Article

Interpretation of modern art masterpieces: no motor reflection

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SUMMARY: *In the article we present conceptual counter-arguments to the embodiement role claim, even when motor areas of the brain are activated and, as a pilot case, resume and reproduce the experiment at the base of one of the seminal work about mirror neurons and neuroaesthetics, slightly modifying its measurement protocol and considerably increasing its statistical population. This new study suggests that the aesthetic experience is so strongly affected by cultural and experiential backgrounds of the beholder that somato-motor resonance effects, if any, seem to be undetectable and, so far, unprovable. Recent trends in neuroaesthetics postulate a nexus between dramaticity, sense of movement, in static works of visual art, beholder's aesthetic experience and embodied simulation mechanisms, the rationale being an asserted twofold motor resonance induced in the observer by the dynamic content of the works and by recognizable traces of the artist's creative gestures. Trying to cope with the effects of the subjective cultural conditioning, some pioneering studies have focused on the beholder's differential response to works of abstract art compared to less motor-evocative, computer-made images. Using the same method reported by Umiltà et al. (2012) in Frontiers in Human Neuroscience, as a major result, those investigations don't contradict the embodied simulation hypothesis but they also don't prove it definitively. Here the authors present conceptual counter-arguments to the embodiement role claim, even when motor areas of the brain are activated and, as a pilot case, resume and reproduce the experiment at the base of one of the seminal work, slightly modifying its measurement protocol and considerably increasing its statistical population. This new study suggests that the aesthetic experience is so strongly affected by cultural and experiential backgrounds of the beholder that somato-motor resonance effects, if any, seem to be undetectable and, so far, unprovable.*

KEY WORDS: *Embodied simulation, Experiment, Falsification, Mirror neurons, Neuroaesthetics.*

INTRODUCTION

Apart from their possible top-down relationships, theoretical neuroaesthetics[19,23], embodied simulation[9] and mirror neuron system[20] share several common points as cognitive paradigms in that, they all try to put in relation neurophysiological evidence with superior concepts which, from the bottom up, can be summarized as action goal understanding (assuming neuronal motor resonance), building-up of high level mental constructs like empathy and language (assuming cognitive representations that are bodily rooted in the motor and perceptual system) and aesthetic experience (assuming balanced network cooperation involving functionally specialized areas of the brain). Also, all these three theories are quite

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y1 y2 ***LIST OF ACRONYMS AND ABBREVIATIONS:*** ANOVA = Analysis Of Variance; EEG = ElectroEncephaloGram; **EMG = ElectroMyoGraphy;** **F = manca???**; HSD = honestly significant difference; MNS = Mirror Neuron System; **MS = manca???.**

recent; they face similar epistemological problems, exemplified by the difficult applicability of the falsification criterion[5,12,15,18]; finally, they are trendy due to the apparent simplicity of the mechanisms they postulate.

In 2007, pivoting on the concept of empathy, a seminal work[7] explicitly connected for the first time neuroaesthetics, embodied simulation and MNS. In that occasion two major ingredients where claimed to participate in the build up of the aesthetic experience in front of visual works of art: first, "the relationship between embodied empathetic feelings in the observer and the representational content of the works" (*sic*); second, "the relationship between embodied empathetic feelings in the observer and the quality of the work in terms of the visible traces of the artist's creative gestures" (*sic*). While that work "did not suggest that the activation of mirror or canonical neurons was sufficient for esthetic appraisal or for judgments about artworks"[2,7], nevertheless it put embodied simulation at center stage, differentiating between "aesthetic appraisal", "aesthetic attitude", "aesthetic experience" (where embodiment should occur) and "aesthetic judgment"[1,6].

In the wake of such claims and in an attempt to uncouple as much as possible cultural and experiential factors from those ones attributed directly to the embodiement mechanism, subsequent investigations concerned the case of non-figurative art or of comparable visual works, for which one could expect a sharpest evidence for at least the second, supposed, ingredient, that is a motor resonance evoked in the beholder by the traces left by the artist in her creative act (affecting, for instance, brushworks style, patterns or trajectories). In this line of research, here are recalled three significant researches that deal with the differential experience that could arise during the observation of both true hand-made visual works and some not human reproductions of them. The first one[22], in the following referred as the "reference work", focused on artworks of the artist Lucio Fontana, compared with some simplified computer-graphics replicas; in this case up to 14 volunteers, exposed to random sequences of originals and simplified copies, were recorded by means of EEG, EMG and an ad-hoc questionnaire; following ANOVA calculations showed significant correlation between originality of the image, activation of motor related area of the brain and subjective perception of "amount of movement" inside the image and its "artistic nature". The second investigation[4] focused on robot-made abstract drawings and their hand-made counterparts made by a sculptor and by a computer-graphics artist; differentiating from images with salient kinematic cues or not (based on the presence of geometrical shapes that are hard to naturally reproduce by hand, as the case of complete circles), ANOVA calculations concerned the answers of 12 volunteers about the guessed human or robotic nature of the sketcher; in this case the correct recognition of the maker type was found to be highly correlated to the absence of geometric salient cues but, even if at a minor extent, also to the presence of subtle kinematics cues (such as smudging in the sketch). In a similar fashion, but in a slightly different context, the third investigation here recalled[16] focused on the recognition of hand-written and typed alphabet letters; in that case, measurements on 11 volunteers clearly showed correlation between changes in the MEG oscillatory activity originating from the motor cortex and changes in the nature of the displayed letters.

All these three investigations appear to show an enhanced activation of motor related areas of the brain when the observer is exposed to clearly hand-made works and they seem not to rule out a possible role for the embodiement mechanism in the aesthetic experience. Nevertheless, till now no satisfactory and uncontroversial explanation has been advanced for the operating details of this mechanism. Even worst, a quite lively scientific community disagrees also with some core claims of the embodied simulation and MNS theories themselves[3,10,14,16].

On the basis of experimental, conceptual and epistemological issues, the author endorses this criticism and he highlights two major problems with embodiement theories. First, low level neural mirroring and high level cognitive experiences belong to different domains that can relate to each other only through matching functions that till now no one has been able to detail. Second, even if many of the pertinent claims seem to rely on experimental results, they appear to fail or at least ignore falsification methods (even when in weak form).

(For a better comprehension of the problem the reader can be see a similar experiment[17] where "The Adoration of the Mystic Lamb" of Jan van Eyck and "Concetto spaziale" of Lucio Fontana are compared on the basis of the theory of mirror neurons, the first, on the basis of simple neuronal plasticity, the second). In order to submit the hypothesis of the embodied aesthetic experience to a falsification test, the author performed an independent verification of the results obtained in the reference work. Pivot of this current investigation is the possibility that the cultural and experiential attitude of the beholder could overwhelm any motor attributable mechanism in her aesthetic experience (rationale: if these were the case, the claim of the embodied simulation applied to art would have been yet to be proven).

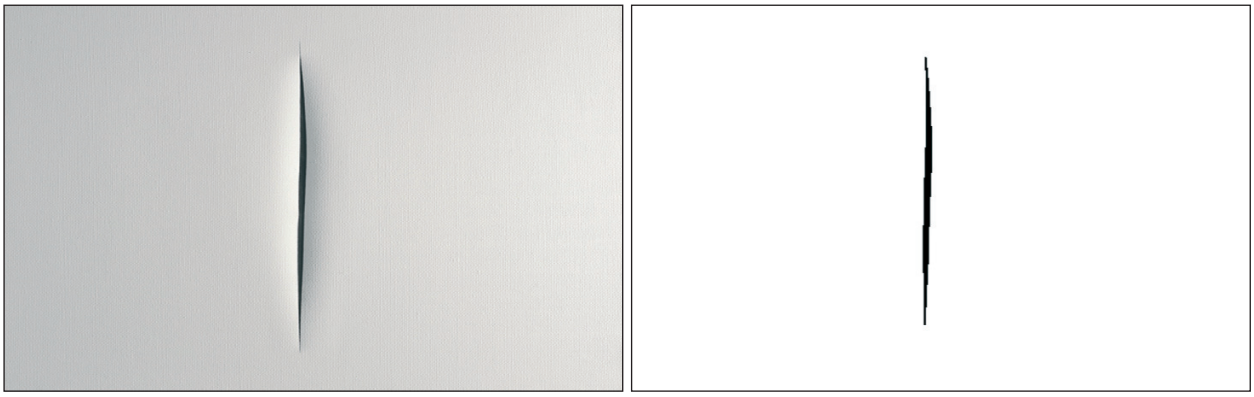
In this new research only the questionnaire survey was considered, although in a slightly modified version, while special care was taken of the selection of a wider population of volunteers, differentiated by their personal background. Instead, no EEG or EMG recordings were taken, due to their squareness to the scope of this work and the above cited controversial relationship between such measurements and the true role of mirroring mechanisms. This experiment takes for example in its methods the seminal works of Parma's Group to allow us to falsify them really; otherwise the work would have expressed conclusions but not the falsification of previous ones'. As a major result, this work clearly shows the importance of the cultural and experiential attitude of the beholder in hiding any supposed effect due to empathetic motor resonance with the artwork and, through it, with the creative act of the artist.

□ METHODS

■ **Participants.** Two groups of volunteers participated in the experiment. The first one included ninety-six healthy subjects, equally represented by gender and of comparable age (mean: 18.03 years), coming from different high schools according to an equal partition between art students, building surveyor students, mechanical students and students of professional institutes, the latter ones (vocational students) without specific skills in art and design; in detail: 24 students, twelve female and twelve male, for each school type. The second group included fourteen healthy subjects (seven females and seven males, mean age: 28.28 years) recruited with no explicit care to their cultural background but in analogy with the protocol followed in the reference work.

The study was ethically approved by the managements/ethical commitees of all the high schools involved and of the University of Udine; all experiments were performed in accordance with relevant guidelines and regulations; informed consent was obtained from all participants; all the collected data (questionnaires, recordings, images) was processed and stored in a strictly anonymous way, irreversibly hiding the identity of the involved subjects.

■ **Procedure.** Apart some improvements, highlighted in the following, the experimental protocol was a strict replica of the one exhaustively described in the reference work. Accordingly, participants were exposed to random sequences of abstract images displayed on a 60 cm far, 17-inch size screen. Each image (stimulus) was shown for 1000 ms preceded by a start marker (a sub-sequence consisting of a 4500, 4000 or 5500 ms lasting black background, anticipating a 450, 500 or 550 ms lasting attention symbol) and it was followed by a 500 ms lasting stop marker. After each stimulus was shown, participants were asked to score it according to: "Q1 familiarity" with the image (semantic differential range: [0,10]); "Q2 aesthetic appraisal" of the image (range: [-10,10]); "Q3 amount of movement" perceived in the image (range: [0,10]); "Q4 artistic nature" of the stimulus (that is, is the image a true artwork? - range: ["no","yes"]). In addition to what was done in the reference work, an open-answer question was added to let the subjects freely express their impressions, sensations and comments. In the reference work the images were selected so as to represent two classes of stimulus. The first class (original stimulus) was featured by 3 black and white, high resolution digitized images of different artworks of Lucio Fontana (one, two and three physical cuts on light color canvasses); the second one (control stimulus) was featured by 3 black and white, high resolution digitized images of graphically modified and simplified versions of the original artworks (an example of a paired stimuli concept is depicted in Figure 1). These stimuli (each one displayed 15 times in a randomly shuffled manner) were adopted also in this work but here they were integrated by additional pairs of original paintings of abstract art and control counterparts. The new entries where excerpts from: "Convergence" by Jackson Pollock (1912-1956), coupled with "Excavation" by Willem De Kooning (1904-1997) (pairing criterion: paintings that are similar in colors and



F1 F2 **Figure 1.** Original and control stimulus. Example of stimuli pair for a Fontana's artwork. *On the left*: original stimulus; *on the right*: smoothed control stimulus.

shapes but made impulsively the first one and quietly the second one); "Number 11" by Jackson Pollock, coupled with a false Pollock (pairing criterion: similar paintings made in different techniques); "Number 14" by Jackson Pollock, coupled with an inkblot pattern by Hermann Rorschach (1884-1992) (pairing criterion: dominance of white and black).

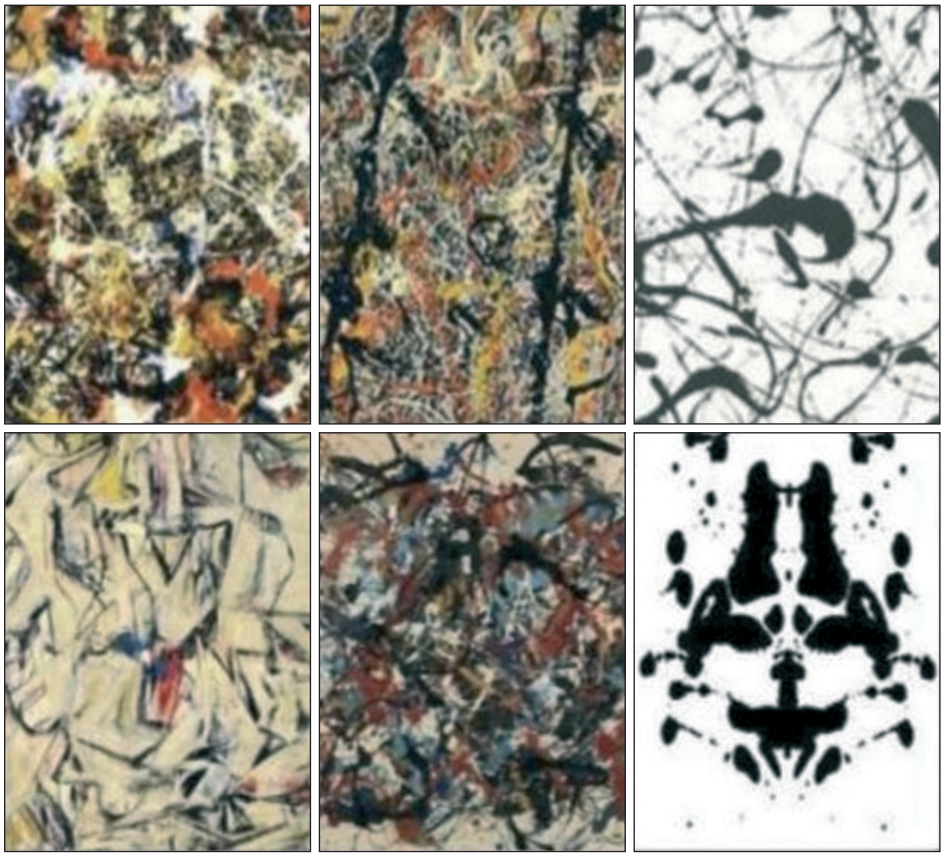
This choice of artworks (Fontana's and Pollock's) was driven by their recurrent pairing within abstract art research and critique, their supposed connection to empathy as stated in one of the seminal works on neuroaesthetics[8] and, as for Pollock, their ability to convey structured information like fractal patterns[11]. The actual stimuli for the Fontana's case are depicted in Figure 1 of the reference work; those one for the Pollock's case are shown in Figure 2 of this work.

■ **Statistical analysis.** After a preliminary tuning analysis, all differential semantic scores were normalized to boolean values, according to the following mappings: for "Q1 familiarity", logical true values were set on scores greater than or equal to 3, as in the reference work; for "Q2 aesthetic appraisal", true values were set on scores greater than 0; for "Q3 amount of movement", true values were set on scores greater than or equal to 3 (answers to "Q4 artistic nature" were already gathered in boolean form). A brief summary of the collected data is given in Table 1 as well as in Figure 3.

Answers to the "Q1 familiarity" question were studied first, also due to the focus given to them in the reference work. While in the present case about 40% of the people declared to be somewhat familiar with the shown artworks, open form remarks provided by the respondents highlighted that, when asserted, this acquaintance was often far from any direct artistic discourse. For instance, Fontana's cuts sometimes evoked female silhouettes (especially in male, aged eighteen, students), blades of grass or simple just another sample of broken fabric: in other words, not really art but somewhat one can experience almost every day. Due to its poor selectivity within the scope of this research, familiarity was thus discharged as a not significant category; instead, in this work the influence of the subjective cultural backgrounds was studied through the lens of the different school specializations.

Accordingly, participants were sorted to form a category (people) explicated by six groups, namely: art students, mechanical students, surveyor students, vocational students (from professional schools), aggregate students (that is, all 96 students) and finally the control, undifferentiated group (14 subjects, aged 28 on average). A second, category (target) was defined according to the nature of the artworks displayed, resulting in four groups: Fontana's original stimuli, synthetic replicas of Fontana's original (control stimuli), Pollock's original stimuli and counterparts to Pollock's originals (control stimuli). A last category (topic) was defined according to which question was asked to the participants, resulting in three groups ("Q2 aesthetic appraisal", "Q3 amount of movement" and "Q4 artistic nature"). Our analysis focused on the role and interactions of these three categories when coupled in a pair-wise fashion as in people versus target and in people versus topic. The statistical analysis consisted in a batch of two-way ANOVA's ($p \leq 0.05$), each one accompanied by pertinent post-hoc Tukey HSD tests (here preferred to the less conservative Newman-Keuls comparisons used in the reference work).

Figure 2. Stimuli around Pollock's artworks. *Upper row:* original stimuli; from the left to the right: details from "Convergence", "Number 11", "Number 14". *Lower row*: control stimuli; from the left to the right: details from "Excavation" by Willem De Kooning, false Pollock, inkblot pattern by Hermann Rorschach.



□ RESULTS

■ **Generality.** For the reader's convenience, this work details only a selection of the obtained results: first, outcomes regarding the aggregate students and the control group are not shown due to their strongly uncorrelated response against the various questions and due to the low nvalue for the control group (here introduced for an assessment of this aspect as addressed in the reference work); second, when people *versus* target is of concern, Tukey test results are reported only when significant variation was obtained for the same people group on different target groups (that is, people intragroup results are not shown in the following); finally, only significant variations ($p \leq 0.05$) are reported; anyway, almost no pvalue was found within the neighboring interval [0.05, 0.10].

■ **Test 1.** ***Amount of movement, Fontana's case.***

❍ *People*. Four groups, students only:
- 1 = art,
- 2 = mechanical,
- 3 = surveyors,
- 4 = vocational.

❍ *Target.* Two groups:
- 1 = Fontana's original stimuli,
- 2 = Fontana's control stimuli.

❍ *Q3*. Amount of movement:
- significant variation at: target (**F(1,86**32) = 10.02, MS = 1.81, p = 0.002);
- significant variation at: people (**F(3,**8632) = 414.58, MS = 74.81, p < 0.001);
- significant variation at: target&people (F(3,8632) = 58.86, MS = 10.62, p < 0.001);
- significant Tukey post-hoc test for: art students group (mean difference = - 0.05, p < 0.001);
- significant Tukey post-hoc test for: mechanical students group (mean difference = 0.27, p < 0.001).

■ **Test 2.** ***Sesthetic appraisal, Fontana's case.***

❍ *People*. Four groups, students only:
- 1 = art,
- 2 = mechanical,
- 3 = surveyors,
- 4 = vocational.

❍ *Target*. Two groups:

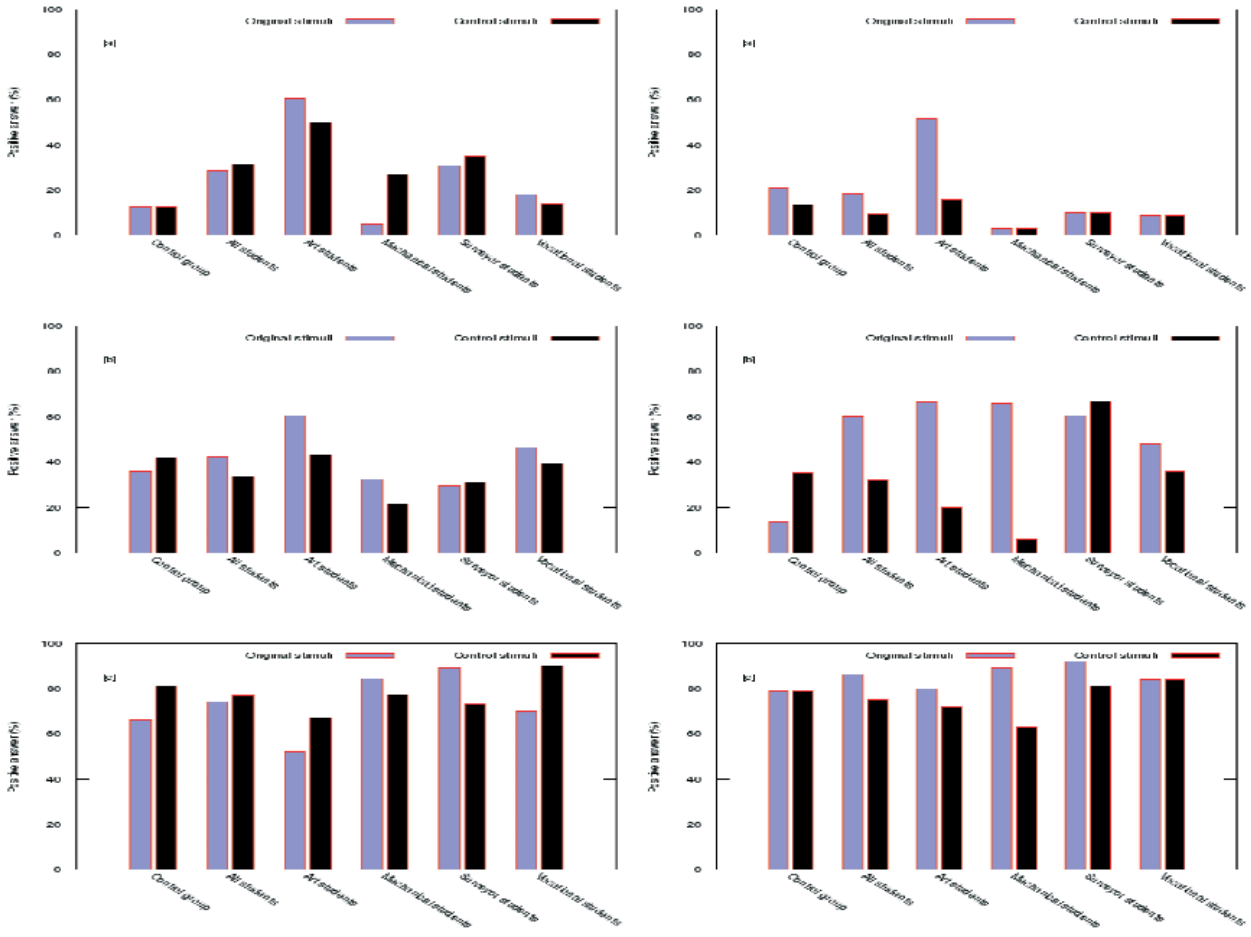


Figure 3. Questionnaire survey summary. Left column: Fontana's case; Right column: Pollock's case. *Legend*: a = perception of movement; b = artistic appraisal; c = recognition of artistic nature.

- 1 = Fontana's original stimuli,
- 2 = Fontana's control stimuli.

❍ *Q2*. Aesthetic appraisal:

- significant variation at: target ($F(1,8632) = 68.41$, $MS = 15.25$, $p < 0.001$);
- significant variation at: people ($F(3,8632) = 129.63$, $MS = 28.90$, $p < 0.001$);
- significant variation at: target&people ($F(3,8632) = 14.61$, $MS = 3.26$, $p < 0.001$);
- significant Tukey post-hoc test for: art students group (mean difference = - 0.11, $p < 0.001$);
- significant Tukey post-hoc test for: mechanical students group (mean difference = - 0.05, $p < 0.001$);
- significant Tukey post-hoc test for: vocational students group (mean difference = - 0.01, $p = 0.013$).

■ **Test 3.** ***Perception of artistic nature, Fontana's case.***

❍ *People*. Four groups, students only:

- 1 = art,
- 2 = mechanical,
- 3 = surveyors,
- 4 = vocational.

❍ *Target*. Two groups:

- 1 = Fontana's original stimuli,
- 2 = Fontana' control stimuli.

❍ *Q4*. Artistic nature:

- significant variation at: target ($F(1,8632) = 12.37$, $MS = 2.11$, $p < 0.001$);
- significant variation at: people ($F(3,8632) = 145.86$, $MS = 24.86$, $p < 0.001$);
- significant variation at: target&people ($F(3,8632) = 96.04$, $MS = 16.37$, $p < 0.001$);
- significant Tukey post-hoc test for: art students group (mean difference = 0.20, $p < 0.001$);
- significant Tukey post-hoc test for: mecha-

nical students group (mean difference = - 0.02, p = 0.002);
- significant Tukey post-hoc test for: surveyors students group (mean difference = - 0.11, p < 0.001);
- significant Tukey post-hoc test for: vocational students group (mean difference = 0.26, p < 0.001).

■ **Test 4.** ***Amount of movement, Pollock's case.***
❍ *People*. Four groups, students only:
- 1 = art,
- 2 = mechanical,
- 3 = surveyors,
- 4 = vocational.

❍ *Target*. Two groups:
- 1 = Pollocks's original stimuli,
- 2 = Pollocks's control stimuli.

❍ *Q3*. Amount of movement:
- significant variation at: target (F(1,8632) = 175.90, MS = 17.07, p < 0.001);
- significant variation at: people (F(3,8632) = 413.30, MS = 40.10, p < 0.001);
- significant variation at: target&people (F(3,8632) = 175.90, MS = 17.07, p < 0.001);
- significant Tukey post-hoc test for: art students group (mean difference = - 0.31, p < 0.001).

■ **Test 5.** ***Aesthetic appraisal, Pollock's case.***
❍ *People*. Four groups, students only:
- 1 = art,
- 2 = mechanical,
- 3 = surveyors,
- 4 = vocational.

❍ *Target*. Two groups:
- 1 = Pollocks's original stimuli,
- 2 = Pollocks's control stimuli.

❍ *Q2*. Aesthetic appraisal:
- significant variation at: target (F(1,8632) = 844.70, MS = 169.46, p < 0.001);
- significant variation at: people (F(3,8632) = 157.50, MS = 31.59, p < 0.001);
- significant variation at: target&people (F(3,8632) = 252.10, MS = 50.57, p < 0.001);
- significant Tukey post-hoc test for: art students group (mean difference = - 0.41, p < 0.001);
- significant Tukey post-hoc test for: mechanical students group (mean difference = - 0.54, p < 0.001);
- significant Tukey post-hoc test for: surveyors students group (mean difference = 0.12, p = 0.018);
- significant Tukey post-hoc test for: vocational students group (mean difference = - 0.06, p < 0.001).

■ **Test 6.** ***Perception of artistic nature, Pollock's case.***
❍ *People*. Four groups, students only:
- 1 = art,
- 2 = mechanical,
- 3 = surveyors,
- 4 = vocational.

❍ *Target*. Two groups:
- 1 = Pollocks's original stimuli,
- 2 = Pollocks's control stimuli.

❍ *Q4*. Artistic nature:
- significant variation at: target (F(1,8632) = 184.62, MS = 27.34, p < 0.001);
- significant variation at: people (F(3,8632) = 43.52, MS = 6.44, p < 0.001);
- significant variation at: target&people (F(3,8632) = 44.90, MS = 6.65, p < 0.001);
- significant Tukey post-hoc test for: art students group (mean difference = - 0.03, p < 0.001);
- significant Tukey post-hoc test for: mechanical students group (mean difference = -0.21, p < 0.001);
- significant Tukey post-hoc test for: surveyors students group (mean difference = - 0.05, p < 0.001).

■ **Test 7.** ***Amount of movement vs. aesthetic appraisal, Fontana's case.***
❍ *People*. Four groups, students only:
- 1 = art,
- 2 = mechanical,
- 3 = surveyors,
- 4 = vocational.

❍ *Target*. Two groups:
- 1 = amount of movement,
- 2 = aesthetic appraisal (Fontana's originals).

❍ *Q4*. Artistic nature:
- significant variation at: target (F(1,8632) = 205.40, MS = 40.15, p < 0.001);
- significant variation at: people (F(3,8632) = 347.19, MS = 67.87, p < 0.001);
- significant variation at: target&people (F(3,8632) = 76.26, MS = 14.91, p < 0.001);
- significant Tukey post-hoc test for: mecha-

nical students group (mean difference = 0.33, $p < 0.001$);
- significant Tukey post-hoc test for: vocational students group (mean difference = 0.34, $p < 0.001$).

■ **Test 8.** ***Amount of movement vs. perception of artistic nature, Fontana's case.***

❍ *People*. Four groups, students only:
- 1 = art,
- 2 = mechanical,
- 3 = surveyors,
- 4 = vocational.

❍ *Target*. Two groups:
- 1 = amount of movement,
- 2 = artistic nature (Fontana's originals).

❍ *Q4*. Artistic nature:
- significant variation at: target ($F(1,8632) = 2666.12$, $MS = 444.60$, $p < 0.001$);
- significant variation at: people ($F(3,8632) = 86.27$, $MS = 14.40$, $p < 0.001$);
- significant variation at: target&people ($F(3,8632) = 462.21$, $MS = 77.10$, $p < 0.001$);
- significant Tukey post-hoc test for: art students group (mean difference = - 0.03, $p < 0.001$);
- significant Tukey post-hoc test for: mechanical students group (mean difference = 0.85, $p < 0.001$);
- significant Tukey post-hoc test for: surveyors students group (mean difference = 0.64, $p < 0.001$);
- significant Tukey post-hoc test for: vocational students group (mean difference = 0.57, $p < 0.001$).

■ **Test 9.** ***Amount of movement vs. aesthetic appraisal, Pollock's case.***

❍ *People*. Four groups, students only:
- 1 = art,
- 2 = mechanical,
- 3 = surveyors,
- 4 = vocational.

❍ *Target*. Two groups:
- 1 = amount of movement,
- 2 = aesthetic appraisal (Pollock's originals).

❍ *Q4*. Artistic nature:
- significant variation at: target ($F(1,8632) = 2202.90$, $MS = 380.90$, $p < 0.001$);
- significant variation at: people ($F(3,8632) = 229.40$, $MS = 39.70$, $p < 0.001$);
- significant variation at: target&people ($F(3,8632) = 129.70$, $MS = 22.40$, $p < 0.001$);
- significant Tukey post-hoc test for: art students group (mean difference = 0.20, $p < 0.001$);
- significant Tukey post-hoc test for: mechanical students group (mean difference = 0.68, $p < 0.001$);
- significant Tukey post-hoc test for: surveyors students group (mean difference = 0.56, $p < 0.001$);
- significant Tukey post-hoc test for: vocational students group (mean difference = 0.45, $p < 0.001$).

■ **Test 10.** ***Amount of movement vs. perception of artistic nature, Pollock's case.***

❍ *People*. Four groups, students only:
- 1 = art,
- 2 = mechanical,
- 3 = surveyors,
- 4 = vocational.

❍ *Target*. Two groups:
- 1 = amount of movement,
- 2 = artistic nature (Pollocks's originals).

❍ *Q4*. Artistic nature:
- significant variation at: target ($F(1,8632) = 8817.30$, $MS = 1002.50$, $p < 0.001$);
- significant variation at: people ($F(3,8632) = 162.60$, $MS = 18.50$, $p < 0.001$);
- significant variation at: target&people ($F(3,8632) = 340.70$, $MS = 38.70$, $p < 0.001$);
- significant Tukey post-hoc test for: art students group (mean diff = 0.33, $p < 0.001$);
- significant Tukey post-hoc test for: mechanical students group (mean difference = 0.91, $p < 0.001$);
- significant Tukey post-hoc test for: surveyors students group (mean difference = 0.86, $p < 0.001$);
- significant Tukey post-hoc test for: vocational students group (mean difference = 0.80, $p < 0.001$).

□ DISCUSSION

Before any comment about our results, it is important to note that the questions was always in the same order: Q1-Q4. We know that is problematic because there could be order effects. Answering the earlier questions may impact one's answering of the later

Artist	Topic	Stimuli	Control group	All students	Art students	Mechanical students	Surveyor students	Vocational students	Mean	Std dev
Fontana	*Perception of movement*	Original	12.5	28.6	60.5	5.0	31.0	18.0	25.9	19.5
		Control	12.5	31.5	50.0	27.0	35.0	14.0	28.3	14.0
	Artistic appraisal	Original	36.0	42.3	60.5	32.5	29.5	46.5	41.2	11.3
		Control	42.0	33.9	43.5	21.5	31.0	39.5	35.2	8.3
	Perception of artistic nature	Original	66.0	74.0	52.0	84.5	89.5	70.0	72.7	13.4
		Control	81.5	77.1	67.0	77.5	73.5	90.5	77.9	7.9
	Mean	Original	38.2	48.3	57.7	40.7	50.0	44.8		
		Control	45.3	47.5	53.5	42.0	46.5	48.0		
	Std dev	Original	26.8	23.3	4.9	40.4	34.2	26.0		
		Control	34.6	25.7	12.1	30.9	23.5	39.0		
Pollock	*Perception of movement*	Original	21.0	18.3	51.5	3.0	10.0	8.5	18.7	17.4
		Control	13.5	9.4	16.0	3.0	10.0	8.5	10.1	4.5
	Artistic appraisal	Original	13.5	60.3	66.5	66.0	60.5	48.0	52.5	20.2
		Control	35.5	32.3	20.0	6.0	67.0	36.0	32.8	20.3
	Perception of artistic nature	Original	79.0	86.4	80.0	89.5	92.0	84.0	85.1	5.2
		Control	79.0	75.1	72.0	63.0	81.5	84.0	75.8	7.6
	Mean	Original	37.8	55.0	66.0	52.8	54.2	46.8		
		Control	42.7	38.9	36.0	24.0	52.8	42.8		
	Std dev	Original	35.8	34.4	14.3	44.7	41.4	37.8		
		Control	33.3	33.4	31.2	33.8	37.8	38.2		

Tab1 Tab2 **Table 1.** Percentage of positive answer to questionnaire survey (after normalization of all semantic differentials to boolean values ["no","yes"]). *Legend:* Mech. = Mechanical; Voc. = Vocational; Std. Dev. = standard deviation.

questions. The order of the questions was not randomized, but they were the criteria used in the paper that we are challenging. We used change position of questions only in the last test (14 participants), to have a correct support for our analysis. Our results from tests T1 and T4 suggest that art students are far more sensitive in decreasing their perception of movement when exposed to the control images instead of the original artworks; conversely, mechanical students show an opposite behavior (at least when Fontana's subjects are of concern); finally, building surveyors and vocational students seem to be quite unconcerned about the nature of the stimuli. This differential outcome, not detectable in the reference work, strongly fades away any apparent effect due to an universal motor resonance between drama expression inside artworks and motor realization in the beholder. Not only at high cognitive levels this claimed resonance appears to be totally undetectable (but still not denied) but it seems that determinant focus should be given to the cultural background of the observer instead. Indeed, art students are specifically educated through theory and exercise in both the recognition and execution (or reproduction) of artworks details and, accordingly, they own a repertoire of techniques that they are also used to embody in form of physical actions and movements. When exposed to original, impetuously made artworks as in the Fontana's or Pollock's case, art students can smartly exploit even the finest details to reverse engineering the artist's creative act; instead, when exposed to more aseptic images, as in the control stimuli case, the same subjects cannot take advantage of landmarks so useful for the expert perception of impressed movements. In a different way, mechanical students are educated to deal with

geometrically exact and clean trajectories as well as to plan and program the operation of devices like Computer Numerical Control routers. For these students, those subtle details so useful to art students are instead likely to be treated as disturbing noise that could obfuscate expected motion patterns inside the image. Among other factors, similar cues could reasonably play a significant role in the recorded differential response: not denied in the reference work, here the author claims their observable preponderance over a somewhat vague, asserted motor resonance between artist and beholder. Furthermore, it should be recalled that also artists get educated through theory and exercise, as pointed out by common sense and pioneering neurophysiological researches[11]. Coherently, if universal mirroring mechanisms are accepted for the comprehension of subtle movements, as impressed in artworks, one should explain how they could keep on operating between eventually diverging neural systems, on the learning artist and on the (not educated) beholder side.

Results from tests T2 and T5 suggest that, when dealing with the artistic appraisal, the transition from the original artworks to the control stimuli induces a coherent variation in the response of all groups (especially the art students one) except the building surveyors students group. In Italy, building surveyors are usually educated to the handling of essential architectural or technical drawings free of smudges and of not geometric decorations. Anyway, in this case the volatility of the concept dealt with, the small amount of variation and the (yet small) size of the statistical population suggest even greater caution in interpreting data.

Results from tests T3 and T6 tests suggest that, when dealing with the artistic nature of the displayed subject, original artworks are better appreciated by all groups, except for the art and vocational students in the Fontana's case. This differential outcome seems to unearth two complementary implications of the subjective cultural background. On one side, personal experience is likely to affect personal sensitivity to expressions of art; on the other one, education could interfere with the understanding itself of the "artistic nature" concept, eventually triggering different mental processes in front of the posed question. While the latter possibility here is only guessed, it seems to be corroborated by the fact that openform remarks given by the participants suggest a strong variability in the perceived (artistic or physical) subjects of the displayed images.

Results from tests T7 and T9 suggest that the perception of movement and the aesthetic appraisal are more correlated for art students than for the other groups (eventually with the exception of the building surveyors students in front of Fontana's originals artworks).

Recalling the considerations just exposed for the outcomes of tests T1, T2, T4 and T5, one can hardly express this correlation in terms of mutual dependency; rather, it seems that, independently, art students show improved attitudes in both movement recognition and aesthetic appraisal.

Tests T8 and T10 suggest similar correlation between perception of movements and recognition of the artistic nature of the subject displayed. Again, the answers of the art students show more coherent variations.

As already mentioned, the aggregate students group and the control group, when compared, have highlighted a variable, different behavior depending on the question that, from time to time, was asked. On one side, the aggregate group synthesizes and averages different scholar backgrounds that have proved to matter; on the other side, the control group, in the image and likeness of that one studied in the reference work, appears to be too much small for any robust statistical investigation. This outcome suggests that further investigation on the topic could take effective advantage by larger statistical populations, carefully categorized in order to better control cultural, emotional and other subjective conditions. Studies suggest, judging by the position and functionality of the premotor cortex investigated with respect to the rest of the cerebral cortex, that, if they exist, mirror neurons could help in the reproduction of works of art depending on the experience of each one rather than in the judgment of the same except in the case in which details such as "the brushstroke" or other similar details of a particular artist are taken. It should be noted, however, that in this case the normal function of the premotor cortex and of the F5 area would be indistinguishable from what passed into literature before the phantom discovery of this new class of neurons[13].

In this case, thinking about an inhibition of the action of the premotor cortex could be sufficient to explain the activation of the areas of the premotor cortex called mirrors both in the precedent study or in the more or less competent evaluation of artworks.

CONCLUSIONS

The results obtained throughout this research shed a different light on some claims and results exposed in previous studies about the embodied simulation role in neuroaesthetics. While no neurophysiological measurements have been taken here due to their problematic linkage to the high level perception of impressed movements and the aesthetic experience, attention was paid to isolate critical factors like personal experiences and cultural backgrounds. On this basis it was found that subjective education, in the broadest sense, deeply modulates our individual mental disposition in front of works of visual art, even subverting what one would expect from the application within art experience of debated paradigms like the somatomotor resonance. Strictly speaking, while a possible role for these paradigms cannot be excluded yet, this work suggests the need for finer experimental protocols where affecting factors, like personal culture and actual mood, are better explained and studied over wider statistical populations.

Until today and in the absence of further evidence, what one can reasonably say is that if the artistic experience is a matter of resonance then this resonance should be of cultural, and not motor, nature.

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