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# Reversibility of the other-race effect in face recognition during childhood[1]

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Early experience with faces of a given racial type facilitates visual recognition for this type of face relative to others. To assess whether this so-called 'other-race effect' can be reversed by subsequent experience with new types of faces, we tested adults of Korean origin adopted by European Caucasian families between the ages 3 to 9. The adoptees performed a face recognition task with photographs of Caucasian and Asiatic faces. They behaved exactly like a control group of French participants, identifying the Caucasian faces better than the Asiatic ones. On the opposite, a control group of Koreans showed the reversed pattern. This result indicates that the face recognition system remains plastic enough during childhood to reverse the other-race effect.

It is a common experience that faces from "other races" look more similar than faces from "one's own race". For example, Feingold (1914) remarked that "to the uninitiated American, all Asiatics look alike, while to the Asiatic, all White men look alike." The reality of this so-called "other-race effect" has been confirmed by several experimental studies (see Meissner & Brigham (2001) for a meta-analysis and Valentine, Chiroro, & Dixon, (1995) for a review). Many experiments have employed an "old-new" recognition paradigm in which participants are shown a set of target faces in a study phase, and have to detect those targets presented among new faces in a subsequent recognition phase (Barkowitz & Brigham, 1982; Chance, Goldstein, & McBride, 1975; Malpass & Kravitz, 1969; Sheperd, Deregowski, & Ellis, 1974). Another experimental paradigm is the delayed match-to-sample task in which a photograph of a target face is briefly displayed, followed by two photographs, then the subject tries to select the one matching the target (Lindsay, Jack, & Christian, 1991; Sangrigoli & de Schonen, 2004).

The other-race effect is thought to reflect the differential amount of experience that an individual has had with other individuals from various race groups. In adults, evidence for this "experience hypothesis" is conflicting (Furl, Phillips, & O'Toole, 2002; Levin, 2000). Some studies found that the size of the other-race effect decreases as the amount of experience with faces from other races increases (Brigham, Maas, Snyder, & Spaulding , 1982; Carroo, 1986; Chiroro & Valentine, 1995). In the same vein, some data suggested that training can reduce the other-race effect (Elliott, Wills, & Goldstein, 1973; Goldstein & Chance, 1985). Yet, other studies found that the amplitude of the other-race effect is not modulated by differential experience (Luce, 1974; Malpass & Kravitz, 1969; Ng & Lindsay, 1994).

While the results of the above experiments, obtained with adults, are not consistent, a few studies with children and adolescents support the "experience hypothesis" (Shepherd , 1981). Cross, Cross and Daly (1971) and Feinman and Entwhistle (1976) found a larger

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other-race effect in children and adolescents living in segregated neighborhoods than in those living in integrated neighborhoods in the USA. The age at which experience with another race group has started may be a crucial factor in determining the face discrimination abilities. Childhood might be a "sensitive period" beyond which the effect of experience on face recognition might be markedly reduced.

Studies investigating the age at which the other-race effect emerges are scarce. In a study by Chance, Turner and Goldstein (1982), 7 to 20 year-old Caucasian children showed superior accuracy with Caucasian than with Asiatic faces while 6 years olds did not. The absence of the race effect for 6 years old children is not clear : more recently, Pezdek, Blandon-Gitlin and Moore (2003) found the other-race effect in 5- and 8-year-old White or Black children. Sangrigoli and de Schonen (2004) assessed the face recognition abilities of 3- to 5-year-old Caucasian children. The stimuli were photographs of Caucasian and Asiatic faces used in a previous study on adults (O'Toole, Deffenbacher, Valentin and Abdi, 1994). Sangrigoli and de Schonen found that Caucasian children were better at recognizing the Caucasian faces than the Asiatic ones. Moreover, the advantage for the "same-race" faces was stable across the age range, suggesting that the other-race effect is already present at age 3.

Are the visual processes involved in face recognition and tuned by experience during the first years of life still plastic at this age ? If plasticity is the rule, will experience with a new type of face add to their previous competence extend or cancel it ? The present study evaluated the face recognition skills of adults of Korean origin who were adopted between ages 3 to 9 years old by Caucasian families living in Europe. They were presented with Caucasian and Asiatic faces in a match-to-sample task. If the sensitive period for the other-race effect does not extend beyond the $3^{rd}$ year, Korean adoptees performance should not be influenced by their experience with Caucasian faces; that is, they should behave like non-adopted Koreans who grew up in Korea. If the sensitive period extends beyond age 3, their experience with Caucasian faces should have reduced, or even inverted, the other-race effect. We would then expect the adoptees to either show a cumulative effect of experience with equally good performances with both types of faces, or to show an advantage for Caucasian faces like a control group of Caucasians raised in Europe.

## Method

### Participants

Thirty-six participants, split into 3 groups of 12, took part in the experiment. The first group consisted of Caucasian participants who had resided in France since birth and had an average age of 27.8 years (SD=3.5) at the time of testing. The second group consisted of native Korean participants brought up in Korea and who had been residing in France for periods ranging from a few months to 11 years (mean=4.5, SD=3.4); they had an average age of 32 years (SD=5.0). The third group consisted of persons of Korean origin who had been adopted in Francophone Caucasian families when they were children (mean age of arrival in France=6.0, range 3 to 9 years, SD=1.8; mean age at time of testing=29.4, SD=4.9). The adopted participants were contacted by mail with the help of an adoption agency in France (Terre des Hommes) and through an association for Korean adoptees (Racines Coréennes). Before adoption, these participants lived in Korea where they had very scarce (if any) contact with Caucasian persons. They were adopted and raised by Francophone Caucasian families living in France, Switzerland or Belgium. After adoption they had no regular contact with Asiatic persons. All participants were naïve with regard to the aim of the experiment.

### Stimuli

We used a sample of 48 photographs coming from the study by O'Toole et al. (1994). The photographs represented Japanese and Caucasian Faces. These photos had been used by O'Toole et al. for testing the other-race effect in Caucasian and Asiatic participants. They found that Japanese faces were better recognized than Caucasian faces by Asiatic participants whether or not they were Japanese. Moreover, after having completed the present experiment, the non-adopted Korean participants were unable to state whether or not the Asiatic faces were from Chinese, Korean, Japanese or other Asiatic nationalities.

These photos were digitized using 16 grey levels and they had the same uniformly gray background (see Figure 1). None of the pictures showed persons with facial hair or glasses, and the images were cropped to eliminate clothing cues. From the 24 Caucasian faces (12 males and 12 females) and the 24 Asiatic faces (12 males and 12 females), twenty-four pairs of faces were generated – 12 pairs of Caucasian faces (6 male pairs and 6 female pairs) and 12 pairs of Asiatic faces (6 male pairs and 6 female pairs). The faces were paired so as to minimize differences in the shape of the hairline.

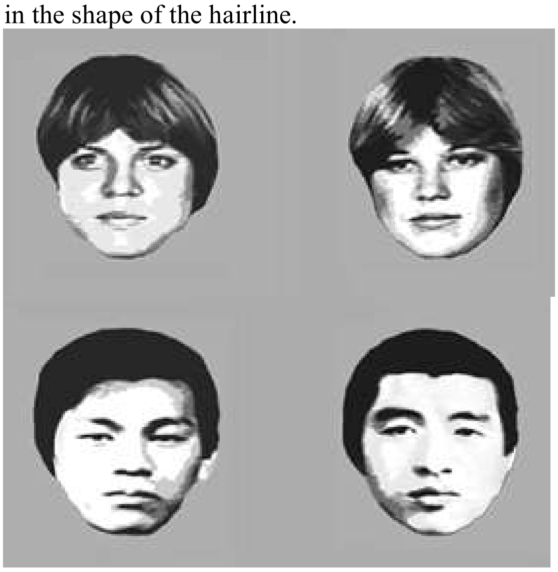

*Figure 1.*Examples of the face stimuli used.

Procedure

The participants were tested individually. An e-prime script controlled the presentation of the stimuli and recorded the responses. Each trial consisted in the display of a target face at the center of the screen (for 250 ms in one session and for 120 ms in another), followed, after a 1 second grey screen, by two faces presented side by side. The faces remained on the screen until the participant pressed one of two response buttons to indicate which picture matched the target. Responses were effected with the right and left index fingers and the participant was instructed to respond as fast and accurately as possible. No feedback was given. The next trial started 1 second after the response.

Each participant did four blocks of trials in two sessions: in each session, there was one block with Japanese faces only, and one block with Caucasian faces only. The order of presentation of the two blocks was counterbalanced across subjects. Each block had 48 trials using one of the two sets of 12 pairs of faces. The set of 24 faces were presented successively twice with a different random order. In a block, each face was presented a total of 4 times (twice as a target and twice as a non target -- twice on the right, and twice on the left side of the screen). The order of the presentation of the targets was the same for all participants. The target face was presented for 250 ms in the first session and for 120 ms in the second session (the duration of presentation was not counterbalanced with the order of session). The visual information which is picked up from a face stimulus depends on the duration of presentation, that is, low spatial frequencies are more likely to be processed than high spatial frequencies when the presentation is short (Breitmeyer & Ganz, 1977). This variation in visual sensitivity with presentation duration is known to affect configural and local processing (Hole, 1994). The other-race effect had already been observed in adults with a presentation duration of 250 ms (Sangrigoli & de Schonen, 2004) and 120 ms (Lindsay, Jack, & Christian, 1991). These two presentation durations were used in order to check whether or not the other-race effect is stronger with a short presentation duration of 120 ms which maximizes the configural processing compared to a longer one of 250 ms.

## Results

Rates of correct identification were computed for each subject and submitted to an analysis of variance with the between subject factor Group (Adoptees vs. French vs. Korean) and the within subject factors Face Race (Caucasian vs. Asiatic) and Presentation Duration (250 ms vs. 120 ms). Figure 2 shows the average scores broken down by Group and Face Race.

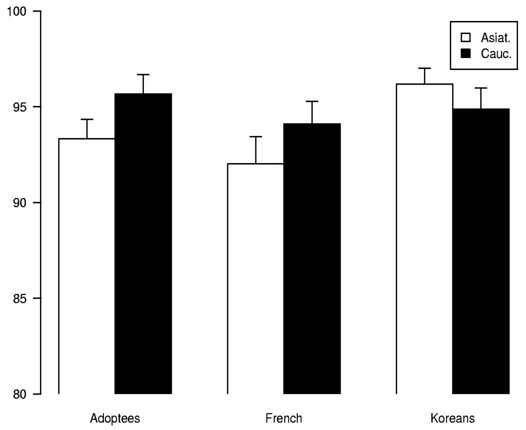


*Figure 2.* Rates of recognition as function of Group (Adoptees, French, and Koreans) and Face Race (Caucasian vs. Asiatic) .

The ANOVA revealed a significant interaction between the factors Face Race and Group ($F(2, 33)=6.03$, $p<0.01$, $p\eta^2=0.30$), and global main effects of Face Race (Caucasian – Asiatic=1.04%; $F(1,33)=4.74$, $p<.05$, $p\eta^2=0.13$) and Presentation Duration (120 – 250 ms=1.27%; $F(1,33)=4.75$, $p<.05$, $p\eta^2=0.12$). To compare the groups two by two, we conducted three anovas restricted to each couple of groups; this revealed significant ($p<.01$) Face Race by Group interactions for the Korean/French and the Korean/Adoptees couples but not for the French/Adoptees couple. Finally, we assessed the effect of Face Race separately for each Group (see Table 1). These analyses showed that the French and Adoptees performed significantly better on Caucasian faces than on Asiatic faces, while the Koreans showed the reverse pattern (this last effect being marginally significant, ($t(11)=4.3$, $p=0.06$).

*Table 1.* Difference of performance on Caucasian vs. Asiatic faces (in %) in each group (Adoptees, French, and Koreans).

| *Group* | *Mean* | *95 % confidence interval* |
|---|---|---|
| Adoptees | 2.3 | (0.14, 4.60) |
| French | 2.1 | (0.30, 3.87) |
| Koreans | -1.3 | (0.08, -2.70) |

Correlation tests were also performed to test whether age of arrival in France for adoptees or duration of stay in France for Koreans correlated with the other-race effect. The size of this effect, defined as the difference in accuracies for recognizing Caucasian vs. Asiatic faces, was computed for each subject. For the adoptees, the age of arrival did not correlate significantly with the size of the other-race effect ($R2$=0.09; $t(10)$=1.0). Inspection of individual data revealed that even those who arrived in Europe after age 7, showed an advantage for Caucasian faces. For the non-adopted Koreans, the number of years spent in France did not correlate significantly with the size of the other-race effect ($R2$=0.002; $t(10)$=-0.14).

## Discussion

Our primary aim was to find out whether the other-race effect is modifiable by novel experience that occurs during childhood after age 3. Adults of Korean origin adopted between ages 3 and 9 by White Caucasian families in Europe were examined. If the effect of early exposure to Asiatic faces was erased by later exposure to Caucasian faces, the pattern of performances of adoptees with Asiatic faces should be similar to Caucasian controls. Indeed, both the adoptees and the Caucasian controls were more accurate with Caucasian than with Asiatic faces. The results of both groups were indistinguishable and opposite to that of Korean controls who were more accurate with Asiatic than with Caucasian faces. This finding suggests that the effect of early visual experience may be erased as a result of immersion in a totally novel face environment.

Given that the other-race effect is observed in Caucasian children by age 3 (Sangrigoli & de Schonen, 2004), and confirmed in 5-year-old Black and White American children (Pezdek et al., 2003), one can assume that most, if not all, of our Korean adoptees, who arrived in France at an average age of 6, had acquired expertise for recognizing Asiatic faces before adoption and lost this advantage. Nevertheless, it would be interesting to test the other-race effect in 3-year-old native Korean children. So far, our result supports the assumption that the other-race effect is reversible even even in late childhood. New experience does not cumulate with previous ones, at least not if the source of earlier experience vanishes.

This finding parallels results obtained in language tests with the same population of adopted Koreans. Pallier et al. (2003) and Ventureyra, Pallier, & Hi-Yon (2004) found no remnant traces of early exposure to Korean, suggesting that the adoptees have essentially lost their native language skills. There is thus an analogy between the sensitive periods for the development of the face processing systems and the speech perception systems. In the face processing domain as in the language domain, environmental inputs can influence normal behavioral over several years in childhood, until the age of 9 at least.

These data fit with results showing that many aspects of face processing improve with age until 12-14 years of age (Bruce & al, 2000; Carey, Diamond, & Woods, 1980; Mondloch, Le Grand, & Maurer, 2002). The early existence of the other-race effect together with the protracted development of face processing show that the face processing system is partly built through interaction with the environment and is specified by this interaction. The present results show that plasticity is still present at age 9 and the specification process itself can be deeply modified during childhood.

## References

Barkowitz, P., & Brigham, J. C. (1982). Recognition of faces: Own-race bias, incentive, and time delay. Journal of Applied Social Psychology, 12(4), 255-268.

Breitmeyer, B. G., & Ganz, L. (1977). Temporal studies with flashed gratings: Inferences about human transient and sustained channels. Vision-Research, 17(7), 861-865.

Brigham, J. C., Maass, A., Snyder, L. D., & Spaulding, K. (1982). Accuracy of eyewitness identification in a field setting. Journal of Personality and Social Psychology, 42(4), 673-681.

Bruce, V., Campbell, R. D., Doferty-Sneddon, G., Import, A., Langston, S., McAuley, S., & Wright, R. (2000). Testing face processing skills in children. British Journal of Developmental Psychology, 7, 3-15.

Carey, S., Diamond, R., & Woods, B. (1980). Development of face recognition: a maturational component ? Developmental Psychology, 16, 257-269.

Carroo, A. W. (1986). Other race recognition: A comparison of Black American and African subjects. Perceptual and Motor Skills, 62(1), 135-138.

Chance, J., Goldstein, A. G., & McBride, L. (1975). Differential experience and recognition memory for faces. Journal of Social Psychology, 97(2), 243-253.

Chance, J. E., Turner, A. L., & Goldstein, A. G. (1982). Development of differential recognition for own- and other-race faces. Journal of Psychology, 112, 29-37.

Chiroro, P., & Valentine, T. (1995). An investigation of the contact hypothesis of the own-race biais in face recognition. The Quaterly Journal of Experimental Psychology, 48*A*, 879-894.

Cross, J. F., Cross, J., & Daly, J. (1971). Sex, race, age, and beauty as factors in recognition of faces. Perception and Psychophysics, 10(6), 393-396.

Elliott, E. S., Wills, E. J., & Goldstein, A. G. (1973). The effects of discrimination training on the recognition of white and oriental faces. Bulletin of the Psychonomic Society, 2 (2), 71-73.

Feingold, C. A. (1914). The influence of environment on identification of persons and things. Journal of Criminal Law and Police Science, 5, 39-51.

Feinman, S., & Entwisle, D. R. (1976). Children's ability to recognize other children's faces. Child Development, 47, 506-510.

Furl, N., Phillips, P. J., & O'Toole, A. J.(2002). Face recognition algorithms and the other-race effect : computational mechanisms for a developmental contact hypothesis. Cognitive Science, 26, 797-815.

Goldstein, A. G., & Chance, J. E. (1985). Effects of training on Japanese face recognition: Reduction of the other-race effect. Bulletin of the Psychonomic Society, 23(3), 211-214.

Hole, G. J. (1994). Configurational factors in the perception of unfamiliar faces. Perception, 23, 65-74.

Levin, D. T. (2000). Race as a visual feature: using visual search and perceptual discrimination tasks to understand face categories and the cross-race recognition deficit. Journal of Experimental Psychology: General, 129(4), 559-574.

Lindsay D. S., Jack, P. C., & Christian, M. A. (1991). Other-race face perception. Journal of Applied Psychology, 76(4), 587-589.

Luce, T. S. (1974). The role of experience in inter-racial recognition. Personality and Social Psychology Bulletin, 1(1), 39-41.

Malpass, R. S., & Kravitz, J. (1969). Recognition for faces of own and other race. Journal of Personality and Social Psychology, 13(4), 330-334.

Meissner, C. A., & Brigham, J. C. (2001). Thirty years of investigating the own-race bias in memory for faces: A meta-analytic review. Psychology, Public Policy, and Law, 7(1), 3-35.

Mondloch, C. J., Le Grand, R., & Maurer, D. (2002). Configural face processing develops more slowly than featural face processing. Perception, 31, 553-566.

Ng, W. J., & Lindsay, R. C. L. (1994). Cross-race facial recognition: Failure of the contact hypothesis. Journal of Cross Cultural Psychology, 25(2), 217-232.

O'Toole, A. J., Deffenbacher, K. A., Valentin, D., & Abdi, H. (1994). Structural aspects of face recognition and the other-race effect. Memory and Cognition, 22, 208-224.

Pallier, C., Dehaene, S., Poline, J. B., LeBihan, D., Argenti, A.M., Dupoux, E., & Mehler, J. (2003). Brain imaging of language plasticity in adopted adults: can a second

language replace the first ?. Cerebral Cortex, 13(2):155-161.
Pezdek, K., Blandon-Gitlin, I., & Moore, C. (2003). Children's face recognition memory: more evidence for the cross-race effect. Journal of Applied Psychology, 88(4), 760-763.
Sangrigoli, S., & de Schonen, S. (2004). Effect of visual experience on face processing: a developmental study of inversion and non-native effects. Developmental Science, (1), 74-87.
Sheperd, J. W., Deregowski, J. B., & Ellis, H. D. (1974). A cross-cultural study of recognition memory for faces. International Journal of Psychology, 9(3), 205-212.
Shepherd, J. W. (1981).Social factors in face recognition. In G. Davies, H. Ellis, & J. Shepherd (Eds.), Perceiving and Remembering Faces (pp. 55-79). London : Academic Press.
Valentine, T., Chiroro, P., & Dixon, R. (1995). An account of the own-race biais and the contact hypothesis based on a ″face space″ model of face recognition. In T. Valentine (Ed.), Cognitive and Computational Aspects of Face Recognition : Explorations in Face Space (pp. 69-94). London: Routledge.
Ventureyra, V., Pallier, C., & Yoo, H.-Y. (2004). The loss of first language phonetic perception in adopted Koreans. Journal of Neurolinguistics, 17, 79-84.