Verbal, visual and spatial memory in wayfinding

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1. Introduction

Working memory subsystems (*with examples for wayfinding*) [1]
- verbal (*e.g., verbal directions*)
- visual (*e.g., image-based representation*)
- spatial (*e.g., geometric layout*)

Which memory system is used in wayfinding?

Theories of spatial memory and their predictions of orientation specificity:
- Mere object-to-object coding: no orientation specificity [2]
- Coding locations in relation to a reference direction [3]
- View dependant: code in orientation experienced [4]

2. Method

- Participants learned two routes through a photorealistic model of the city centre of Tübingen. They had never been to Tübingen before.
- During learning, participants performed a secondary task which interfered with a specific working memory system.

Secondary task	Partici-pants
verbal	6
visual	6
spatial	6
none	6
sum	24

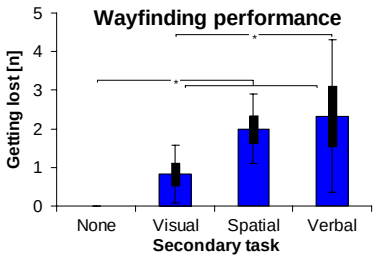
- The secondary tasks were provided through headphones. Accuracy responses were collected using a button-press response box.
- All secondary task were constructed for equal difficulty. Before learning the routes, participants performed a baseline measure.
- Participants had to retrace the learned route using a joystick.
- We recorded getting lost, stops, time to reach the goal and distance covered.

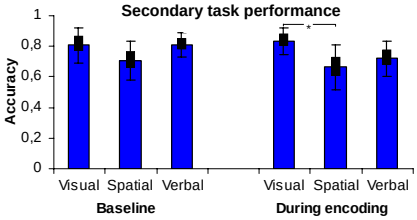
Orientation specificity
- Participants saw pictures of the intersections from different orientations or pictures of intersections not encountered before.

- Participants had to decide whether they had seen the intersection before. Accuracy and reaction time were recorded.

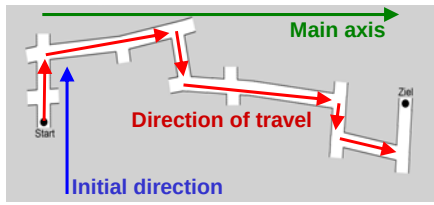
3. Results

Memory systems
- Participants with a secondary task got lost more often than participants without a secondary task.
- On the short route participants with verbal secondary task got lost more often than participants with a visual secondary task.

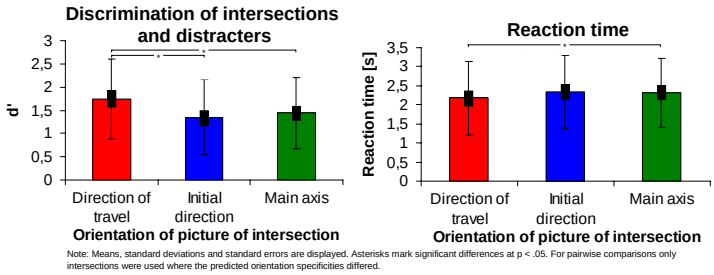




- During baseline, before learning the routes, no significant difference was found.
- During route learning, participants performed better for the visual secondary task than the spatial secondary task



Orientation specificity
- Participants discriminated pictures of intersections from distracters.
- Pictures taken along the direction of travel were recognised better than pictures aligned with a reference direction. According to [3] a reference direction is defined by the initial direction or the main axis of an environment.



Note: Means, standard deviations and standard errors are displayed. Asterisks mark significant differences at p < .05. For pairwise comparisons only intersections were used where the predicted orientation specificities differed.

4. Discussion

- Spatial and verbal memory were used to encode wayfinding knowledge.
- A trade-off between first and secondary task could be excluded.
- We observed a non-significant higher difficulty of the spatial secondary task during baseline. This might provide an alternative explanation for the importance of spatial memory.
- In agreement with previous studies, verbal memory is used in wayfinding [5] and reorientation [e.g., 6]. These results are consistent with a dual coding approach which states that environmental information is not only encoded spatially or visually, but also encoded verbally.
- In our large scale simulated environment participants stored view-dependant information about intersections as experienced when traveling along the route. These results are inconsistent with an orientation independent storage [2]. The results are also inconsistent with storage based on a reference direction [3].

5. References

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