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Supplementary Materials for

Illusion of visual stability through active perceptual serial dependence

Mauro Manassi* and David Whitney

*Corresponding author. Email: mauro.manassi@abdn.ac.uk

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Supplementary Materials
Figs. S1 to S3
Legends for movies S1 to S11

Other Supplementary Material for this manuscript includes the following:

Movies S1 to S11

H2: Supplementary Materials

Additional Experiments. An obvious question is whether our illusion is restricted to the specific identity we tested. For this reason, in **Experiment 8** we replicated our illusion with a different set of identities. As before, four separate groups of 50 participants rated on Mechanical Turk the age of young or old static faces embedded in a blue frame, with low and high dynamic noise (young: 13.5 and 14.8 years, low and high noise, respectively; old: 21.4 and 23.8 years, low and high noise; Figure S1A-B; white squares and circles). A fifth group of 50 participants was presented with a face morphing movie that gradually aged from young to old, and after an Inter-Stimulus Interval (I.S.I.) of 1 second each observer was asked to rate the age of the old face embedded in a blue frame (Figure S1A; blue circle). A sixth group of 50 participants was presented with a face morphing movie that gradually rejuvenated from old to young, and after an ISI of 1 second they were asked to rate the age of the young face embedded in a blue frame (Figure S1B; blue square). Movie conditions were presented with increasing dynamic noise and high noise in the static test face (**MOVIE 9**). Depending on the face morphing movie, the old or young static test face was rated as three years younger (20.3 vs 23.8 years; Figure S1A, green brackets; $p<0.001$) or older (17.3 vs 14.8 years; Figure S1A; green brackets; $p=0.014$) than what it actually was. Static face age ratings were attracted 33% of the movie length (Figure S1C; $p<0.001$).

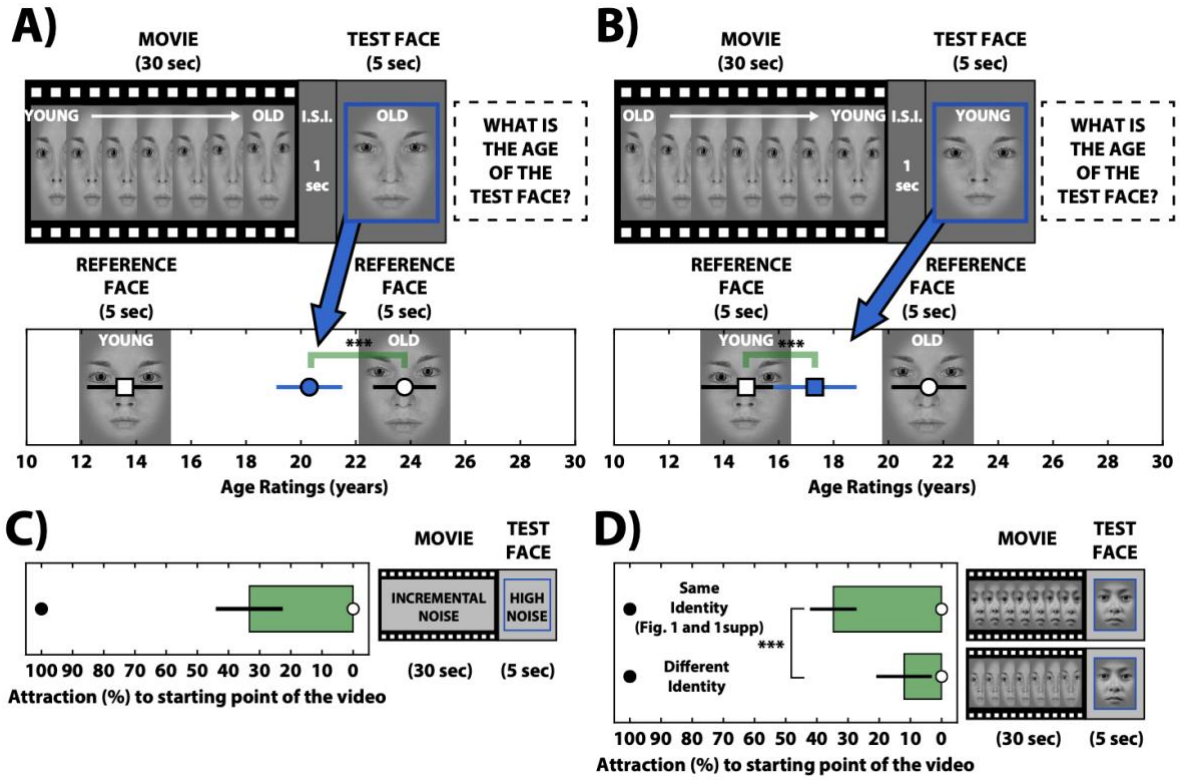

Figure S1: A-C) **Experiment 8.** Experimental design was similar to Figure 1A-B, with three main differences. First, a new set of face stimuli was used. Second, an inter-stimulus-interval of 1 second was added in between movie and static face and a new set of stimuli. Third, incremental noise and high noise were added to movie and static face (test or reference), respectively. Different reference faces ratings between panels A and B are due to incremental noise (A: low-high; B: high-low). C) Test face age ratings were attracted towards 34% of the movie. D) **Experiment 9.** When collapsing the attraction results from two sets of face stimuli (Figure 1A-B and Figure 3A-B), attraction was 35%. When intermixing the two identities in movie and test face, attraction dropped to 12%. Error bars are bootstrapped 95% confidence intervals. Photo Credit: Mauro Manassi.

As a further confirmation of featural tuning of our illusion, in **Experiment 9** we compared four conditions where the movie and test face had the same identity (identity from Figure 1 or identity from Figure S1) with four other conditions where the movie and test face belonged to different identities (identity from Figure 1 and S1 intermixed). For example, we presented a movie with the identity from Figure S1, and a static test face with the identity from Figure 1. When comparing the four conditions within the same identity with the four conditions with different identity, attraction towards the movie was higher when the movie and static face had the same identity compared to when they had different ones (Figure S1D; 35% vs 12%; $p<0.001$; **MOVIE 10**).

In order to confirm the results of Experiment 7 hold across different stimuli and task, in **Experiment 10** we used the gender morph stimuli from Figure 4 (Figure S2). Three separate groups of observers were presented with a male, middle, or female baseline test face, respectively, and were asked to rate the face gender (male: 33.6%; middle: 51.2%; female: 74%; Figure 5A; white circles and red diamond). Following exposure to the morphing movie (female-to-middle and male-to-middle), observers rated the gender of the same static test faces. Whereas the middle baseline face was rated as 51.2% female (red circle), that same face was rated as more masculine (41.8%; light-blue diamond) or feminine (70.7%; dark-blue diamond) depending on the content of the previous movie (blue dots comparison; $p<0.001$; **MOVIE 11**).

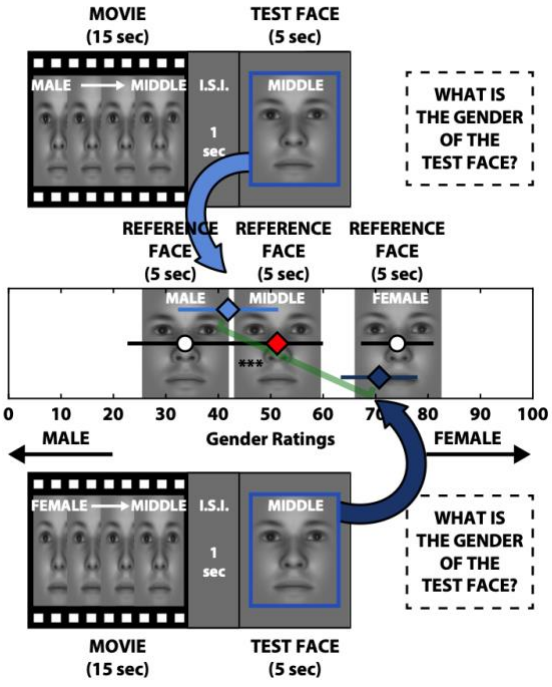

Figure S2: A) **Experiment 10.** Three groups of observers were asked to rate the age of a male, middle gender or female face embedded in a blue frame (white circles and red diamond). A fourth group was presented a movie with a face gradually changing from male to middle gender, and were then asked to rate the gender of the middle face embedded in a blue frame (light-blue diamond). The middle face was rated as more masculine than what is actually was. A fifth group was presented a movie with a face gradually changing gender from female to middle, and were then asked to rate the gender of the middle face embedded in a blue frame (dark-blue diamond). The middle face was rated as more feminine than what is actually was. Photo Credit: Mauro Manassi.

As a further confirmation of temporal integration, we computed the attraction index with the last 6, 18 and 30 seconds of the video preceding the test face (**Experiment 11; Figure S3A**). Attraction linearly increased with increasing video duration, thus showing that the attraction effect involves all parts of the preceding video.

In order to address the discriminability of the video per se, we computed the Just Noticeable Difference (minimum face difference that can be reliably discriminated) for the faces presented in our experiments (Figure 1). The movie with stable high dynamic noise from Experiment 1 was cut to obtain videos of duration 0.5/1.5/2.5/3.5/4.5/5.5/6.5/7.5 seconds in both age directions. On each trial, observers were presented with two videos with the same starting point and duration; one video aged and the other video rejuvenated. Videos (0.5 size in PsychoPy height units) were simultaneously presented on the left and right side (-0.3 or +0.3 PsychoPy height units). The position of ageing/rejuvenating videos was randomized on each trial. Observers were asked to tell whether the rejuvenating face was on the left or right side (spatial 2AFC discrimination task; **Experiment 12; Figure S3B-D**). Each video duration condition was repeated 48 times (48*8 video durations, 384 trials in total for each observer). We then computed the video duration for which the observers could discriminate the age with 75% accuracy. The average 75% JND for the eleven observers was 8.4 seconds (4.2x2). The average effect of our illusion was 12.9 seconds (absolute age difference between test face and reference face; Figure 1 and Figure S3D, red dashed line), thus meaning that our illusion was at least 1.5 times the JND measured here.

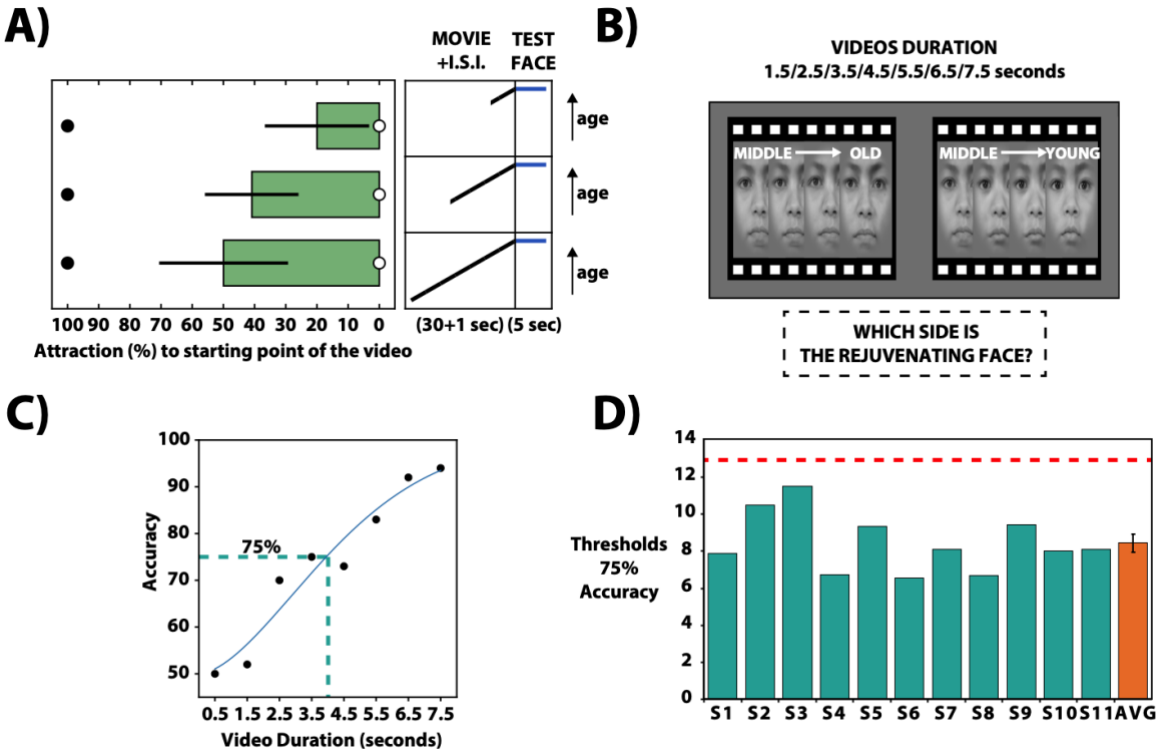

Figure S3: A) **Experiment 11.** We presented the last 6, 18 and 30 seconds of the movie, followed by the test face. Attraction percentage was computed as age difference between reference faces (e.g., reference face: old) and test faces (e.g., movie: young-to-old, test face: old), divided by the total age range (e.g., old reference face – young reference face). Increasing and decreasing age directions were equally balanced. White and black circles indicate zero (0%) and full (100%) attraction towards the beginning of the movie. Incremental noise and high noise were added to movie and static face (reference or test faces), respectively. Error bars are bootstrapped 95% confidence intervals. Attraction gradually increased with increasing the movie length before the test face. B) **Experiment 12.** On each trial, two videos with high dynamic incremental noise were simultaneously presented on the screen (left/right position). Both videos began at the same random age point; one video rejuvenated, whereas the other one aged. The position of ageing directions was randomized on each trial (left/right). Observers were asked to tell on which side the rejuvenating video was presented (free viewing conditions). Video duration in both videos could be 0.5, 1.5, 2.5, 3.5, 4.5, 5.5, 6.5 or 7.5 seconds. C) For each individual observer, we plotted the accuracy as a function of video duration, and we fit a Weibull function to the resulting plot. We took the x values for which the Weibull curve had a y value of 75% as the JND. Each 75% threshold value was doubled, as the two videos on each trial went in opposite age directions. D) Video duration thresholds for 75% of accuracy are shown for 11 participants. Red dashed line indicates the magnitude of the illusion from Experiment 1C, High constant noise condition. Photo Credit: Anthony Cerniello. Computer generated face images were slightly modified for visualization purposes.

MOVIE 1: Experiment 1

MOVIE 2: Experiment 2

MOVIE 3: Experiment 2

MOVIE 4: Experiment 4

MOVIE 5: Experiment 5

MOVIE 6: Experiment 6

MOVIE 7: Experiment 7

MOVIE 8: Stability Illusion Demo

MOVIE 9: Experiment 8

MOVIE 10: Experiment 9

MOVIE 11: Experiment 10