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Young without plastic surgery: Perceptual adaptation to the age of female and male faces

Stefan R. Schweinberger [a,b,*], Romi Zäske [b], Christian Walther [a,b], Jessika Golle [b], Gyula Kovács [a,c,d], Holger Wiese [a,b]

[a] DFG Research Unit Person Perception, Friedrich Schiller University, Jena, Germany
[b] Department of General Psychology, Friedrich Schiller University, Jena, Germany
[c] Institute of Psychology, University of Regensburg, Regensburg, Germany
[d] Department of Cognitive Science, Budapest University of Technology and Economics, Budapest, Hungary

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ABSTRACT

Adaptation influences perception not only of simple stimulus qualities such as motion or colour, but also of complex stimuli such as faces. Here we demonstrate contrastive aftereffects of adaptation to facial age. In Experiment 1, participants adapted to either young or old faces, and subsequently estimated the age of morphed test faces with interpolated ages of 30, 40, 50 or 60 years. Following adaptation to old adaptors, test faces were classified as much younger when compared to classifications of the same test faces following adaptation to young faces, which in turn caused subjective test face "aging". These aftereffects were reduced but remained clear even when facial gender changed between adaptor and test faces. In Experiment 2, we induced simultaneous opposite age aftereffects for female and male faces. Overall, these results demonstrate interactions in the perception of facial age and gender, and support dissociable neuronal coding of male and female faces.

1. Introduction

Contrastive aftereffects in visual perception of simple stimulus characteristics such as colour or motion have been known for a long time. For instance, prolonged viewing of unidirectionally moving stimuli subsequently elicits illusionary perception of motion in the opposite direction in a static image, an effect already noted by Aristotle (Parva Naturalia). A striking recent discovery was that adaptation also influences the perception of complex stimuli, and faces in particular. Contrastive aftereffects have been reported for perception of facial gender (Kloth, Schweinberger, & Kovács, 2010; Kovács, Zimmer, Harza, & Vidnyanszky, 2007; Kovács et al., 2006), identity (Leopold, O'Toole, Vetter, & Blanz, 2001), ethnicity, emotional expression (Webster, Kaping, Mizokami, & Duhamel, 2004), or gaze direction (Jenkins, Beaver, & Calder, 2006; Kloth & Schweinberger, 2008; Schweinberger, Kloth, & Jenkins, 2007). High-level perceptual adaptation effects were also reported for both non-face visual stimuli, such as biological motion stimuli (Troje, Sadr, Geyer, & Nakayama, 2006) or bodies (Ghuman, McDaniel, & Martin, 2010) and for auditory voice perception (Schweinberger et al., 2008).

Faces provide important information about a person's age, and age perception on average is surprisingly robust and accurate (Burt & Perrett, 1995; George & Hole, 2000). Humans sometimes spend considerable effort towards appearing physically older (e.g., during adolescence) or younger (during middle and older age). Similar to physical attractiveness or gender, perceived age arguably is of considerable sociobiological importance. Sociobiological relevance of age also may differ between men and women, causing characteristic patterns of age preference during adulthood (Kenrick & Keefe, 1992). However, it is controversial whether perception of these different types of facial information are perceived independently or more interactively (Perrett et al., 1998; Wiese, Schweinberger, & Neumann, 2008; Zhao & Bentin, 2008).

The first aim of the present study was to determine whether contrastive aftereffects in the perception of facial age can be induced by adaptation. Experiment 1 thus investigated possible aftereffects of adaptation to facial age (facial age aftereffect, FAAE), such that prolonged exposure to old faces would cause a subsequent test face to appear younger, and vice versa. Very recently, researchers have also begun to use a variant of the adaptation paradigm to study related questions of whether or not different types of facial information are processed independently. For example, adaptation to facial expression was found to be significantly reduced (but still present) when adaptor and test faces were of different identities (Fox & Barton, 2007). A second aim of the present study was therefore to investigate to which extent a possible FAAE

* Corresponding author at: Friedrich Schiller University Jena, Department of General Psychology, Am Steiger 3/Haus 1, 07743 Jena, Germany. Fax: +49 3641 945182.
E-mail address: stefan.schweinberger@uni-jena.de (S.R. Schweinberger).

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would transfer between faces of different gender. If perception of age is completely gender-independent, adaptor faces which are gender-incongruent to test faces should elicit a FAAE of comparable magnitude as gender-congruent adaptor faces.

2. Experiment 1

2.1. Methods

2.1.1. Participants

Twenty-four young adults (mean age = 21.3 years; range 18–25) were tested in two groups. Group 1 (N = 12, 6 female) adapted to young and old male faces, whereas Group 2 (N = 12, 6 female) adapted to young and old female faces. All participants gave written informed consent and received course credit.

2.1.2. Stimuli and apparatus

Stimuli were images from 15 female and 15 male young (range 18–22 years) and 15 female and 15 male old (range 68–72 years) faces from the CAL/PAL Database (Minear & Park, 2004). All were front-view colour images showing Caucasian people with neutral expression. Where necessary, stimuli were transformed to approximately equal luminance and contrast.

Young-old morphs were then created for 15 female and 15 male young-old pairs, using morph software Sierra software Morph™ (Version 2.5). From each morphed pair four stimuli were chosen, corresponding to 80/20%, 60/40%, 40/60%, and 20/80% young/old proportions. Ten pairs were used for experimental trials, comprising a total of 80 different test stimuli (four morph levels for each of 10 female and 10 male young-old pairs). The other five pairs were used for practice (see below), and original young and old faces from those five pairs were used as adaptors. These different faces were used as adaptors for experimental trials, to exclude any overlap in facial identity between adaptor and test faces, avoiding repetition effects (Schweinberger, Huddy, & Burton, 2004). Also, to ensure that aftereffects were generated in nonretinotopic higher level visual areas, adaptors were 50% larger (255 × 324 pixels) than test faces (170 × 216 pixels). Examples of the stimuli are given in Fig. 1.

2.1.3. Procedure

2.1.3.1. Pre-adaptation phase. Participants were tested individually in a sound-attenuated chamber. Participants were instructed in writing to perform four-alternate forced choice age judgments, estimating each test face as being approximately 30, 40, 50, or 60 years old, by pressing one of four adjacent keys (a,y,m,k; standard keyboard, German layout), using index and middle fingers of both hands. Keys were labelled (“30”, “40”, “50”, “60”; from left to right). These response options were based upon the mean age of the young and old faces weighted by the percentage of the morphs. Participants were told to select the nearest value available wherever they believed to be able to estimate age with higher precision (e.g., to select the response “40” for a face believed to depict a 36-year-old).

All 80 test faces were presented in randomized order. Each trial started with the presentation of a fixation cross for 500 ms, followed by the test face for 1000 ms (or until a response was detected). Responses were scored until 2500 ms after face onset. Following a 1000 ms blank screen, the next trial then started. If no response was detected after 2500 ms, a message to respond faster was shown for 1000 ms instead of the blank screen. Forty practice trials (four morph levels × five pairs × two genders each) were performed initially. Practice trials should ensure proper familiarization with the task and response key assignment.

2.1.3.2. Adaptation phase. The four types of adaptors consisted of five original old male, five old female, five young male, and five young female faces. Participants adapted for 40 s to a series of 10 consecutive faces (2 × 5 faces from one of these four groups, presented sequentially for 4 s each, in randomized order). Two adaptation phases (old, young) were used. Order of adaptation phases was counterbalanced across participants. Note that adaptor gender

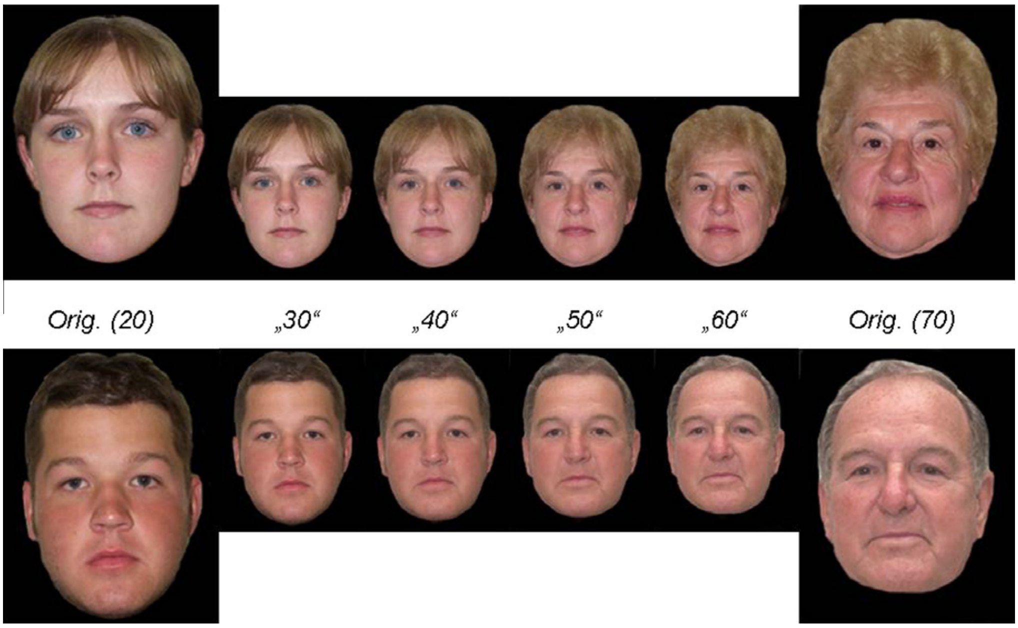

Fig. 1. Examples of the stimulus material. The large photos in the left and right columns show original images of young (20 ± 2) and old (70 ± 2) female and male faces, respectively. The smaller images show faces that were morphed between these young and old original faces, with young-old proportions of 80/20%, 60/40%, 40/60%, and 20/80%, corresponding approximately to interpolated ages of 30, 40, 50, and 60 years. The size difference between original and interpolated faces corresponds to the size difference between adaptor and test in the experiments. Note that the selection of images is for illustration only, and that identities of the adaptor faces never overlapped with those of the test faces in the actual experiment (see Methods).

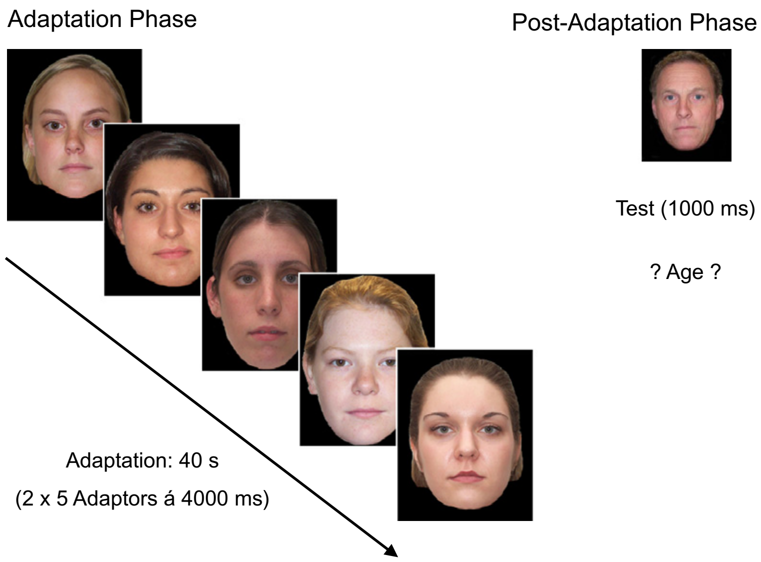

Fig. 2. Schematic sequence of the experiment. Left: adaptation phase in which participants adapted to a series of 2 × 5 large adaptor faces from one of four groups (here, young female faces), each presented for 4000 ms. Right: during the post-adaptation test, smaller test faces (morphs between different original young and old faces, with young-old proportions of 80/20%, 60/40%, 40/60%, and 20/80%) were shown for 1000 ms. Note that before each test face, two large top-up adaptor faces (from the same group as in the preceding adaptation phase) were presented for 2000 ms each, in order to maintain a high level of adaptation.

was a between-subjects variable. During adaptation, participants attentively watched each face, but no response was required.

2.1.3.3. Post-adaptation test. The post-adaptation test was identical to the pre-adaptation phase, except that before the test face, two top-up adaptors were presented for 2 s each.

Overall, each participant performed two consecutive sessions with pre-adaptation, adaptation, and post-adaptation, respectively. A schematic display of the adaptation and test method is given in Fig. 2.

2.2. Results

Errors of omission (no key press) and responses <200 ms were excluded from statistical analysis (1.6% of all experimental trials). Analyses of variance (ANOVAs) were performed, with epsilon corrections for heterogeneity of covariances (Huynh & Feldt, 1976) where appropriate.

We performed an ANOVA on mean age estimations in the post-adaptation test, with repeated measures on *test stimulus gender* (female/male), *adaptation condition* (old/young) and *morph level* (30, 40, 50, and 60 years), and with *adaptor gender* as between-subjects variable.[1]

Participants could perform the age estimation task easily, as suggested by the significant main effect of *morph level*, $F(3, 66) = 342.23$, $p < .001$, $\eta_p^2 = .94$ (see Fig. 3). Importantly, adaptation to young or old faces led to a significant contrastive shift of age perception of the test face towards being perceived as older and younger, respectively (main effect of *adaptation condition*, $F(1, 22) = 161.43$, $p < .001$, $\eta_p^2 = .88$). This age adaptation aftereffect was, however, larger at intermediate morph levels, as indicated by the significant interaction of *adaptation condition* and *morph level*, $F(3, 66) = 16.41$, $p < .001$, $\eta_p^2 = .43$ (Fig. 3).

Of particular interest, the gender congruence of the adaptor and test faces determined the magnitude of the observed adaptation effect. We observed smaller adaptation effects if the gender of the test face was incongruent with that of the adaptor face (for example male adaptors and female test face) than when they were congruent (interaction of *test stimulus gender*, *adaptation condition,* and *adaptor gender*, $F(1, 22) = 28.32$, $p < .001$, $\eta_p^2 = .56$, Fig. 3).

Finally, an interesting minor finding was that adaptation effects were somewhat larger for female than male test faces at all morph

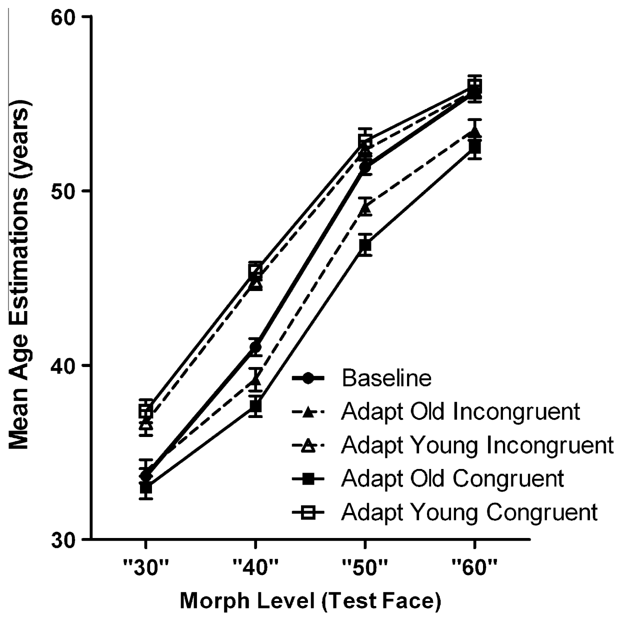

Fig. 3. Aftereffects on age perception induced by old or young adaptor faces in Experiment 1, depending on whether adaptor and test faces were of the same (congruent) or different (incongruent) gender. Baseline age estimations from the first pre-adaptation block preceding any age adaptation are also depicted for illustration. Error bars depict standard errors of the mean (SEMs).

[1] We initially ran the same analysis including an additional factor participant gender. This analysis revealed an interaction between participant gender and adaptor gender $F(1, 20) = 5.61$, $p < .05$, $\eta_p^2 = .22$. In subsequent separate analyses of the data from female and male participants, the effect of adaptor gender was neither significant for female, $F(1, 10) = 4.09$, $p = .07$, $\eta_p^2 = .29$, nor for male participants, $F(1, 10) = 2.08$, $p > .10$, $\eta_p^2 = .17$. As participant gender yielded no significant main effect and no further interactions, all *p*s > .10, we decided to disregard this variable in all subsequent analyses.

levels except for morph level 30, as indicated by a three-way interaction of *test stimulus gender*, *adaptation condition* and *morph level*, $F(3, 66) = 3.04$, $p < .05$, $\eta_p^2 = .12$, *Mdiff* between young and old adaptation conditions = 3.46 vs. 3.67, 7.40 vs. 5.99, 5.44 vs. 3.72, and 4.18 vs. 1.58 years, for female vs. male test faces at morph levels 30, 40, 50, and 60, respectively. This effect was not moderated by adaptor gender.

2.3. Discussion

Experiment 1 demonstrated what, to the best of our knowledge, is the first clear evidence for a facial age aftereffect (FAAE) in which the subjective perception of facial age is systematically biased following adaptation to young or old adult faces. Importantly, the FAAE was observed across large size changes between adaptor and test faces, and despite the fact that facial identity changed between adaptor and test faces. The fact that the observed adaptation related age aftereffect is reduced for faces of different gender shows an interesting parallel with the perception of facial expressions. Fox and Barton (2007) found that, similar to the FAAE observed in our current experiment, the aftereffect observed after adaptation to different facial expressions is also reduced when the identity of the adaptor and test faces is different. In a complementary study, adaptation to identity appeared to completely transfer across different facial expressions (Fox, Oruc, & Barton, 2008). The present results suggest that the FAAE occurs at relatively high levels beyond retinotopically-based visual processing, but that it depends to some extent on the congruence of facial gender between adaptor and test. Similar to the related findings of identity-dependent adaptation to facial expression (Fox & Barton, 2007), the present findings of gender-dependent adaptation to facial age may provide important constraints for models that assume that different social signals in faces are processed by independent systems (e.g., Bruce & Young, 1986). One possibility to account for these findings considers the fact that both identity and gender are stable characteristics of a face, whereas expression varies from moment to moment, and age slowly but continually increases. Perhaps the representation of an individual face is tolerant of some changes and not others (and as a result, is subject to some aftereffects and not others). Accordingly, while the present research demonstrated only partial transfer of facial age aftereffects across facial genders, it could be interesting for future research to determine whether gender aftereffects show a pattern of more complete transfer across facial ages.

Although the FAAE was still present when the adaptor faces were of a different gender to the test faces, it was significantly reduced when compared to congruent adaptor and test face genders. This suggests that there are at least two different neural representations of facial age, with one specific to the gender of a person, and another coding age in a gender-independent fashion. Thus, the perception of facial age may not be completely independent from the perception of gender. We expect that this interpretation could gain further support from relevant neuroimaging work in the future. The somewhat greater adaptability of female faces may also be an interesting finding, and one that could be a hint (together with the gender-specific part of the FAAE) for the idea that different characteristics may be used to judge age in female and male faces. We reasoned that, if this were the case, it should be possible to elicit simultaneous opposite FAAEs for female and male faces.

Several recent studies have already shown the possibility to induce simultaneous opposite aftereffects for two groups of faces (for the general idea of inducing opposite category-contingent face aftereffects see Rhodes et al., 2004), and such findings provide more direct evidence for the relationships between mechanisms coding different kinds of social information in faces (Little, DeBruine, Jones, & Waitt, 2008; Rhodes et al., 2004; Yamashita, Hardy, De Valois, & Webster, 2005). For instance, opposite aftereffects have been reported for faces from different ethnicities (Jaquet, Rhodes, & Hayward, 2007) or genders, and the latter finding was suggested to be evidence for distinct neural populations coding male and female faces (Little, DeBruine, & Jones, 2005; but see also Jaquet & Rhodes, 2008). In Experiment 2, we determined whether it would be possible to induce simultaneous opposite FAAEs for male and female faces, by simultaneously adapting participants to old male and young female faces (or vice versa).

3. Experiment 2

3.1. Methods

3.1.1. Participants

Twenty-four different young adults (mean age = 21.3; range 19–28; 12 female) were tested.

3.1.2. Stimuli

Stimuli were the same as in Experiment 1.

3.1.3. Procedure

The procedure was as in Experiment 1, with the following exceptions. Participants performed six-alternate forced choice age judgments, estimating each test face as being approximately 20, 30, 40, 50, 60 or 70 years old, by pressing one of six response keys with index, middle and ring fingers of both hands (standard keyboard; a,s,x,m,k,l; German layout). Keys were labelled (from left to right) "20", "30", "40", "50", "60", "70". Relative to Experiment 1, we therefore used two additional response options. While we did not expect that this would affect the results overall or lead to difficulty in solving the task, we wanted to allow a situation in which participants could both under- and overestimate the age of test faces even at the youngest and oldest test morph levels 30 and 60, respectively.

3.1.3.1. Pre-adaptation phase. Various test stimuli (4 morph levels × 10 pairs × 2 genders each) were presented in randomized order. Each trial started with a fixation cross for 500 ms, followed by the test face for 1000 ms (or until a response was detected). Responses were scored until 2500 ms after face onset. Following a 1000 ms blank period, the next trial started. If no response was detected, a message to respond faster was shown for 1000 ms instead of the blank screen. Initially, 40 practice trials (four morph levels × five pairs × two genders each) were shown.

3.1.3.2. Adaptation phases. The same set of stimuli and trial parameters as in Experiment 1 were again used for adaptation phases. However, to induce opposite aftereffects for male and female faces, participants adapted to a series of 10 faces consisting of either *five young male and five old female faces* (or, in a second adaptation phase, of *five old male and five young female faces*). The order of adaptation phases was counterbalanced across participants.

3.1.3.3. Post-adaptation test. Post-adaptation tests were identical to the pre-adaptation test, except that two top-up adaptors (one male, one female, age as in the preceding adaptation phase) were presented for 2 s each, in randomized order. Each participant performed two consecutive sessions with pre-adaptation, adaptation, and post-adaptation phases, respectively.

3.2. Results

Errors of omission (no key press) and responses <200 ms were excluded (0.3% of all experimental trials) from any further statisti-

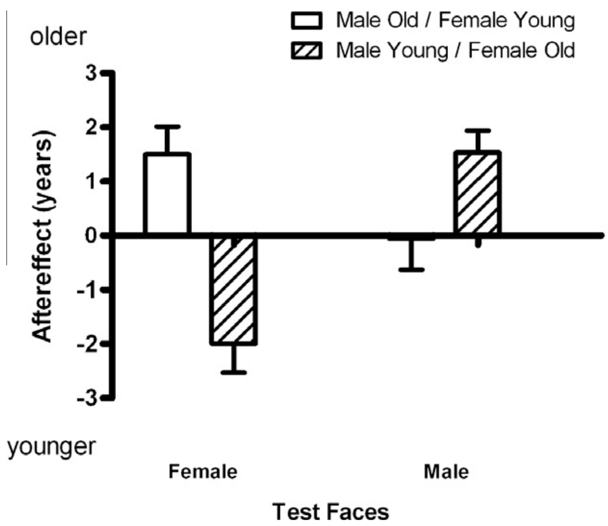

Fig. 4. Simultaneous opposite aftereffects on age perception as observed in Experiment 2. Values depict mean age estimations relative to the first pre-adaptation baseline. Negative values indicate "younger" and positive values indicate "older" ratings compared to baseline.

cal analysis. As before, ANOVAs were performed, with epsilon corrections (Huynh and Feldt, 1976) where appropriate.

ANOVAs were performed on mean age estimations in the post-adaptation test, with *adaptation condition* (male old/female young faces or female old/male young faces), *test stimulus gender* (female or male) and *morph level* (30, 40, 50, 60 years) as repeated measures variables.[2] Our participants could solve the age categorisation task based on morph levels easily, main effect of *morph level*, $F(3, 69) = 695.01$, $p < .001$, $\eta_p^2 = .97$. Most importantly, simultaneous opposite facial age aftereffects were induced for female and male faces, as indicated by a prominent interaction of *adaptation condition* and *test stimulus gender*, $F(1, 23) = 139.84$, $p < .001$, $\eta_p^2 = .86$. Across morph levels, female test faces were judged younger when preceded by old female/young male adaptor faces as compared to when preceded by young female/old male adaptor faces, $M = 44.1$ vs. 47.6 years, whereas male test faces were judged older when preceded by old female/young male adaptor faces as compared to when preceded by young female/old male adaptor faces, $M = 46.3$ vs. 45.0 years, respectively (also cf. Fig. 4).[3]

In addition, female test faces were judged particularly young when preceded by old female/young male adaptor faces (compared to when preceded by young female/old male adaptors) at intermediate morph levels (*Mdiff* = −3.3, −5.4, −4.1, and −1.1 years, for morph levels 30, 40, 50, and 60, respectively), and male test faces were also judged particularly old at intermediate morph levels when preceded by old female/young male adaptor faces (compared to when preceded by young female/old male adaptors; *Mdiff* = 1.3, 2.8, 2.2, and 0.1 years, for morph levels 30, 40, 50, and 60, respectively), as reflected in the three-way interaction of *adaptation condition*, *test stimulus gender* and *morph level*, $F(3, 69) = 15.08$, $p < .001$, $\eta_p^2 = .40$. Moreover, aftereffects were somewhat larger for female than male test faces, similar to what was found in Experiment 1. Separate analyses revealed both a significant main effect of *adaptation condition*, and a significant interaction of *adaptation condition* and *morph level* for both female test faces ($F(1, 23) = 70.68$, $p < .001$, $\eta_p^2 = .75$, and $F(3, 69) = 8.01$, $p < .001$, $\eta_p^2 = .26$) and male test faces ($F(1, 23) = 12.91$, $p < .01$, $\eta_p^2 = .36$, and $F(3, 69) = 3.53$, $p < .05$, $\eta_p^2 = .13$, respectively).

4. General discussion

Experiment 2 demonstrated simultaneous opposite aftereffects on the perception of facial age for female and male faces, indicating that female and male faces are coded by dissociable neuron populations. The aftereffects survived substantial changes in both face size and identity, ruling out adaptation of low level (retinotopic) face coding mechanisms. Based on these and other recent results (Bestelmeyer et al., 2008; Jaquet et al., 2007), the present effects likely reflect gender category-contingent adaptation, rather than adaptation at lower levels of visual structural encoding. It should be noted that we used unfamiliar faces throughout, in a design in which facial identity invariably changed between adaptor and test faces. However, there is evidence for substantial differences in coding familiar vs. unfamiliar faces (Megreya & Burton, 2007). Specifically, while coding of unfamiliar faces is relatively image-dependent, coding of familiar faces is remarkably robust against transformations in viewpoint or expression. Judging from reports of surprisingly accurate familiar face recognition after many decades without contact (Bahrick, Bahrick, & Wittlinger, 1975), it seems likely that compared to unfamiliar faces, representations of familiar faces also are relatively robust against transformations created by the aging process. It would therefore be interesting for future research to determine whether the FAAE is modulated by personal familiarity, and in a situation in which identity is kept constant between adaptor and test. It will also be of interest to determine neural mechanisms mediating the present FAAE. While the present data alone do not permit inferences with respect to relevant brain regions, data from brain lesioned participants and neuroimaging experiments suggest the right fusiform cortex as one tentative candidate region (DeRenzi, Bonacini, & Faglioni, 1989; Eger, Schweinberger, Dolan, & Henson, 2005; Kovács, Cziraki, Vidnyánszky, Schweinberger, & Greenlee, 2008).

Our findings also are informative for a current controversy centered around findings of facial adaptation, in which one research team reported almost no transfer of adaptation across facial genders (Little et al., 2005), whereas another team observed almost complete transfer of adaptation across facial genders, with relatively little additional gender-specific effects (Jaquet and Rhodes, 2008). Of potential importance, both these studies used not only radically different adaptation dimensions, but also manipulations that arguably may have altered the faces beyond the range of naturally observed variability (particularly in the case of spatial distortions used by Jaquet et al.; see, for instance, their Fig. 2). By contrast, the current study used adaptation to natural and undistorted images of old or young faces. It is therefore interesting that our results, with prominent aftereffects across genders and comparatively smaller but still clear gender-specific aftereffects, demonstrate both gender-independent (similar to Jaquet and

[2] As before, we initially ran the same analysis including an additional factor participant gender. This analysis revealed no significant main effects or interactions involving participant gender. The only effect approaching significance was between participant gender and test stimulus gender $F(1, 22) = 3.20$, $p = .09$, $\eta_p^2 = .13$. This effect seemed to reflect a trend for an own-sex bias in age perception, such that on average, female observers numerically judged female faces slightly younger than male faces, $M = 45.9$ years vs. 46.8 years, respectively, whereas male observers judged female faces slightly older than male faces, $M = 45.8$ years vs. 44.9 years, respectively. As participant gender yielded no significant effects or interactions, we decided to disregard this variable in all subsequent analyses.

[3] Inspection of Fig. 4 suggests that male test faces preceded by old male/young female adaptors were only judged minimally younger (*Mdiff* = 0.1 years) compared to the pre-adaptation baseline. However, a closer look at the data revealed that, at morph level 30 only, male test faces preceded by old male/young female adaptors were judged *older* than the same faces in the pre-adaptation baseline ($M = 30.5$ vs. 26.7 years). As these values suggest, this seemed due to an apparent outlier in the baseline data for which we have no ready account, and where male facial age was *underestimated* in the baseline at this morph level only. All other morph levels showed the theoretically predicted pattern for male test faces, with younger judgements in the adaptation condition relative to the baseline. While this explains the pattern shown in Fig. 4, it should be also noted that the difference between the two adaptation conditions was still clear for male test faces.

Rhodes, 2008) and gender-specific aftereffects (similar to Little et al., 2005). Of particular relevance, another recent study (Little et al., 2008, Experiment 2) investigated age-contingent aftereffects in a task in which participants judged the normality of test faces following adaptor faces that were manipulated in eye spacing (wide vs. narrow). For both baby and adult faces, age-contingent aftereffects on perceived normality were found such that images with increased (or decreased) eye spacing were perceived as more normal after adaptation to age-congruent faces with increased (or decreased) eye spacing. It was concluded that functionally different neural populations code faces of different ages. As a constraint, baby and adult faces exhibit major differences in facial proportions. It is therefore noteworthy that we used different ages within the adult range in the present study (between 20 and 70 years). More importantly, Little et al. (2008) tested normality judgments on distorted faces (eye-distance manipulations) and the transfer of such adaptation effect across different ages, but did not assess the perception of age in test faces. By contrast, the present study is the first to demonstrate a contrastive bias in the perception of facial age in test faces as a function of adaptor facial age.

Like most face adaptation studies (Jenkins et al., 2006; Kovács et al., 2006; Leopold, Rhodes, Muller, & Jeffery, 2005; Rhodes, Jeffery, Clifford, & Leopold, 2007; Webster & Maclin, 1999; Webster et al., 2004), we used an adaptor-test interval of just a few hundred milliseconds. From the present data alone, it is thus unclear whether these aftereffects would survive for longer intervals. Face adaptation effects have been investigated for a multitude of social signals, some of which (e.g., eye gaze, expression) are typically subject to relatively rapid changes whereas others (e.g., gender, identity) are much more stable over time. Importantly, invariant versus changeable aspects of faces are probably processed in different neural systems (Haxby, Hoffman, & Gobbini, 2000). Age does not easily fall in either category, because age is subject to a relatively slow change over time, and because this change is monotonic and, hence, predictable to some extent.

A few recent studies demonstrated that adaptation-induced biases in face perception survive for several minutes in the case of eye gaze perception (Kloth and Schweinberger, 2008), and possibly much longer in the case of perception or recognition of familiar faces (Carbon et al., 2007). A plausible hypothesis – though one clearly requiring further test – is therefore that the recalibration processes evident in adaptation effects may be more long-lasting for systems coding relatively invariant aspects of facial information. If so, this would make the FAAE a good candidate for inducing changes in face perception that persist longer than eye gaze or expression aftereffects. Whatever the outcome of relevant future research, persistence over reasonable time periods will likely determine the relevance of the FAAE for a common human aspiration: to appear young, without plastic surgery.

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