

# Vection Perception During Exposure to Visual Motion of Narrow Field of Views

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## 1 Introduction

Vection is the illusory perception of self-motion often generated when watching wide field-of-view (FOV) visual motion. Vection perception is also part of the thrill when playing computer games (Guo *et al.*, 2013). Since vection perception can generate symptoms of motion sickness among 1/3 of the population (So *et al.*, 1999), perception of vection when watching wide visual moving fields has been the subject of many studies (e.g., Ji *et al.*, 2009; So and Ujike, 2010). However, little attention was given to the perception of vection when watching visual motion of narrow field of views. Johansson (1977) reported that subjects experienced vection for a falling (/rising) random dot pattern covering 1 degree (horizontal) and about 47 degrees (vertical) of the visual fields at each side of the subjects' peripheral visual field.

In Johansson's study, subjects were exposed to larger FOVs first, and then the FOV was reduced gradually (till 1 degree) for the subjects who reported vection. This might have biased the results. In this study, we seek to repeat Johansson's study without the bias. Not all virtual reality (VR) applications provide wide FOV visual presentations (e.g., So and Chung, 2002). In fact, most head-coupled VR systems only have FOV of less than 50 degrees and yet were able to generate perception of vection (e.g., So, 1994).

## 2 Methods

We conducted an experiment to study the interaction effects among (i) the presence and absence of ceiling light; (ii) direction of the visual motion (up/down); (iii) holding a

cardboard in front versus staring at an LED placed also in front of the subjects; and (iv) speed of the visual motion (approximately 5, 9, 18, 25 °/sec at 70° horizontal) on vection ratings (from 0 to 6) and vection onset time.

### 2.1 Participants and Apparatus

Six male and two female subjects attended the experiment. Their ages ranged from 22 to 30. Following Johansson's (1977) method, two monitors were placed on each side of the subjects. A random white dot pattern on a black background was presented on both monitors. The screen of each monitor was partially covered so that the FOV of each stimulus was 1 (horizontal) x 47 (vertical) degrees. This stripe of display was positioned at 70 degrees to the left and to the right of the viewers. The center of each monitor was placed at the subjects' eye height level.

### 2.2 Procedures

Each condition was presented to the subjects for 120 seconds. Vection onset time and rated level of vection were measured (modified from Webb and Griffin, 2003). If a subject didn't feel vection during the 120 second period, vection onset time was assumed to be 240 seconds for data analysis purposes.

In the holding a cardboard condition, subjects held a black cardboard with two hands and stared at it to block their frontal vision; whereas at LED condition, the cardboard was removed and the subjects stared at an LED in front of them.

## 3 Results and discussion

Rated levels of vection and the vection onset times during the lights-off conditions were significantly higher and shorter than those reported during lights-on conditions ( $p < 0.001$ ). The results of holding a cardboard (versus staring at an LED) were similar to the effects of turning the lights off ( $p < 0.001$ ). Both upward and downward moving stimuli

at all speeds caused vection among the subjects but there was no significant effect across different direction ( $p>0.7$ ) nor speeds ( $p>0.15$ ).

According to the General Linear Model constructed, the interaction effect of Ceiling Light X Cardboard Condition on vection onset time was significant ( $p<0.01$ ) while all the other two-way interactions had no significant effect on onset times. However, for the vection ratings, in addition to the interaction effect between Ceiling Light and Cardboard, interaction between Ceiling Light and Speed was also significant ( $p<0.01$ ).

Ceiling Light	Cardboard vs LED	N	OnsetTime		Rating	
			Mean	Std Dev	Mean	Std Dev
OFF	LED	64	51.05	84.42	3.31	2.03
OFF	Cardboard	64	45.58	80.43	3.28	2.01
ON	LED	64	175.27	94.88	0.45	0.73
ON	Cardboard	64	128.72	106.56	1.22	1.56

Table 1 Interaction Effect of Ceiling Light X Cardboard Condition.

Ceiling Light	Speed	N	OnsetTime		Rating	
			Mean	Std Dev	Mean	Std Dev
OFF	4.6	32	59.81	89.72	2.97	1.96
OFF	9.2	32	53.44	84.93	3.09	2.07
OFF	18.4	32	46.19	85.53	3.50	2.09
OFF	24.6	32	33.81	68.54	3.63	1.95
ON	4.6	32	146.00	108.47	0.91	1.47
ON	9.2	32	159.47	101.38	0.88	1.31
ON	18.4	32	160.06	105.39	0.81	1.35
ON	24.6	32	142.44	101.01	0.75	0.95

Table 2 Interaction Effect of Ceiling Light X Speed of the Stimuli.

Vection has been shown to be related to retinal slip (Guo *et al.*, 2012) and the current results suggest that vection generated by peripheral retina slip should be studied.

## 4 Conclusion

Perception of vection does not require a large moving visual field-of-view. Vection was reported when watching two narrow stripes of moving visual scenes (1 degree x 47 degrees). Significant effects of holding a cardboard or turning the lights off are interesting and will be discussed in the presentation. Only preliminary results of the first 8 subjects are presented. More subjects will be recruited.

## 5 Acknowledgement

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