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To cite this version:
Luca F. Ticini, Laura Rachman, Jerome Pelletier, Stephanie Dubal. Enhancing aesthetic appreciation by priming canvases with actions that match the artist’s painting style. Frontiers in Human Neuroscience, Frontiers, 2014, 8, pp.391. 10.3389/fnhum.2014.00391. hal-01320218

HAL Id: hal-01320218
https://hal.sorbonne-universite.fr/hal-01320218
Submitted on 23 May 2016
Enhancing aesthetic appreciation by priming canvases with actions that match the artist’s painting style

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INTRODUCTION
Perceptual, cognitive, and affective evaluations contribute to the aesthetic experience of a work of art (Cela-Conde et al., 2004; Kawabata and Zeki, 2004; Vartanian and Goel, 2004). Although much research has focused on reward-related brain regions involved in artistic preference (above all the orbitofrontal cortex; Jacobsen et al., 2006; Ishizu and Zeki, 2011, 2013; see also Ticini and Omigie, 2013), the role of other brain structures has remained thus far poorly explored. Here, we investigate the contribution of motor areas to aesthetic experience, a topic of very wide interest (Freedberg and Gallese, 2007). Several neuroimaging experiments have shown that the perception of artworks elicits motor activity in the observers’ brain without fully clarifying its role in aesthetic experience (Kawabata and Zeki, 2004; Cela-Conde et al., 2009; Cross et al., 2011; Ishizu and Zeki, 2011, 2013; Cross and Ticini, 2012; Umiltà et al., 2012; Sbriscia-Fioretti et al., 2013). Indeed, on the one hand, motor activity may simply be triggered by a covert approach or avoidance response related to the emotional nature of the artwork, as it has been shown for other types of stimuli (Hajcak et al., 2007). On the other, some have hypothesized that it may represent the covert and involuntary simulation of the artist’s gestures when viewing a work of art, signs of which may be present on the canvas in the form of brushstrokes (Freedberg and Gallese, 2007). Whether the latter interpretation is correct and whether motor activity contributes to the aesthetic experience at all, is still unclear.

We recorded the preference of naïve individuals for 90 high quality reproductions of pointillist-style paintings presented under conditions specifically designed either to be compatible or not with the actions required to produce them (as established in associative training conducted beforehand, see Materials and Methods). Each painting was preceded by a supraliminal priming consisting of a static image depicting a hand either holding a paintbrush with a precision (Compatible) or a power grip (Incompatible). A hand resting palm down on a table was used as baseline (Control). We hypothesized that if action simulation is causally involved in the affective response to art, subjects would like the artwork in the Compatible condition more than in the other two conditions.

MATERIALS AND METHODS
PARTICIPANTS
Twenty naïve healthy right-handed individuals (13 females; mean age = 24 years) participated in the study. They were all naïve to the purpose of the investigation and with normal or corrected-to-normal vision.

STIMULI
Stimuli consisted of 90 high quality color images of pointillist-style paintings (Table 1). Thirteen individuals (7 females; mean age = 27.9 years) who did not participate in the study pre-selected them among 200 canvases according to their style: pointillist-style, stroke-style, or otherwise. 90 images indicated as pointillist-style paintings by at least 10 out of 13 subjects were chosen for the experiment. Furthermore, three right gloved-hand images (holding a paintbrush with a power or a precision grip, or rested palm down) were used in the sensorimotor training (see Visuomotor Training) and as...
supraliminal priming images in the experiment (see Painting Observation and Liking Rates). All images were adjusted to the same size ($470 \times 351$ pixels) using Adobe Photoshop and presented on a screen with a resolution of $1280 \times 800$ pixels, at $55\,\text{cm}$ distance to subtend $12^\circ$ horizontal and $9^\circ$ vertical visual angles.

### VISUOMOTOR TRAINING

We first established an association between the participants' own movements and the creation of pointillist-style or stroke-style paintings. To achieve this, we presented the participants with one out of three right gloved-hand images (Figure 1A) displayed on a screen (in random order, for 10 s, 6 times each) that served as
instruction for the subjects to perform the desired training with the right hand.

The image of the hand holding a paintbrush with a precision grip instructed the participants to paint dots by executing stippling movements while holding the paintbrush with the precision grip (Figure 1B). The image depicting the hand holding a paintbrush with a power grip instructed the participants to paint strokes of about 10 cm by holding the paintbrush with a power grip (Figure 1C). The image depicting the hand rested palm down instructed the participants to position their hand palm down on the table. Task completion was supervised by the experimenter. The training was repeated before the first, third and sixth primed trials. Due to the numerous unconfirmed ratings (≥ 10%) two participants were excluded from further analysis. In the remaining 18, a total of 3.25% of unconfirmed ratings was excluded.

PAINTING OBSERVATION AND LIKING RATES

After the visuomotor training, participants observed the 90 pointillist-style paintings preceded by one of the three images (700–1000 ms, randomly presented) depicting a right gloved-hand holding a paintbrush with a grip that supraliminally primed actions (for studies investigating how hand images prime actions see Borghi et al., 2007) that were either Compatible (precision grip) or Incompatible (power grip) with the drawing of pointillist-style paintings (Figure 2A). A palm down image served as Control. Each painting was presented three times, in nine randomized blocks (of 30 trials each) preceded by a different priming image. After 500 ms, the participants rated the paintings by moving a dot along a 9-point Likert-type scale displayed below the painting for 2500 ms (from “I like it very much” to “I do not like it at all,” direction counterbalanced across subjects) by left ring and index finger key-presses. Choices were confirmed by middle finger key-presses. A 1000 ms blank screen completed each trial. Upon completion of the experiment, the participants were debriefed to assess their familiarity with art by using an art questionnaire adapted from Chatterjee et al. (2010) by excluding questions 1–3 due to differences between the France and USA education systems. A median split (median of the Sums = 5.5) of the questions in Table 2 separated the participants into art-familiar and art-unfamiliar groups composed of nine participants each.

DISCUSSION

In this behavioral study we show that the aesthetic appreciation for pointillist-style paintings is enhanced by presenting supraliminal action priming images that are congruent (Compatible condition) with the style required to create those paintings. How can the priming modulate liking ratings of passively observed canvases? We believe that the congruent priming facilitated the covert simulation of the brushstrokes present in the paintings, thus yielding to higher ratings. This interpretation is consistent with the hypothesis that motor structures have a role in aesthetic and particularly that involuntary painting simulation contributes to aesthetic appreciation (Freedberg and Gallese, 2007; Leder et al., 2012; Umiltà et al., 2012). In agreement with previous work (Umiltà et al., 2012), our results also suggest that this effect is independent of familiarity with art. Nonetheless, since all participants were not actively engaged in creating artwork (see Question
Kalenine, 2010) may have facilitated the most functional and action needed to manipulate the paintbrush (see Buxbaum and it is plausible that the implicit knowledge about the correct mechanisms not necessarily involving painting simulation. For instance, when they match (or not) the style of the painting (Leder et al., 2012). When they are directly observed as well as when they are represented as static pictures (i.e., images depicting body movements, see Mado-Proverbio et al., 2009; Urgesi et al., 2010), and particularly when they are hidden from view and only their sound (Ticini et al., 2012) or their traces (Longcamp et al., 2003) are perceived. For instance, there is evidence that observation of hand written letters triggers activity in motor areas involved in writings (Longcamp et al., 2003; see also Ticini, 2013), and particularly that learning to write facilitates the visual recognition of letters through the participation of brain areas known to be activated by the execution, imagery and observation of actions (Longcamp et al., 2008). Our result is supported by these and more recent behavioral findings reporting that the direction of observed brushstrokes affects participants’ response speed in reaction time experiments (Taylor et al., 2012) and that active execution of movements increases (or decreases) the viewer’s liking ratings when they match (or not) the style of the painting (Leder et al., 2012).

These results could be also explained by alternative mechanisms not necessarily involving painting simulation. For instance, it is plausible that the implicit knowledge about the correct action needed to manipulate the paintbrush (see Buxbaum and Kalenine, 2010) may have facilitated the most functional and effortless motor program to grasp a brush in order to create pointillist-like paintings. This would be in accordance with the idea that fluency in stimulus processing can influence aesthetic responses, as well (Reber et al., 2004). Moreover, unlike in Leder et al. (2012), we cannot exclude that self-observation of one’s own’s hands during the training may have strengthened visuo-aesthetic (instead of visuo-motor) associations between the hand grip and the painting style. We also cannot exclude that the prior training alone could be sufficient to enhance the ratings as a result of an exposure effect, without the need of priming images presented before each painting.

In conclusion, we here provide empirical evidence that, beyond other factors such as upbringing, historical context and nature of the artistic stimuli, covert painting simulation may influence affective responses to art (Freedberg and Gallese, 2007). Although we cannot fully rule out alternative explanations, we suggest that the contribution of motor areas may be fundamental for the attribution of the hedonic value to some objects of art. Since simulation appears pivotal for understanding the actions and emotions of others, one important area of future research

![FIGURE 2](image-url)
will be to characterize its influence on affective centers beyond the domain of artistic preference. Obtaining a better understanding of the contribution of action simulation in affective states is likely to shed light not just on how the brain encodes affective stimuli but also may enrich our perspective on the neural mechanisms involved in some social and communicative deficits associated with action simulation, such as autism spectrum disorder (Oberman and Ramachandran, 2007).

ACKNOWLEDGMENTS

The authors wish to thank A. Berthoz, H. Leder, M. Nadal, and the reviewers for their insightful comments. This work was supported by the French National Research Agency (ANR-10-CREA-005).

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Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Received: 16 December 2013; accepted: 16 May 2014; published online: 03 June 2014.

Citation: Ticini LF, Rachman L, Pelletier J and Dubal S (2014) Enhancing aesthetic appreciation by priming canvases with actions that match the artist’s painting style. Front. Hum. Neurosci. 8:391. doi: 10.3389/fnhum.2014.00391

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