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OBSERVATION

Can Massive But Passive Exposure to Faces Contribute to Face Recognition Abilities?

Galit Yovel, Keren Halsband, and Michel Pelleg
Tel-Aviv University

Naomi Farkash and Bracha Gal
Rabin Medical Center, Petah Tikva, Israel

Yonatan Goshen-Gottstein
Tel-Aviv University

Recent studies have suggested that individuation of other-race faces is more crucial for enhancing recognition performance than exposure that involves categorization of these faces to an identity-irrelevant criterion. These findings were primarily based on laboratory training protocols that dissociated exposure and individuation by using categorization tasks. However, the absence of enhanced recognition following categorization may not simulate key aspects of real-life massive exposure without individuation to other-race faces. Real-life exposure spans years of seeing a multitude of faces, under variant conditions, including expression, view, lighting and gaze, albeit with no subcategory individuation. However, in most real-life settings, massive exposure operates in concert with individuation. An exception to that are neonatology nurses, a unique population that is exposed to—but do not individuate—massive numbers of newborn faces. Our findings show that recognition of newborn faces by nurses does not differ from adults who are rarely exposed to newborn faces. A control study showed that the absence of enhanced recognition cannot be attributed to the relatively short exposure to each newborn face in the neonatology unit or to newborns' apparent homogeneous appearance. It is therefore the quality—not the quantity—of exposure that determines recognition abilities.

Keywords: other-race effect, perceptual training, individuation, face recognition, newborn-face effect

A well-documented phenomena in face recognition is our poor ability to discriminate faces of other races compared with own-race faces (for review, see Meissner & Brigham, 2001). This other-race effect is usually attributed to the lesser amount of experience that our face recognition system has with other-race faces (Chiroro & Valentine, 1995). Indeed, high recognition of own-race faces typically depends on two factors. First, we are passively exposed to faces of our own race. Second, we frequently attempt to individuate own-race faces; that is, to represent these faces at a subcategory level (Hugenberg, Young, Bernstein, & Sacco, 2010; Levin & Beale, 2000; Scott & Monesson, 2009; Tanaka, Curran, & Sheinberg, 2005; Tanaka & Pierce, 2009).

Because passive exposure and individuation usually operate in concert, it is important to determine whether either of these can alone mediate the development of recognition abilities. Similar to the other-race effect, recognition of faces from other ages is also poor (Anastasi & Rhodes, 2005; Cassia, Picozzi, Kuefner, & Casati, 2009) and can provide insight with respect to the role of exposure and individuation on face recognition. This study was motivated by the insight that neonatology nurses—who though constantly exposed to newborn faces—are strongly discouraged from using facial features to discriminate between newborns. Most adults have minimal—if any—repeated exposure to newborn faces. We asked, therefore, whether extensive real life exposure-without-individuation of newborns by neonatology nurses would improve face recognition abilities.

Indeed, recent studies have compared training protocols for other-race faces that involve individuation to protocols that require identity-irrelevant categorization (e.g., eye luminance; Tanaka & Pierce, 2009; McGugin, Tanaka, Lebrecht, Tarr, & Gauthier, 2010). These studies revealed greater improvement of recognition following individuation than following categorization. Critically, these studies included relatively short exposures to a small number

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Galit Yovel, Keren Halsband, Michel Pelleg, and Yonatan Goshen-Gottstein, Department of Psychology, School of Psychological Sciences, Tel-Aviv University, Ramat-Aviv, Israel; Naomi Farkash and Bracha Gal, Neonatology Unit, Women's Hospital, Rabin Medical Center, Petah Tikva, Israel.

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Correspondence concerning this article should be addressed to Galit Yovel or Yonatan Goshen-Gottstein, Department of Psychology, Tel Aviv University, Tel Aviv 69978, Israel. E-mail: gality@post.tau.ac.il or goshen@post.tau.ac.il

of other-race faces for a few days in a laboratory setting. It, therefore, leaves open the question of whether conditions of massive daily exposure over years to other-race faces seen in different views and expressions for long exposure durations—albeit with a patent absence of individuation—would nonetheless enhance recognition abilities.

Experiment 1

We used a delayed match-to sample paradigm to compare recognition of newborn faces in neonatology nurses to age-matched controls. We also measured recognition of adult faces to obtain baseline levels of recognition.

Method

Participants. Fifteen female nurses (mean age = 47.67 years, range = 31–58 years), with mean experience in a neonatology unit of 13.40 years (range = 2–30 years), and 15 age-matched female participants, ObGyn nurses, rehabilitation nurses, and librarians (mean age = 46.4, range = 30–58 years).

Stimuli. Fifty-four photos of newborn faces were downloaded from the American Somerset Hospital (http://www.somersethospital.com), and 54 photos of adult faces were taken from an American high school yearbook (Paller, Bozic, Ranganath, Grabowecky, & Yamada, 1999). Stimuli were grayscale images matched for average luminance, contrast, and size (180 × 164; Figure 1) and subtended 4.5 cm (4.3°) long and 3.5 cm (3.3°) wide.

The stimuli were divided into three study-test blocks, presented one after the other. Each of the 3 study blocks comprised 3 adults and 3 newborn faces presented in random order. These studied photos served as targets in the subsequent test phase, with the remaining 45 photos serving as distractors, for a total of 54 photos per category.

Procedure. For each of the study-test blocks, participants were asked during study to memorize six faces—each displayed for 4 s followed by 500 ms blank screen—presented sequentially. Next, in the test phase, each of the studied faces was presented alongside 5 distractor faces which were presented in random order and random location in two rows of 3 photos (Figure 1). Participants were asked to identify which one of six faces had been displayed in the preceding study phase by pressing a corresponding key on the computer keyboard.

Results

We calculated the percent of trials in which target photos were correctly recognized (Figure 2). A two-way analysis of variance (ANOVA) with Exposure group (Neonatology, Control) as a between-subjects factor and Face category (Newborn, Adult) as a within-subject factor revealed better performance for adult (79.26%) than newborn (46.3%) faces ($F(1, 28) = 61.13$, $p < .000001$, $\eta = 0.7$) in both nurses and the control groups, $F(1, 28) < 1$ for Exposure group; $F(1, 28) < 1$ for Exposure group × Face category). Examination of performance on a participant-by-participant shows that the newborn-face effect was robust. Of 15 participants in the control group, only one participant did not show

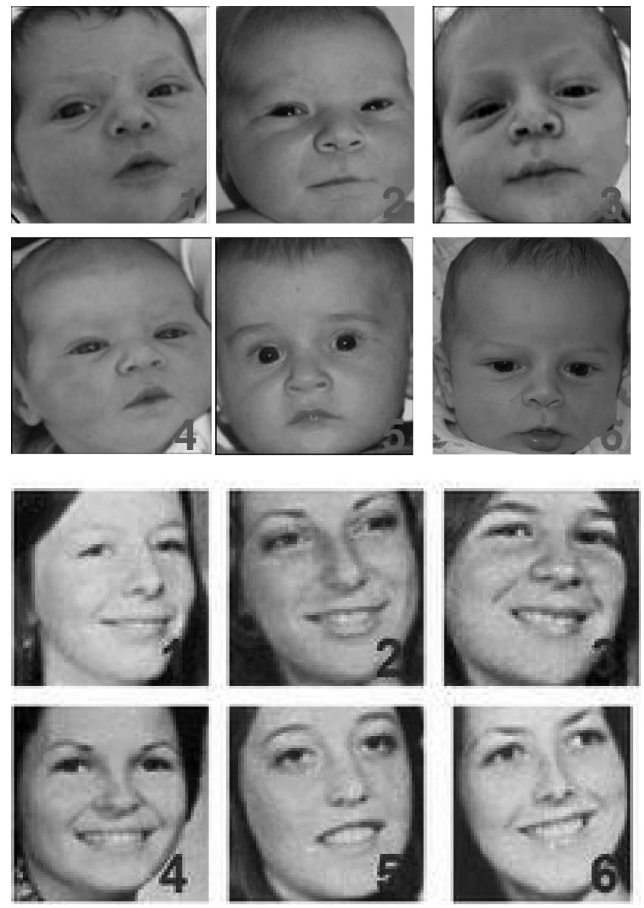

Figure 1. Two rows of 3 faces each (sextet) of newborn (A) or adult (B) faces were presented during the test phase. One of the faces was a target face that was presented during the study phase, and the other 5 were distractors. To protect the privacy of the newborns used in the study, the figure shows newborn face stimuli that were taken from a different database and were not used in the study, but which are similar in all critical features (A). Adult faces were taken from a 1970s high school yearbook- (Paller et al., 1999) (B).

worse performance for newborns than for adult faces. The same effect was found in the group of the 15 nurses.

Follow-up analysis revealed no difference in recognition between neonatology nurses and the controls, for either newborn faces, $t(28) = 0.296$, $p = .769$, or adult faces, $t(28) = 0.401$, $p = .692$.

Discussion

Our findings demonstrate that neonatology nurses recognize newborn faces no better than their age-matched controls despite their massive exposure to newborn faces on a day-by-day basis over many years. Moreover, their adult-face recognition is much better than their newborn-face recognition.

We suggest three possible explanations for the poor recognition of newborn faces found in the neonatology nurses, First, newborn faces are more homogeneous in their appearance relative to adult faces and, therefore, are inherently harder to discriminate regard-

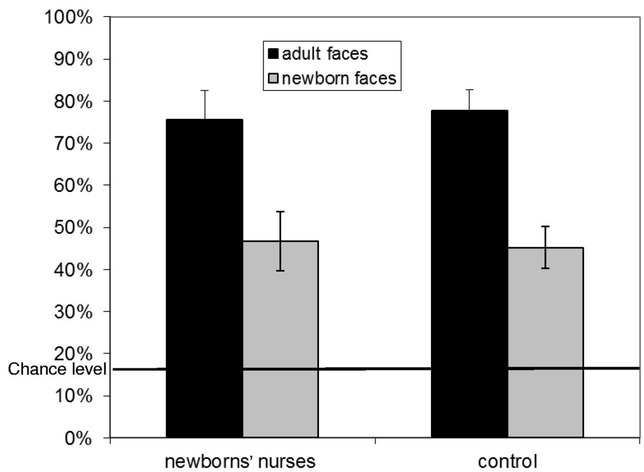

Figure 2. Recognition of adult and newborn faces by nurses working in the neonatology unit (left) and age-matched controls (right). Error bars represent the standard error of the difference between performance for adult and newborn faces (*newborn-face effect*). Error bars represent the *SE* of the difference between performance for adult and newborn faces.

less of the quantity and the quality of exposure to newborn faces. Second, despite the massive exposure to a large number of newborn faces, nurses in the neonatology unit are not exposed to any given face for more than the standard newborn hospitalization period of 2–4 days. Third, neonatology nurses do not individuate newborn faces based on their facial features. These alternatives are examined in Experiment 2.

Experiment 2

To distinguish between the alternate hypotheses, we trained university students, none with children of their own, to individuate newborn faces by associating each face with a name (cf., McGugin, Tanaka, Lebrecht, Tarr, & Gauthier, 2010; Tanaka & Pierce, 2009). We tested newborn recognition abilities before and after training for the trained faces, as well as after training for the novel faces. If training improves recognition of newborn faces, then the lack of individuation by neonatology nurses will remain the only viable interpretation for the absence of enhanced recognition in our nurses.

Method

Participants. Twenty Tel-Aviv University undergraduates (5 men, mean age = 21.9 years) participated in the experiment.

Stimuli. A new set of 57 newborn and 54 adult faces was added to the experiment set. To avoid stimulus-specific effects, the two sets were used either as a training set or as a novel set, counterbalanced across participants. The training session included 12 faces, the 9 faces that were used in the recognition tests and 3 additional faces.

Design and procedure. Figure 3 summarizes the training protocol. We first tested newborn recognition abilities with the task used in Experiment 1. Following training, we repeated the task with the trained faces as well as tested recognition for novel newborn faces.

The Newborn Face Training Protocol. The individuation-training protocol (based on Tanaka et al., 2005) included 5 phases.

Day 1.

Phase 1: Individual inspection. Participants were introduced to half (i.e., six) of the newborn faces and their respective names. Each face was presented above his or her name for 5 s. Here and in subsequent phases, newborn faces were presented 5 times, in a different random order within each set.

Phase 2: Naming with response. The same faces and names were presented. Participants were asked to press the key of the first letter of their name.

Phase 3: Naming with feedback. Faces were presented without names and participants were asked to press the key of the first letter of their name, with feedback given following incorrect responses.

Phase 4: Naming. Faces alone were presented and participants were asked to press the key of the first letter of the name. No feedback was given.

Phase 5: Verification. Participants were presented with a name for 1 s followed by a face for 1 s. Participants judged whether the name and the face matched. Verification included 60 trials, 30 matched and 30 nonmatched. Incorrect responses were followed by the feedback.

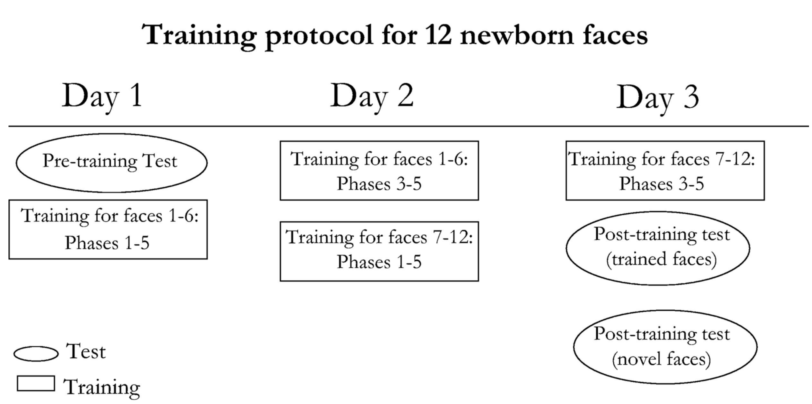

Figure 3. The training study included a pretraining test, a 5-phase training protocol with 12 newborn faces, and two posttraining tests, one with the trained faces and the other with novel newborn faces.

On Day 2, participants repeated Phases 3–5 with the first set of 6 faces that were presented on Day 1 and then learned the second set of faces (Phases 1–5). On Day 3, participants repeated Phases 3–5 of the second set and then completed two posttraining recognition tests.

Results

Mean recognition during the face-name matching task (during Phase 5 of the training session) for the two sets of faces was 96.3%. Thus, newborn faces can be discriminated following even a short individuation session despite their apparent homogenous appearance.

Recognition of newborn faces before versus after training. For each of the recognition tests, performance was calculated as in Experiment 1. A one-way ANOVA revealed a main effect of training (pre, post, novel) on recognition of newborn faces, $F(1, 18) = 27.66$, $p < .0001$. Performance was markedly better posttraining (93.9%) than pretraining (59.4%) for the trained faces, $t(19) = 8.929$, $p < .0001$, $d = 1.99$. More important, recognition of novel newborn faces was better posttraining (71.7%) than pretraining (59.4%), $t(19) = 2.431$, $p = .013$, $d = 0.54$. Thus, recognition of newborn faces improved significantly following the individuation protocol.

We further examined whether training increased the recognition level of newborn faces to the level of adult faces, using a paired *t* test for adult versus newborn face for each of the pre- and posttraining recognition tests (Figure 4). Prior to training, performance was better for adult (80%) than newborn faces (59.4%), $t(19) = 5.403$, $p < .0005$, $d = 1.2$. In contrast, posttraining performance was better for the studied newborn faces (93.9%) than for the adult faces (86.1%), $t(19) = -2.333$, $p = .03$, $d = .52$. Regarding novel newborn faces, the difference between performance for adult faces (76.1%) and novel newborn faces (71.7%) was not significant, $t(19) = 0.727$, $p = .476$.

Finally, to assess whether recognition of novel newborn faces was significantly better after training than beforehand, we performed a two-way ANOVA with training (pre, post-novel) and face (newborn, adult) as repeated measures. A significant interaction of Training and Face, $F(1, 19) = 4.465$, $p = .048$, $\eta = .19$, confirmed that recognition was significantly better for novel newborn faces following individuation training than before training.

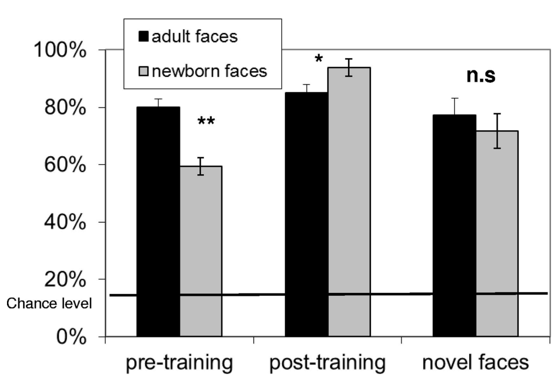

Figure 4. Recognition results of newborn faces and adult faces before and after training reveal that training raised recognition of newborn faces to the level of adult faces for both the trained faces and novel faces. Error bars represent the *SE* of the difference between performance for adult and newborn-faces (newborn-face effect). $^{*}p < .05$. $^{**}p < .005$.

Table 1
Recognition Levels on Adult and Newborn Delayed-Match to Sample Tasks in a Group of Subjects Who Underwent Training

	"Pre test"	"Post test"	Novel test
Adult	76%	86%	82%
Newborn	63%	73%	67%

Note. In contrast to the training effect, performance did not improve for the novel newborn faces following 2 sessions (pre and post) of newborn face recognition tasks, if no training was given between the tests.

To rule out the possibility that the improved performance for newborn faces resulted from the exposure to the two sessions of the delayed match- to-sample tasks, rather than the training session, 29 subjects performed the same experiment without the training session. Two days after the first task ("Pre test"), these participants performed the same task again ("Post test") followed by a similar task with novel faces ("Novel test"). Twenty-eight participants performed above chance level in all the conditions. Results (Table 1) revealed no difference between performance on the "Pre test" task and the "Novel test" task, $t(27) = 1.18$, $p = .25$, with better performance for adult than newborn faces on both the "Pre test," $t(27) = 3.00$, $p < .005$, and the "Novel test," $t(27) = 2.44$, $p < .01$. Thus, improved performance for newborn faces following the training session must be attributed to the act of individuation.

General Discussion

Experiment 1 demonstrated that massive exposure that does not involve individuation does not improve face recognition. Experiment 2 established that the reverse—minimal exposure with individuation—does indeed improve recognition abilities. The findings of Experiment 2 also suggest that the poor recognition of newborn faces by nurses is due neither to the relatively short exposure to each individual face nor to the apparent more homogenous appearance of newborn faces relative to adult faces. Taken together, our findings suggest that it is the act of individuation itself that is critical for proficient recognition of newborn faces.

In summary, our findings extend previous findings in that they show that even exposure to other-race faces in real-life settings across different views and expressions for extensive exposure duration over months and years does not improve face recognition providing it does not involve individuation. Remarkably, a 3-day training that included individuation of only 12 newborn faces was significantly more efficient for improving face recognition abilities than years of passive exposure. It is therefore the quality rather than the quantity of exposure to faces that is critical for intact face recognition abilities.

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