Similarity Between Room Layouts Causes Orientation-Specific Sensorimotor Interference In To-Be-Imagined Perspective Switches

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Poster #1086 presented at Psychonomics 2007 in Long Beach, CA, USA. Supported by NIMH grant 2-R01-MH57868, P30-EY008126

• Introduction & Motivation

Can our facing direction in a rectangular room influence what we can easily imagine, even if in a different room?

If so, this would be critical for spatial cognition experiments and our understanding of spatial memory!

May (1996, 2004) suggested that the difficulty of imagined perspective switches is not only caused by "**transformation costs**", but also by interference between the sensorimotor (actual) and to-be-imagined orientation ("**interference costs**").

Here, we demonstrate a similar interference in judgment of relative direction (JRD) tasks, even if participants are in a remote room and do not know their physical orientation. That is, one's physical orientation in a test room can influence which orientations in the learning room are easier/harder to imagine.

• Methods

Participants learned 15 objects in a learning room.

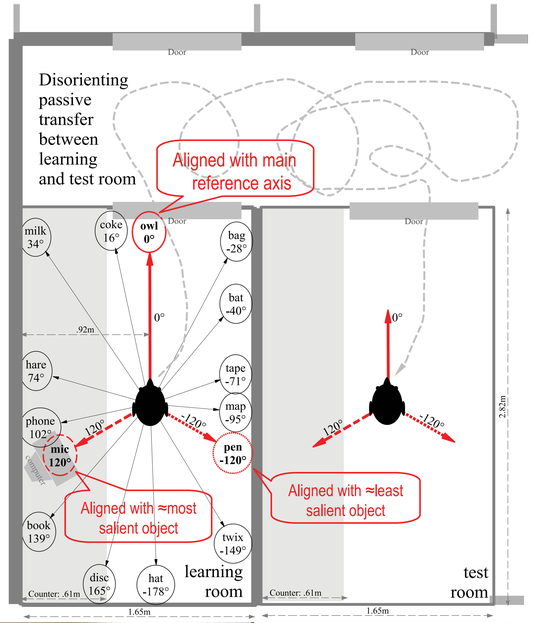
They were disoriented and wheeled into an empty test room of similar geometry.

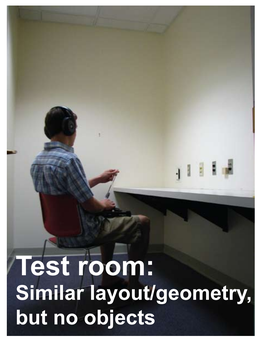
Learning, test, and to-be-imagined orientation was independently manipulated in a JRD task.

Learning phase: Participants learned 15 target objects located in a small cluttered office from one of 3 orientations ($\mathbf{H_{learn}}$ = 0°, 120°, or -120°, between-subject, N=3×12) until reaching a criterion.

Passive transport: Participants were blindfolded and disoriented before being wheeled to an empty test room of similar layout and geometry.

Test phase: Participants were seated facing $\mathbf{H_{test}}$ = 0°, 120°, or -120° (3 blocks, within-subject, balanced order), and asked to perform judgments of relative direction ("JRD" using rapid pointing) as if they were in the learning room facing one of the 3 different to-be-imagined orientations ($\mathbf{H_{TBI}}$ = 0°, 120°, or -120°) E.g., *imagine facing "pen", point to "phone"*). We used 6 repetitions per condition ("trials" with 6 pointings each).





• Results

No direct influence of H_{learn} or H_{test}

Better performance if to-be-imagined orientation aligned w/ room (H_{TBI}=0°).

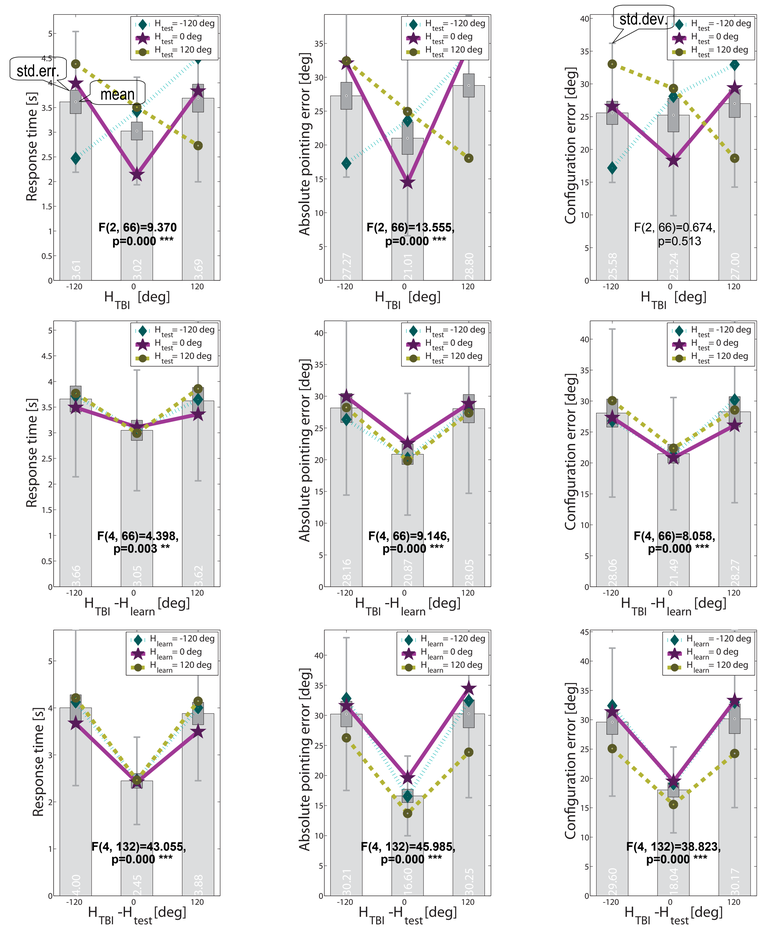
However, no benefit for alignment with salient object (H_{TBI}=120°).

Better performance if to-be-imagined orientation aligned w/ learning orientation (H_{TBI}-H_{learn}=0°).

Better performance if no interference, i.e., if the to-be-imagined orientation is aligned with the corresponding orientation in the test room (H_{TBI}-H_{test}=0°)

→ even though participants did not know the relative orientation of the learning and test room!

Neither learning orientation H_{learn} nor test orientation H_{test} showed any significant influences by themselves (p > 19%).



• Discussion & Conclusions

On can no longer assume that test room orientation and geometry is irrelevant.

→ Depending on one's physical orientation wrt. one's surroundings, certain perspectives can be easier or harder to imagine.

Environmental geometry is not only crtitical for re-orientation, but also for retrieval of spatial information from memory.

Perspective switches were facilitated when participants' to-be-imagined orientation in the learning room was aligned with the corresponding orientation in the test room. This suggests that merely being in an empty room of similar geometry/layout can be sufficient to automatically re-anchor one's representation (similar to "instant-based spatial updating" proposed by Riecke et al., 2005) and thus produce orientation-specific interference. These results challenge the prevailing opinion that test room layout does not interfere specifically with mental perspective taking tasks, and should be considered when designing experiments involving perspective switches.

There is strong evidence that environmental geometry has primacy over non-geometric features for (re-)orientation in many species, including humans in some situations (e.g., Cheng & Newcombe, 2005). Here, we demonstrated that environmental geometry can also affect the retrieval of spatial relations from memory and specifically interfere with one's current to-be-imagined mental spatial representation.

References

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