

Measuring haptics with eyes: The case of the Uznadze haptic aftereffect

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Introduction: Every science has a bag full of puzzling phenomena. In psychology of perception one of such phenomena is the simultaneous haptic size contrast aftereffect described by the Soviet psychologist Dimitri Uznadze in 1949. To create the illusion, two spheres of different size but equivalent weight are placed, simultaneously and out of vision, in the hands of a participant who is asked to grasp the spheres with strength and then open hands again. This procedure is repeated several times (10-15) to reinforce the adaptation set (adaptation to the two spheres). Right after the adaptation procedure, the adaptation set is replaced by two identical test spheres with size in between those of the adaptation spheres. The impression reported by the participant is that the two identical test spheres are quite different in size, with the sphere grasped by the hand adapted to the large inducing sphere feeling much smaller than the other one. As of today this phenomenon is not yet fully understood. In the present study we attempt to measure the magnitude of the haptic size contrast illusion using a visual matching method with an actual 3D visual scale.

Experiment: Purpose is to test the reliability of a visual matching method to measure the magnitude of the illusion: right-handed participants were asked to indicate the size of each hand-held sphere on a 12 step visual scale made of spheres painted matt black. Before and at the end of the experimental session, participants were also asked to judge the spheres' sizes (both adaptation and test ones) without set-inducing adaptation (pre-tests and post-tests).

Stimuli:

Set-inducing spheres' diameter: 2.7cm (small) and 4.3 cm (big);
Test spheres' diameter: 3.9 cm;

Variables:

- (a, within) size of the adaptation spheres;
- (b, between) evaluation direction (right hand-left hand, left-right);
- (c, between) position of the small adapting sphere (right, left);
- (e, between) scale distance (30 cm, 160 cm).



Visual scale (60 cm) made of 12 metallic spheres painted matt black: 2.2, 2.5, 2.7, 2.9, 3.1, 3.5, 3.8, 3.9, 4.1, 4.3, 4.5, and 4.7 cm

Participants and Procedure: 160 right-handed participants (Oldfield, 1971), randomly assigned to one of 8 groups. Each participant underwent an adaptation process (15 simultaneous exposures to the adaptation spheres), after which they were suddenly exposed, out of vision, to two identical spheres which size was in between those of the adaptation spheres. Participants were asked to indicate the size of each sphere on the visual scale in front of them. Depending on the group of participants to which they were randomly assigned, they would first indicate the size of the sphere in the right hand and then that in the left hand, or vice versa. All participants also indicated the 4 spheres involved in the experimental task in a pre-adaptation test and post-adaptation test.

Results: An ANOVA confirms the aftereffect determined by the within factor *size of the adapting spheres* $F(1,152)=511.51, p<.0001$ (see Graph 1). The between factor *scale distance* also determined a significant effect on size matchings $F(1,152)=13.53, p=.0003$ (see Graph 2). Of the other within factors, only *evaluation direction* $F(1,152)=11.34, p=.001$ (see Graph 1) determined significant effects on size matchings: when participants started their judgment from the right hand they evaluated spheres' sizes somewhat bigger than when they started their judgment from the left hand. Only the interaction *position of the small adapting sphere x scale distance* was significant $F(1,152)=6.83, p=.0098$. Pre-tests and post-tests showed no statistical differences among experimental conditions.

Separated ANOVAs conducted on the data for the two scale distances revealed that the within factor *evaluation direction* is statistically significant only for the far scale far: $F(1,76)=11.25, p=.0012$; near: $F(1,76)=1.66, p=.2$.

Discussion: Measuring the magnitude of the Uznadze haptic aftereffect by means of a visual scale is feasible and an easy task to accomplish. What we did not expect to find is the effect of scale distance in relation to the *evaluation direction* (which sphere is matched first, right hand vs left hand). This finding calls for further testing with left-handed participants.

