The Construction of Cognitively-Adequate Tactile Maps

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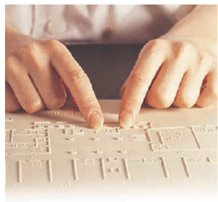
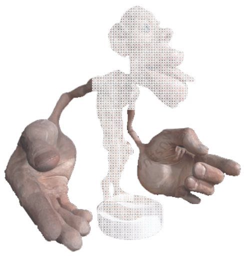
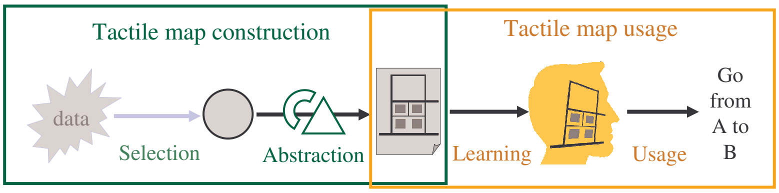


Introduction



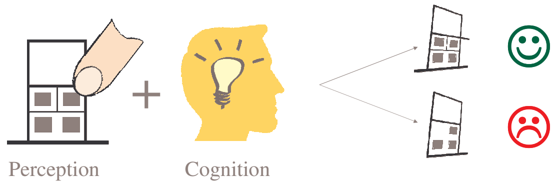
Tactile printers are available but principles on how to enable knowledge acquisition with computer generated tactile survey maps are lacking.

Principles for the usage of tactile survey maps need to rely on cognitive considerations to suggest cognitively-adequate abstractions that can be employed in the process of tactile map construction → *cognitively-adequate* (Strube, 1992) tactile maps.



Problem Statement

In touch, serial sensory percepts (of the tactile map) and cognition yield a mental representation. Properties of a tactile map play a role in so far as to which mental representation the reader is able to construct from it.



Goal: Principles for the abstractions of tactile maps and corresponding usage recommendations. Both help in defining inventories to generate *cognitively adequate tactile maps* (CAT maps) for communicating qualitative spatial knowledge in a granularity that is customized for a generic overview of an environment that was not known before and that is about to be navigated on foot.

Research Questions

Which sensory constraints have to be taken in account when constructing tactile maps?

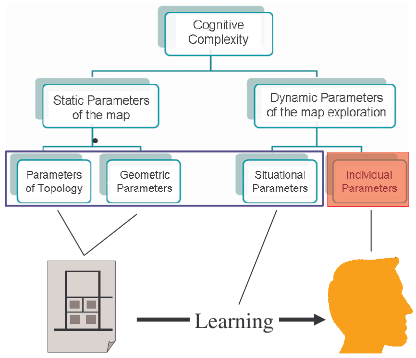
What are the cognitive differences between visually impaired persons and sighted persons to be considered?

How can cognitive adequacy in using a tactile map be modelled?

Which types of parameters have an effect on the cognitive adequacy of the tactile map usage and how are they related?

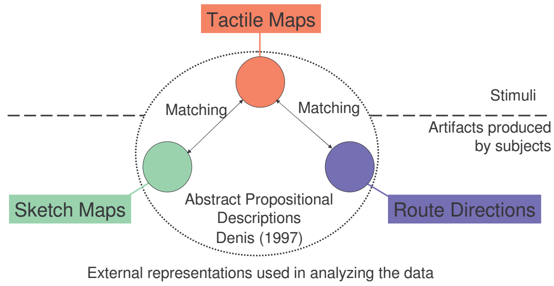
Working Modell

Cognitive adequacy modelled with *cognitive complexity* as stand-in



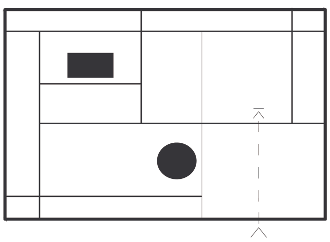
Methodology

1. Systematic construction of variants of artificial map
2. Learning by sequentially touching one variant (*stimulus*)
3. Recall by sketching and verbalizing (*artifacts*)
4. Assessment of quality by matching *artifacts* to *stimulus*



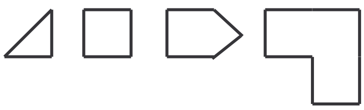
Phase 1: Geometric Parameters

What is the effect of different types of „*Geometry of the Tactile Indicator*" to the You-Are-Here point? How hindering are different indicators in the process of acquiring survey knowledge? How satisfied are the map users with the indicators?



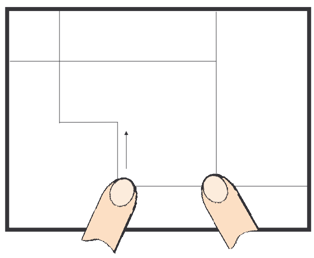
Phase 2: Topologic Parameters

On the background of region based navigation strategies (Wiener & Mallot, 2003), what is the effect of different types of „*Topology of regions*" on the cognitive complexity of the map usage? In what way do landmarks in a reagion/near some segments change the effect?



Phase 3: Situational Parameters

What is the effect of the situative parameter „*Exploration Strategy*" (either one moving finger or one moving and one static finger) on the cognitive complexity of map usage?



Selected Results with Tactile YAH Maps

- One geometric parameter was investigated (see Graf, 2010)
- Suggestion that the focus of attention is in the center of a tactile map even if it the task was to learn the WHOLE map
- Suggestion that a *turn-optimal route* rather than a length optimal route could be an option as strategy for route learning

Projected Results

Inventory and principles for constructing CAT Maps will be proposed as candidates for implementation in schematization frameworks to realize the automatic generation of tactile maps.

Denis, M. (1997). The description of routes: A cognitive approach to the production of spatial discourse. Cahiers de Psychologie Cognitive, 16(4), 409-458.

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Strube, G. (1992). The role of cognitive science in knowledge engineering. In Contemporary Knowledge Engineering and Cognition, Lectures Notes in Computer Science (Vol. 622, pp. 159-174). Berlin / Heidelberg: Springer.

Wiener, J. and Mallot, H.A. (2003). 'Fine-to-coarse' route planning and navigation in regionalized environments. Spatial Cognition and Computation, 3 (4), :331-358

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