

## TIMING PERCEPTION IS AFFECTED BY CUBIST PAINTINGS REPRESENTING HUMAN FIGURES

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### Abstract

*The perception of time can be affected by different pictorial characteristics of artworks. Overestimations, related to higher levels of arousal, were obtained when people observed figurative artworks representing human body movements exposed for approximately 1.5 s. As the levels of arousal are maintained for 2-3 s, this study verified whether abstract paintings representing different types of movement affect time perception. Undergraduate participants observed 20 paintings implying different types of movement that were exposed for 3 s in random sequences. The prospective paradigm to record the time estimations was used. Data analysis showed that cubist paintings representing human figures were differently perceived: the painting with greater arousal and more implied movement was estimated longer than the paintings with less arousal and movement. These results are in agreement with those that used figurative human bodies exposed for short and long term durations which were explained through embodiment mechanisms.*

Movement representation in abstract and figurative artworks has been discussed in the scientific literature (Braddick, 1995; Cutting, 2002). According to Cutting (2002), the painters use at least five different criteria to represent motion, such as to blur the background of the scene (photographic blur) and superimposing different instants of a moving object in the same painting (stroboscopic images). For example, in the abstract cubist painting *Nude Descending a Staircase* by Marcel Duchamp the human figure is repeatedly overlapped in order to show all the movements of the human body descending the stairs. Similarly, the futurist painting *Dynamism of a Dog on a Leash* by Giacomo Balla show to the viewers the movements done by the dog using stroboscopic images and also by blurring the background of the scene.

Kim and Blake (2007), using 24 paintings of the early 20th century, showed that the subjects were able to distinguish the movement intensity of different artworks: the paintings portraying motion were rated with higher scores than the paintings in which motion is not explicitly intended by artists. They found greater activity for the MT+ encephalic brain area in *Nude Descending a Staircase* and in *Dynamism of a Dog on a Leash* paintings (more movement) than in abstract expressionist paintings (less movement) in observers with prior viewing experience of these artworks. In these experiments, the authors used expressionist paintings made by Paul Klee and Piet Mondrian that are basically composed of geometrical forms and lines.

On the other hand, Thakral, Moo and Slotnick (2012) evaluated the magnitude of activity in sensory motion processing region MT+ and also in the prefrontal cortex, while subjects viewed 20 post impressionist paintings: the portraits and the landscapes of van Gogh. Based on each subject's motion experience ranking, the authors showed a significant positive correlation between the intensity of movement associated to viewing each painting and the magnitude of activity in the MT+ area. Furthermore, the paintings classified as pleasant were associated with greater activity in MT+, in relation to the paintings classified as unpleasant.

These results suggested that the activity of this brain area is associated with the experience of both movement and aesthetical pleasure.

The effects of aesthetical episodes on time perception has revealed that the experience of duration varies directly with the processing of the pictorial characteristics of artworks. They determine how long an observer spends on cognitive activities to understand a piece of art (Cupchick & Gebotys, 1988). Using paintings by Claude Monet, Edgar Degas and Édouard Manet exposed for 18, 36 and 72 s, these authors found that judgments of pleasure by subjects varied according to the complexity and the exposure duration of these artworks. However, this work was not focused on the effect of movement perception on subjective time.

Photographs of ballerina sculptures by Edgar Degas in different ballet postures, representing movements of distinct intensities, modulate time perception (Nather & Bueno, 2011). Presented for 36 s, the static postures (ballet steps) with lower movement scores were judged to have shorter duration than those with intermediary scores, and the ballet postures with intermediary scores were judged to be shorter than those with the highest scores (*arabesque* and *attitude*). According to the authors, arabesque and attitude postures are more asymmetric than other static ballet postures - because of the relationships among the body parts positions - providing to the observer subsidies to understand the represented movements (see Cutting, 2002). Probably, the realism of the body postures of Degas's sculptures affect MT+, as was observed in abstract and figurative paintings (Kim & Black, 2007; Thakral, Moo, & Slotnick, 2012), since this brain area was differently activated by real pictures of people performing different movements: the observation of an athlete throwing a basketball cause more activation of MT+ than this same athlete in a static posture (Kourtzi & Kanwisher, 2000). Moreover, an element of aesthetic episodes consists of the activation of specific mechanisms related to the simulation of actions and corporeal sensation that is being observed by embodiment (Freedberg & Gallese, 2007).

Embodiment mechanisms have been associated with time distortions. Nather, Bueno, Bigand, and Droit-Volet (2011) showed that the duration was judged longer for Degas' ballerinas requiring more movement than for the ballerinas requiring less movement. However, the magnitude of the time distortions was relatively greater for the shorter (0.4-1.6 s) than for the longer (2-8 s) durations of stimuli exposures. Further, the authors found a positive relation between the intensity of movement and arousal levels: body postures requiring more movement were judged with more arousal than body postures requiring less movement.

Using pictures of people of different emotional contents which were presented for 2, 4 and 6 s, Angrili, Cherubini, Pavese and Manfredini (1997) verified that arousal levels were associated with time distortions. They showed that the subjects underestimated all the pictures as the arousing effect is transient and limited to brief durations shorter than 2-3 s.

Time perception was affected by figurative artworks exposed for different durations. Different characteristics (movement, pleasure and arousal) of images representing human figures explained these time distortions. This study verified whether abstract paintings of different themes by different artistic movements affect time perception. Twenty paintings with different criteria of movement representation were used: for example, stroboscopic images, photographic blur and action-movement (action painting) which were not tested in the studies of subjective time.

## **Method**

The experiment was approved by the Ethics Committee of the University of São Paulo School of Philosophy, Sciences, and Letters in Ribeirão Preto, Brazil.

Fifteen undergraduate students (8 men; M age = 20.26 yr., SD = 2.12) from the University of São Paulo of Ribeirão Preto were randomly invited to participate. They were untrained in visual arts with normal or corrected-to-normal vision.

The experiment was performed during daylight in an isolated, soundproofed room at the central library of the Ribeirão Preto Campus. Digital photographs of 20 abstract paintings selected according to its pictorial compositions, themes and artistic movements were used (Table 1).

Exposure of stimuli and recording of time estimations were done by the *Wave Surfer* program installed on an HP notebook. The tasks were orally explained to the participants. They were positioned facing the central region of the LG 19" monitor and were asked not to count time. The stimuli were exposed by pressing the "presentation" key and their exposures were finalized after 3 s. At this moment, the monitor was filled with white color indicating that the participant could initiate time estimation. Then, immediately after each time observation the participant reproduced the presentation duration by pressing the "initiate" key. The experienced duration of each stimulus was finalized by pressing the "finished" key (reproduction method). The stimuli were presented randomly to the participants. The *Wave Surfer* program also registered the latency of the participants.

Table 1 – List of paintings presented to participants

Painting	Author	Artistic Movement	Theme
1. <i>Woman with a guitar</i>	Georges Braque	Cubism	Person
2. <i>Girl with Mandolin Fanny Tellier</i>	Pablo Picasso	Cubism	Person
3. <i>The Guitar Player</i>	Pablo Picasso	Cubism	Person
4. <i>Wounded Bird and Cat</i>	Pablo Picasso	Cubism	Animal
5. <i>Portrait of Pablo Picasso</i>	Juan Gris	Cubism	Person
6. <i>Nude Descending a Staircase</i>	Marcel Duchamp	Cubism/Surrealism	Person
7. <i>The Knife Grinder</i>	Kazimir Malevich	Constructivism	Person
8. <i>Abstract Speed</i>	Giacomo Balla	Futurism	Geometric forms
9. <i>Dynamism of a Dog on a Leash</i>	Giacomo Balla	Futurism	Animal
10. <i>Lines of Movement and Dynamic Succession</i>	Giacomo Balla	Futurism	Animal
11. <i>Shape and Noise of Motorcyclist</i>	Giacomo Balla	Futurism	Geometric forms
12. <i>The Car Has Passed</i>	Giacomo Balla	Futurism	Geometric forms
13. <i>Girl Running on a Balcony</i>	Giacomo Balla	Futurism	Human body part
14. <i>The Hand of the Violinist</i>	Giacomo Balla	Futurism	Human body part
15. <i>Contemplating</i>	Paul Klee	Expressionism	Geometric forms
16. <i>Red Wainscot</i>	Paul Klee	Expressionism	Geometric forms
17. <i>The Goldfish</i>	Paul Klee	Expressionism	Animal
18. <i>Composition VIII</i>	Wassily Kandinsky	Expressionism	Geometric forms
19. <i>Number 8, 1949</i>	Jackson Pollock	Abstract Expressionism	Geometric forms
20. <i>Number 14 Grey</i>	Jackson Pollock	Abstract Expressionism	Geometric forms

After the time estimations, the participants' task was to observe the paintings and rate, on a 7-point scale (Likert type), the amount of movement represented, complexity, and about the identification of the figure depicted in the painting: movement, complexity and recognition scales, respectively. They were also asked to rate their level of arousal using the Self-Assessment Manikin scale of 5-point scale (Lang, 1980).

The One Way test (ANOVA) without repeated measures and the Student-Newman-Keuls test for *post hoc* comparisons were used to compare the time estimation, latency, movement, and arousal data for all paintings. One way test analyses were also used to compare the data considering the artistic movements and the themes of paintings

separately. Student *t*-test analyses were conducted comparing the mean values of time ratios of the stimuli with the actual time of exposure of 3 s.

## Results

The analyses of variance comparing mean time estimation values of the 20 paintings showed no statistical differences. However, statistical differences for latency [ $F(19, 280)=1.66; p<.05$ ], movement [ $F(19, 240)=8.28; p<.001$ ] and arousal [ $F(19, 240)=3.05; p<.001$ ] variables were found. As the paintings were very different in relation to their pictorial compositions, as was confirmed by movement, recognition and arousal scales, analyses of variance considering the artistic movement and the themes of the paintings conjointly were conducted.

Statistical differences were not verified in the analyses of variance of mean time estimation values for geometrical futurist paintings (8, 11, 12; see Table 1); geometrical expressionist paintings (15, 16, 18, 19, 20); futurist paintings representing human body parts (13, 14); and cubist and futurists painting representing animals (4, 9, 10).

On the other hand, the analyses of time estimation values showed statistical differences between the cubist paintings (1, 2, 3, 5, 6) representing abstract human bodies [ $F(4, 70)=2.60; p<.05$ ]. *Pos hoc* comparisons showed that *Woman with a guitar* (1) and *The Guitar Player* (3), more abstract paintings, were estimated shorter than *Nude Descending a Staircase* (6), the painting with stroboscopic representation of a human figure ( $p<.05$ ). The *t* test analyses showed that *Woman with a guitar* (less movement) was underestimated [ $t(28)=-2.05; p<.05$ ] and *Nude Descending a Staircase* was marginally overestimated [ $t(28)=1.92; p<.06$ ] in relation to the actual time of painting exposures (3 s).

The movement scale data showed that these paintings were differently scored [ $F(4, 60)=4.48; p<.001$ ]: *Nude* painting was scored with a higher movement than the other paintings (all  $p<.05$ ). Arousal levels among these paintings were also different [ $F(4, 60)=5.32; p<.001$ ]: there was scored more arousal to *Nude* painting than to *Woman with a guitar*, *Girl with Mandolin Fanny Tellier* and *Portrait of Pablo Picasso* paintings (1, 2, 5; all  $p<.01$ ).

Table 2 – Mean values and standard deviation (parentheses) of time estimation, latency, movement, arousal, recognition and complexity by participants for the 20 cubist paintings

Painting	Time (sec.)	Latency (sec.)	Movement	Arousal	Recognition	Complexity
1	2.66 (0.64) -	1.00 (0.60)	2.23 (1.23)	1.62 (0.63)	1.69 (1.25)**	2.53 (2.10)
2	2.84 (0.70)	1.14 (0.74)	3.00 (1.52)	2.23 (0.92)	6.69 (0.48)	3.38 (1.85)
3	2.88 (1.03)	1.01 (0.70)	3.23 (1.83)	2.69 (0.75)	6.61 (0.76)	2.69 (1.70)
5	3.08 (0.64)	0.99 (0.30)	2.76 (1.23)	2.07 (1.18)	6.84 (0.37)	2.69 (2.17)
6	3.65 (1.30) +	1.88 (1.16)*	4.53 (1.39)*	3.30 (1.25)*	4.30 (1.93)**	4.30 (1.65)

(-) Underestimated; (+) Overestimated; (\*) 1 and 3 < 6; (\*\*) 1 and 6 different from 7 points score.

The analyses of variance for the complexity scale did not show statistical differences among the paintings (1, 2, 3, 5, 6). However, for the recognition scale the paintings were differently scored in

dicating that the abstraction of the human figure was not easily evident [ $F(4, 60)=52.03; p<.001$ ]. Considering a 7-point score as indicator of more evident identification of human figure, *t*-test analyses showed that *Woman with a guitar* ( $t(24)=15.30; p<.001$ ) and *Nude Descending a Staircase* [ $t(24)=5.02; p<.001$ ] were less easily associated to the human

image than were the other three paintings.

The mean latency scores were also statistically different [ $F(4, 70)=3.89; p<.01$ ]. This analysis showed that the *Nude Descending a Staircase* painting was different from the other paintings (all  $p<.05$ ). The data for all of the cubist painting variables are presented in Table 2.

## Discussion

This work showed that abstract paintings exposed for 3 s affected time perception. However, this effect was associated with the interaction between the painting themes and their artistic movements: only the cubist paintings representing human figures were differently estimated. Stoyanova, Yakimoff, Gourevich, and Mitran (1987) also verified that figurative and abstract paintings presented for short intervals (0.6 to 1.5 s) distorted time perception. They pointed out that the under- and overestimations were caused by the complexity of the artworks but did not describe which their pictorial features were responsible for these results.

The cubist paintings used in this work are mostly brown, ocher, and green. Representing the analytical phase of cubism, they were almost monochromatic analyzing the form without the distraction of the color (Strickland, 2004). On the other hand, they differ in relation to the amount of pictorial abstraction resulting of the different 3-D planes of the human figure representation which causes distinct interpretative ambiguities.

Nicki, Lee, and Moss (1981) showed that subjects observed cubist paintings for more time according to the increase of the subjective ambiguity of paintings. They pointed that interest and pleasure of subjects were associated to the identification of an object or person represented in the pieces. Kuchinke, Trapp, Leder, and Jacobs (2009) asked subjects to indicate the moment when they recognized any object in several cubist paintings. The paintings with high content accessibility were processed faster toward the point of explicit classification of the depicted content. These works showed that affective aesthetic responses depend on the ease with which an artwork can be processed.

In this study, all paintings received scores not different for complexity scale. However, *Woman with a guitar* and *Nude Descending a Staircase* were less easily associated to the human image (recognition scale). Also, these two paintings that were differently scored by the movement scale were under- and overestimated in relation to the actual time of the painting exposures (3 s). This information would explain why the stroboscopic painting *Nude* (more movement) was estimated longer than the other cubist paintings - as *Woman* (less movement) - which do not represent human intentional movements (see Table 2).

Hekker and van Wieringen (1990) used the reaction time to access information about the time required for subjects to recognize human figures in cubist paintings. The results showed that *Nude Descending a Staircase* was recognized after 7.5 s while *Portrait of Pablo Picasso* was quickly identified (less than 1 s). Paintings with similar composition of *Woman with a guitar* were recognized above 9.5 s. The authors pointed that aesthetical pleasure was related to capacity of recognize human figures independently of paintings complexity. Note that *Nude* received the greatest score for latency (Table 2).

Pictorial characteristics of cubist paintings were analyzed by different perspectives involving hedonic factors, pleasure and emotions. Nather et al. (2011) showed that the duration of figurative human figures (Degas' ballerinas) were differently estimated using shorter durations of the stimuli exposures (0.4 to 1.6 s). However, the magnitude of the time distortions was relatively smaller using long exposures (2 to 8 s) due to this the body postures requiring more movement were judged with more arousal. Embodiment mechanisms were associated to these time distortions.

*Nude Descending a Staircase* painting received the highest arousal score. It is possible to infer that the same mechanisms of time estimations were required when people

observed abstract or figurative human figures representing movements of different kinds and intensities. Future researches using artworks will highlight different aspects of time perception related to embodiment mechanisms of movement perception in static images.

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