Outlining face processing skills of portrait artists: Perceptual experience with faces predicts performance

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Abstract

Most humans seem to demonstrate astonishingly high levels of skill in face processing if one considers the sophisticated level of fine-tuned discrimination that face recognition requires. However, numerous studies now indicate that the ability to process faces is not as fundamental as once thought and that performance can range from despairingly poor to extraordinarily high across people. Here we studied people who are super specialists of faces, namely portrait artists, to examine how their specific visual experience with faces relates to a range of face processing skills (perceptual discrimination, short- and longer term recognition). Artists show better perceptual discrimination and, to some extent, recognition of newly learned faces than controls. They are also more accurate on other perceptual tasks (i.e., involving non-face stimuli or mental rotation). By contrast, artists do not display an advantage compared to controls on longer term face recognition (i.e., famous faces) nor on person recognition from other sensorial modalities (i.e., voices). Finally, the face inversion effect exists in artists and controls and is not modulated by artistic practice. Advantages in face processing for artists thus seem to closely mirror perceptual and visual short term memory skills involved in portraiture.

Keywords: drawing, portrait artists, face expertise, face perception, face recognition, visual art, voice recognition

1. Introduction

Faces convey much biologically and socially relevant information and we are very good at discriminating one face from another, despite the very similar structure they all share. For instance, most people can easily tell the difference between a picture of Brad Pitt and one of Benicio Del Toro, although they look somewhat similar. For these reasons, it is often claimed that human beings are experts or specialists in face processing. If we generally excel at recognizing familiar faces despite variations in viewpoints or degraded viewing conditions (Burton, Bruce, & Hancock, 1999, but see Carbon, 2008), our ability to process unfamiliar faces gives rise to a much more nuanced picture (see e.g. Hancock, Bruce, & Burton, 2000): perceptual discrimination and recognition performance can then be dramatically low (for a review on the differences between familiar and unfamiliar faces recognition, see Johnston & Edmonds, 2009).

In fact, important individual differences exist, as demonstrated by a growing number of studies. At one extreme, people with congenital prosopagnosia show significant and incapacitating impairments in face recognition (Behrmann & Avidan, 2005) and sometimes in other face processing tasks (e.g., recognition of facial expressions; Duchaine, Murray, Turner, White, & Garrido, 2009; Susilo & Duchaine, 2013). At the other extreme of what may be a continuum, some people display exceptionally good face processing abilities. In a seminal study by Russell, Duchaine and Nakayama (2009), four people who reported superior face recognition abilities performed far above average on two different face recognition tests. Moreover, they also outperformed controls on a face discrimination task and exhibited a larger inversion effect (i.e., performance decrement for upside-down stimuli in comparison with upright stimuli). More recently, others of these “super-recognizers” were tested on a face-matching task in a line-up configuration, and on a recognition task from CCTV images; they also performed much better than controls on both tasks (Bobak, Hancock, & Bate, 2016).

The existence of “super-recognizers” indicates that the range of face perception and recognition abilities might be wider than previously thought (Russell et al., 2009) and these findings have opened up a new avenue in face processing research (see Young & Bruce, 2011). The importance of investigating individual differences is now emphasized (e.g., Burton, 2013; Susilo, Germine, & Duchaine, 2013) and a growing number of studies examine the impact of factors such as genetics (e.g., Wilmer et al., 2010; Zhu et al., 2010), gender (e.g., Megreya, Bindemann, & Havard, 2011) or personality (e.g., Bate, Parris, Haslam & Kay, 2010; Megreya & Bindemann, 2013; Saito, Nakamura, & Endo, 2005; Valentine & Mesout, 2009) on face processing skills. This new emphasis may be helpful in our understanding of the origin of the variability in face processing abilities. In the current paper, we studied a group of people who are more specialist at face processing than the layman, namely portrait artists, and we assessed whether they display advantages on various face processing abilities.

Some advantages in face processing skills have been reported before in relation to particular individual characteristics or experiences with faces. For instance, individuals with Body Dysmorphic Disorder, which is characterized by an obsessive preoccupation with perceived defects in physical appearance (Rief, Buhlmann, Wilhelm, Borkenhagen, & Brähler, 2006), exhibit better performance at recognizing inverted famous faces compared to control participants, presumably because of their increased tendency to focus on specific facial features (Jefferies, Laws, & Fineberg, 2012). Consistently, they also outperform controls when requested to discriminate subtle changes of aesthetically-relevant features of a neutral face (Stangier, Adam-Schwebe, Müller, & Wolter, 2008). Other researchers have turned to people whose professional occupation involves face processing, like security agents or police officers. For instance, Damjanovic, Pinkham, Clarke, and Phillips (2014) examined the relation between levels of professional expertise in hostile crowd management and threat detection abilities using the face in the crowd paradigm. Compared to controls, professionals displayed a facilitated detection of angry target faces among emotional and neutral crowds, as well as an enhanced inhibitory control of angry face distractors when looking for happy target faces. Furthermore, more experienced officers outperformed not only civilian participants but also unspecialized trainee officers. Sadly enough though, even if super-recognizers can sometimes be found in the police ranks (Robertson, Noyes, Dowsett, Jenkins, & Burton, 2016), police or passport officers are not always good at face matching or *recognition* (e.g., Burton, Wilson, Cowan, & Bruce, 1999; White, Kemp, Jenkins, Matheson, & Burton, 2014) and they most likely do not choose their occupations out of a keen interest for the human face. Similarly, although people are generally good at estimating other people's age (Moyse, 2014), precise age distinctions are not always accurate. Importantly, this is also true for people whose profession implies frequently judging age for selling alcohol or tobacco according to legal age limitations (for a review, see Rhodes, 2009). So people in professions that call for good face processing skills do not always display desirable advantages.

One profession that requires tremendous face processing abilities is portrait artist. Contrary to security agents, clerks or bartenders, portrait artists often choose this career path out of a genuine passion for the human face and what it conveys. Because studying faces is one of the core elements of their activity, these artists can be considered as a very singular population that might be super specialist (i.e., more specialist than the average human being) at face processing. Their occupation implies that they strive to perceive faces accurately in order to *reproduce* the essential features and configuration that make a face recognizable.

Training in art is linked to advantages in various domains of cognition and visual perception, both in the context of drawing tasks and in other perception tasks (Kozbelt, 2001). For example, in a recent study using an ingenious setting involving two screens, people's working memory was tested while they were drawing (Perdreau & Cavanagh, 2015). They had to use one touch screen to copy a shape presented on the other screen. Crucially, the reference shape and the drawing were presented in alternation and sometimes underwent changes while they were not visible. The three artists who took part in the study showed better working memory than novices, both for the original shape and for their drawing. Another study showed that when instructed to view or memorize pictures, people with artistic training do not look at them in the same way as controls (Vogt & Magnussen, 2007). When freely viewing images, controls tend to look at objects and human figures while artists have more widespread scanpaths that include abstract features of the images. Moreover, although artists and controls remember a similar number of pictures, artists remember more pictorial features than controls. Another recent study also suggests that the ability to flexibly switch one's attention from local to global processing predicts better drawing skills (Chamberlain & Wagemans, 2015).

Only a few studies have looked at differences in perception associated with the activity of portraiture specifically. Interestingly, in one fMRI study, the act of drawing faces involved brain areas attuned to face processing, even when drawing from memory and while the resulting drawing was not visible. Participants, who were not trained in art, showed increased activity in the fusiform face area and in the occipital face area while they were drawing cartoon human faces in the scanner (Miall, Gowen, & Tchalenko, 2009). In a study that compared artists' and non-artists' performance in representing a famous face with a limited number of pieces of dark tape, artists provided more accurate drawings than non-artists (Kozbelt, Seidel, ElBassiouny, Mark, & Owen, 2010). While non-artists focused on incidental aspects of the face, resulting in drawings that were generic and not very distinctive, artists focused on the internal facial features and captured the key components. A single case study of a portrait painter showed that his eye-movements pattern changed when he was drawing a face, as compared to when he was looking at the model before the painting session (Miall & Tchalenko, 2001). During the realisation of the portrait, he would make single, long, very targeted fixations on specific facial details of the model, guided by the development of the drawing. By contrast, in the same situation novice participants made multiple, short, and spread out fixations. In a more recent study, performance of art students and controls was compared on a face composite task (see Young, Hellawell, & Hay, 1987, for an original account of the composite-face effect). Results showed that art students displayed less holistic processing than controls, as they were less disrupted by the alignment of incongruent face parts (Zhou, Cheng, Zhang, & Wong, 2012). Apart from this study, there have not been extensive studies about whether and how the practice of portraiture relates to face processing abilities beyond the context of the act of drawing a face.

To fill this gap, here, we used six different tasks to assess whether portraitists display better performance than controls on perceptual discrimination of faces and whether their possible advantage would extend to short and longer term recognition abilities. We also tested with three tasks whether the potential perceptual advantage in artists is specific to faces or if it also applies to other objects (i.e., houses), perceptual tasks (i.e., mental rotation) or modalities (i.e., voices). Finally, most of our face tasks also included inverted faces in order to explore whether the specific experience of artists with faces is associated with a different pattern of performance with inverted faces. For instance, it could be that better face processing skills leads to a larger face inversion effect as it does in super-recognizers (Russell et al., 2009, see also Richler, Cheung, & Gauthier, 2011). Alternatively, portraitists may display a similar advantage in switching to a featural/local mode of processing as people with Body Dysmorphic Disorder when they process faces (Jefferies et al., 2012) or as artists when they process non-face stimuli (Chamberlain & Wagemans, 2015); which might be expected to reduce the face inversion effect.

2. Method

2.1.1. Participants

We recruited a total of 22 participants from Liège and surroundings. Artists (*N* = 11, 4 females, *mean age* = 26 ± 3.9 years) were searched and contacted through internet and social networks. They all drew faces (portraits and/or caricatures) aimed at achieving a likeness with a model on a regular basis, and could be either professionally trained or self-taught. Controls (*N* = 11, 4 females, *mean age* = 26 ± 2.8 years) were recruited to match artists in terms of gender, mean age and education. They reported that they did not draw figurative or realistic subjects on a regular basis. They all had normal or corrected-to-normal vision. The study was conducted in accordance with the Declaration of Helsinki and participants signed an informed consent prior to their inclusion in the study. They received monetary compensation for their time.

2.2. Procedure

Participants were all tested at the University of Liège in standardized settings. Upon their arrival at the lab, they completed a questionnaire we designed to assess subjective ability to recognize faces, and artists answered questions about their artistic practice (see Appendix). The questionnaire comprised 38 statements inspired by characteristics found in super-recognizers or in mild developmental prosopagnosia (see Russell et al., 2009) and focused mainly on the physical aspects of face recognition (e.g., good recognition abilities: “I recognize at first glance people I have only met once” or poor recognition abilities: “I often need to pretend that I recognize someone to avoid disappointing or offending the person”). The statements are rated with 7-point Likert scales from 1 = totally disagree to 7 = totally agree. The ratings are inverted when appropriate so that highest scores reflect higher self-reported abilities (range from 38 to 266).

Participants then performed a drawing test followed by seven different tasks aimed at assessing their general visual perception abilities, face perception skills, recognition of newly learned and famous faces, and recognition of other person-related features from another sensory modality (i.e., voices). The tasks were performed on a PC (screen resolution 1024 X 768) in a dim lighted room. Except for the Cambridge Face Perception Test (CFPT) and the Cambridge Face Memory Test (CFMT) Long form, stimuli were displayed and responses were recorded with E-Prime 2 (Psychology Software Tools, Pittsburgh, PA).

In an attempt to avoid contamination from one task to another as much as possible, we alternated perceptual and recognition tasks and organized them as followed: CFMT Long form, Sequential matching of faces and houses, Recognition of famous faces and voices, Mental rotation, Perceptual matching of features/configurations, CFMT Australian version, CFPT. Half of the participants performed the tasks in this order, and the other half in the reversed order.

2.2.1. Drawing test

In order to objectively assess participants' drawing abilities, they were required to draw a face and a house that were each displayed on a computer screen for five minutes. They received a black ballpoint pen and an A4 white sheet of paper for each drawing. They were instructed to reproduce the original pictures as faithfully as they could within the time allowed and to stop drawing as soon as the images went off screen. We later asked 12 independent judges (6 females, mean age = 25.6 ± 3.2 years) to rate each of the 44 drawings according to their faithfulness with the original picture and their aesthetic value by means of two 7-point Likert scales (1 = Not resembling/aesthetic at all, 7 = Very resembling/aesthetic). The drawings had been scanned and were presented in a random order on a computer screen in two different blocks (i.e., one with 22 faces and one with 22 houses). After the initial ratings, judges were told that the drawings had been made either by artists or by people not accustomed to drawing, and assigned each drawing to one of these two categories (i.e., artist or non-artist).

2.2.2. Cambridge Face Perception Test (CFPT)

This test assesses face perception abilities (see Duchaine, Germine, & Nakayama, 2007). It consists of a sorting task in which participants have one minute to arrange six frontal-view faces according to their degree of similarity to a target face oriented in a ¾ view and positioned above them. The six faces are arranged in a random order and are of different individuals morphed to a different degree with the target face (i.e., 28, 40, 52, 64, 76, or 88% of the target face, respectively). The test comprises 8 different target faces presented once each in upright and inverted form, for a total of 16 intermixed trials. Before the test, participants complete one upright and one inverted practice trial. Scores for each trial are the sum of the deviation of each face compared to its correct position in the faces sequence (i.e., from 88% target face = 1^{st} position to 28% target face = 6^{th} position). The total score for each orientation adds up the scores of the 8 trials. Therefore, lower scores reflect a better performance.

2.2.3. Sequential matching of faces and houses

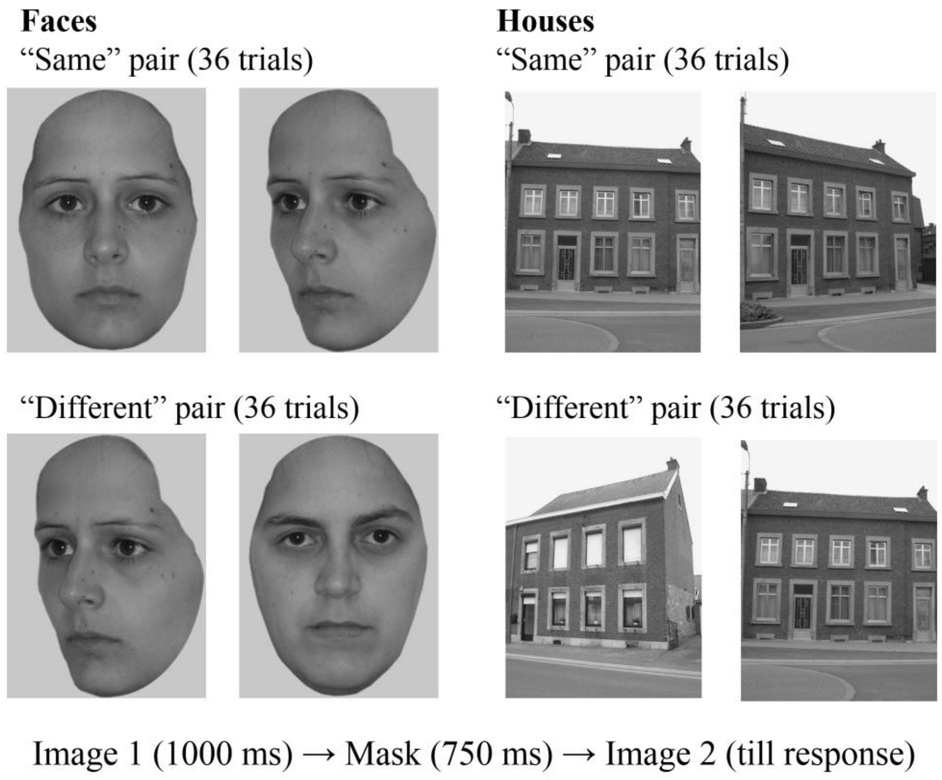

Figure 1. Examples of pairs of stimuli used in the sequential matching task, and time course of a trial.

This test was designed to compare perceptual abilities of artists and non-artists with faces and another class of stimuli (i.e., houses). Participants had to decide, as fast and accurately as possible, whether two images presented sequentially had the same identity or not by means of two response keys ("Z" and "L"). The test consisted of 288 trials divided in four blocks presenting faces or houses, in an upright or an inverted orientation. The order of the blocks was counterbalanced across participants. Each trial started with a fixation cross (1000 ms), followed by a first picture stimulus at the centre of the screen (1000 ms), followed by a mask (750 ms), followed by a second image representing either the same object (36 trials/block) or a different but visually similar object (36 trials/block) until the participant's response. The trial ended with a blank screen (1000 ms). Within each trial the object was presented in a frontal view on one image and in a ¾ view on the other, with order randomized across trials. Within each block, each individual object appeared once per pair type (same/different), meaning that there were 36 different individual houses and 36 different individual faces (18 males and 18 females displaying a neutral facial expression, with hair removed). In the different pairs, we tried to match two different stimuli as best as possible according to their physical characteristics (see Figure 1). All pictures were presented in greyscale, on a light grey background. The mask for each category of objects was composed by blending together all the exemplars from that category. Before the experimental trials, participants performed 8 practice trials with cartoon characters.

2.2.4. Simultaneous matching of features and configuration

This test was designed to assess whether artists and controls rely to the same extent on featural and configural information when processing faces. We designed a simultaneous matching task in which we presented pairs of computerized facial stimuli (see Van Belle, De Smet, De Graef, Van Gool, & Verfaillie, 2009). The stimuli are constructed in such a way that featural and configural information can be varied independently. Each trial started with a fixation cross (1000 ms), followed by the stimulus display showing a pair of faces (until response or with a maximum duration of 5000 ms), followed by a mask (400 ms). Participants had to judge as quickly and accurately as possible whether the two faces (one in frontal view and the other in ¾ view) belonged to the same individual ("yes" response) or whether they differed despite some possible similarities ("no" response). The test consisted in 192 trials, divided into one block with upright faces (96 trials in total) and one block with inverted faces (96 trials in total). The order of the blocks was counterbalanced across participants and the order of the trials within a block was randomized. There were breaks every 32 trials. There were four different types of pair: no difference, same features/different configuration, different features/same configuration, different features/different configuration. There were 48 trials with identical pairs in each orientation (upright or inverted) and 16 trials per type of pair per orientation. Before the actual test, participants saw a demo image of each type of pair (i.e., same and different pairs).

2.2.5. Mental rotation

The aim of this test was to assess more general perceptual skills of artists and controls. We used 8 white geometrical pseudo-3D shape stimuli from the database by Peters and Battista (2008), all presented on a black background. Each trial started with a fixation cross (1000 ms), followed by a display consisting of a pair of stimuli presented side by side, but each slightly displaced in opposite directions from the horizontal axis (to avoid simple comparison) until the participant's response. Participants were to judge as quickly and as accurately as possible whether the two stimuli showed figures that could match when mentally rotated (i.e., "same pair", 50 trials) or figures that could never match when mentally rotated (i.e., mirror-reversed, "different pair", 50 trials), by using two response keys (i.e., "Z" and "L"). We used stimuli rotating on the X axis (i.e., rotation on a horizontal axis, like a gymnast around a high bar, 50 trials) and on the Z axis (i.e., rotation around a vertical axis, like a wooden horse around a carousel, 50 trials). The two stimuli were either viewed from the same angle (i.e., 0°, giving identical positions in the "same" pair condition, and mirroring positions in the "different" pair condition) or one of them was rotated by an angle of 45°, 90°, 135° or 180°, compared to the other (with 5 trials per angle in each type of pair and for each axis of rotation). The order of all the trials was randomized and participants were given the opportunity to take a break every 20 trials. Before the actual test, participants saw a demo image of each type of pair (i.e., same and different pairs) and performed 12 practice trials.

2.2.6. Cambridge Face Memory Test (CFMT) – Long form

This test assesses the highest limits of recognition of newly learned faces (see full description in Russell, Duchaine, & Nakayama, 2009) more thoroughly than the original CFMT (see Duchaine & Nakayama, 2006). As in the original version of the test, participants learn to recognize 6 unfamiliar male faces from which hair has been removed, from 3 different views. Recognition is then tested by means of a three-alternative forced-choice amongst exemplars with gradually higher levels of transformations (e.g., changes in facial expression, head orientation, lighting) and/or degradations.

The three first levels are the same as in the original CFMT (72 trials). In a first training phase using cartoon faces, the target faces are the same as those learned. In a second phase (“easy” condition), the target faces are showed in a novel view or with different lighting. In a third phase (“noise” condition), visual noise is added. In a fourth and last level (30 trials, “difficult” condition), in addition to visual noise, the target faces differ more greatly from the original (i.e., profile view, full heads including hair, internal features only, smiling faces, and emotional expressions, 6 trials each). Moreover, in order to further increase the difficulty in the fourth level, the distractor faces are repeated more often.

2.2.7. Cambridge Face Memory Test – Australian version (CFMT-Aus)

In order to have another measure of face recognition abilities and because some faces used in the CFMT Long form are the same as in the CFPT, we also used the Australian version of the CFMT that includes another set of faces (see McKone et al., 2011). This version consists of the three same levels of difficulty as the original CFMT (see Duchaine & Nakayama, 2006), namely, a training phase followed by an “easy” phase and a “noise” phase.

2.2.8. Recognition of famous faces and voices

This test was used to assess recognition of familiar faces as well as recognition of familiar persons from another cue to person identity, namely from the voice. The goal was to test whether the possible advantage of artists also concerns longer term forms of face recognition across perceptual modalities. In this task, the participants were informed that they would be presented with a sequence of faces (i.e., muted videos, 32 items) and voices (i.e., audio files presented during a blank screen, 32 items), and that some of these faces/voices were well known to them (32 items), whereas the other faces/voices belonged to unknown persons (32 items). Famous face and voice stimuli had been previously selected to test a population with similar demographics as the current sample (i.e. French-speaking young adults) and were equated on their levels of familiarity (see full description of the stimuli in Barsics & Brédart, 2012). After each item presentation, the clip was paused to enable the participants to perform a recognition task: they had to answer “yes” when they recognized the presented item and “no” when they found it unfamiliar. In case of recognition, the experimenter assessed whether the participants were able to recall semantic information about the target person (i.e., biographical details) and her/his name, or whether the recognition was based on mere familiarity (i.e., the face/voice is recognized as familiar but the participant cannot recall any facts about the target person).

3. Results and discussion

3.1.a. Evaluation of drawings by independent judges

We conducted Wilcoxon signed-rank tests to compare ratings by the independent judges of drawings made by artists and controls (see average ratings in Table 1). Regarding Faithfulness, faces drawn by artists were judged as more faithful than those drawn by controls, $Z = 3.06$; $p < 0.005$; r = 0.65, as were houses, $Z = 3.06$; $p < 0.005$; r = 0.65. For artists, as well as for controls, houses were judged as more faithful than faces, $Z = 2.98$; $p < 0.005$; r = 0.63, and $Z = 3.06$; $p < 0.005$; r = 0.65, respectively. In terms of Aesthetic value, faces as well as houses drawn by artists were judged as more aesthetic than those drawn by controls, $Z = 3.06$; $p < 0.005$; r = 0.65, and $Z = 2.99$; $p < 0.005$; r = 0.64, respectively. Artists’ drawings of faces and houses were similarly aesthetic, $Z < 1$, but controls’ drawings of houses were judged more aesthetic than their drawings of faces, $Z = 2.67$; $p < 0.01$; r = 0.57. Examples of drawings are shown on Figure 2.

We analysed correct classification rates of the drawings with a 2-way ANOVA with Category (face vs. house) and Drawing expertise (artists vs. controls) as within-subjects factors. There was only a main effect of Drawing expertise, with drawings by controls categorized more accurately than drawings by artists, $F(1,11) = 20.89$; $p < 0.001$; $\eta_p^2 = 0.655$.

Figure 2. Photographic models and examples of portraits/houses drawn by artists (top black frames) and controls (bottom grey frames). Drawings are the two most and the two least faithful in each group, with their mean rating shown in a box. Ratings (range from 1 to 7) were made by 12 independent judges who were blind to the drawers' artistic practice.

The aim of the drawing test was to objectively assess artists' skills compared to controls. The ratings by independent judges confirm that artists' productions were more faithful and more aesthetic than controls' even though drawings by controls were afterward correctly classified more often than drawings by artists. This could be due to independent judges being conservative in their classifications or to artists producing drawings of variable quality. It is also possible that independent judges experienced difficulty with the classification task because they were not trained artists. Other studies have shown that non-artist judges cannot necessarily distinguish drawings made by artists and non-artists, whereas artist judges can (Kozbelt, Seidel, ElBassiouny, Mark, & Owen, 2010).

	Faces		Houses	
	Artists	Controls	Artists	Controls
Faithfulness (range 1-7)	3.78 ± 0.84	2.11 ± 0.75	5.2 ± 0.65	4.02 ± 0.78
Aestheticism (range 1-7)	4.2 ± 0.67	1.86 ± 0.49	4.31 ± 0.54	2.49 ± 0.44
Correct classification rates (%)	73 ± 11	89 ± 9	69 ± 54	89 ± 44

Table 1. Mean ratings and standard deviations of the drawings made by artists and controls by independent judges (two first rows) and correct artist/non-artists classification rates of the drawings of each category and group.

3.1.b. Self-reported face recognition abilities questionnaire

Our questionnaire had an excellent internal consistency, as shown by a Cronbach's $\alpha = 0.949$. Artists self-reported better face recognition abilities (*Mean score* = 204 ± 23; range from 163 to 252; Median = 203) than controls (*Mean score* = 161.5 ± 29; range from 115 to 206; Median = 172), and the difference between the two groups was significant, as assessed by a Mann-Whitney test, $U = 14$; $Z = 3.02$; $p < 0.005$, r = 0.64.

3.2. CFPT

We performed a 2-way mixed effects analysis of variance (ANOVA) with Group (artists vs. controls) as between-subjects and Orientation (upright vs. inverted) as within-subjects factors on mean deviations obtained during the ordering of faces. Results are presented in Table 2. Artists (*Mean deviation* = 40.7, SD = 16.5) performed better than controls (*Mean deviation* = 53.7, SD = 22.5), as shown by a main effect of Group, $F(1, 20) = 5.9$; $p < 0.05$; $\eta_p^2 = 0.228$. There was a main effect of Orientation, with upright faces (*Mean deviation* = 33.5, SD = 15.5) being ordered better than inverted faces (*Mean deviation* = 61, SD = 15), $F(1, 20) = 92.9$; $p < 0.001$; $\eta_p^2 = 0.823$. There was no significant interaction between Group and Orientation, $F(1, 20) < 1$. These results indicate better perceptual abilities with faces in artists than in controls and a general inversion effect that is not modulated by portraiture practice.

	Upright		Inverted	
Artists	28.00	*8.94*	53.45	*11.70*
Controls	38.91	*19.02*	68.45	*15.02*

Table 2. Mean deviations of each group and for each orientation condition on the CFPT. Smaller values indicate better performance. Standard deviations are in italics.

3.3. Sequential matching of faces and houses

3.3.a. Accuracy

We conducted a 3-way mixed effects ANOVA with Group (artists vs. controls) as between-subjects and Category (faces vs. houses) and Orientation (upright vs. inverted) as within-subjects factors on mean correct responses in the sequential matching task. We found a significant main effect of Group, $F(1, 20) = 20.34$; $p < 0.001$; $\eta_p^2 = 0.504$, as artists (*Mean proportion of correct responses* = 0.93, SD = 0.05) were more accurate than controls (*Mean* = 0.86, SD = 0.08). There was also a significant main effect of Category, $F(1, 20) = 37.72$; $p < 0.001$; $\eta_p^2 = 0.653$. Matching of houses (*Mean* = 0.92, SD = 0.05) was more accurate than that of faces (*Mean* = 0.86, SD = 0.08). Finally, there was a significant main effect of Orientation, $F(1, 20) = 23.59$; $p < 0.001$; $\eta_p^2 = 0.541$, with more accurate responses to upright stimuli (*Mean* = 0.92, SD = 0.07) than to inverted ones (*Mean* = 0.87, SD = 0.07).

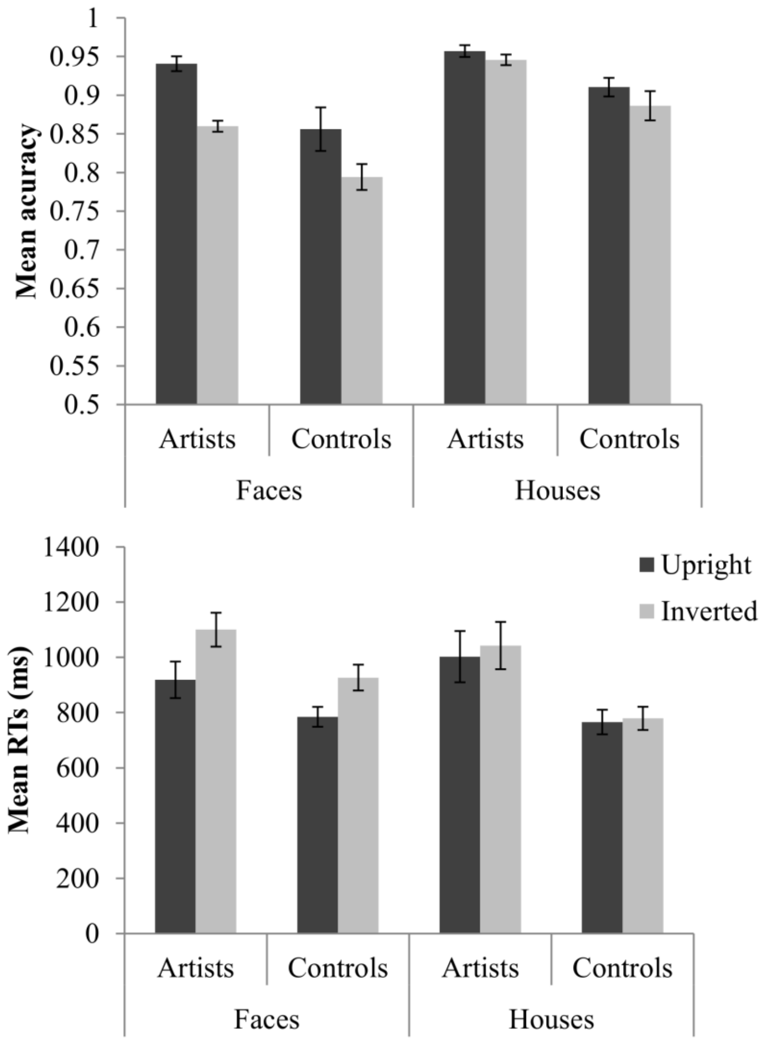

Figure 3. Mean accuracy (top) and mean correct reaction times (bottom) to the sequential matching task for each group as a function of image Category and Orientation. Error bars represent standard errors of the mean (SEM).

Interestingly however, Category significantly interacted with Orientation, $F(1, 20) = 10.84$; $p < 0.005$; $\eta_p^2 = 0.351$, replicating the classical face inversion effect. The top panel of Figure 3 indicates that the inversion effect was driven by faces, which was confirmed by simple main effects analyses (LSD). When responding to faces, participants were more accurate with upright than with inverted pictures, $p < 0.001$, but the orientation made no significant difference with houses, $p = 0.076$. Moreover, in both orientations, i.e., upright and inverted, people were more accurate with houses than with faces, $p = 0.013$ and $p < 0.001$, respectively. No other interaction reached significance or in other words, Group did not interact with Category nor with Orientation, $F(1, 20) = 1.19$; $p = 0.288$; $\eta_p^2 = 0.056$ and $F < 1$, respectively.

All in all, these results indicate that artists are more accurate than controls in judging whether two subsequent images represent the same object stimulus, independently of the type of stimuli at hand. All participants were more accurate with houses than with faces, and with upright than with inverted stimuli.

3.3.b. Reaction times

We performed the same 3-way mixed-effects ANOVA on mean correct reaction times (RTs). We found a significant main effect of Group, $F(1, 20) = 6.17$; $p < 0.05$; $\eta_p^2 = 0.236$, with controls (*Mean RTs* = 814 ms, SD = 151) responding faster than artists (*Mean RTs* = 1016 ms, SD = 257). A significant Group by Category interaction, $F(1, 20) = 5.52$; $p < 0.05$; $\eta_p^2 = 0.216$, was driven by much faster RTs of controls to houses (*Mean RTs* = 773 ms, *SD* = 141) than to faces (*Mean RTs* = 856 ms, *SD* = 153), $p = 0.01$, as indicated by simple main effects analyses (LSD). By contrast, artists had similar RTs with faces (*Mean RTs* = 1009 ms, *SD* = 226) and with houses (*Mean RTs* = 1022 ms, *SD* = 290), $p = 0.65$. Artists were slower than controls both with faces, $p = 0.044$, and houses, $p = 0.016$. There was a significant main effect of Orientation, $F(1, 20) = 16.89$; $p < 0.001$; $\eta_p^2 = 0.458$, with faster responses to upright (*Mean RTs* = 868 ms, SD = 226) than to inverted stimuli (*Mean RTs* = 962 ms, SD = 232), but no significant effect of Category, $F(1, 20) = 2.9$; $p = 0.104$; $\eta_p^2 = 0.127$. Interestingly, there was also a significant interaction between Category and Orientation, $F(1, 20) = 17.04$; $p < 0.001$; $\eta_p^2 = 0.46$. Simple main effect analyses (LSD) showed that upright faces (*Mean RTs* = 852 ms, SD = 186) were responded to faster than inverted faces (*Mean RTs* = 1014, SD = 198), $p < 0.001$, and that there was no such inversion effect for houses, $p = 0.379$. When the stimuli were upright, RTs to faces and houses (*Mean RTs* = 884 ms, *SD* = 265) did not significantly differ, $p = 0.208$, but when they were inverted, houses

(*Mean RTs* = 911 ms, *SD* = 257) were responded to faster than faces, $p = 0.001$. No other interaction reached significance. Results are shown on the bottom panel of Figure 3.

3.3.c. Discussion

Artists and controls seem to have different strategies when making perceptual discrimination; artists are more accurate overall, but at the cost of speed. However, this speed difference is mostly driven by controls responding faster to houses, and to some extent to faces (at the cost of accuracy), than artists. Artists respond to faces and houses at similar speed. Results also show that our task (with novel stimuli) successfully replicates the classical face inversion effect. Indeed, performance (speed as well as accuracy) with faces was more affected by inversion than performance with houses stimuli. The absence of modulation of the inversion effect by the practice of portraiture points to a quantitative rather than qualitative difference of performance between artists and controls.

3.4. Simultaneous matching of features and configuration

3.4.a. Accuracy

Performance on this task revealed an unexpected difficulty with one category of stimuli: participants were not able to perceive changes of features within the same facial configuration (i.e., error rates > 65% in that condition). In other words, participants would in most cases erroneously accept pairs of faces with different features but with the same configuration as identical faces. We nonetheless tentatively examined the pattern of results in the three other Types of face pairs, namely no difference (i.e., identical pairs), same features/different configuration, and different features/different configuration, as a function of Group (artists vs. controls) and Orientation (upright vs. inverted) with a 3-way mixed effects ANOVA. There was a significant effect of Group $F(1, 20) = 8.02$; $p < 0.01$; $\eta_p^2 = 0.286$, with artists (*Mean accuracy* = 0.82,SD = 0.16) being more accurate than controls (*Mean* = 0.75,SD = 0.19). Orientation also had a significant effect $F(1, 20) = 74.57$; $p < 0.001$; $\eta_p^2 = 0.789$, with upright pairs of faces (*Mean* = 0.87, *SD* = 0.13) being judged more accurately than inverted pairs (*Mean* = 0.71, *SD* = 0.19). The Type of pair also significantly affected performance $F(2, 40) = 31.54$; $p < 0.001$; $\eta_p^2 = 0.612$. Planned comparisons with Bonferroni corrections indicated that participants were less accurate when only the configuration of the face differed (*Mean* = 0.65, *SD* = 0.19) compared to identical pairs (*Mean* = 0.88, *SD* = 0.10) and to totally different pairs (*Mean* = 0.83, *SD* = 0.16), both *p*s < 0.001. Finally, there was an Orientation by Type of pair interaction, $F(2, 40) = 3.87$; $p < 0.05$; $\eta_p^2 = 0.162$. Simple main effects analyses (LSD) showed that Inversion affected all the types of pairs, all *p*s ≤ 0.002. Judging an upright face with a change in configuration only was more difficult than judging identical or totally different pairs, both ps < 0.001, with these two not differing significantly from each other, $p = 0.812$. For inverted faces, judging pairs with a difference in configuration only was more difficult than judging completely different pairs, $p = 0.012$, which was more difficult than judging identical pairs, $p < 0.001$. Results are presented on the top panel of Figure 4.

3.4.b. Reaction times

We performed the same ANOVA on mean correct RTs. Artists (*Mean* = 2005 ms, *SD* = 528) were slower than controls (*Mean* = 1685 ms, *SD* = 404), as confirmed by a main effect of Group, $F(1, 20) = 6.2$; $p < 0.05$; $\eta_p^2 = 0.237$. Responses were faster with upright (*Mean* = 1614 ms, *SD* = 376) than with inverted faces (*Mean* = 2077 ms, *SD* = 494) as shown by a significant main effect of Orientation, $F(1, 20) = 51.14$; $p < 0.001$; $\eta_p^2 = 0.719$. Finally, the Type of pair also had a significant effect, $F(2, 40) = 5.2$; $p < 0.01$; $\eta_p^2 = 0.206$. Planned comparisons with Bonferroni corrections indicated that participants were faster with totally different pairs (*Mean* = 1728 ms, SD = 443) than with pairs differing only in configuration (*Mean* = 1934 ms, SD = 476), $p = 0.025$. None of the interactions reached significance.

3.4.c. Discussion

In this test only involving faces, artists were slower but more accurate than controls which may again indicate that artists make their judgments with more caution. As in the previous tasks, we observed a clear inversion effect that was not modulated by artistic practice. Although these results should be interpreted with caution because performance on the whole task may have been affected by the presence of the very difficult condition we discarded, they are nonetheless in keeping with the results of the sequential matching task.

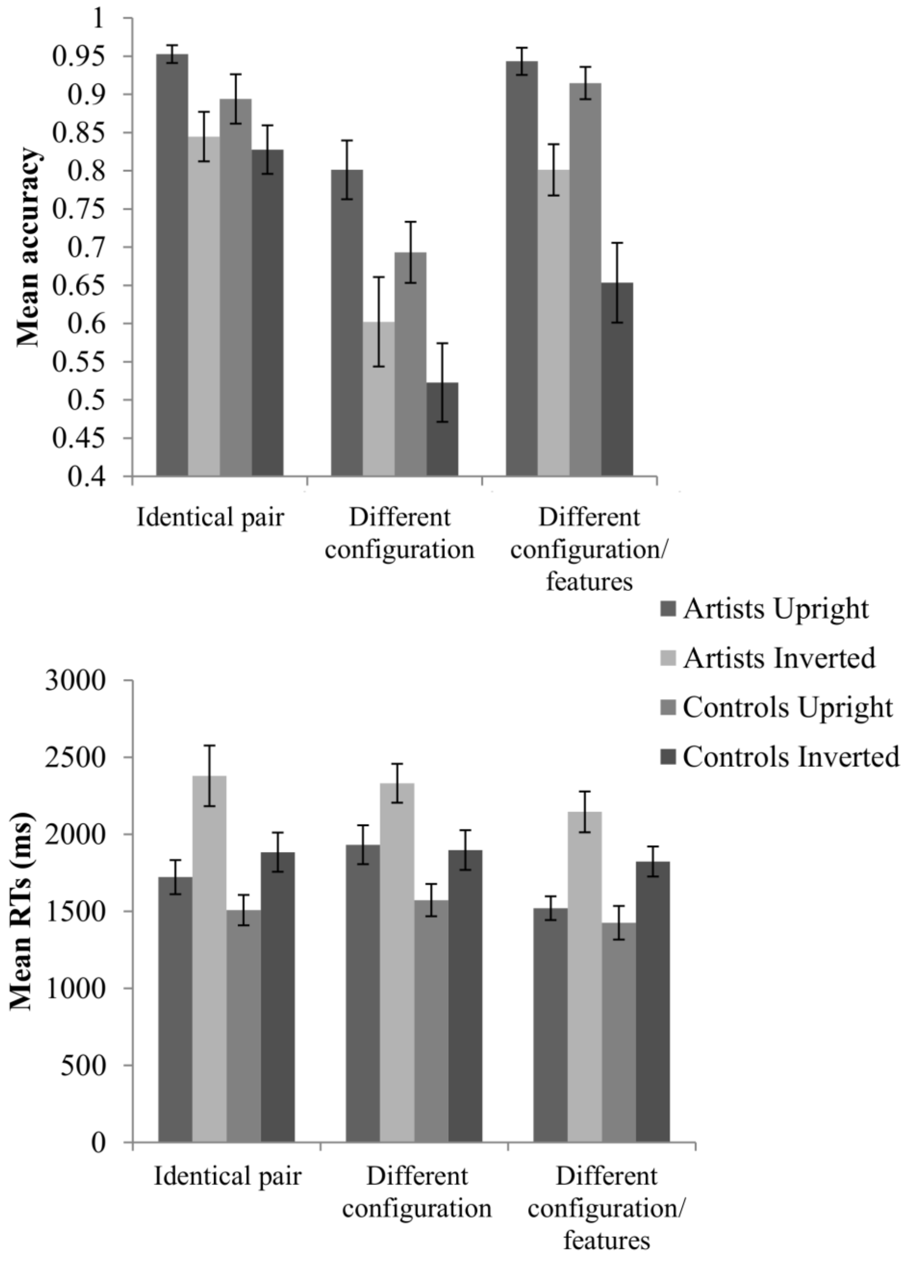

Figure 4. Mean accuracy (top) and mean correct reaction times in milliseconds (bottom) to the matching of configuration and features task for each group as a function of Type of pair and Orientation. In the "Identical pair" condition, faces had the same features and facial configuration; in the "Different configuration" condition, pairs differed in their configuration but had the same features; in the "Different configuration/features" conditions, faces differed on both dimensions. Error bars represent standard errors of the mean (SEM).

3.5. Mental rotation

3.5.a. Accuracy

We performed a 3-way mixed effects ANOVA with Group (artists vs. controls) as between-subjects and Axis (X vs. Z) and Angle (0-45-90-135-180°) as within-subjects factors on mean correct responses. Here again, there was a significant main effect of Group, with artists (*Mean* = 0.91, SD = 0.07) being more accurate than controls (*Mean* = 0.82, SD = 0.08), $F(1, 20) = 7.5$; $p < 0.02$; $\eta_p^2 = 0.273$. As it is classically observed, there was also a main effect of Angle with a performance decrement as the angle of rotation between the two figures increased, $F(4, 80) = 12.16$; $p < 0.001$; $\eta_p^2 = 0.378$. Finally, there was a significant interaction between Angle and Axis, $F(4, 80) = 5.6$; $p < 0.001$; $\eta_p^2 = 0.219$. No other effect or interaction were significant, all *p*s > 0.1 (see Figure 5, top panel).

3.5.b. Reaction times

We performed the same ANOVA on mean correct RTs. Here, the Group had no significant effect, $F(1,20) < 1$. There was a significant main effect of Axis, $F(1, 20) = 43.8$; $p < 0.001$; $\eta_p^2 = 0.687$. Participants responded faster to rotations on the Z axis (*Mean* = 4797 ms, SD = 954) than on the X axis (*Mean* = 5907 ms, SD = 1659). There was a significant main effect of Angle, $F(4, 80) = 44.2$; $p < 0.001$; $\eta_p^2 = 0.688$, with increased RTs for larger angles of rotation. There was again an interaction between Axis and Angle, $F(4, 80) = 4.7$; $p < 0.002$; $\eta_p^2 = 0.19$, with the disparity between X and Z axes increasing as the angle of rotation increased. No other interaction reached significance, all *p*s > 0.1. Results are displayed on Figure 5 (bottom panel).

3.5.c. Discussion

In line with the sequential matching task on houses, this test also indicates that artists are more accurate than controls on a perceptual task not involving faces. Here, contrary to what happened in the two previous tasks, the higher precision of artists relies on similar reaction times as controls.

This rules out the possibility of a general differential speed-accuracy trade-off between artists and controls.

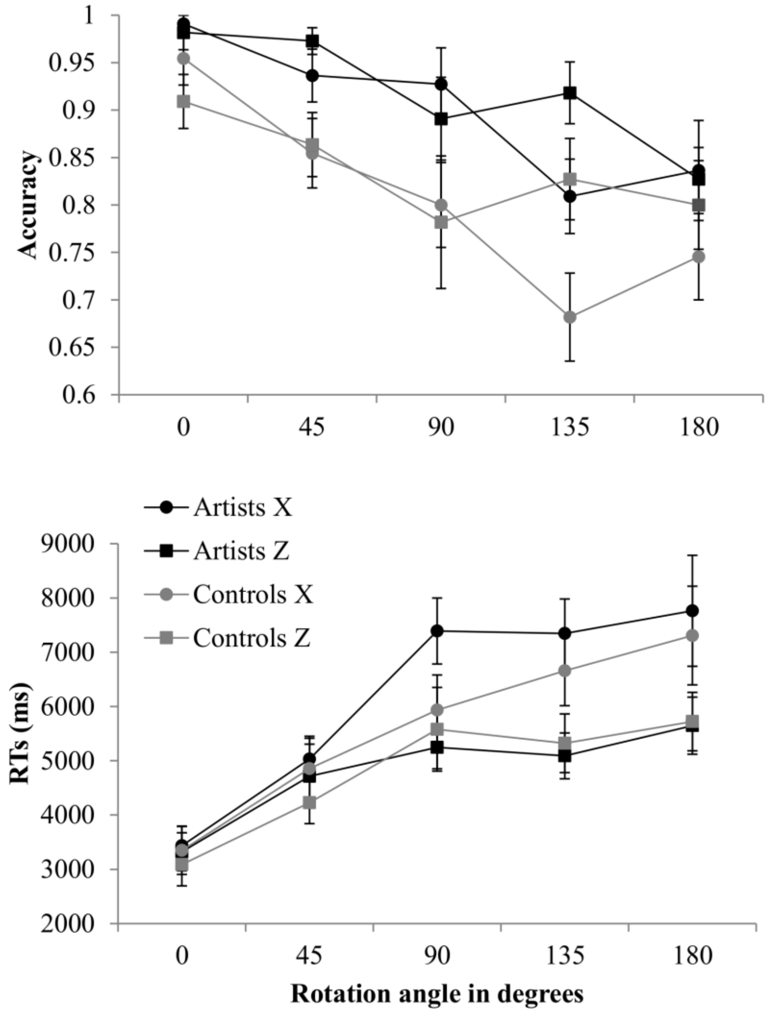

Figure 5. Mean accuracy (top) and mean correct reaction times (bottom) to the mental rotation task for each group as a function of Axis of rotation (i.e., X, Z) and Rotation angle. Error bars represent standard errors of the mean (SEM).

3.6. CFMT-Australian

We then conducted a 3-way mixed effects ANOVA with Group (artists vs. controls) as between-subjects and Difficulty (easy vs. noise) and Orientation (upright vs. inverted) as within-subjects factors on mean correct responses to the 3 alternative forced-choice responses on the Cambridge Face Memory Test-Australian version. We found a significant main effect of Group, $F(1, 20) = 4.96$; $p < 0.05$;

η_p^2 = 0.199. Artists were more accurate overall (*Mean* = 0.69, SD = 0.21) than controls (*Mean* = 0.58, SD = 0.24). There was also a main effect of Orientation, $F(1, 20) = 134.78$; $p < 0.001$; $\eta_p^2 = 0.871$, with higher accuracy for upright (*Mean* = 0.78, SD = 0.19) than for inverted faces (*Mean* = 0.49, SD = 0.16). Difficulty also had a significant effect, $F(1, 20) = 104.89$; $p < 0.001$; $\eta_p^2 = 0.84$; participants performed worse in the "noise" condition (*Mean* = 0.55, SD = 0.2) than in the "easy" condition (*Mean* = 0.72, SD = 0.22). Apart from a marginal triple interaction between Group, Orientation and Difficulty, $F(1, 20) =$ 3.15; $p = 0.091$; $\eta_p^2 = 0.136$, no other interaction approached or reached significance. Results are presented in Table 3.

		Easy		Noise	
Artists	Upright	0.92	*0.11*	0.75	*0.13*
	Inverted	0.63	*0.12*	0.46	*0.13*
Controls	Upright	0.85	*0.14*	0.59	*0.21*
	Inverted	0.49	*0.19*	0.39	*0.11*

Table 3. Mean accuracy of each group and for each difficulty and orientation condition on the CFMT. Standard deviations are in italics.

This test suggests that artists have a better recognition memory for recently learned faces than controls. Once again, we found an inversion effect that was not significantly modulated by artistic practice.

3.7. CFMT Long form

We performed a 3-way mixed effects ANOVA with Group (artists vs. controls) as between-subjects and Difficulty (easy, noise, vs. difficult) and Orientation (upright vs. inverted) as within-subjects factors on mean correct responses to the 3 alternative forced-choice of the Cambridge Face

Memory Test-extended version. Surprisingly, even though artists (*Mean correct reponses rates* = 0.63, SD = 0.21) performed numerically better than controls (*Mean* = 0.57, SD = 0.2) as in the CFMT-Aus, here there was no significant main effect of Group, $F(1, 20) = 2.28$; $p = 0.147$; $\eta_p^2 = 0.102$. There was a main effect of Orientation, $F(1, 20) = 99.23$; $p < 0.001$; $\eta_p^2 = 0.832$, reflecting an inversion effect and better performance with upright faces (*Mean* = 0.70, SD = 0.21) than with inverted faces (*Mean* = 0.50, SD = 0.15). Here again, there was a main effect of Difficulty, $F(2, 40) = 114.9$; $p < 0.001$; $\eta_p^2 = 0.852$. Planned comparisons with Bonferroni corrections showed that performance decreased as the Difficulty increased, with better performance in the "easy" condition (*Mean* = 0.73, SD = 0.18) compared to the two others, and better performance in the "noise" condition (*Mean* = 0.63, SD = 0.19) compared to the "difficult" condition (*Mean* = 0.44, SD = 0.14), all *p*s < 0.001. Finally, there was a significant interaction between Orientation and Difficulty, $F(2, 40) = 10.47$; $p < 0.001$; $\eta_p^2 = 0.344$, with the disparity between the performance on upright and inverted faces decreasing as the difficulty increased, and a steeper decrease of performance as a function of difficulty with upright faces than with inverted faces (see Table 4). No other interaction reached significance, all *p*s > 0.1.

		Easy		Noise		Difficult	
Artists	Upright	0.91	*0.10*	0.81	*0.12*	0.54	*0.16*
	Inverted	0.61	*0.16*	0.51	*0.13*	0.42	*0.09*
Controls	Upright	0.83	*0.12*	0.70	*0.18*	0.45	*0.16*
	Inverted	0.58	*0.11*	0.50	*0.13*	0.36	*0.09*

Table 4. Mean accuracy of each group and for each difficulty and orientation condition on the CFMT Long form. Standard deviations are in italics.

Contrary to what was observed in the CFMT-Australian version, artists did not show significantly better recognition abilities than controls for recently learned faces on this task. This might be due to a lack of statistical power or to a contamination by the previous exposure to faces during the CFPT in half of the participants.

3.8. Recognition of famous faces and voices

One participant of the control group did not complete this task because it appeared that he had already done so for an earlier study. Analyses presented here therefore include 21 participants. Two-way ANOVAs with Group (artists *vs.* controls) as between-subjects factor and Domain (face vs. voice) as within-subjects factor, were conducted on the corrected recognition performance (i.e., hits minus false alarms) and on discrimination, as assessed by *A′* (Donaldson, 1996). The analyses only showed a main effect of Domain on the corrected recognition performance, $F(1, 19) = 51.26$, $p < 0.001$; $\eta_p^2 = 0.73$, and a main effect of Domain on discrimination, $F(1, 19) = 34.36$, $p < 0.001$; $\eta_p^2 = 0.644$. Faces were therefore better recognized and discriminated than voices by both artists and controls (see Table 5).

	Faces				Voices			
	Artists		Controls		Artists		Controls	
Corrected performance	0.72	0.*20*	0.79	0.*16*	0.41	0.*22*	0.49	0.*22*
A’	0.91	*0.07*	0.94	*0.05*	0.81	*0.09*	0.83	*0.10*
B’’D	0.34	*0.62*	0.04	*0.52*	0.65	*0.39*	0.60	*0.29*
Semantic information	0.81	*0.18*	0.87	*0.16*	0.48	*0.32*	0.46	*0.16*
Name	0.63	*0.18*	0.70	*0.16*	0.41	*0.28*	0.40	*0.18*

Table 5. Mean Corrected performance (hit rates – false alarm rates), Discrimination (A’) and Bias (B”D) (rows 1-3); mean proportions of Semantic information and Name responses conditionalized on the hit rate measures (rows 4 and 5). Standard deviations are in italics.

The same 2-way ANOVA performed on bias (as assessed by *B''D*, Donaldson, 1996) also revealed a main effect of Domain, $F(1, 19) = 10.43$, $p < .01$; $\eta_p^2 = 0.354$, indicating that both artists and controls used more conservative decision criterion for voices than for faces. A further question was to assess whether faces and voices would lead to a differential access to identity-specific semantic information, and whether some differences between artists and controls might arise in this respect. Therefore, we performed 2 two-way ANOVAs with Group (artists *vs.* controls) as between-subjects factor and Domain (face vs. voice) as within-subjects factor, taking the retrieval of identity-specific semantic information and of the person's name, each conditionalized on the hit rates, as the dependent measures. A main effect of Domain indicated that significantly more semantic information was retrieved from faces than from voices, $F(1, 19) = 59.38$, $p < 0.001$; $\eta_p^2 = 0.758$, in line with previous findings showing a face advantage over voice regarding the retrieval of semantic information. Congruently, names were more easily accessed from faces than from voices, $F(1, 19) = 32.32$, $p < 0.001$; $\eta_p^2 = 0.63$. In sum, these results replicate previous findings that faces are easier to recognize than voices (see Brédart & Barsics, 2012). Importantly, there was no difference between artists and controls regarding the recognition of famous faces and voices nor in access to semantic and lexical information from these identity cues; both artists' and controls' performance was consistent with previous observations (Barsics & Brédart, 2012). Descriptive data are presented in Table 5.

4. General discussion

This study demonstrates for the first time that a population of artists specialised in portraiture shows enhanced face processing abilities. These artists, who devote a significant amount of time to observing and drawing faces, do not only report better face discrimination and recognition abilities than non-artists, but their subjective impression is, to a certain degree, supported by various objective measures. Three tasks involving perceptual discrimination of faces (i.e., CFPT, sequential matching and simultaneous matching of features/configurations) consistently showed that artists were more accurate than controls.

Besides finer perceptual skills, artists also displayed increased face recognition abilities. Indeed, artists recognized recently learned faces better than controls, as demonstrated with the CFMT-Australian. Results on the CFMT Long form did not reach significance despite numerically showing the same trend. The advantage shown by artists did not apply to recognition of celebrities' faces or voices, skills that draw on long-term memory.

Altogether, the face processing advantages displayed by artists seem to be tightly linked to the type of skills required for reaching a likeness when rendering a particular face. That is, fine perceptual discrimination skills, in order to perceive the defining facial information of a model or to compare the model and the rendering, and to some extent, good visuospatial working memory, to hold a facial element while it is reproduced (Cohen, 2005). Most artists report using life or photographic references when portraying a specific individual (at least when a certain level of facial detail is required) and for the most part do not rely on long-term memory. Actually, Cohen (2005) has shown that drawing accuracy is directly affected by gaze frequency to a reference picture, suggesting that reducing memory distortion by actually looking at the reference facilitates the rendering. He concluded that even though the process of drawing successfully relies more on perceptual discrimination abilities than on working memory, the frequent gazes directed at objects in the process of drawing might eventually lead to a better perceptual memory. One might reason that better perceptual abilities should lead to better encoding, and therefore to better long term memory, but our findings do not support this prediction. While this may hold true for face exemplars that an artist has studied, it does not necessarily apply to any face they have been exposed to.

Of important note is that portrait artists' superior perceptual abilities are not specific to faces. They also outperform controls when they discriminate houses in the sequential matching tasks and when they mentally rotate geometrical shapes. People in our sample reported spending at least a third of their artistic practice on other subjects (see Appendix). It therefore makes sense that the observation skills they use with faces also apply to other subjects. This idea is consistent with a study showing that artists display perceptual advantages tightly linked to their practice of drawing on a set of different perceptual tasks (Kozbelt, 2001).

One may ask how portrait artists and super-recognizers compare, and whether artists are in fact super-recognizers. Our portraitists only seem to perform in the same range as super-recognizers on the CFPT and seemed to do less well on the CFMT Long form (see Bobak et al., 2016; Russell et al., 2009). The very fact that artists did not do better than controls on famous face recognition could suggest that portraitists are not necessarily super-recognizers. The well-known portrait artist Chuck Close is also famous for being prosopagnosic, and he probably has a particular method for constructing his intriguing pixelated portraits. Contrary to super-recognizers then, the artists' better performance with faces is thus limited to tasks relevant to their occupation. Moreover, while artists' perceptual skills apply to other object categories, the abilities of some super-recognizers with other objects or with other perceptual tasks have only started to be documented (Bobak, Bennetts, Parris, Jansari, & Bate, 2016). Some show advantages specific to faces but others seem to display more general enhanced visual abilities and/or memory.

Another point of difference between our portrait artists and super-recognizers is that they did not demonstrate a greater face inversion than controls (see Russell et al., 2009). It could be that in artists, a larger face inversion effect associated with superior face perception abilities (Richler, Cheung, & Gauthier, 2011) is cancelled out by other mechanisms. For instance, a recent study on art students showed that they can, *as per task requirement*, switch more flexibly between global and local processing than the layman, as demonstrated with geometrical shapes or with Navon figures (Chamberlain & Wagemans, 2015). This ability to switch from global to local processing could apply to faces as well. The pattern of single fixations on specific features observed in a portrait painter while making a portrait - but not when interacting with the model before the painting session (Miall &

Tchalenko, 2001) - may illustrate this ability. This capacity to focus on single features could also explain why artists are less disrupted than controls by the alignment of incongruent faces in a face composite task (Zhou et al., 2012). If portraitists can isolate facial parts when needed and focus on specific features (e.g. top part of the composite face only) to compare faces, they would show less of the disruption created by holistic processing that 'blends' incongruent faces halves together in such a paradigm. Unfortunately, our attempt at assessing the type of information (i.e., featural vs. configural) artists and controls rely on to discriminate faces failed because of unexpected difficulty with the stimuli. Understanding what type of facial information portrait artists use, whether and how they can switch between a featural mode and a holistic mode of processing, and whether this skill can be trained, are fascinating questions that warrant further investigation, for instance by taking advantage of eye-tracking techniques. The outcome could prove useful for individuals with congenital prosopagnosia who seem to be restricted to a featural mode of face processing (Avidan, Tanzer, & Behrmann, 2011; Carbon, Grüter, Weber, & Lueschow, 2007).

The present study has some limitations. The first one is that we used a heterogeneous sample of educated or self-taught artists, and of professional or non-professional artists, for whom portraiture was not always the main activity. The faithfulness ratings provided by independent judges revealed a broad range of performance in terms of the physical resemblance between the produced drawings and the photographic model. One of our participants actually reported pursuing his passion for portraiture despite difficulties with face recognition in his daily life. Therefore, future studies could benefit from a stricter selection of experienced artists (e.g. professional portrait artists with a given level of experience and frequency of practice). Second, we only assessed long term memory for faces with one task involving famous faces, whereas we used several tasks to assess perceptual abilities and recognition from short term memory. This, combined with our small sample size, may have led to a failure to detect an existing advantage in artists. We chose this specific task because the celebrities matched the cultural background of our participants. Future studies could assess memory for familiar faces further with other existing tasks (e.g. before they were famous). Finally, our study is correlational in nature, because we did not manipulate artistic practice and levels of experience with faces. Therefore, we do not know whether artists were drawn to that activity because they were better at face perception in the first place or whether artists' advantages are a consequence of their activity. A favourable genetic background in terms of perceptual skills could make early artistic endeavours more rewarding and encourage some individuals to continue to practice, and to eventually pursue an artistic path. As pointed out by Gauthier and colleagues (2014), the development of expertise with specific visual stimuli may be facilitated by an interaction between a certain genetic background and practice. A promising way to determine whether the practice of portraiture can fine-tune face processing skills would be to conduct a longitudinal study that assesses face processing abilities of aspiring artists before and after they undertake extensive practice of portraiture.

In conclusion, we assessed a range of face processing abilities in portrait artists showing that their super specialisation with faces advantages them, but only for face processing skills that are relevant when rendering a face, namely perceptual discrimination and short-term visual memory. Artists and controls showed comparable levels of performance on a task that draws on long term memory. These results illustrate the need to further investigate individual differences in conjunction with the impact of specific visual experience with faces to better understand variability in face processing abilities.

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Appendix

Portraiture practice (years)	8.55	*5.15*
Estimated time devoted to representing faces (%)	62.18	*23.47*
Estimated time devoted to portraiture (%)	33.36	*18.42*
Mean likeness targeted with faces (1-7)	6.27	*0.79*
Mean realism targeted with faces (1-7)	5.27	*1.19*
Mean likeness targeted with non-faces (1-7)	5.27	*1.19*
Mean realism targeted with non-faces (1-7)	5.09	*1.22*

Table A. Mean artists' estimates regarding their artistic practice. "Estimated time devoted to representing faces" refers to the percentage of total drawing/painting time devoted to representing faces in general, which includes portraits and instances where new faces are created from imagination. "Portraiture" refers to the drawing/painting time devoted to portraiture in particular, namely the act of specifically representing existing persons, from a reference or from memory, with likeness in mind. Likeness and realism targeted when drawing faces or other subjects (e.g. objects, landscapes) were rated on 1 (very low) to 7 (very high) points Likert scales. Standard deviations are in italics.