has proven thus to be an effective device. A region like that has been termed (for instance, in an eyetracking manual of SensoMotoric Instruments GmbH, Teltow, Berlin) an *Area of Interest* (AOI).

PRD is, as has been stated earlier, a prerequisite for understanding a continuous pictorial narration. What then are the oculomotor essentials required in order for PRD to occur? A continuous pictorial narrative is, in a way, a composition of regions that contain person depictions. Regions containing depictions of persons that repeatedly (k times) appear in a narrative picture count as areas of interest in the present study. It is assumed that apprehension of an individual AOI needs, minimally, one fixation and it is furthermore understood that, maximally, one AOI can be apprehended with a single fixation. Detection of a single person repetition would thus require two fixations, and in case of $k = 2$ the entire detection process could then have been completed, in principle. The visual inputs resulting from those fixations, however, must be related to each other. This kind of "interrelation" could, in principle at least, be fully worked out in memory and in the absence of conspicuous oculomotor responses (cf. Johansson, Holsanova, & Holmqvist, 2006). We assume instead that it is indicated by eye movements that join fixations of AOI. Our third hypothesis was that "Inter-AOI-Saccades" facilitate the rise of subjects' person repetition hypotheses, and they are essential for the confirmation of these hypotheses and may eventually lead to PRD. Though Inter-AOI-Saccades are necessary preconditions, they scarcely guarantee that PRD will occur. In order to make its occurrence known to others, it has to come out as a significant response—in the actual sense of the word. This can be assessed by think-aloud protocols.

An experiment was conducted to test these three hypotheses:

Hypothesis 1: The higher the level of face processing, the greater the probability of PRD.

Hypothesis 2: TTR and PRD are inversely related.

Hypothesis 3: PRD requires Inter-AOI-Saccades.

METHOD

Participants

Sixteen undergraduate students (2 males, 14 females) at the University of Regensburg, Germany, participated in the study. They ranged in age from 20 to 27 years (mean 22.6 years). In order to ensure an intermediate level of aesthetic fluency, students of art history were excluded from participation.

Half of the participating students had psychology as their major subject and received credits for participation. Participants had either normal or corrected-to-normal vision.

Stimuli

Twelve continuous pictorial narratives were extracted proportionately from four sources (corpora).[1] Biblical stories, voyages of discovery, saints' legends, and Greco-Roman traditional stories were included. Across the paintings, we balanced for (a) TTR (low/medium/high; numerical fillings of the three-levels are corpus-specific[2]), (b) format (horizontal/vertical; i.e., orientation of the picture's major extension), and (c) artistic category (painting/engraving).

Figure 1 presents the stimuli *en miniature* as a picture tableau. Figure 2 documents the formal stimulus properties: the aspect ratios of the stimuli, the numbers of entrances, the type token ratios, and the relative AOI extents. AOI are defined as the smallest rectangles enclosing entrances of depicted repeated persons. Examples of AOI demarcations are shown in Figure 3.

Apparatus

Instructions and stimuli were presented on a 19" Dell™ monitor (resolution 1024 × 768 pixels). The presentation was controlled by Super-Lab-Pro 2.0 (Cedrus). Areas of stimuli were aligned; any picture covered 47% of the otherwise black screen (606^2 pixels in case of a square). The chosen viewing distance of 70 cm resulted in viewing angles (horizontal and vertical, respectively) of 27.3° and 22.2° for the entire screen, 25.6° for the widest and 20.7° for the tallest stimulus picture. A picture tableau (Figure 1) presented finally the entire stimulus set *en miniature* to the participants. Eye-movement recordings were obtained by means of an iView Highspeed Eyetracker (SensoMotoric Instruments GmbH, Teltow, Berlin; temporal resolution 240 Hz, spatial resolution 0.5°, minimum fixation duration 90 ms).The chinrest of the device had been detached in favor of "thinking aloud." Respondents' verbalizations were recorded throughout by a loose-sitting microphone, connected with a separate laptop that was equipped with Microsoft Movie Maker 5.1. These recordings did not support synchronization.

[1] The three wall paintings in the Sistine chapel by Sandro Botticelli (1481-2; 'Sistine corpus'); engravings in the *Collectiones peregrinatorum in Indiam Occidentalem et Indiam Orientalem* by Theodor de Bry (1594-1628; 'de Bry corpus'); altarpieces in the cathedral in Xanten by Jan Baegert and Barthel Bruyn (1510-1534; 'Xanten corpus'); engravings by Henrik Goltzius (1585-1589; 'Goltzius corpus'). Stimuli are individually shown at: http://journals.zpid.de/Empir_Stud_Arts/2011/kalkofen_strack/index.html

[2] For example, a TTR of .87 is medium in the De Bry-corpus, but high in the Goltzius-corpus (see Figure 2).

Figure 1. Stimuli.
Notes: (1) Scenes From the Life of Moses; (5) The Temptation of Christ; (9) The Punishment of Korah and the Stoning of Moses and Aaron; (2) What the Dutch Captain Negotiated With the King and What Occurred to Them; (6) The Wife of a Chief in the Province of Cumana Bring Gifts to the Governor Herrera; (10) Devon Sea Captain Richard Whitbourne Sees "a Strange Creature" in St. John's, Newfoundland, in 1610; (3) Scenes From the Life of St. Anthony; (7) Departure of St. Victor From Emperor Maximian and Blessing by the Pope Marcellinus; (11) The Finding of the Holy Cross by St. Helena and Transfer of the Relic; (4) The Great Hercules; (8) Horatius Cocles; (12) Mars and Venus Surprised by Vulcanus.

Design

The experiment consisted of four experimental blocks and three stages.

The task in Block 1 (Stage 1) was *Aesthetic Evaluation* of the 12 stimulus pictures which were presented to all 16 subjects. The instructions (translated from German here and elsewhere) were:

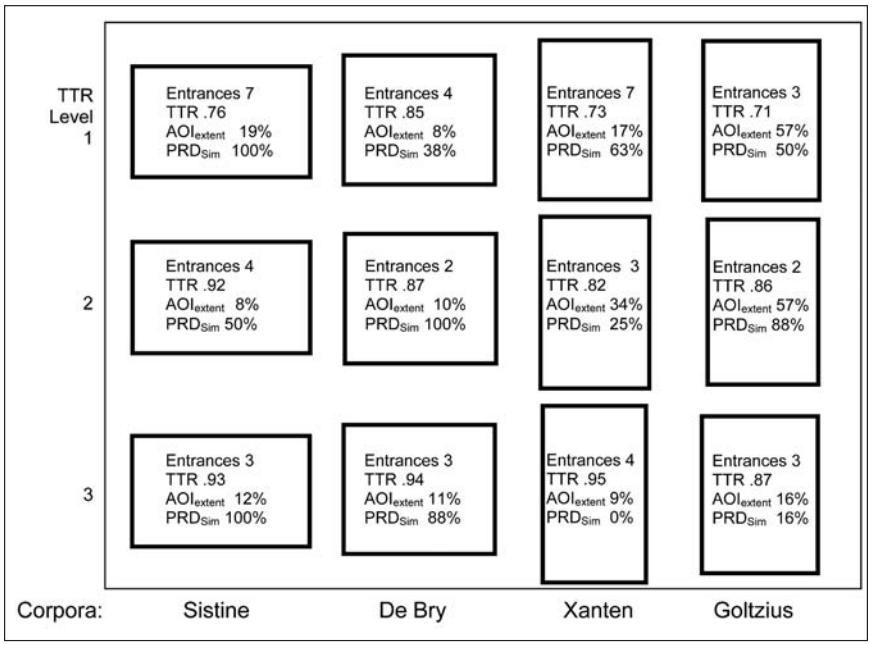

Figure 2. Formal Stimulus Properties (compare to Figure 1) and amounts of Person Repetition Detection in the Block 3 Similarity Recognition Task (PRD_{Sim}).

> Our investigation deals with the perception of persons as they have been represented in ancient pictures of historical and mythological content. First, however, we would like to know, how pleasing you find these pictures to be and how you estimate their artistic value. For that you have a scale from minus three (very bad) to zero (neutral) to plus three (very good) at your disposal. While your aesthetic judgment develops, please tell the microphone what you are thinking. Think aloud! After 45 seconds the picture disappears. Then make your judgment.

In Stage 2 the subjects were randomly assigned to Blocks 2 and 3; the task in Block 2 was *Average Age Estimation*. The instructions were:

> The second stage is about person perception. Any living being with a human face, such as (for example) an angel, should be regarded as a person. Please

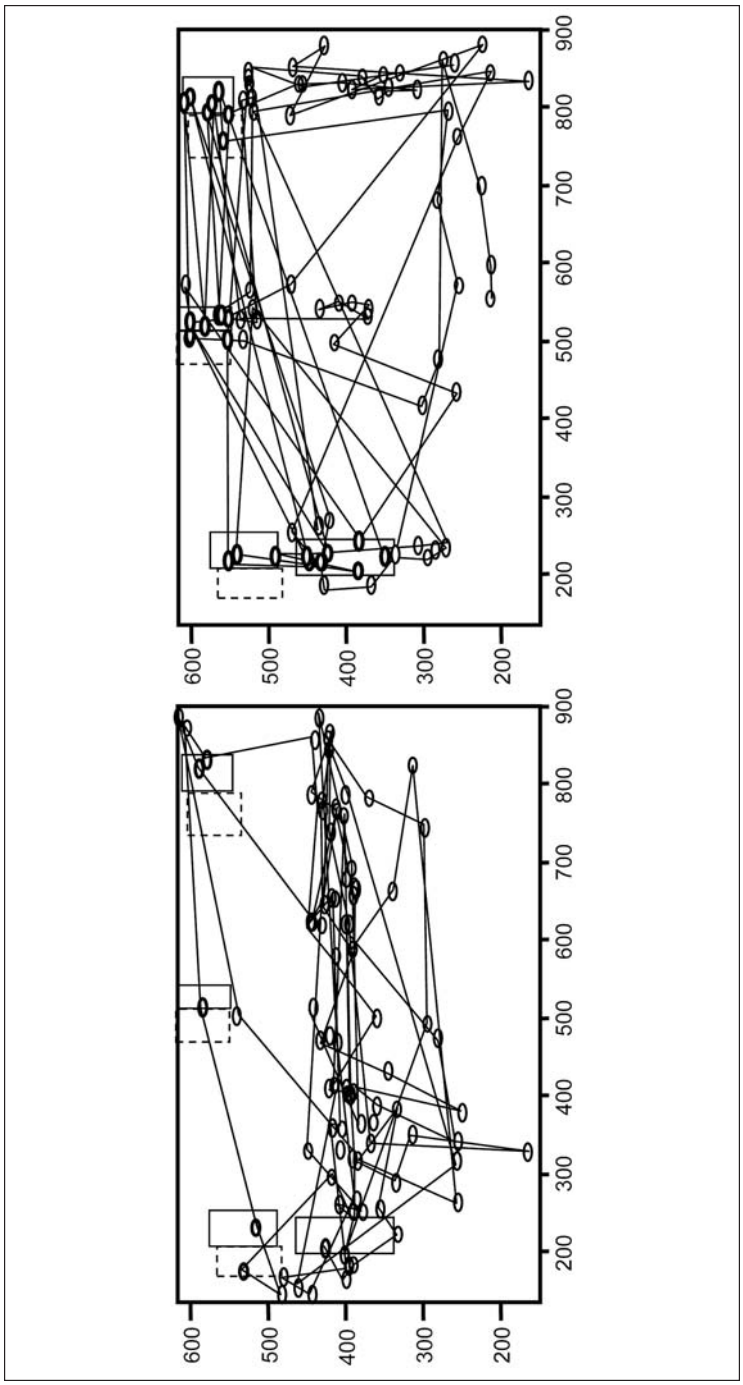

Figure 3. Two examples of scanpaths across the stimulus "The Temptation of Christ" during the Similarity Recognition task. **Notes**: Numbers denote pixels; unbroken AOI demarcations: entrances of Christ; broken demarcations: entrances of the Tempter.

> estimate the average age of the persons that the next picture shows. While your estimation of the mean age develops, please tell the microphone what you are thinking. Think aloud! After 45 seconds the picture disappears. Then you state your estimate.

The task in Block 3 was *Similarity Recognition*. The instructions were:

> The second stage is about person perception. Any living being with a human face, such as (for example) an angel, should be regarded as a person. Faces may be more or less similar. Does the next picture show persons that are particularly similar to each other? While your answer develops, please tell the microphone what you are thinking. Think aloud! After 45 seconds the picture disappears. Then you tell us if there were persons particularly similar to each other and if so which ones.

The final task (Stage 3, Block 4) was *Aided Recall*. The instructions were:

> Many thanks! You'll see the pictures once more, with numbers under them, in compilation. Now you are asked the question: On which picture or which pictures did at least one person appear repeatedly? In case you have observed such repeated entrances, you should quickly call out the numbers.

The corpora appeared in Stages 1 and 2 in one out of two orders at random assigned to subjects; either Sistine-DeBry-Xanten-Goltzius or vice versa. Order of stimuli within corpora was randomized by the presentation software.

Procedure

Following his/her consent in participation and verification of the dominant eye, S was seated at the eyetracking equipment (head resting on a foam-covered rest). Each of the Blocks 1-3 began with a calibration, that is, the matching of the corneal reflex and the centre of the pupil at nine fixation crosses separately presented at corners, edges, and the centre of the screen. After successful calibration, instructions appeared. Subjects finished their exposition by pressing a key. A centered fixation cross followed. The onset of each stimulus was administered by subjects through pressing a key. The stimulus lasted for 45 seconds; then the fixation cross appeared anew, and so forth. Subjects "thought aloud" during stimulus presentation and sometimes a little longer. PRDs were recorded on a prepared protocol sheet by the experimenter. At the end of Block 1, which required about 15 minutes, subjects were asked to leave the equipment and walk around for a while. Then either Block 2 or Block 3 followed, assigned by a predefined list of random numbers. The session ended with Block 4, that is, the aided recall task. Subjects' PRD-declarations were recorded by the experimenter. Subjects were debriefed at the end of the experiment.

RESULTS

Processing Instructions

The think-aloud protocols for experimental Block 1 (Aesthetic Evaluation; $N = 16$) indicated PRD in 7 of the 192 cases (4%). At Stage 2 of the experiment, PRD occurred in Block 2 (Average-Age-Estimation, $n = 8$) in 7 (6%), and in Block 3 (Similarity-Recognition, $n = 8$) in 57 of 96 cases each (59%, range over subjects 25%–75%, $SD = 16\%$, see Table 1). PRD was lower in Block 2 than in Block 3 (Wilcoxon-test between subjects: $W = 36.0$, $p = .001$); and in Block 1 lower than in Block 2 (Wilcoxon-test within subjects: $z = 2.53$, $p = .02$). Hypothesis 1 is thus confirmed: level of face processing positively affects the probability of PRD.

The larger standard deviation over stimuli, $SD = 35.79$, compared with that over subjects, $SD = 16.38$, in Block 3 (Table 1) implies that for some stimuli person repetitions were mostly (in cases of three stimuli[3] in total), and for others hardly detected (in case of one stimulus[4] none at all; see Figure 2). The aided person repetition recall (Block 4) showed interesting results: Subjects who came from Block 2 to Block 4 recalled more PRDs (24% vs. 6%), whereas subjects coming from Block 3 to Block 4 recalled fewer PRDs (43% vs. 59%) in Stage 3 than had been indicated when thinking aloud in Stage 2.

Eye Movement Patterns

Block 1 brought about more and shorter fixations than Blocks 2 and 3. Block 2 required the longest fixations. Block 3, however, led to the highest number of fixations on AOI (Block 2 < Block 3; between subjects $t[14] = 2.17$, $p = .03$ [one-tailed]; Block 1 < Block 3; within subjects $t[7] = 1.81$, $p = .07$ [one-tailed]). Consequentially, the proportion of Inter-AOI-Saccades, too, is higher for Block 3 (Block 2 < Block3, between subjects $t[14] = 5.46$, $p = .001$; Block 1 < Block 3, within subjects $t[7] = 10.41$, $p = .001$). Observing the standard deviations (Table 1) enables us to attribute number of fixations and fixation durations to subjects, but proportion of AOI-Fixations and proportion of Inter-AOI-Saccades to the stimuli.

Oculomotor Responses

Hypothesis 3 proposes Inter-AOI-Saccades as a predictor of PRD. To ensure PRD variance within stimuli, correlations were computed for those stimuli that evoked a PRD rate above zero, but below 100%. That was the case for 4 out of 12 stimuli in Block 1, 5 stimuli in Block 2, and 8 stimuli in Block 3. The correlations within each stimulus were computed by means of aggregation

[3] "Scenes From the Life of Moses"; "The Punishment of Korah and the Stoning of Moses and Aaron"; "Devon Sea Captain Richard Whitbourne Sees 'a Strange Creature' . . ."

[4] "The Finding of the Holy Cross by St Helena and Transfer of the Relic."

Table 1. Descriptive Statistics for the Level of Processing Conditions

		Aesthetic evaluation	Average age estimation	Similarity recognition
Person repetition detection	%	3.63	6.25	59.38
(Stage 1-2, Thinking Aloud)	*SDsubjects*	7.45	7.50	16.38
	SDstimuli	6.24	10.30	35.79
Person repetition recall	%		23.96	42.71
(Stage 3)	*SDsubjects*		22.12	16.99
	SDstimuli		19.55	33.05
Number of fixations	*M*	97.95	76.06	84.42
	SDcases	14.48	18.12	14.95
	SDsubjects	10.35	16.31	9.19
	SDstimuli	5.07	3.73	5.52
Fixation duration (msec)	*M*	369.31	527.94	425.97
	SDcases	56.05	124.12	72.50
	SDsubjects	41.75	101.99	39.98
	SDstimuli	16.95	33.86	27.90
Proportion of	%	30.67	33.87	37.72
AOI-fixations	*SDcases*	22.88	24.10	22.92
	SDsubjects	3.33	3.66	4.85
	SDstimuli	22.81	23.59	20.87
Proportion of	%	2.97	5.03	9.72
Inter-AOI-Saccades	*SDcases*	3.58	5.46	10.00
	SDsubjects	0.82	0.97	2.23
	SDstimuli	2.53	4.24	7.53

Note: *SDcases* = standard deviation over 192 cases for Aesthetic Evaluation (Block 1), and 96 cases each for Average Age Estimation (Block 2) and Similarity Recognition (Block 3). *SDsubjects* = standard deviation over 16 subjects (Block 1) for Aesthetic Evaluation, and 8 subjects each for Blocks 2 and 3. *SDstimuli* = standard deviation over 12 stimuli.

Table 2. Correlations[a] of Eyetracking Parameters and PRD

Person repetition detection (Stage 1-2, Thinking Aloud)	Aesthetic evaluation (4 stimuli, $df = 60$; $r_{crit} = .12/.15$)	Average age estimation (5 stimuli, $df = 35$; $r_{crit} = .28/.33$)	Similarity recognition (8 stimuli, $df = 56$; $r_{crit} = .22/.26$)
Number of fixations	–.05	–.03	.08
Fixation duration (msec)	.03	.06	.14
Proportion of AOI-fixations	.16*	.01	.31*
Prop. of Inter-AOI-Saccades	.29*	.28*	.21

[a]Correlations computed *within* those stimuli that show variance in the dependent variable; r_{crit} = critical *r* for one-tailed/two-tailed 5% significance.

*$p < .05$ (one-tailed).

of covariances and degrees of freedom within stimuli. The correlation coefficients required for a one-tailed and a two-tailed 5% significance level are given in Table 2.

Whereas the number of fixations and the duration of fixations were generally not related to PRD, the amount of attention attracted by AOI, assessed as the proportion of AOI-Fixations, correlates with PRD in Block 1 with a small and in Block 3 with a medium effect. The proportion of Inter-AOI-Saccades, however, reveals nearly equally sized correlations in all three Blocks ($r = .21$-$.29$; see Table 2)[5]. We therefore summarize: the more Inter-AOI-Saccades occur, the higher the probability for PRD, supporting the third hypothesis.

Figure 3 illustrates the regression of PRD on AOI-Fixations and on Inter-AOI-Saccades with two examples of scanpaths across the stimulus "The Temptation of Christ" during the Similarity Recognition task. The path in the graph on the left concentrated on the scene of the *Purification of the Leper* in the foreground. Only 7% of the 89 fixations touched an AOI, only 1% of the saccades connected two AOI. In contrast, the subject who produced the scanpath on the right spent 31% of her 83 fixations on the AOI; 19% of her saccades connected two AOI. Accordingly, the former neglected the repetitions of Christ and the tempter, the latter detected them. For this particular stimulus, the data are perfectly consistent with our third hypothesis.

[5] The proportion of AOI-Fixations and the proportion of Inter-AOI-Saccades correlate within stimuli with $r = .33$ in the Aesthetic Evaluation, $r = .23$ in the Age Estimation, and $r = .62$ in the Similarity Recognition task.

Table 3. Correlations[a] of Selected Dependent Measures and Stimulus Properties

		Block 3: Similarity Recognition, *df* = 88			
	Aesthetic judgments (Stage 1, *df* = 167)	PRD (Stage 2)	PR-Recall (Stage 3)	Proportion of AOI-fixations	Proportion of Inter-AOI-Saccades
Painting	.25**	–.07	.02	–.11	–.03
Vertical format	.07	–.42**	–.40**	.34**	.03
TTR	.11	–.04	.07	–.42**	–.38**
Entrances	.14	.07	.08	–.16	.05
Tokens	.19*	–.25*	–.14	–.48**	–.36**
AOI_extent	–.13	.05	–.05	.79**	.50**

[a]Correlations within subjects.
*$p < .05$, **$p < .01$ (two-tailed).

Formal Stimulus Properties

Hypothesis 2 proposed that TTR is correlated negatively with PRD. This source of variance is located in the stimuli (cf. Figure 2); correlations were computed by means of aggregation of covariances and degrees of freedom within subjects (Table 3).

Contrary to Hypothesis 2, the TTR was not related to the PRD (neither in the Similarity Recognition task, see Table 3, nor in the Aesthetic Evaluation or the Age Estimation task). However, a low TTR seemed to facilitate the direction of attention to the AOI (proportion of AOI-Fixations) and therefore the proportion of Inter-AOI-Saccades.[6] But this was the same with the number of tokens (Table 3). The number of tokens was higher in paintings ($r = .67$ across 12 stimuli) and lower for stimuli with a larger extent of AOI ($r = –.60$ across 12 stimuli). The AOI-Extent explains the proportion of AOI-Fixations as well as the proportion of Inter-AOI-Saccades, if correlated across stimuli with subjects. Beside the preponderance of tokens there are also more entrances in paintings ($r = .58$ across 12 stimuli).

[6] The proportion of AOI-Fixations and the proportion of Inter-AOI-Saccades correlate within subjects $r = .54$ in the Aesthetic Exploration, $r = .61$ in the Age Estimation, and $r = .74$ in the Similarity Recognition task, respectively.

DISCUSSION

Hypothesis 1 was confirmed: PRD increased from less than 10% in Block 1 to nearly 60% in Block 3, but even here there remained substantial neglect when our participants searched for persons that were particularly similar to each other. This remainder is, seeing that *self*-similarity stands for numerical identity, rather amazing. An introduction into the essence of continuous pictorial narration would likely have brought about more PRD. *Direct* approaches to enhance our naïve participants' aesthetic fluency, however, were beyond the scope of this investigation. The view that an actual PRD would go together with an aha-experience (Bühler, 1909) found accordingly little support in the recorded verbal responses: explicit astonishment was rare; repetitions were reported unemotionally more often than not. This resulted presumably from an aha-experience's characteristic of being correlated to a task solution. The tasks in stages 1-3 were more or less different to the undeclared and, in a way, hidden task of repetition detection. Discoveries of repetitions were thus findings the participants had not been looking for.

Hypothesis 2 was rejected: the stimulus property TTR and PRD were unrelated. Why? The TTR had its origin in the linguistic domain; it has been adopted by Kalkofen, Müller, and Strack (1988) in their research on the evaluation of tessellations or tilings. Words and prototiles, that is, the tokens that build texts and tilings, make up comparatively *homogeneous* sets, whereas representational pictures are typically made up by (depictions of) *two* kinds of tokens: characters and settings. We believe that our estimation of the TTR based solely on the *characters* depicted resulted in the failure of Hypothesis 2. Research on PRD must incorporate both kinds of tokens. In principle, this can be dealt with by a suitable construction of experimental stimuli in future studies.

Hypothesis 3 was confirmed: PRD required regressive saccades. These Inter-AOI-Saccades connect fixations on pictorial regions in which repeated persons appear. It is a well-founded view that fixations in general imply attention. There are, however, indications that "simply attending to an object does not guarantee a complete representation of its features" (Simons, 2000, p. 5).

This phenomenon has been demonstrated by research on *Change Blindness.*[7] Change Blindness refers to findings that "across saccades, blinks, blank screens, movie cuts, and other interruptions, observers fail to detect substantial changes to the visual details of objects and scenes" (Simons, 2000, p. 1). In a study carried out by Simons and Levin (1998):

> . . . one experimenter approached a pedestrian (the subject) to ask for directions. During their conversation, two other people rudely interrupted them by carrying a door between the experimenter and the pedestrian.

[7] A metaphoric usage of blindness—Hochberg and Brooks (2006, p. 6) advocate "inattentional disregard or neglect"—is almost a tradition for some cognitive psychologists (cf. Kanwisher, 1987).

> During the time that the subject's view was obstructed, the first experimenter was replaced by a different experimenter. Only *50%* of observers noticed the change even though the two experimenters wore different clothing, were different heights and builds, had different haircuts, and had noticeably different voice. (Simons, 2000, p. 5, 1998)

Thus, making a face the center of interest for a sufficient time does not necessarily mean that information gets extracted other than what is required by the demands of the task; for instance, giving directions to someone who had asked for them.

The epistemologist Dretske, who mentions that change blindness be more accurately described as difference blindness (Dretske, 2004, p. 4), discerns three kinds of perception: perception of objects, perception of properties, perception of facts. Whereas the former two "involve[s] essential use of the eyes," perception of facts is, "echoing James . . . that part of perception that occurs entirely 'in the head.'" The perception of objects and properties "is all over before fact perception even begins" (Dretske, 2004, p. 16). "I can see, without noticing, both x and the (different) properties of x," but "*facts* (e.g., that x has changed color), unlike concrete objects (x) and properties (colors), cannot be seen without being noticed. . . . Seeing a fact *is* (among other things) noticing it" (p. 13). Both Change (or Difference) Blindness and Person Repetition Neglect are failures of fact perception. But, whereas a change-blind observer overlooks *differences* and perceives sameness, a person repetitions neglecting observer overlooks *identities* and perceives differences.

The levels of processing that have been operationalized by instructions here correspond to Dretske's types of perception. Aesthetic Evaluation of the art stimuli concurred with perception of objects and properties; it brought about more frequent and shorter fixations than the two other tasks. Averaging the ages of pictorial persons concurred with the perception of a property that can be achieved irrespectively of other facial features (cf. Bruce & Young, 1998); this task required the longest fixations. The task of Similarity Recognition called upon perception of fact. Only now appeared a substantial rate of PRD. Neither number nor duration of fixations but the proportion of saccades that connect depictions of repeated persons proved a predictor of PRD.

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