Fast translational motion, but not radial, circular or biological motion, causes spatially selective adaptation of event duration

Michele Fornaciai¹, Roberto Arrighi¹-*¹, David C. Burr¹,²

¹Department of Neuroscience, Psychology, Pharmacology and Child health (NEUROFARBA), University of Florence, via di San Salvi 12, Firenze 50139, Italy
²Institute of Neuroscience, National Research Council (CNR), Viale Moruzzi 1, Pisa 56124, Italy

Abstract

It has been recently shown that adaptation to gratings oscillating at high-frequency compress perceived duration of subsequent, slower stimuli displayed in the same location. These temporal distortions are spatially selective (Johnston et al., 2006), coded in spatiotopic coordinates (Burr et al., 2007, 2011), and do not result from changes in perceived speed of the adapted stimulus. These findings are important as they support the idea of a distributed framework of multiple mechanisms processing event time across the visual field. However, time distortions induced by motion adaptation have been tested only with simple translational motion, rather than more complex motions. Here we used a similar technique to Burr and coll. (2007) to measure time compression induced by adaptation to four kinds of motion stimuli: a) translating gratings, b) expanding concentric gratings, c) rotating radial gratings, and d) biological motion. We first measured changes in perceived speed caused by the motion adaptation (20Hz for the gratings). We found that perceived speed of the 10Hz test stimuli was dramatically reduced by around 40-50% in all conditions. Subsequently, we used these data to adjust the speed to compensate for the adaptation effects, and measure distortions in perceived duration with equated speed of test and probe gratings. In line with previous reports, perceived duration for translating patterns (displayed for 500 ms) was found to be reduced up to 30-40%, even after speed compensation. However, duration estimates for radial and circular moving gratings (500 ms) were always veridical. We used two versions of circular motion: with tangential speed constant across the visual patch (non-rigid-motion), and with rigid rotation, but neither caused temporal compression. Similarly, adaptation to a “runner” in biological motion reduced considerably the apparent speed of a briefly presented walker, but when matched for apparent speed, duration estimations were completely unaffected by adaptation. Taken together these results suggest that different mechanisms underlie time processing for simple and complex motion profiles. Why should only translational motion cause changes in temporal duration? fMRI evidence (Morrone et al., 2000) suggests that translational motion stimulates different brain regions from those responding to radial and circular motion, and this could be the basis for the selective effects on duration. Interestingly, however, the duration effects (after matching for apparent speed) are almost entirely spatiotopic, suggesting that they are not occurring at early, retinotopic brain areas. On the other hand it makes

* Corresponding author. Tel.: +39 050 6213185; fax: +39 050 6213210.
E-mail address: roberto.arrighi@unifi.it
sense that the adaption should occur in space-based rather than retinal-based coordinates, if the purpose is related to temporal calibration of objects (in the real world). Why translational motion, but not other more complex forms of motion, should calibrate event duration is far from clear.

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References


