

Does Cross-Modal Aftereffect Occur in Variance Perception?

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Introduction

Human observers perceive the statistical information of the various features in the environment. In some cases, perceived variance affects subsequent decision-making and behavior because a large variance of stimuli set or outcome may indicate the abnormalities and risk. The perceived variance, however, is not necessarily equal to the physical variance. A previous research showed that the variance aftereffect occurred across different visual representations as well as within the same visual property (Payzan-LeNestour, et al., 2016). In this study, we investigated whether the variance aftereffect extended across different sensory modalities. In short, we focused on the following two points. (1) Does variance aftereffect occur in auditory pitch? (2) Does the auditory pitch variance adaptation distort the visual size variance perception? (cross-modal aftereffect)

Discussion

(1) Does variance aftereffect occur in auditory pitch?

After repeated exposure of the auditory tones with the small pitch variance, the variance of the pitch of the same stimuli was judged larger. Variance aftereffect, however, did not occur after large variance adaptation. Further consideration is necessary for this asymmetric effect.

(2) Does the auditory pitch variance adaptation distort the visual size variance perception?

Cross-modal aftereffect did not occur in variance perception; instead, after large variance adaptation, the variance of the visual size was perceived larger. This might be cross-modal positive priming, but the mechanism remain unclear.

On going & future research

Previous studies investigating the variance aftereffect did not investigate the change before and after adaptation. Using the method of this, it needs to investigate whether variance aftereffect occurs between different visual property

Acknowledgement

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Methods

Participants were 7 paid volunteers (all male, aged 21–24 years).

Stimuli

- In each trial, eight pure tones or white disks were presented, one-by-one, in sequence.
- The frequencies of each tone and diameters of each disk were randomly chosen from the lognormal distribution, $\ln N(\ln F, \sigma^2)$, $\ln N(\ln D, \sigma^2)$. The baseline frequency and diameter were changed for each sequence.

Design

- This experiment consisted of following four conditions: “small variance” and “large variance” adaptors in **AA (auditory pitch adaptor, auditory pitch test) and AV (auditory pitch adaptor, visual size test)**. All participants experienced the four conditions in pseudorandom order on separate days.

Procedure

Pre-adaptation Test - 8 minutes

- There were six pitch (in AA condition) or size (in AV condition) variance magnitude levels. Participants judged individual stimuli relative to the mean or median of a group of stimuli. We did not provide an explicit reference standard; instead, participants were exposed to training stimuli that included all of the test variance and were given feedback. After training, there were 120 pre-adaptation test trials on this variance discrimination task.

Adaptation - 5 minutes

- During the adaptation phase, participants listened to the sequences consisting of eight various pitch tones 100 times repeatedly. In small variance adaptation condition, pitch variance was 0.05. In large variance adaptation condition, pitch variance was 0.8.

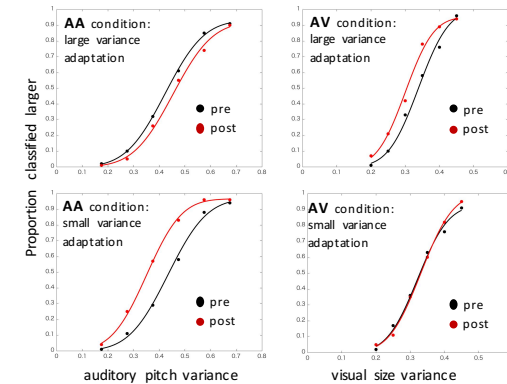
Post-adaptation Test - 15 minutes

- There were total of 120 post tests. The variance discrimination task was the same as the pre-adaptation test, except that adaptation trials were interleaved for top-up. Test block (consist of six trials) and adaptation block (consist of six sequences) were presented alternately.

Results

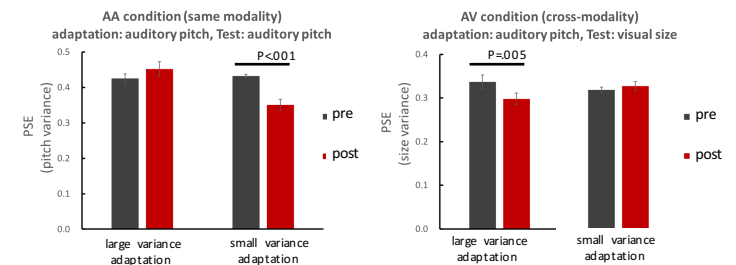
Calculation of PSE

The PSE was calculated for the pre-and post-adaptation test trials by fitting a cumulative normal function and finding the 50% point. The aftereffect was quantified as the difference(post – pre) in PSE.



A two-way repeated-measures ANOVA for PSE

In AA condition (i.e. same modality), negative aftereffect arose only after small variance adaptation. In AV condition (i.e. cross-modality), size variance was judged larger after large variance adaptation.



* Pre and Post adaptation data of each participant

	AA condition (adaptation: pitch, TEST: pitch)						AV condition (adaptation: auditory pitch, TEST: visual size)					
	large variance adaptation			small variance adaptation			large variance adaptation			small variance adaptation		
	PSE before adaptation	PSE after adaptation	change in PSE	PSE before adaptation	PSE after adaptation	change in PSE	PSE before adaptation	PSE after adaptation	change in PSE	PSE before adaptation	PSE after adaptation	change in PSE
participant 1	0.407	0.478	0.071	0.420	0.329	-0.091	0.338	0.282	-0.057	0.313	0.319	0.006
participant 2	0.481	0.530	0.049	0.433	0.329	-0.104	0.338	0.312	-0.027	0.328	0.354	0.026
participant 3	0.441	0.394	-0.047	0.436	0.365	-0.071	0.363	0.260	-0.103	0.343	0.325	-0.018
participant 4	0.425	0.461	0.035	0.414	0.295	-0.119	0.335	0.330	-0.005	0.291	0.328	0.037
participant 5	0.369	0.460	0.091	0.436	0.333	-0.104	0.344	0.324	-0.020	0.310	0.304	-0.006
participant 6	0.407	0.368	-0.039	0.433	0.420	-0.012	0.346	0.269	-0.076	0.305	0.315	0.011
participant 7	0.445	0.475	0.030	0.453	0.382	-0.071	0.355	0.307	-0.048	0.342	0.347	0.005
mean	0.425	0.452	0.027	0.432	0.350	-0.082	0.337	0.298	-0.039	0.319	0.327	0.009