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The contents of m anuals, entries therein and fiel d-kit materials are m odified from time to tim e, and this pro vides an ad ditional m otivation fo r keeping clo se contact with the Language and Cognition Group. We would welco me suggestions fo r changes and add itions, and comm ents on the viability of different materials and techniques in various field situations.

Contact

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Path Integration

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- <u>Relevant Projects:</u> Space and SPIN (Space in Neurocognition)

- <u>Nature of Task:</u> "Walking without vision" task

- <u>Priority:</u> For those wishing to extend the set of cognitive tasks conducted within the Space Project (cf. Pederson et al 1997 in *Language* 74.3, 1998, p557ff; Levinson et al in *Cognition* 84, 2002, p155ff, Levinson *Space in language and cognition*, 2003, CUP).

- <u>Basic Nature of the task:</u>
    In this task Subjects are blindfolded and asked to find their way back to origin after being led along two sides of a triangular path. IF YOUR COMMUNITY IS NOT COMFORTABLE WITH BLINDFOLDS DO NOT RUN THIS TASK!

- <u>Motivation:</u>
    Experiments conducted in urban, relative-speaking societies show that subjects have difficulties updating their position in space when guided without vision. This has been taken as an indication that their use of a geometric cognitive map, being the most efficient representational format for path integration, seems to be malfunctioning. One reason for this could be that many relative speakers (i.e. speakers of languages that use predominantly a relative frame of spatial reference; Levinson 2003) at no time maintain a constant spatial reference, which is needed to later lock a cognitive map back onto the real environment. For speakers of non-relative communities their spatial reference tracking "constantly ticks in the background and never goes on holiday" (Levinson, 2003). If this is the case speakers of non-relative systems should outperform speakers of predominantly relative systems in this path integration task.

    The basic idea behind this task is to see if speakers of non-relative systems differ in their performance from speakers applying a relative system.

- <u>Materials:</u>
    One blindfold.
        Ideal for this would be an airplane sleeping-mask, but alternatively any dense piece of cloth will do.
    One guidance stick of the size of approximately a detached bicycle handlebar.
        This could for example be a tree branch or a larger tool handle
    One measure tape.
        This tape is used to record the Subject's response.
    Eight bright pin like things.
        These pins will be used to mark Origin, Turning Point and Release Points (for explanation of these terms, see below) if not available some differently coloured sand will do to mark the mentioned locations.
    One different coloured pin like thing.
        This pin is used to record the subjects' Responses. Alternatively some button or small toy will do to mark the subject's response.

- <u>Subjects:</u>
    Subjects should be adults or teenagers. In general the rule is THE MORE THE BETTER; THE FEWER, THE MORE OFTEN THEY SHOULD DO THE TASK. Five subjects is the absolute minimum. You can inform the subjects about the general nature of the task, but not about expected effects. Subjects can be instructed in any language.

- How to run:

    This experiment is run in *sessions*. A session involves one subject and consists of 6 *trials* (single presentations). Subjects can and should participate in several sessions if possible. One session takes approximately 30 minutes. The response sheet illustrates all 6 trials of one session.

    The location to run this experiment should have fairly soft and level ground and be at least 5x5 meters in size. In preparation of a session the eight white pins should be placed at Origin, Turning Point and the 6 Release Points as indicated on the response Sheet and illustrated in the Figure below. The White pins should be pushed into the ground so deep that they cannot be felt if stepped on; nevertheless they should be visible to the experimenter at all times. Use the response sheet as a guide to place the positions relative to each other in distance and direction. The angles illustrated in the figure can be estimates. But the more precise your setup, the more telling the data will be.

    Every trial is illustrated on the Response Sheet with an illustration comparable to figure 1 below. The three black dots mark the three corners of a triangular path. The Origin and the Turning Point are the same for every Trial while the third black dot, the Release Point, varies from Trial to Trial.

    So now, six potential triangular paths, in a combination of two kinds of outbound route segments (2 m x 2 m versus 2 m x 3 m) and three outbound turn angles between the segments (60, 90, or 120 degrees) are marked on the ground.

    After this preparation the subject should be instructed and blindfolded out of sight of the testing grounds. The subject is not allowed to take off the blindfold until the sessions with all its trials is over. The subject is then led to the testing grounds already wearing the blindfold.

1. Place the subject on Origin facing the Turning Point.

2. Grab the guidance stick at its centre and have the subject hold on to its two ends with his/her two hands as they would hold onto a detached bicycle handlebar (see figure 2).

3. "Pull" the subject along a straight line to the Turning Point.

4. After stopping there, the subject is turned on the spot by still guiding him/her with the guidance stick to face the release Point marked black on the response sheet.

5. Then guide the subject along a straight line to the Release Point.

6. Here the subject is instructed to let go of the guidance stick and walk back to Origin by him/herself, still blindfolded.

7. After the subject has stopped wherever they think origin was, instruct him/her to put his/her feet together. Now mark the midpoint between the two big toes with the red golf pin (see figure 3).

8. Now ask the subject to again hold on to the guidance stick in the same manner as before and lead him/her to a random waiting position some meters away from both Response and Origin. Thus, the path back to Origin before the next trial is indirect, and there is no direct feedback provided regarding the accuracy of performance. Feedback should also not be provided in any other way before the experiment is over.

9. While the subject is waiting, measure the distances between Response and Origin and between Response and Turning Point and record them on the response sheet. Now guide the subject back to Origin to start the next trial.

There are two versions of the response sheet available, one with all right-hand turns and one with all left-hand turns. The response sheet type should be alternated between subjects. If several sessions are run with the same subject, the response sheet type should also be alternated between left and right type. A video recording of an example session would be informative but is not immediately necessary.

- More Background:

Etienne, A.S., Maurer, R., Georgakopoulos, J., & Griffin, A. (1999). Dead reckoning (path integration), landmarks, and representation of space in a comparative perspective. In R. Golledge (Ed.), *Wayfinding behavior: Cognitive mapping and other spatial processes* (pp. 197-228). Baltimore: Johns Hopkins University Press.
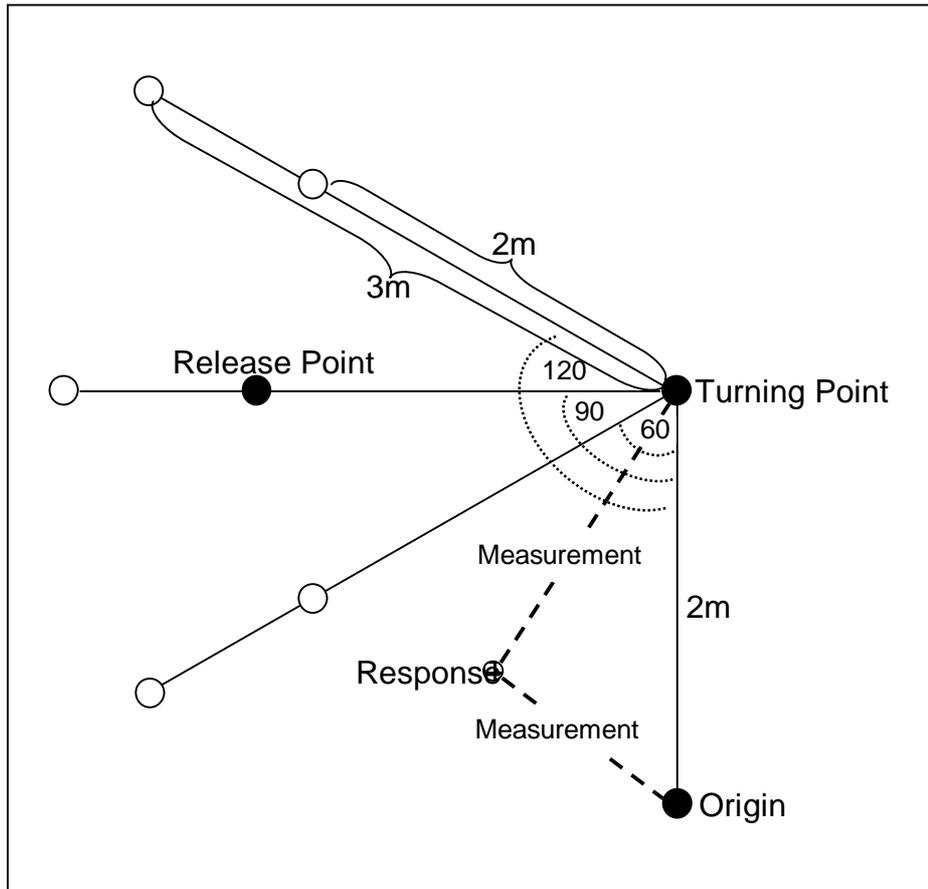
Golledge, R. G. (1999). Human wayfinding and cognitive maps. In R. Golledge (Ed.), *Wayfinding behavior: Cognitive mapping and other spatial processes* (pp. 5-45). Baltimore: Johns Hopkins University Press.
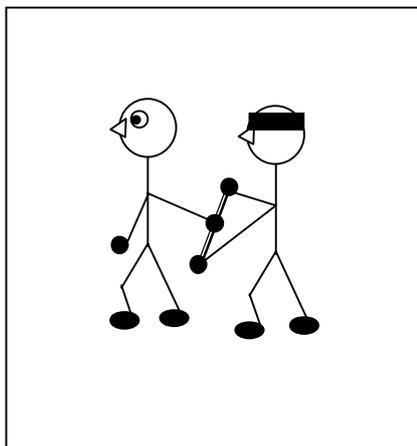
Klatzky, R. L., Beall, A. C., Loomis, J. M., Golledge, R. G., & Philbeck, J. W. (1999). Human navigation ability: Tests of the encoding-error model of path integration. *Spatial Cognition and Computation*, 1, 31-65.

Klatzky, R.L., Loomis, J. M., & Golledge, R.G. (1997). Encoding spatial representations through nonvisually guided locomotion: Tests of human path integration. In D. Medin (Ed.), *The psychology of learning and motivation: Advances in research and theory* (Vol. 37; pp. 41-84). San Diego: Academic Press.

Loomis, J.M., Klatzky, R.L., Golledge, R.G., & Philbeck, J.W. (1999). Human navigation by path integration. In R. Golledge (Ed.), *Wayfinding behavior: Cognitive mapping and other spatial processes* (pp. 125-151). Baltimore: Johns Hopkins University Press.

2m

3m

Release Point

120

90

60

Turning Point

Measurement

2m

Response

Measurement

Origin

Figure 1

Figure 2

Red Pin
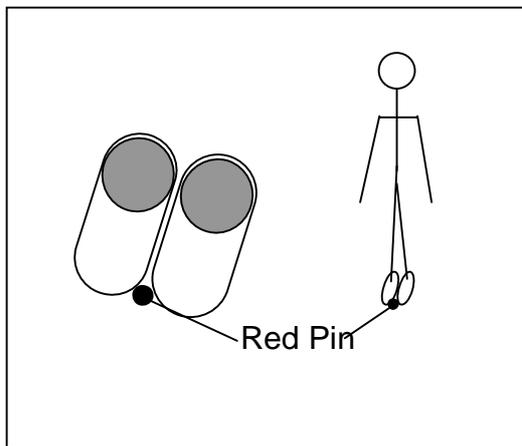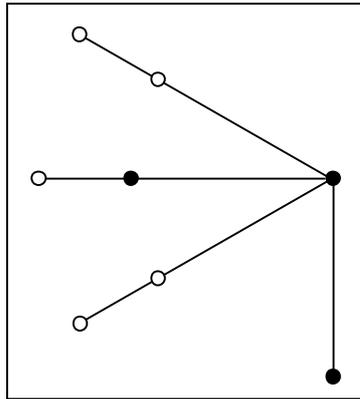
Figure 3
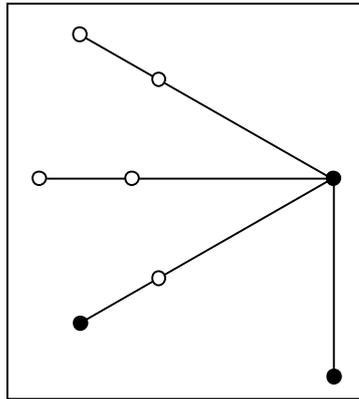
Response Sheet Path Integration Type 1:
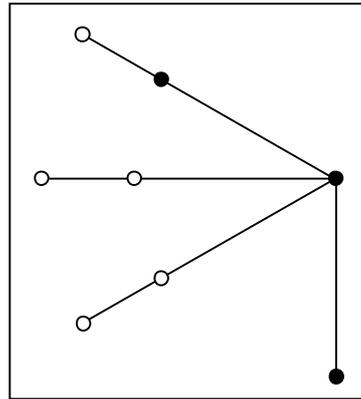
Subject:
     Gender: female O   male O
     Age:
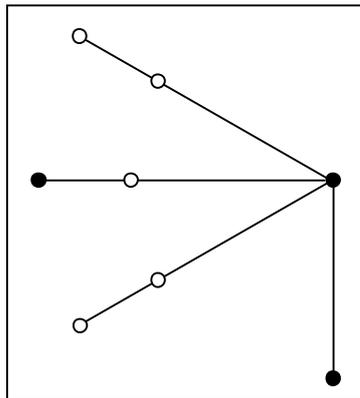
1: M1:   M2:

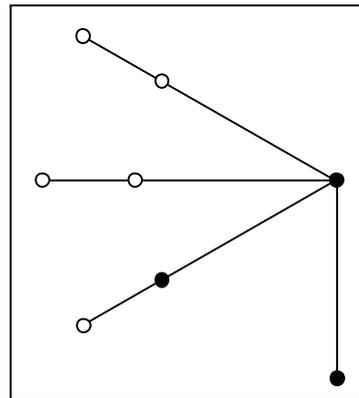2: M1:   M2:
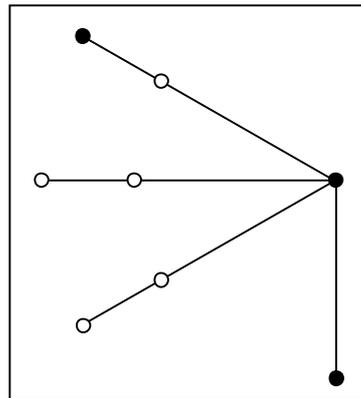
3: M1:   M2:

4: M1:   M2:

5: M1:   M2:

6: M1:   M2:

Notes:

Response Sheet Path Integration Type 2:

Subject:
  Gender: female O   male O
  Age:

7: M1:   M2:

8: M1:   M2:

9: M1:   M2:

10: M1:   M2:

11: M1:   M2:

12: M1:   M2:

Notes: