

# **Purely visual saltation cutaneous, auditory, “rabbit”**

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Handout: <http://www.klab.caltech.edu/~farshadm/ECVP2004/>

# **illusion similar to and cross-modal**

**Shinsuke Shimojo**

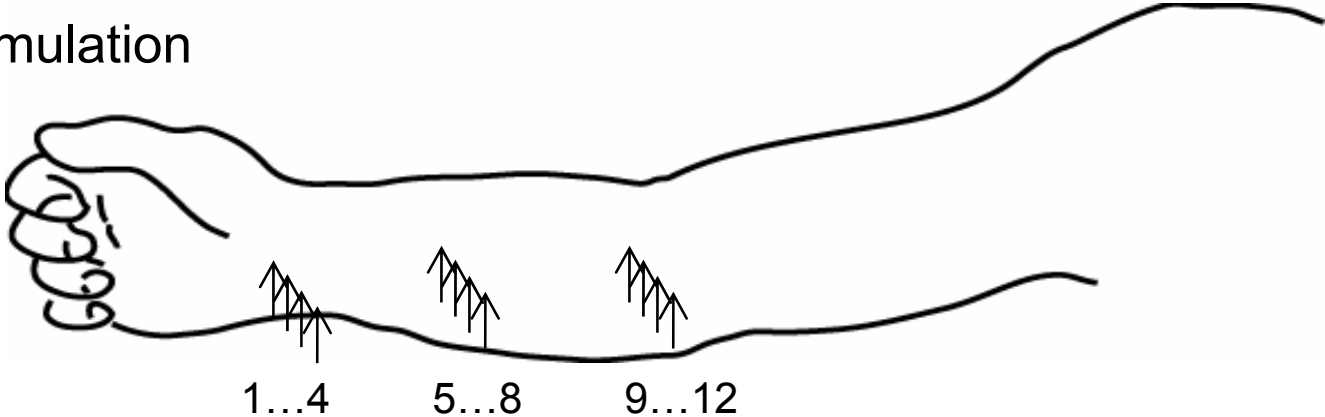
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## ***Abstract***

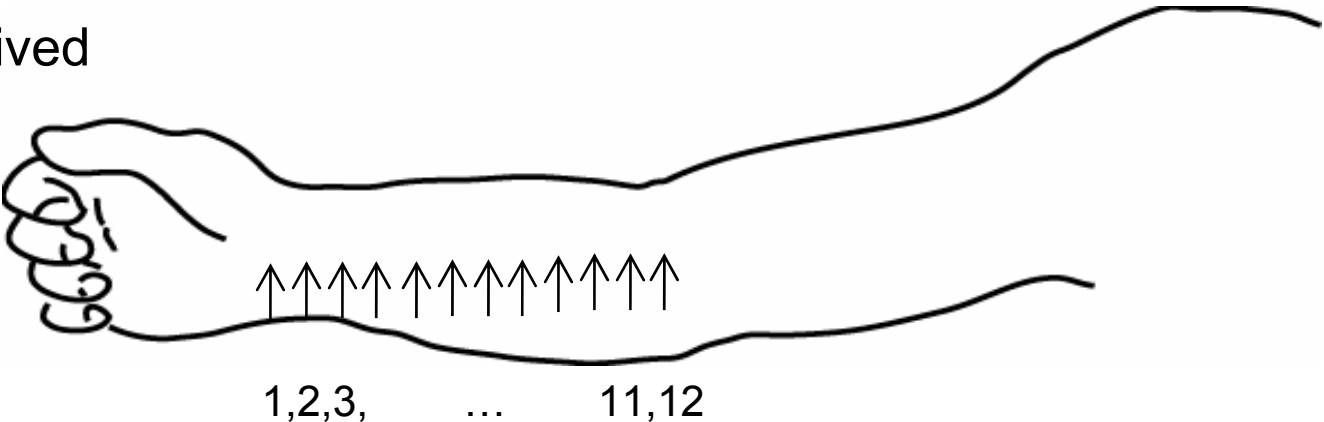
When a train of stimuli presented in one location is followed by stimulation in another location, the intermediate stimuli are perceived as shifted in the direction of the apparent motion. This illusion was originally discovered for cutaneous (Geldard & Sherrick, 1972 *Science*), and auditory (Bremer et al, 1977 *Am J Psychol*) stimulation. Recently, Kamitani & Shimojo (VSS 2001) reported a cross-modal version. Here we explore unimodal rabbit illusion in peripheral vision (Geldard 1975 *Bull Psychonomic Soc*) and its discriminability from veridical salutatory motion.

# Rabbit illusion (Geldard & Sherrick, 1972)

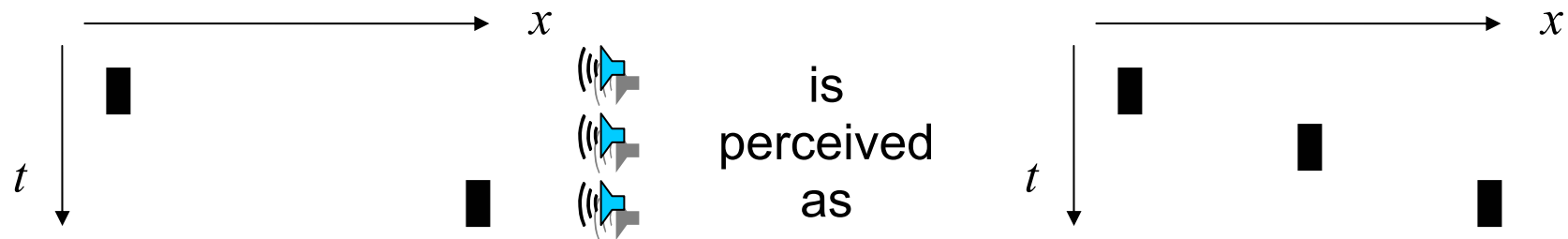
Stimulation



Perceived



# Cross-modal Rabbit (Kamitani & Shimojo VSS 2001)



Auditory beeps can induce perception of an additional flash (Shams et al, Nature 2000). The location of the illusory flash is, however, affected by the apparent motion between the two real flashes, *consistent with the timing of three beeps*.

Although cross-modal rabbit can be easily obtained near fovea, purely visual rabbit occurs only in periphery.

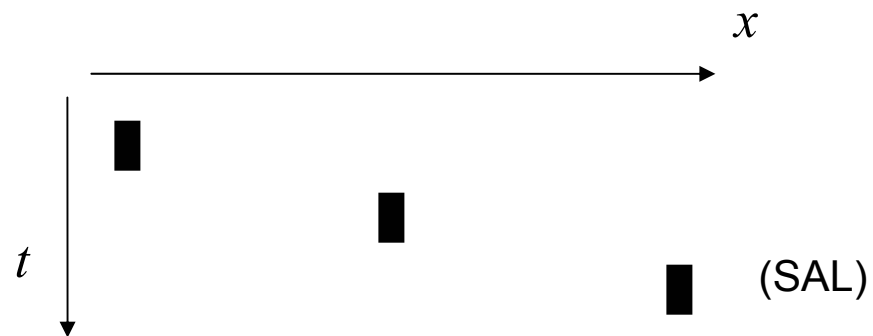
# Visual Rabbit



(Geldard 1975 Bull Psychonomic Soc)



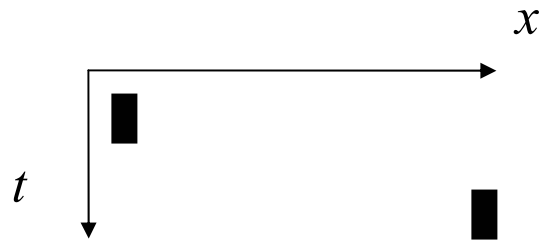
is perceived as



# Methods

- Stimuli consisted of white bars (0.2 deg x 1.1 deg) flashed on a black background for 24 ms.
- Naïve volunteers from Campus population participated in the experiments.
- Experiments were programmed using the Psychophysics Toolbox extensions (Brainard, 1997, Pelli, 1997) on a Windows PC. Stimuli were presented on a 17" CRT monitor (Dell Trinitron Ultrascan 1000HS) at 85Hz viewed binocularly from a distance of 54cm.
- Observers were instructed to fixate at a crosshair presented in the lower half of the screen. Flashes appeared in upper left or right quadrants (randomly chosen). The eccentricity was varied between trials (4 to 16 degree, randomized).
- Before the experiment we showed a schematic drawing of the stimuli to the participants.
- 4 cond. x 4 ecc. x 10-16 repetition (160-256 trial per subject)

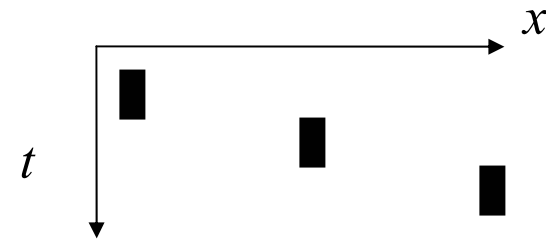
Apparent motion (AM)



Expected report:

**1**

Saltation (SAL)

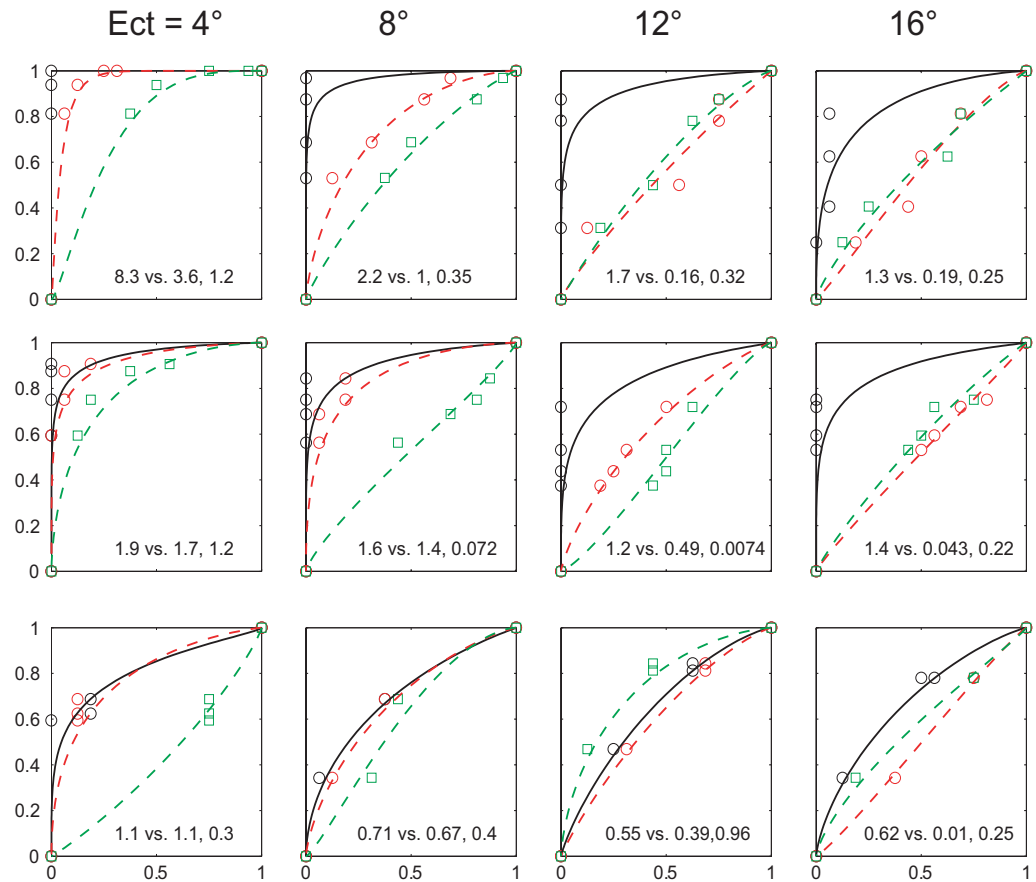
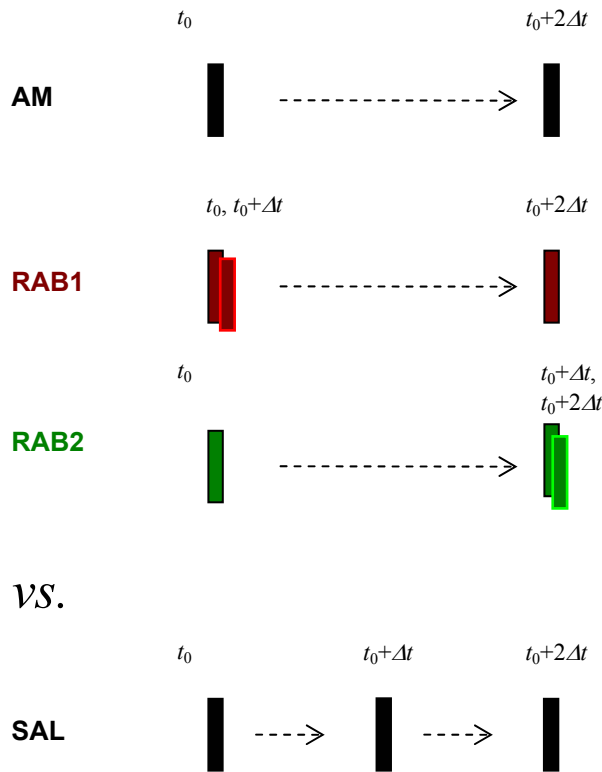


**5**

- Observers were asked to report if they perceived veridical saltation or not on a scale from 1 (jump, not-saltation) to 5 (true saltation; 3 is not confident either way).
- ROC curves were estimated for each subject by fitting a bi-normal model to the data.

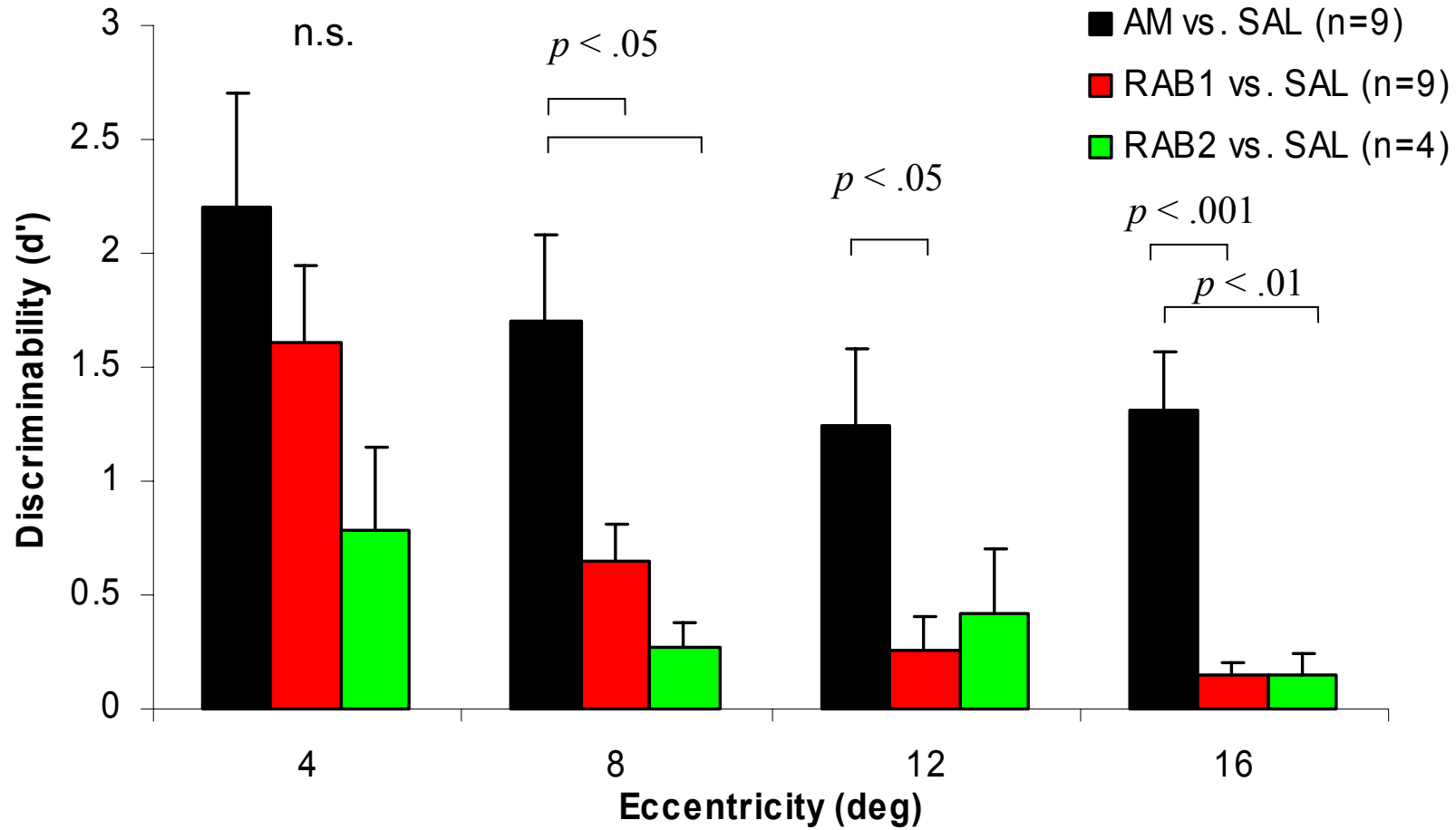
# Basic rabbit illusion

Task: *discriminate*



# Results

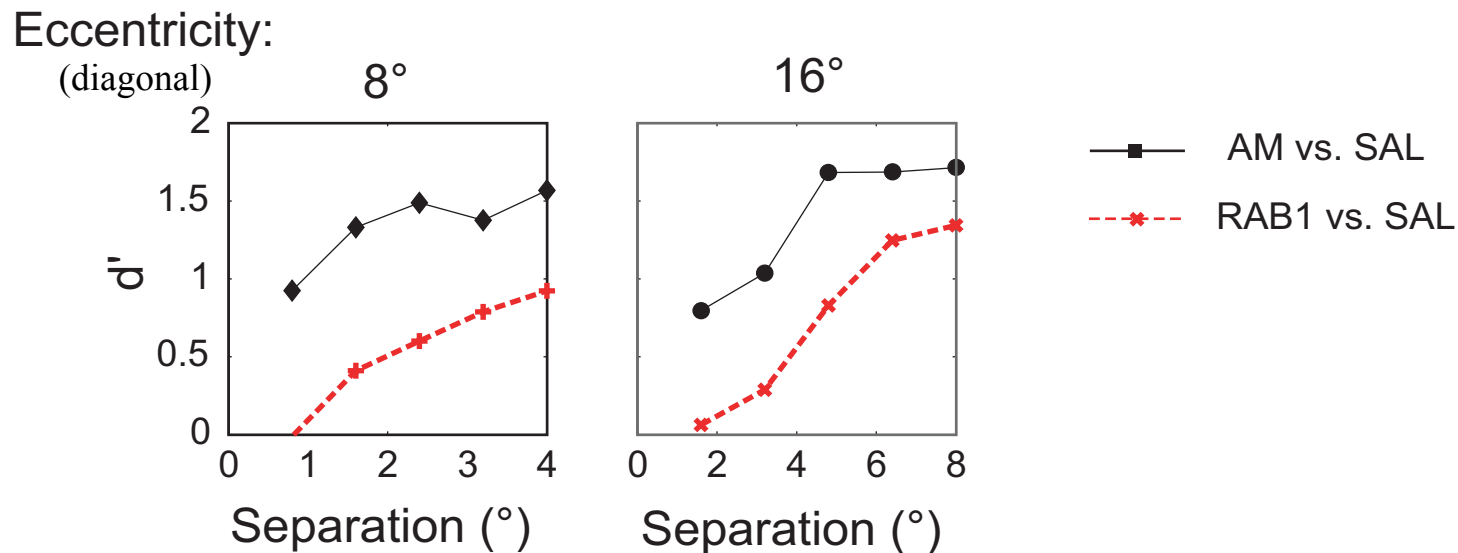
ISI = 120 ms, 2.4° separation



- ✚ For all eccentricities, discrimination between apparent motion (AM condition) vs. saltation (SAL condition) was easy.
- ✚ Near fovea, observers could discriminate RAB1 (and perhaps RAB2) vs. SAL. However, at larger eccentricities participants failed to distinguish RAB1 or RAB2 vs. SAL. There was no significant difference between RAB1 and RAB2 in any eccentricity.
- ✚ In RAB1, the second flash seems to be mislocalized in the direction of motion.
- ✚ In RAB2, the second flash can either be mislocalized in the *opposite direction* of motion, or it is possible that the third flash is mislocalized in the direction of motion (motion extrapolation).
- ✚ Perception of motion and position are interlinked: Motion can influence position; it is not merely the derivative of position over time. Retinal location is not the only determinant of position of a moving object.

# Separation vs. Eccentricity

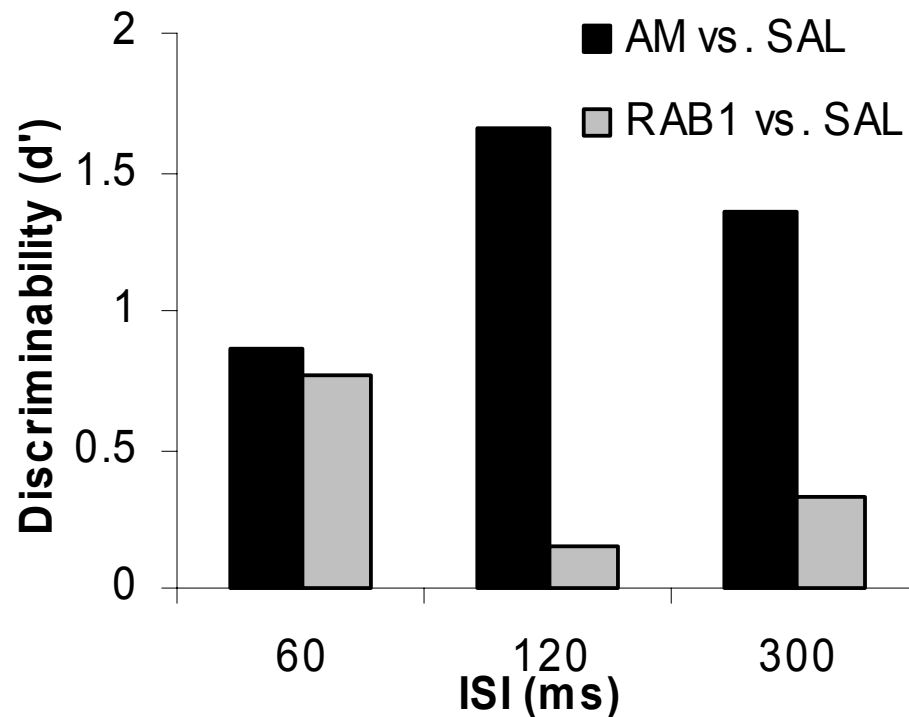
Critical separation reflects the cortical magnification (ISI = 120)



At a separation roughly equal to one-eighth of eccentricity, the RAB1 condition (red line) is virtually indistinguishable from saltation, whereas the apparent motion can be still discriminated from saltation. For larger separations, observers could discriminate both AM and RAB1 vs. saltation, but their performance was higher for AM vs. SAL.

Scaling of the separation with the eccentricity is consistent with the **Cortical Magnification**.

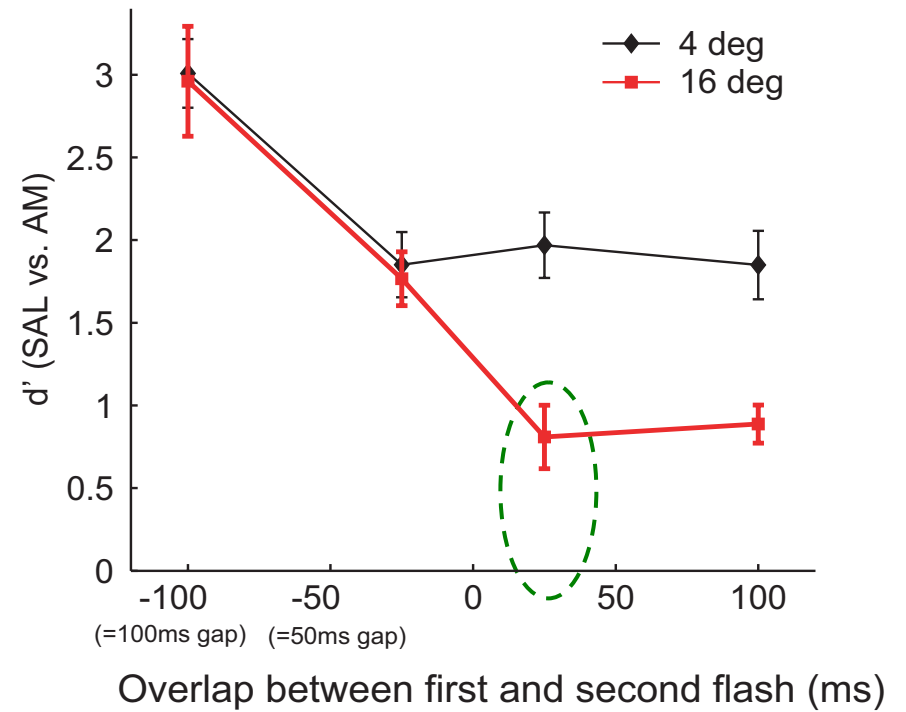
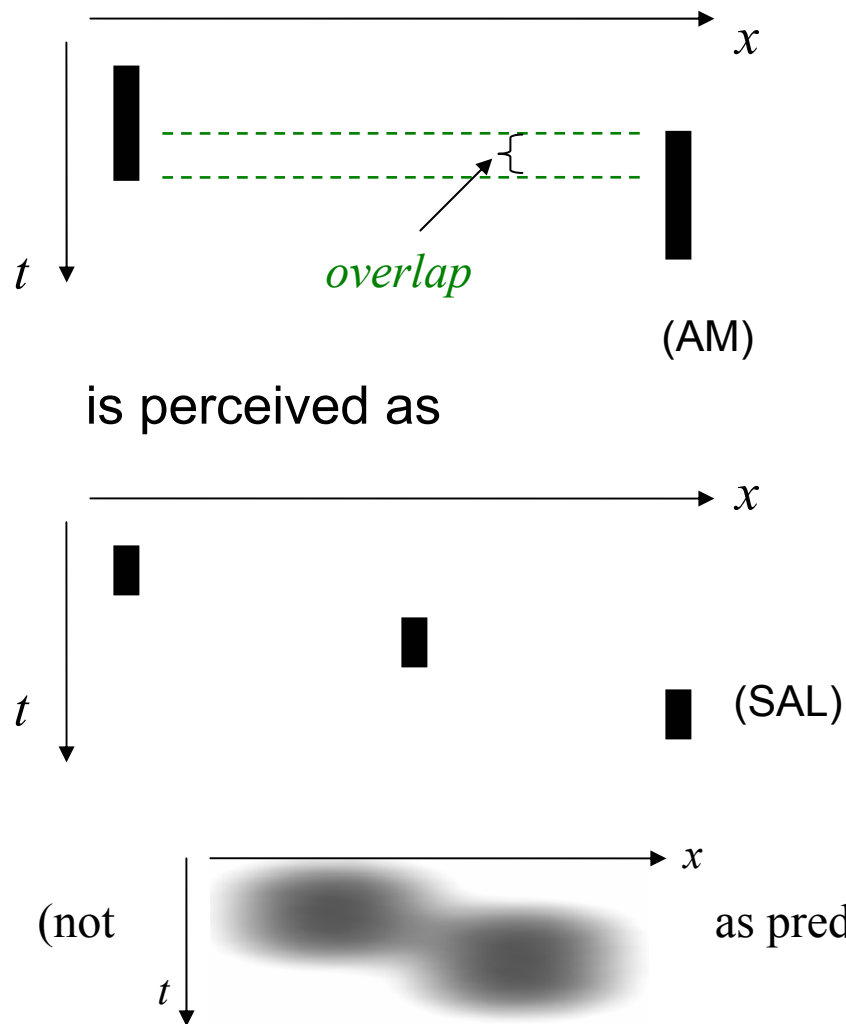
Illusion depends on ISI and it disappears for very short ISIs.



## Role of Visual Transients

*Visual transient was induced by temporally overlapping the two flashes*

Three flashes are perceived when the flashes overlap in time (although the overlap condition can still be distinguished from SAL).



In a separate observation, **blinking the fixation crosshair** had a similar (but weaker) effect.

# Summary

- ✚ “**Visual rabbit**” is functionally analogous to previously reported cutaneous (Geldard & Sherrick, 1972), auditory (Bremer et al, 1977), and cross modal (Kamitani & Shimojo, 2001) rabbit illusion.
- ✚ In “beta” or apparent motion (Palmer, 1999), two successive flashes are perceived as a continuous motion, as if the flash travels between the first and second location. However, in visual rabbit *each flash is distinctively perceived*. In fact, observers could easily distinguish apparent motion from saltation.
- ✚ If the intermediate flash appears before the motion, it is mis-localized in the direction of motion (comparable to the Frohlich effect). In contrast, an intermediate flash that appear following the motion seem to be displaced in the opposite direction.
- ✚ Motion and position are linked: Perception of precise location beyond the resolution of the visual system (deblurring of position in peripheral vision) is modulated by motion.
- ✚ Rabbit illusion seems to be *induced by visual transients* in the context of the perceived motion.

# References

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# Acknowledgement

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