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# Orientation free representations or multiple perspectives in Virtual Environments?

## A case for increased use of eye-tracking data

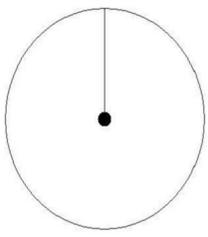
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### Introduction

- As people move through an environment they may encode spatial information according to a particular frame of reference.
- The spatial information encoded within a preferred frame of reference can be indicated by the presence of a spatial alignment effect.
- Spatial alignment effects refer to more efficient recall about an environment and the objects within it from an imagined perspective aligned with a particular source of information.
- Alignment effects are revealed through judgment of relative direction (JRD) tasks which require the use of vectorial learning and measure orientation dependence.

Imagine you are standing at the ?  
Directly behind you is the ?  
Point to the ?



Example of a computer based pointer used for JRD's

- The First Perspective Alignment Effect (FPA) refers to significantly more accurate judgments when participants imagine themselves in alignment with the very first experienced perspective within a novel environment than those that are misaligned with the first perspective (FP).
- The FPA effect can be found in real world environments, virtual environments (VE's) and secondary media.

### General Issue

- There is a key issue that is often neglected - ensuring the investigator defined FP is the same as the participant's.
- Is an absence of an FPA effect a reflection of an absence of the FP's influence or a mismatch in the investigator/participant definitions?
- Has the presence of an alignment effect been masked by limitations in the object arrangement's/alignments tested?
- This can complicate interpretations of results as well as hinder the discovery of potential sources of spatial information/alignment that might be investigated.
- Attended sources of spatial information/alignment might be neglected in an experiment or potential analysis because the experimenter may be unaware of its importance or existence to the participant.

### Example: Tlauka, Carter, Mahlberg & Wilson (2011)

**Rationale:** There appeared to be a discrepancy in the literature despite the occasional presence of the FPA effect in real world experiment designs - with it being more apparent in what some might consider secondary media. This discrepancy was investigated to determine whether differences in levels of detail or procedure were involved.

**Design/Procedure:** Two Experiments were conducted.

In Experiment 1 four levels of VE detail/complexity were manipulated (Indoor Low, Indoor High, Outdoor Low, Outdoor High) to ascertain impact on the presence of the FPA.

In Experiment 2 three levels of VE experience/procedure were manipulated (No Tour, Tour Immediate, Delayed Tour) to ascertain impact on the presence of the FPA.

Scan QR code for full .pdf of Tlauka et al. (2011) paper

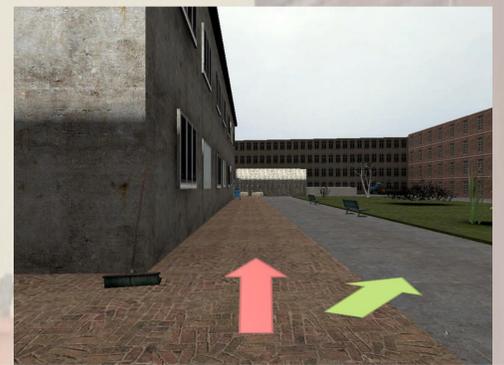


Scan QR code or visit <http://tinyurl.com/pcarter-vid> for video clip of the Outdoor High detail VE



### Eye-Tracking Solutions

- Piloting beforehand with static images to establish FP has been defined appropriately. VE design could then be altered to ensure experimenter and participant defined FP's are congruent or suitable JRD's could be included during testing to incorporate both experimenter and participant's FP's if incongruent.



Discrepancies between experimenter defined FP (red arrow) and FP as experienced by participant (green arrow).

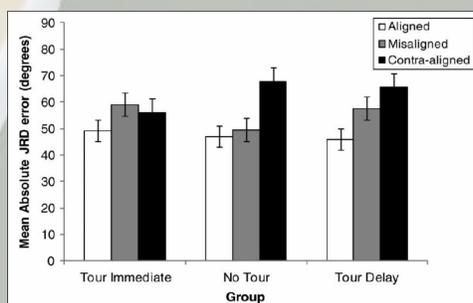
- Once calibrated for motion, tracking could be used during the experimental exploration phases to define a flexible FP on a participant by participant basis rather than static defined FP for all participants and analyses.
- Tracking could be used in conjunction with larger object arrays/arrangements. Data from the tracking could be used to determine which judgements are of interest in determining whether other sources of alignment are being used and how many - reducing the need to test extremely high numbers of object arrangements to ensure alternative alignments are not missing.
- In standard FPA effect experiments initial eye-tracking data could be used to determine common features of the FP experience across a range of VE's. This data could then be used to determine the properties of salient sources of spatial information/alignment. This in turn could be used for creating suitable alternative alignment effects for investigation.



Eye-tracking 'hotspots', as in this mock up, could indicate salient spatial features that lead to alignment effects such as the FPA

### Tlauka et al. Results

- No significant effects of VE detail were found but a significant interaction between tour experience and alignment was found  $F(2, 282) = 14.34$ ,  $MSE = 2504.80$ ,  $p < .05$ ,  $\eta^2_p = .03$ .



- Concluded that experience of the surrounding environment allows for the encoding of multiple perspectives, temporarily attenuating the importance and reliance of the FP.

### Issue with Results

- The results from such experiments do not define what these perspectives are, what alternative sources of spatial information were adopted.
- It is difficult to adequately state if multiple perspectives or a completely orientation free representation have been adopted.
- JRD's presented to participants are pre-set and require the experimenter to have identified possible sources. If appropriate judgments are not investigated or presented in the JRD task then sources of spatial information may be overlooked.

### References

Tlauka, M., Carter, P., Mahlberg, T. and Wilson, P. (2011) 'The first-perspective alignment effect: The role of environmental complexity and familiarity with surroundings' *The Quarterly Journal of Experimental Psychology*, 64 (11), pp. 2236-2250. ISSN 0272-4987

### Further information

Pelham Carter Staff Profile  
<http://www.hud.ac.uk/ourstaff/profile/index.php?staffuid=shumpjc2>

Scan QR code below or visit <http://tinyurl.com/pcarter-cosit13> for original Tlauka et al. paper, poster abstract and a gallery of VE screenshots.

