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Does Regular Visual Art Training Enhance Visual Memory Capacity and Enable Young Adults to Outperform in Face Recognition?

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Abstract: Specialists usually tend to noticeably outperform others who are novices in that field. Numerous studies suggest that portrait artists who are experts in outlining and recognizing human faces develop more advanced visual working memory. Whether systematic artistic training could strengthen a person's visual memory ability particularly in face memory is therefore worth investigating. Thus, in an attempt to find the correlation between regular artistic training and visual working memory in face memory ability, 22 random samples were collected twice to complete a self-evaluation survey and a set of face memory test. The outcome indicates no statistically significant difference of face memory ability between regularly trained arts students and novices. However, due to several practical concerns, it's worthwhile to conduct further studies to eliminate these issues and hence give evidence to support the study result.

Keywords: face memory ability, face recognition, regular artistic training, super-recognizers, visual working memory.

1. Introduction

Receiving pleasantries from a person with a very recognisable face but having no memory of who he is is usually an awkward situation. It's also fairly uncommon for a person's face and name to be mismatched. However, these would rarely happen for some super-recognizers, who are able to memorize a face firmly and recall it consistently. How do these people become super-recognizer is a question of interest. Despite genetic reasons, it's also worthwhile to investigate whether face memory ability can be enhanced through acquired training.

Some studies have suggested that visual working memory is positively associated with systemic artistic practices. Specifically, portrait artists, who have trained and being expertised in faces, showed better perceptual skills and face processing ability than controls [1]. One possibility could be that artists present stronger abilities on observing internal facial features and capturing the key components [2], and eye tracking studies of portrait drawing artists have shown that they intend to gather visual information detail by detail instead of capturing holistically [3,4]. However, speculations on whether face recognition and memory are enhanced arise, for which other findings suggest that adults' facial recognition ability has reach a peak, and hence few improvement could be

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obtained from training [5], and also study result illustrates that artistic training has no impact on face memory in middle-age adults [6].

Many studies have been conducted to examine the relationship between artistic practices and face processing abilities among professional portrait artists, however, few studies have concentrated on whether the face memory ability of art-major college students (young adults) with comparatively shorter artistic training time-span is possibly better than non-art major college students. Art students showed smaller holistic processing than ordinary participants when disrupted by composite faces [7]; on the contrary, studies demonstrate that no obvious disparities occur in face memory ability between art and non-art students.

This study aims to discover if there's a correlation between regular visual arts training and visual working memory capacity particularly the face recognition ability for young adults. Based on reliable studies and empirical evidence, an hypothesis that regular visual art training can enhance visual memory capacity in individuals, thereby enabling them to outperform their peers in the recognition of faces is made.

2. Method

2.1. Participants

Participants were recruited to complete an online study, which included an adapted version of the Stirling Face Recognition Scale [8] and a face memory test (CITE)-Cambridge Face Memory Test(CFMT).

22 participants (11 experts, in which eight females, two males, and one not prefer to say; 11 non-experts, in which seven females, four males) are invited to complete the self-evaluation survey - SFRS. These participants were selected based on whether they are professionally learning in arts college or not, and they are divided into two groups, "Experts" if they have been professionally studying arts for more than one year, and "Non-experts" if subjects have studies arts for less than one year.

2.2. Stirling Face Recognition Scale

The SFRS included subjective questions about one's experience associated with their face recognition ability. The scale comprised of 20 specific questions related to the individual's daily face recognition and memory experiences and their self-rated face recognition ability.

The survey included ten positive and ten reversed questions (predominantly adapted from the PI-20 questionnaire) aiming to include multiple questions that consider to both the low and high end of the face recognition spectrum. Each question is scored from 1, if the participant totally disagrees with the statement, to 7, if the participant totally agrees the statement, by all participants.

Additional demographic questions were added to the SFRS including age, gender, and years of systematic art training. Participants also completed the objective Cambridge Face Memory Test (CFMT) to determine the relationship between face memory and level of visual art training.

2.3. Cambridge Face Memory Test (CFMT)

After finishing the set of questions, participants are required to complete the online Cambridge Face Memory test- original (CFMT). The faces contained in CFMT are all white (same race). In the test, three phases are involved: at phase one, learning stage, participants have to learn one target face at a time, six different faces in total, from left, front, and right angles each for five seconds; at phase two, test stage, participants select the target face from three different faces. Participants were invited to complete the test individually.

There are three levels, from the easiest, where faces are shown with normal and identical light settings in phase one and phase two, to the middle level, where faces are shown in different light settings in phase two, to the most difficult, where noises are introduced as distraction on faces (Figure 1).

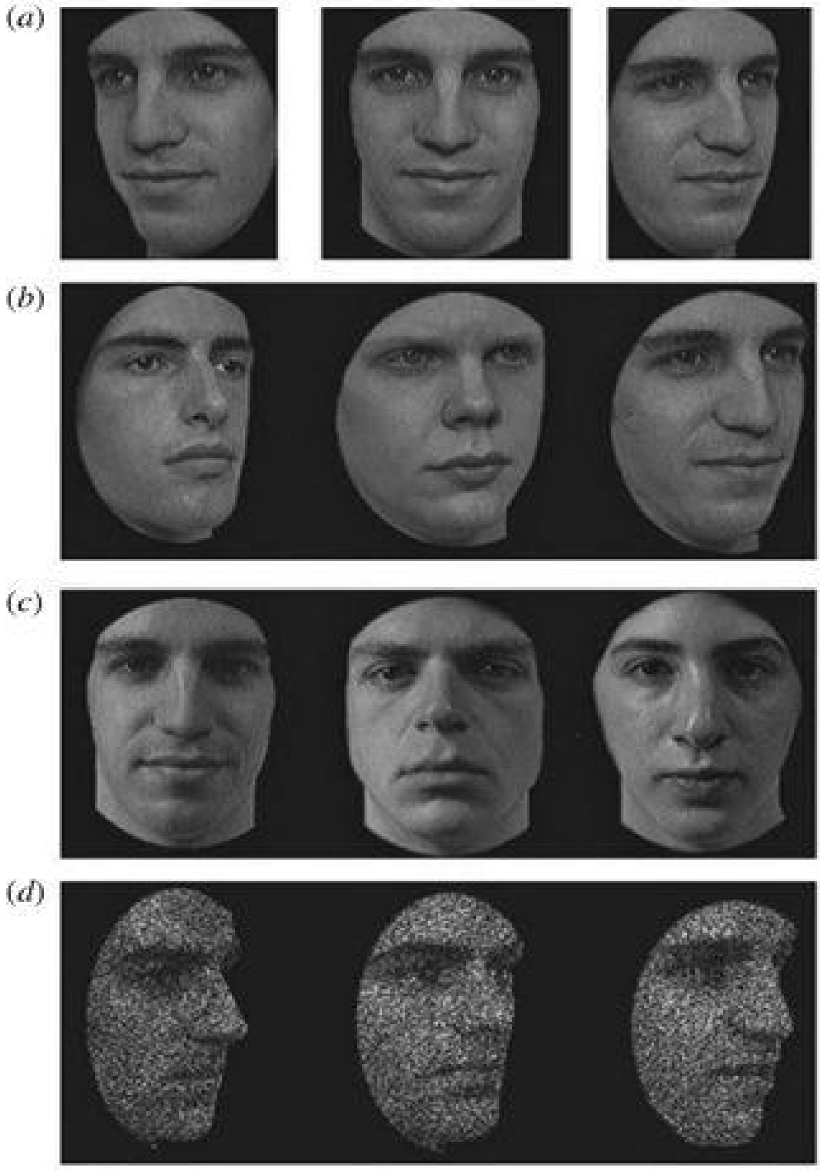


Figure 1: Examples of three levels in the CFMT [9].

Note. participants are required to remember a total of six different faces represented similarly in part a) and then select the target face from options similar to part b). Part c) is an example of the middle level of the test, where lighting on the faces is different from that in part a). Part d) is an example of level 3, faces are noised.

However, only seven out of eleven experts and two out of eleven non-experts complete CFMT. Additional four experts and nine Non-experts were selected to complete the CFMT in an attempt to address the imbalance of data.

3. Results

The data indicates in the scale, experts tend to score lower in the positive items (table 1) while score higher in the reverse questions (table 2); conversely, experts achieve higher average CFMT score than non-experts in our sample, implying experts present a more conservative self-evaluation than the non-experts.

Table 1: Experts and Non-experts rates in positive questions.

Question	Experts	Non-experts
Q1	5.18	5.09
Q3	5.09	5.27
Q5	3.55	4
Q8	5.91	6
Q9	4.73	6
Q11	4.36	4.27
Q13	4	4.73
Q15	3.64	5.09
Q17	4.64	5.45
Q20	3.82	5.18

Note. higher scores in positive questions indicate participants' self belief of better performances in face memory ability

Table 2: Experts and Non-experts rates in negative questions.

Question	Experts	Non-experts
Q2	2.55	1.82
Q4	1.82	1.64
Q6	2.55	2.18
Q7	2.91	1.91
Q10	3.09	2.27
Q12	2.09	2.18
Q14	2.82	2.73
Q16	2.73	1.73
Q18	2	1.73
Q19	2.73	1.64

Note. lower score in the reverse questions suggests participants believe they perform better in face memory.

An Independent-samples t-test was performed for the positive items and reverse items in the survey separately.

The difference of mean scores for all positive questions combined is -0.0618 (4.491 for experts and 5.109 for non-experts). The independent-samples t-test revealed that true mean score of positive questions for experts is not statistically significant than that of non-experts. ($\mathrm{t-statistics} = 1.397$, $\mathrm{P-value} = 0.186$). Also the 95 percent confidence interval, $95\%\ \mathrm{CI} = (-1.573, 0.336)$, contains 0.

The independent-samples t-test for all reversed questions combined also reveals no apparent, statistically insignificant result for the true mean score difference. ($\mathrm{mean} = 0.275$, $\mathrm{t-statistics} =$

1.151 , P − value = 0.271). The 95 percent confidence interval contains 0, 95% CI = (− 0.480,0.571), which further indicates statistical insignificance.

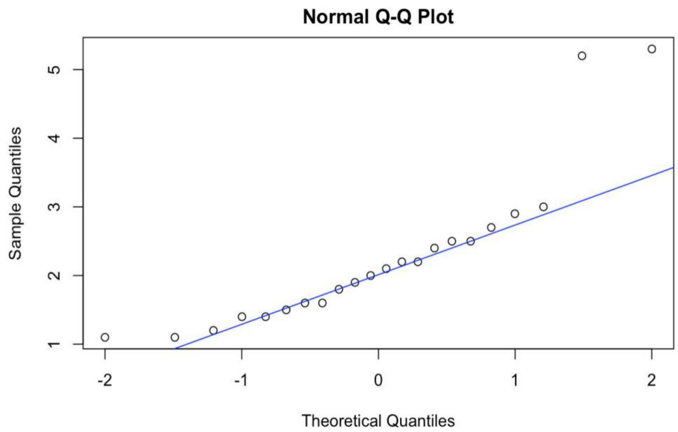
An independent-samples t-test is also used to examine whether the true mean CFMT scores for experts is higher than the true mean CFMT score of non-experts. The result shows no statistically significant difference between the population mean scores. ($t = 1.259$, $p - value = 0.223$, $95\%\ CI = (-0.046, 0.186)$)

4. Discussion

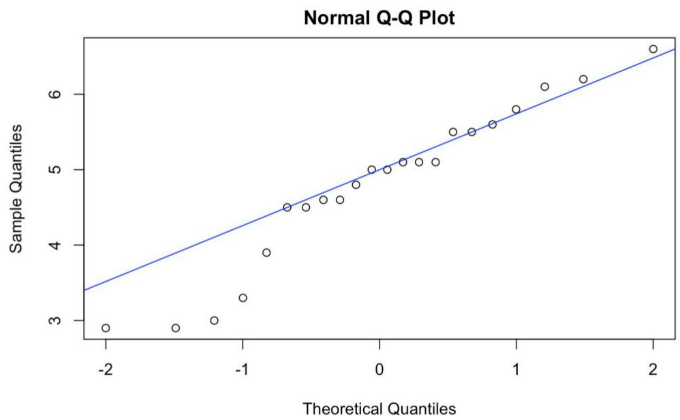
Based on above results, there seems to be no correlation between regular visual art training and visual working memory. However, several potential problems should be considered before interpreting the test result.

4.1. Sample Size

The samples we collected are limited (only 22 participants in each section), which would possibly be less accurate than tests done using more data. Although a normal distribution is checked and assumed for all scores, there are some obvious outliers in the qqnorm plot (figure 2, figure 3). We have no clue whether there's any problem with heteroscedasticity and whether the scores would be related to regular arts training if transformation is(e.g. log, square root, etc.) applied to the dependent variable (it would be possible to see non-linear relationship between the IV and DV).



(1)



(2)

Figure 2: QQplot for scores of positive questions(1) and negative questions (2).

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Note. the QQplot shows three outliers, one at the low end and the other two at the high ends are off

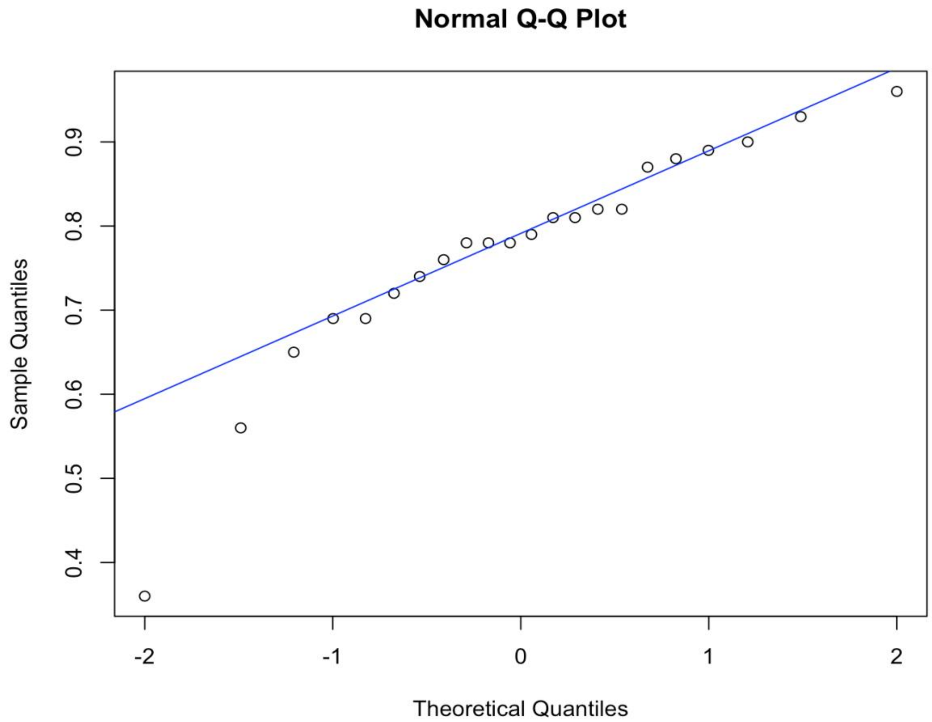

Figure 3: QQplot for CFMT scores Note. two outliers in the low end, the one at the lowest sample quantile is much more distant from the line than any other scores in the plot.

the line

Note. in (2) five outliers all in the low end are obviously off the line

4.2. Sampling Scheme

Majority of samples are collected using Availability sampling and Snowball. Therefore, there would be bias since these participants may share some characteristics that are not representative enough to the whole population, e.g. participants grouped as "experts" are majorly arts students studying in the UK and US, so places of studying could be a potential confounding variable that affects the outcome.

4.3. Imbalance Between Samples

It's noticeably that in the survey, experts are majorly females, while in the CFMT, all experts are females. However, in the non-experts group, the gender balance is well controlled for the CFMT. Consequently, when analysing the true mean scores difference, gender acts as a confounding variable, so it's not rigorous to compare the outcome when apparently a third variable is affecting the DV as well. However, gender is controlled and only females outcomes are compared across groups, a severe issue of limited sample size arise.

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4.4. Other Race Effect (ORE)

All participants are Asian international students, so the CFMT-original may not provide an accurate scale of face memory ability since all faces shown in the test are whites. Stelter and Degner pointed out in a study that individuals facing outgroup faces perform worse than facing ingroup faces in multiple visual working memory tasks [10]. Hence, the result we gathered might be affected by ORE and therefore not reflect the true face recognition ability.

4.5. Survey Subjectivity

In the survey, positive questions and reverse questions are mixed randomly, so it would be possible that some participants misunderstood the questions or mistakenly reversed the scales. This could be problematic because rating incorrectly could alter the mean score as our sample size is very limited.

In the survey, non-experts generally reported a higher score than experts in the positive questions and a lower score than experts in the reverse items. Conversely, non-experts, when looking at the score distribution boxplot (figure 4), generally reached a lower score in the CFMT.

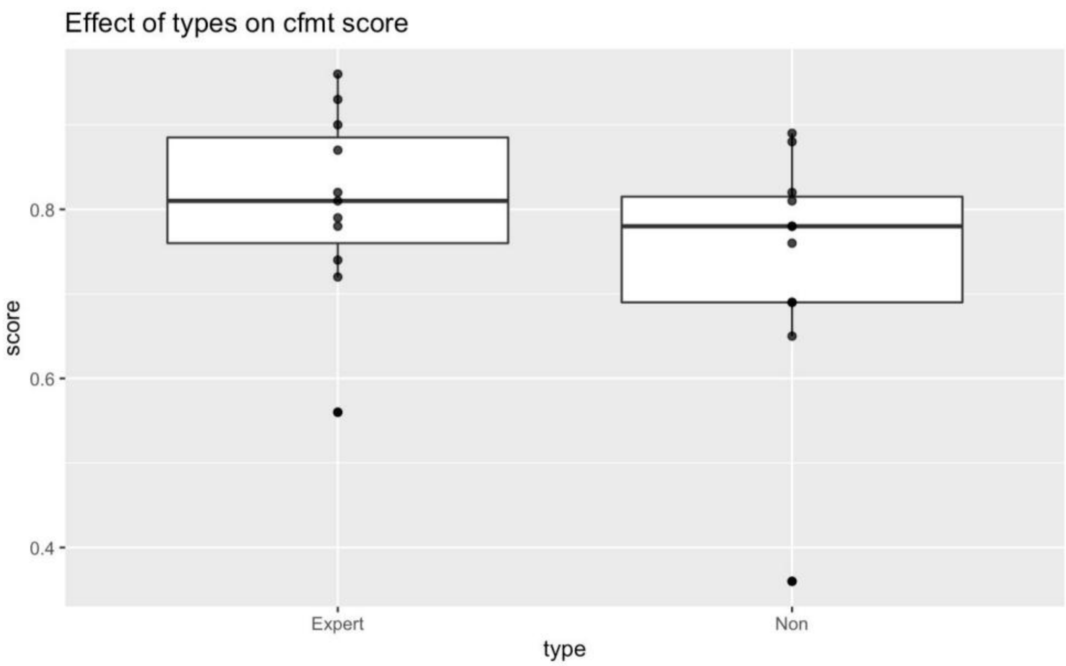

Figure 4: CFMT scores distribution.

Note. the median in the boxplot for type “Expert” is higher than the median for type “Non-expert”, indicating half of all experts achieve higher score than the non-experts. Also notice that both groups have one low-end outlier.

This divergence leads to further questions regarding whether participants accurately reported their face recognition ability in the survey, and how much insight these participants have in the face recognition ability evaluation. Study conducted by Bobak et al gave evidence that “young adults have only moderate insight into their FRA, but those who have been previously informed of their (exceptional) performance, the SRs, estimate their FRA accurately.” [11] Consequently, this finding would reasonably deduce that some participants in the study felt more confident in their FRA and hence reported higher scores “by accident” than their true FRA, and thus using the self-evaluation questionnaire as the exclusive measure would not be accurate and reliable.

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Another noticing point is the divergence between statistical insignificant result we found and the result from previous studies, which indicate portrait artists can better recognize a face. Therefore, whether there's indeed no effect between face recognition and memory and regular arts training or any impacts that we didn't capture in the study is worth questioning. One possibility supporting we fail to capture the effect is that in our sample, experts are largely females (particularly all experts are females in the CFMT scores analysis). Male adolescents outperformed female adults on visual episodic and visual working memory measures [12]. And hence we would deduce that, if, males and females were balanced in the survey data and CFMT data, then there would be a discrepancy between the true mean scores for all three measures after proper statistical testing.

5. Conclusion

This study is mainly interested in exploring whether artistic training enhances young adults' face recognition ability. 22 participants are selected to complete a face recognition ability self-evaluation survey, and 22 participants are sampled to have objective Cambridge Face Memory test. However, the t-test comparing mean difference in neither evaluation showed significant discrepancy in face recognition ability between art students and non-art students. Problems of non-representativeness in availability sampling, survey subjectivity, and other race effect are issues we need to have further considerations.

5.1. Cambridge Face Memory Test - Chinese (CFMT - Chinese)

Since all participants we have are Asian students, but data about how long they have stayed abroad is lacking. However, it could be possible that some of participants have lived or studied abroad for more years than others so they have a longer time period accessing to white faces, which could possibly exert a positive impact on the performances of those subjects in the CFMT - original. Therefore, using a CFMT - Chinese, where only Chinese faces are presented in the test, would be adjust for this confounding effect, and hence provide a more accurate and reliable reflection of participants' real face memory skills.

5.2. Record Accuracy in Each Difficulty Level of CFMT

In this test, three levels (detailed discussion in the method section) are involved, but the final result only gives an overall accuracy. Therefore, any possible difference between the performances of experts and non-experts in each difficulty level is ignored. Although previous studies suggested that artists changed facial features-viewing strategies after a session interaction[13], it's reasonable to assume that the performance gap between specialists and non-experts, as measured by score difference, is widening throughout levels, as changed lighting and noise may operate as potential distractions: the disparity may be to moderate in the first two levels, but the accuracy rate of specialists might be much greater than that of non-experts in the third level. Studies showed that "the artistically untrained participants showed preference for viewing human features and objects, while the artists spent more scanning time on structural/abstract features" [14]. Additionally, face processing (e.g., eyes, nose, and mouth) could account for a considerable fraction of the unexplained variation in face appearance recognition [15].

Therefore, further investigations would be worthy to give evidence whether there's true discrepancy between experts and non-experts visual working memory in face memory.

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