

## IMPLIED MOVEMENT PERCEPTION IN DIFFERENT STATIC ARTWORKS AFFECTS SUBJECTIVE TIME

José Lino Oliveira Bueno and Francisco Carlos Nather  
*Center for Experimental Aesthetics, University of São Paulo, School of Philosophy, Sciences  
and Letters of Ribeirão Preto, São Paulo, Brazil*  
jldobuen@ffclrp.usp.br and f.nather@hotmail.com

### Abstract

*Several experiments from our laboratory are showing that paintings and sculptures with more implied movement were estimated longer than those artworks with lesser movement. Furthermore, presentations of short and long term duration of abstract and figurative artworks differently distorted the perception of time. These time distortions have been related to changes in levels of arousal associated to embodiment mechanisms and to different cognitive processes as memory and attention. Aspects of different movement representation in static artworks of different artistic movements (for example impressionism, cubism and op art) are associated to different duration exposures on subjective perception of time. Eye tracking and force platform procedures confirm the relationship between implied movement perception and subjective time. The aesthetic experience of art is not limited to vision and cognitive components of the observer, but involves different aspects of work-spectator relation as the representation of movement, emotions and mechanisms of embodiment.*

### 1.

It is well known the relationship between perception of objects in motion and the subjective experience of time. However, static objects can, surprisingly, induce the perception of motion. Will this perception of implied motion affect also the subjective time?

Several experiments from our laboratory showed that pictures of paintings and sculptures exposed to the participants for the same duration but with more implied movement were estimated longer than those with lesser movement. The temporal distortions were similar to those obtained with visual stimuli in real movement. In a first study, Nather and Bueno (2006) showed that the picture of an artwork sculpture of a doll with less suggestion of implied movement was reproduced as shorter duration than that one with greater suggestion of movement. Nather and Bueno (2008), in sequence to this study, developed the Body Movement Ranking Scale (BMRS), which allows identification of the degree of movement implied by body position in still images, using photographs of the sculptures of the impressionist Edgar Degas ballerinas. The results obtained from the use of this scale showed that dancers standing on steps or with small movements (1.5 and 3.0 points) were reproduced as with shorter duration than ballerinas dancing (4.5 points); standing on steps or dancing ballerinas were estimated shorter than those that represent major steps of classical ballet (6.0 points). Consistent with these data, the dancers with 1.5 and 3.0 (points) were underestimated in relation to the actual duration of stimulus presentation, but those with 6.0 points were overestimated.

The use of BMRS scale showed that the visual processing of motion induced by static images can modulate the estimation of experienced time (Nather & Bueno, 2011).

Furthermore, the data can be interpreted as a processing similar to temporal bisection, which depends on the distances among the values of the series of BMRS stimuli presented to the participants: individuals tend to estimate as having similar duration images with closest movement intensities; for example, there are no differences between the time estimations of 4.5- and 6.0-point stimuli, but both are different from the 1.5-point stimulus; at the same time, there are no differences between the time estimations of 1.5- and 3.0-point stimuli, but both estimations are different of the 6.0-point stimulus. Furthermore, a stimulus can be estimated with different durations depending on the relationship between its movement score and different scores of the others with which it is presented.

## 2.

Distortions in subjective time on static images, which may be occurring due to induced or represented movements, have found support in other experiments that evaluated aspects of visual perception of motion: eye movements and body oscillations.

Nather, Bueno and Bigand (2009) examined the eye movements to describe where and how often body parts in different positions were observed in a study of implicit movement and subjective time. Stimuli were photographic images of 3 Degas ballerinas sculptures ordered by BMRS in geometric progression. Images were presented to participants whose tasks were to observe the images and estimate the presentation time duration. Data analysis showed that the same duration static images with 1.5 and 3.0-point stimuli were estimated as shorter than 6.0-point; 1.5 and 3.0-point were underestimated; 6.0-point were overestimated regarding real time. Most attention to arms and legs was observed in the sculpture with more movement and more attention to head and trunk to sculptures with less represented movement. These data suggest that visual perception of movement modulates the pattern of eye movements which are related to the time distortions.

Nather, Bueno, Abreu and Gomes (2010) considered that the observation of body movements in static images generates the experience of movement that can induce real movements in the observer. This study examined whether these real movements were related to the intensity of the observed movement. Stimuli were photographic images of 2 dancer sculptures (BMRS): 1.5- and 6.0-point stimuli. Images were presented at a random order to the participants positioned on a force platform, whose tasks were to observe each image and estimate its presentation time duration. Participants moved more when they observed the dancing ballerina (6.0-point). Also, 6.0-point stimulus was overestimated. This result showed that images of body movements internally generate unconscious body oscillations suggesting that different processes are involved in the subjective time distortions.

Thus, distortions in the subjective time perception of images with induced movement may be attributed to the activation of specific neurons related to visual perception of movement.

## 3.

These data employing segments of artworks, presented with longer durations than that more usual in traditional studies of perception of time, raise special issues. Could these data on the aesthetic appreciation and perception of movement be limited to the parameters of this experiment? Another characteristic of these events could be identified as important in the subjective perception of time. Among the variables present in these studies, in addition to the issue above discussed, the experimental procedures and duration of the stimuli are important components to be considered.

Using the same method of previous cited works (reproduction method), Nather & Bueno (2012c) presented the sculptures of Edgar Degas for 9, 18, 27 or 45 seconds (G9, G18, G27 and G45 groups, respectively) and the stimuli were randomly presented in arithmetical (1.5-, 3.0- and 4.5-point) or geometrical (1.5-, 3.0- and 6.0-point stimuli) progressions. Data analysis showed that time was not distorted in G9, G18 and G45 groups, except: 6.0-point stimulus was overestimated in geometrical (G9) and 1.5-point was underestimated in arithmetical (G45) progressions. However, time distortions in G27 group were modulated by different implied movement intensities as was observed in previous works that used 36 s of image exposure. These results show that different processes evolving the visual perception of movement in static images are also associated to the different exposure duration. That is, the duration of the stimulus should be considered for studies of subjective time and induced movement perception of artworks.

The time estimation method may also affect the subjective perception of time under the experimental conditions described above. Nather, Bueno, Bigand and Droit-Volet (2011), using a temporal bisection task with two ranges of standard durations (0.4-1.6 s and 2-8 s), investigated whether the perception of presentation durations of 1.5- and 6.0-point stimuli was distorted as function of the embodied movement that originally produced these stimuli of BMRS. The participants had to judge whether the presentation duration of each of the pictures was more similar to the short or to the long standard duration. The results showed that the duration was judged longer for the stimulus requiring more movement than for the stimulus requiring less movement as was observed in previous studies using long durations (36 s). The authors related these data with an arousal effect of limited duration on the speed of the internal clock system, once low-arousal body posture was judged to require no movement and the other with a high-arousal body posture was judged to require considerable movement.

Another method to examine the time perception is the exploration time of an event. Nather and Bueno (2012b) allowed the participants to observe the 1.5-, 3.0-, 4.5-, and 6.0-point stimuli for any length of time (exploration time) and, immediately after each image was observed by the participants they recorded the duration as perceived. The results of temporal ratio (exploration time/time estimation) showed that exploration time of images also affected perception of time, i.e., the subjective time for sculptures representing implied movement were overestimated. Together with data obtained using fixed time of 36 s, the authors concluded that long durations of exposure involve more complex cognitive mediation, as attention and memory of the events.

#### 4.

The aesthetic experience, particularly in the appreciation of works of visual art, assumes exposure to stimuli or longer duration pictures than those often used in studies of visual perception and subjective time. The intrinsic properties and characteristics of the artistic appreciation must, therefore, affect the perception of induced movement and the subjective experience that accompanies it. In this sense, it is important to consider the properties of the image used as its pictorial composition.

Nather (2006) and Nather and Bueno (2012a) argue that the scene of a ballet painting by Edgar Degas may implicitly contain narratives which involve different time durations. In this sense, focusing parts of a scene, for example the body of a ballerina in a scene of a ballet choreography, reveals a time that may be related to perceived implicit movement between the body parts. Expressive qualities of movement are connected to what we know about their meaning. The photograph of a dancer gives the observer dynamic properties, because the position of the body in a pose of ballet is perceived as a deviation from the normal. More than reference points for the eyes, the parts of the body not only direct the

eye, but also show what the body is doing: in *Dancer Posing at a Photographer's studio*, the dancer's arms are not directed at the top, but raised as in a specific classical ballet step suggesting that some properties and functions of the body constitute an inseparable part of its visible character. One might suspect intentionality on the part of the artist to paint or sculpt movement, representing it in the intensity that he specifically wanted. This would explain why the time may be distorted differentially when participants see the sculptures with different movement intensities, as consequence of the asymmetries generated by the specific characteristics of the diverse parts of the body.

Can the movement implicit in more abstract artworks (paintings) affect the perception of time in the same way that when individuals observed figurative paintings and sculptures of Edgar Degas?

Using 20 abstract paintings implying different types of movement that were exposed by 3 s in random order sequences, Nather, Fernandes and Bueno (2012) showed that cubist paintings (Georges Braque, Juan Gris and Pablo Picasso) representing human figures were differently perceived: the painting with greater arousal and more implied movement was estimated longer than the paintings with lesser arousal and movement. These results are in agreement with those that used figurative human bodies exposed by short and long-term durations which were explained by embodiment mechanisms. The perception of time can be affected by different pictorial characteristics of artworks. Also, Nather, Mecca and Bueno (2012) using two optical paintings of Bridget Riley exposed for 9 or 36 s (G9 and G36 groups) showed no time distortions in G9 group. In the G36 group the paintings were differently perceived: 6.0-point was estimated longer than 2.0-point. Also, the exhibition time of the 2.0-point painting was underestimated, compared with the real time. These results show that also optical illusion of movement in static images caused time distortions related to long duration of exposures.

Artworks employ different experiences of movement perception. In this way, short and long term duration stimuli involve different types of implicit movement and different processing of subjective time, originated from the interaction of various variables or factors, including duration, type of movement, context of the art observation, etc.

The literature of movement perception and, more specifically, the perception of movement in artwork static images has shown that specific brain areas respond differentially to the perception of movement, as in abstract works, as in figurative images of human bodies. More than that, the representation of movements in different artworks has been associated with mechanisms of embodiment that point to the fact that the movement represented in a work of art would be experienced in the body of the observer.

The data presented in this paper enable the establishment of relations between embodiment mechanisms and the subjective time perception. Since the movement occurs at the intersection of space and time, our studies allow the examination of the time representation implicit in the artworks. Works of art are visual objects related to the real life which can represent the movement and the time in a diversity of ways.

In this sense, the aesthetic encounter and the relationships that are established between the observer and the artwork are added when different implicit movements, different durations of observation and different ways of estimation of the observed time are studied in different experimental contexts.

## 5.

The temporal distortions and illusions following the visual processing can be explained by different perceptual and cognitive models of subjective time. Works of art representing more implicit movement generate greater arousal in individuals, causing temporal over estimations,

due to the acceleration of a neural marker. Because they are more complex, they require more processing and memory space, being overestimated. The works with more movement should induce greater directed attention by generating the expectation of the movement. In the case of figurative works, for example, the “paralyzed” image of a dancer in a great ballet step provides clues about how the movement would occur in space, generating the expected time needed for completion.

Our studies show that the aesthetic experience of works of visual art is not limited to vision and cognitive components of the observer, but involves different aspects of work-spectator relationship: collative properties of the artworks as the representation of movement, emotions and embodiment mechanisms.

The artistic appreciation is involved in temporal processing of stimuli and the longer duration of these conditions can be a condition for aesthetic episode, mobilizing not only basic psychological processes such as attention and memory, but also mechanisms of embodiment.

### Acknowledgements

Francisco C. Nather received a Postdoctoral Scholarship and a Young Investigators Awards support both from São Paulo Research Foundation (FAPESP). José L. O. Bueno received a Research Grant from the National Counsel for Technological and Scientific Development.

### References

- Nather, F. C. (2006). *Percepção de movimento e tempo subjetivo nas artes visuais*. PH. D. Th., University of São Paulo.
- Nather, F. C., & Bueno, J. L. O. (2006). Efeito de imagens estáticas com diferentes representações de movimento sobre a percepção subjetiva de tempo. *Psicologia: Reflexão & Crítica*, 19, 217-224.
- Nather, F. C., & Bueno, J. L. O. (2008). Movement ranking scale of human body static images for subjective timing estimation. In *Proceedings of the Annual Meeting of the Society for Psychophysics*, 24, 185-190.
- Nather, F. C., Bueno, J. L. O., & Bigand, E. (2009). Time estimation and eye-tracking movement in human body static images. In *Proceedings of Annual Meeting of the Society for Psychophysics*, 25, 399-404.
- Nather, F. C., & Bueno, J. L. O. (2011). Static images with different induced intensities of human body movements affect subjective time. *Perceptual and Motor Skills*, 113, 157-170.
- Nather, F. C. & Bueno, J. L. O. (2012a). Timing perception in paintings and sculptures of Edgar Degas. *Kronoscope: The Journal for the Study of Time*, 12, 16-30.
- Nather, F. C. & Bueno, J. L. O. (2012b). Exploration time of static images implying different body movements causes time distortions. *Perceptual and Motor Skills*, 115, 105-110.
- Nather, F. C. & Bueno, J. L. O. (2012c). The presentation of long term duration of body movement in impressionist artworks differently distorts the perception of time. In *Proceedings of the Annual Meeting of the International Society for Psychophysics*, 28.
- Nather, F. C., Fernandes, P. A. M., & Bueno, J. L. O. (2012). Timing perception is affected by cubist paintings representing human figures. In *Proceedings of the Annual Meeting of the International Society for Psychophysics*, 28.
- Nather, F. C., Mecca, F. F., & Bueno, J. L. O. (2012). Motion illusions caused by paintings of Op Art distort the perception of time. In *Proceedings of the Annual Meeting of the International Society for Psychophysics*, 28.

- Nather, F. C., Bueno, J. L. O., Abreu, D. C. C., & Gomes, M. M. (2010). Body movements and timing estimation related to visual observation of different images representing distinct body positions. In *Proceedings of Annual Meeting of the Society for Psychophysics*, 26, 433-438.
- Nather, F. C., Bueno, J. L. O., Bigand, E., & Droit-Volet, S. (2011). Time changes with the embodiment of another's body posture. *PLoS ONE*, 6, 19818.