Short-term Adaptation Effects on Perceived Duration in Random Dot Kinematograms (RDKs) and Drifting Gratings

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INTRODUCTION

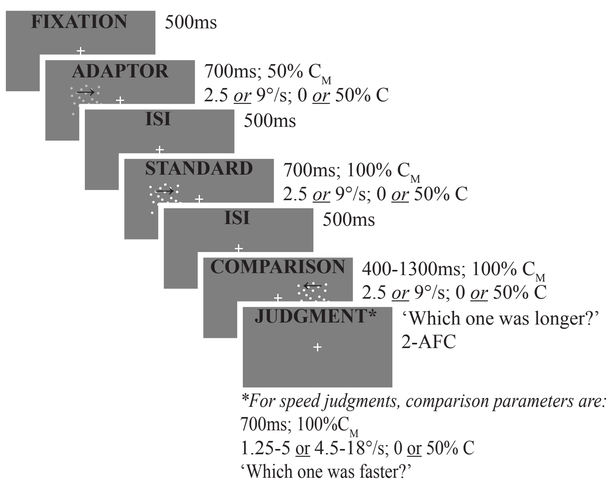
• Adaptation to motion or flicker in a local region of the visual field affects perceived duration of a consecutively presented dynamic stimulus on the same position:
Spatially localized mechanisms of time perception[1]
• These **temporal effects** on apparent duration show narrow spatial tuning (i.e. strong relation with location), and are dissociated from the effects of adaptor on apparent temporal frequency:
Early locus in the visual pathway; **subjective time's dependence on spatial vision; separated mechanisms for subjective time and temporal frequency / speed**[2]
• Shift in the phase of the temporal impulse response function as a result of a **contrast-gain mechanism**[3] has been suggested to be the main mediator for duration distortion effects originated in in the early levels of the visual pathway (i.e. Magnocellular layers of the LGN)[4].
• Early source contrast gain effects are known to be manifested in the response of higher- level motion areas such as MT+[5].
• Thus, **we hypothesized that** if contrast-gain effects were a mediator in the duration distortion effects, as Johnston and Bruno have suggested, then, we could also expect to observe subjective duration changes as a result of manipulations changing the temporal tuning of neurons in higher-level motion areas (i.e. area MT+).

GENERAL METHODS

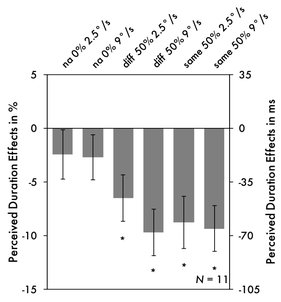
Participants: Students affiliated with the Bogazici University & Vision Laboratory
Materials: MATLAB & Psychophysics Toolbox
Procedure: Standard psychophysical experimental routines, using 2-AFC or QUEST
Data Analysis: PSE or PSS of psychometric functions, data analysis mainly either corrected t-tests, or (ANOVA) with multiple factors, using IBM SPSS

STUDY 1

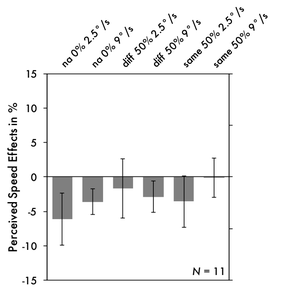
1A & 1C: Short-term adaptation effect in a global motion paradigm
1B: Prior control for changes in perceived speed



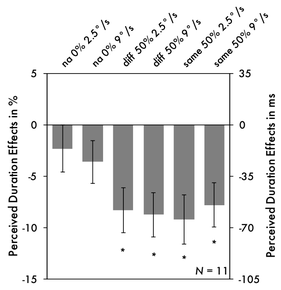
(1A)



(1B)

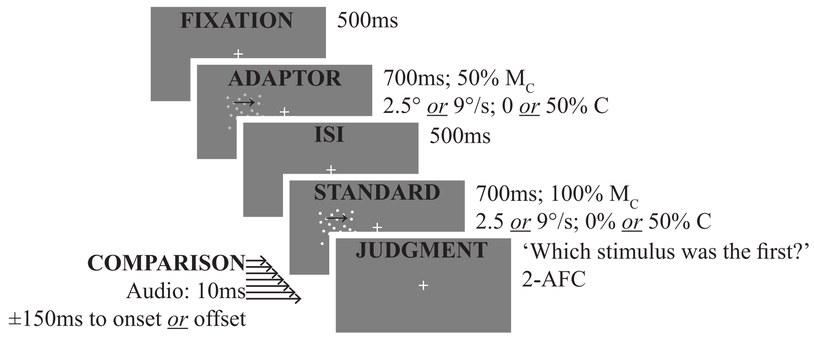


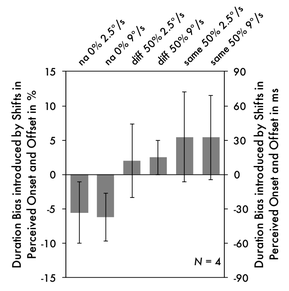
(1C)



• Significant **short-term motion adaptation effects on duration** compression are always present for **50% coherence**, but not for 0%
• The effects of adaptation on perceived duration are **dissociable from those on perceived speed:**
(i) perceived speed following adaptation does not show a significant difference across different coherence conditions
(ii) duration effect survives even after having matched the perceived speeds of two tests individually for each condition
• Insignificance of precisions (=psychometric functions' width) = effect **not due to the attentional priming** to the location of the standard stimulus following adaptation (data not shown here).

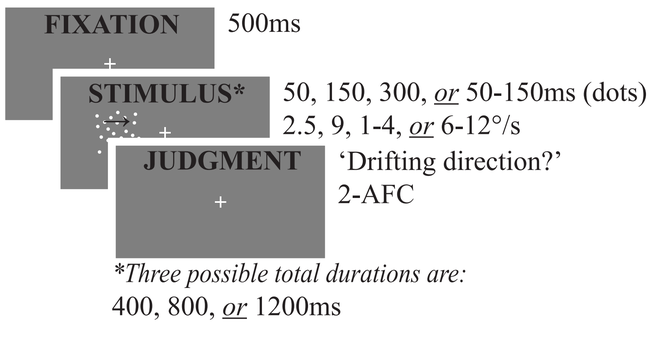
1D: Control for perceived onsets/offsets using an audio cue

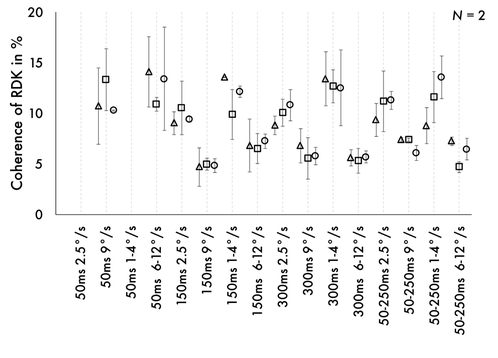




• Underlining a genuine time mechanism, rather than changes in **stimulus' perceived onset-offset.**

1E: Control for the coherence thresholds using QUEST

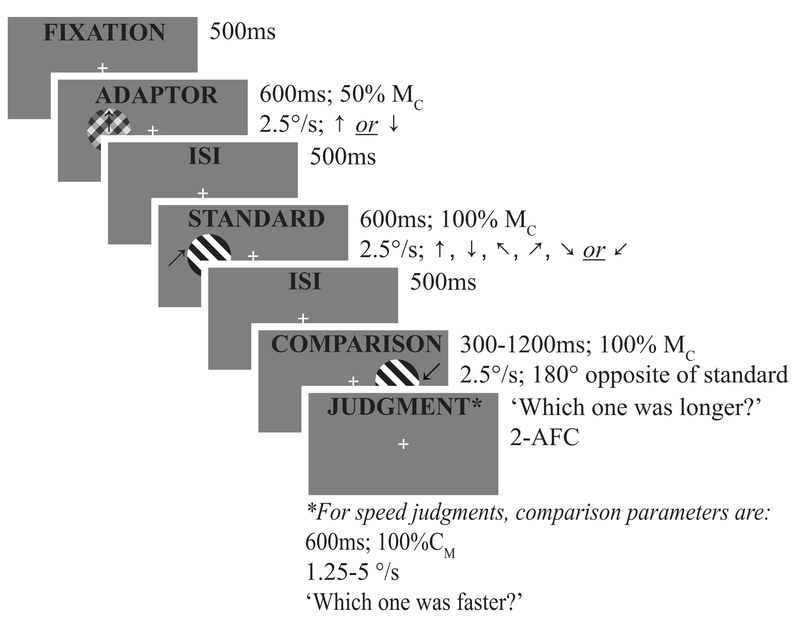




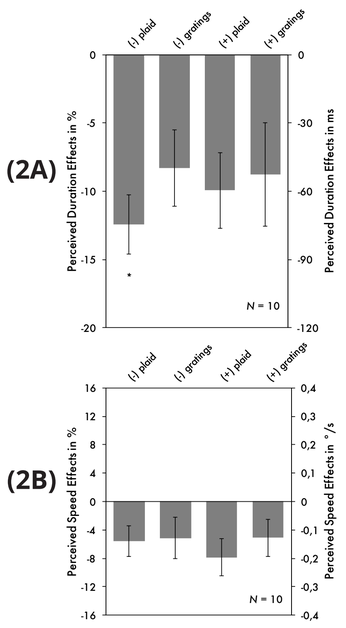
• Coherence thresholds are found to range from 5-to-15%, thus, 50% of coherence is always **supra-threshold** for different conditions with various parameters of RDK in the main experiments.

STUDY 2

2A: Short-term adaptation effect using drifting sinusoidal gratings
2B: Prior control for changes in perceived speed



(2A)

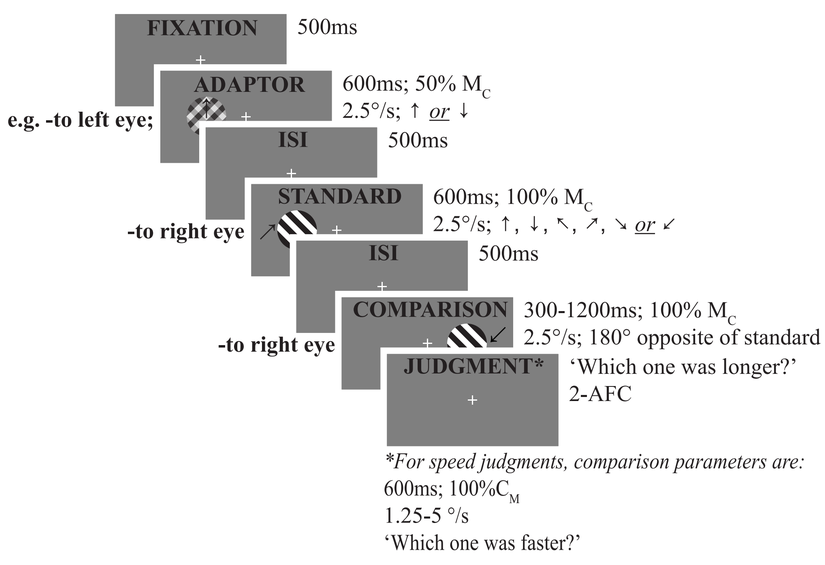


(2B)

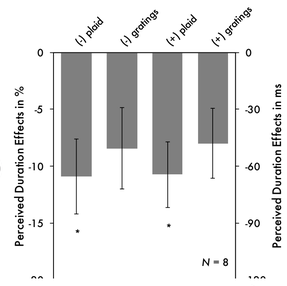
• Investigating whether the short-term adaptation-induced temporal change is direction specific using drifting gratings and plaids.
• **Short adaptor drifts in opposite directions** cause not only an enhancement of the response to subsequent test motion, but also an **increase in the latency of response in neurons of macaque area MT**[6].
• A significant duration compression when the plaid adaptor & the subsequent standard grating move in different directions. Effect disappears when the plaid and the standard move in the same direction or when the standard move in plaid's component directions.
• Effects are separated from changes in **attention** or **perceived speed**.

STUDY 3

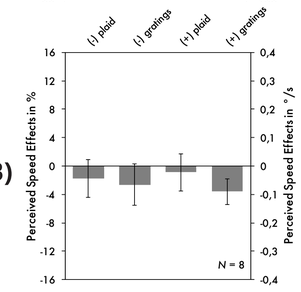
3A: Interocular transfer
3B: Prior control for changes in perceived speed



(3A)



(3B)



In the plaids and drifting gratings paradigm;
• Using **shutter glasses** to investigate the **interocular transfer of the adaptation effects**
• Presence of the interocular transfer = The locus of the observed effect is within a **higher level area** (i.e. beyond V1), where info coming from the two eyes have already been integrated.

CONCLUSIONS

• Introducing a novel effect: **Short-term adaptation to motion changes the apparent duration** of a successively presented dynamic stimulus
• Controls for changes in perceived **speed, attention, and perceived onset-offset**
• Manipulating various parameters of (RDKs) and plaid/grating stimuli showed
(i) coherence dependency,
(ii) direction sensitivity,
(iii) interocular transfer
of duration compression effects
• Results overall proposes a potential **locus** in a **higher-level motion area**, such as area MT+.
• Duration changes with a locus in higher level areas might also be mediated by the phase of temporal impulse function, complimenting Bruno and Johnston (2010) results linking duration effects to contrast gain changes in low-level LGN.

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ACKNOWLEDGEMENTS

Our research is funded by Bogazici University BAP [Scientific Research Projects], Project No: 9248.
We would like to thank Ezgi Coşkun with her help in data collection.

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