The Cognitively-Adequate Construction of Tactile Maps

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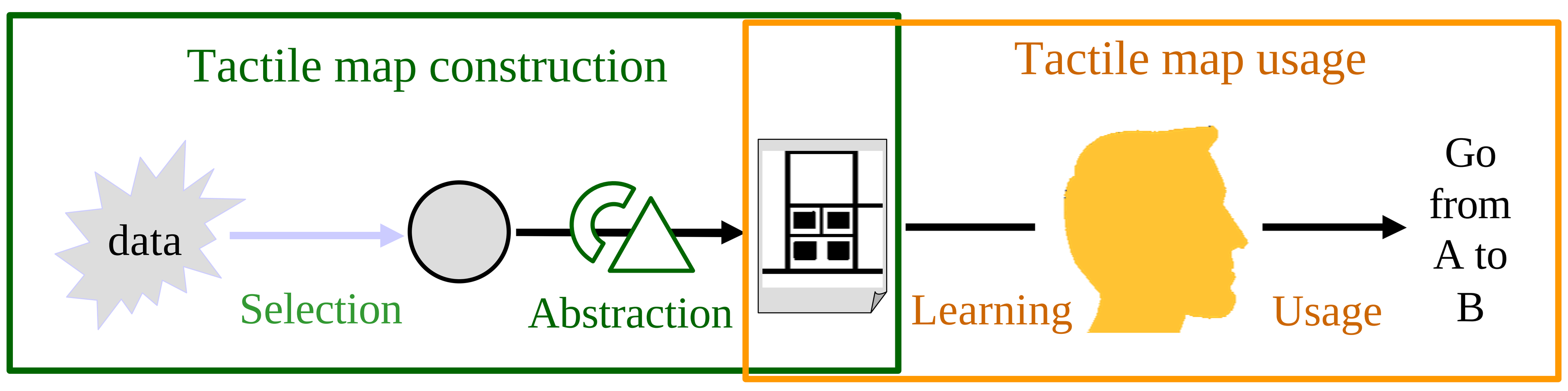
Introduction

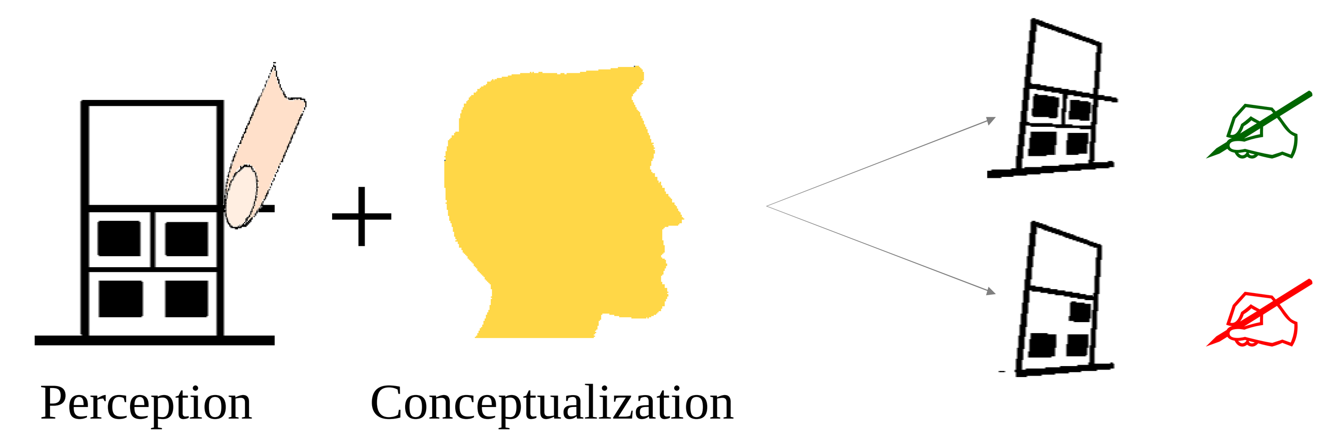
This work wants to contributes to the construction of *cognitively-adequate* (Strube, 1992) *Tactile Environment Maps* (TEMs) which should facilitate successful tactile map usage and understanding. Due to the very low resolution in tactile maps, heavy selection and abstraction of content is needed. Selection reduces the number of elements in the map and hence the amount of entities to be learned. Abstraction influences how the entities are realized.

TEMs communicate qualitative spatial knowledge as overview of an environment for exploring some unknown environment on foot (e.g. a park, a zoo, a university).



Problem Statement

Properties of a tactile map play a role in so far as to which extent or quality the reader is able to yield a mental representation that is helpful for spatial reasoning.



Goal: Principles for the abstractions of tactile maps and corresponding usage recommendations. Both should help in defining abstraction criteria and processes to ease spatial knowledge acquisition by using *cognitively adequate tactile environment maps* (CATEM).

Research Questions

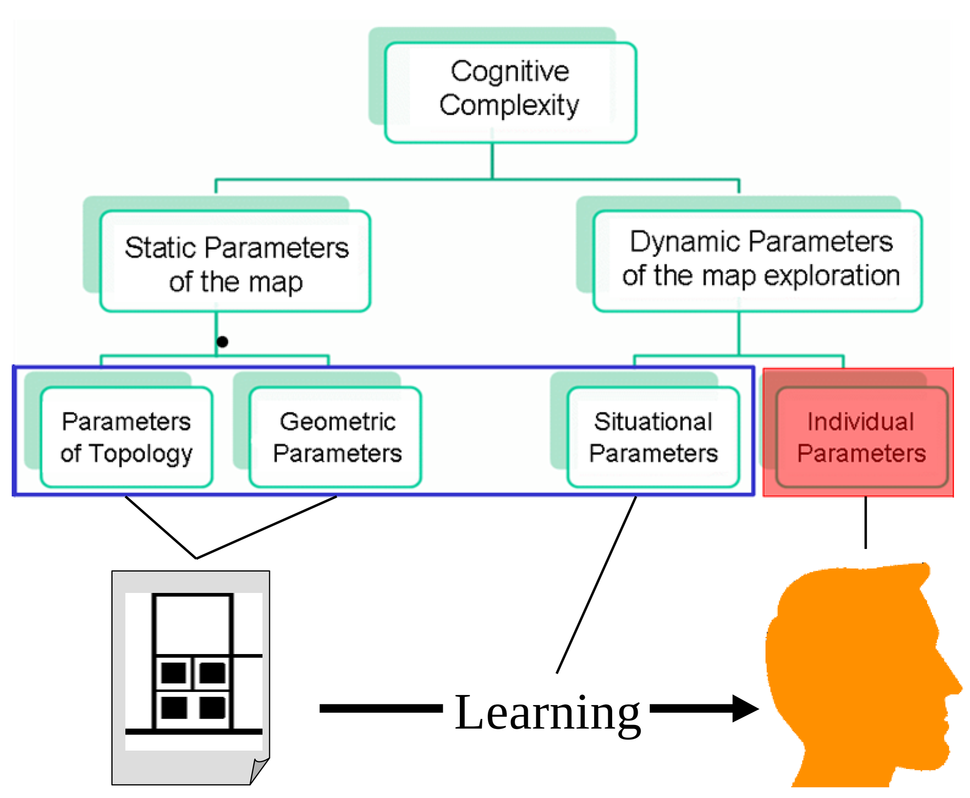
How can cognitive adequacy and the influencing parameters in tactile map usage be modelled?

How can the impact of different parameters of the tactile map on the mental representation be evaluated?

In a You-Are-Here TEM, what is the effect of the style of the tactile indicator to the You-Are-Here (YAH) symbol on the understanding and the usage of that map?

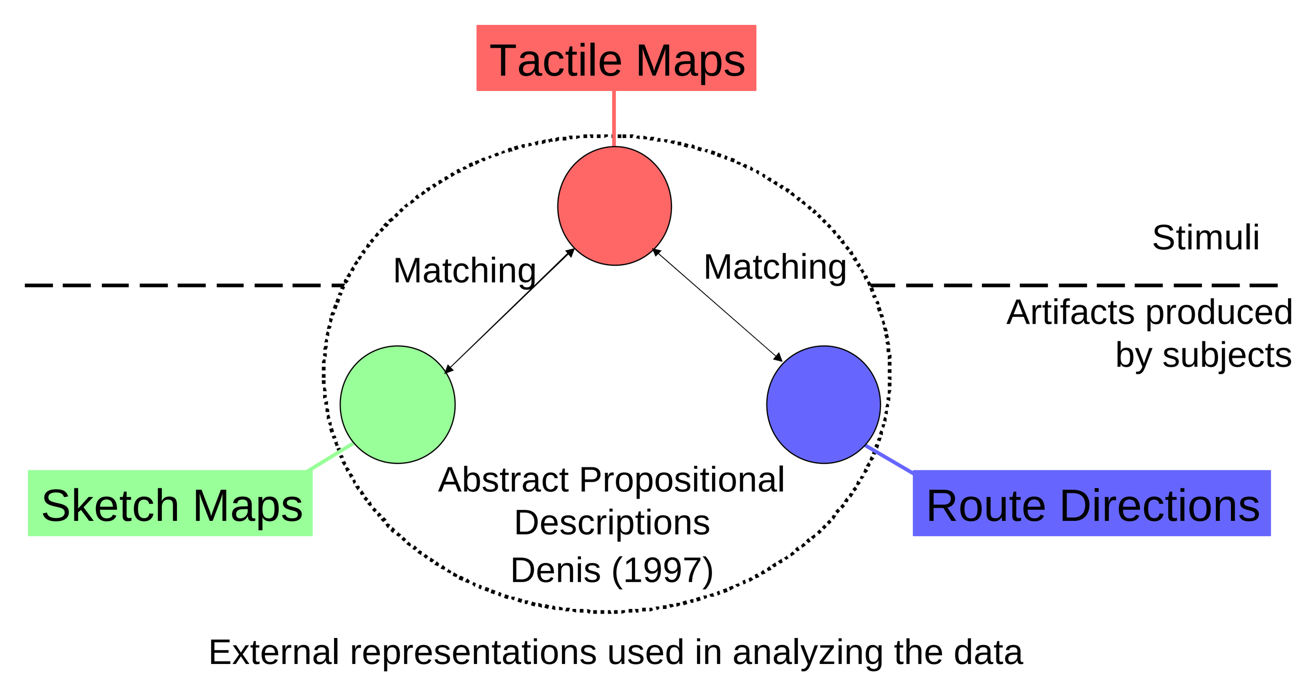
Working Modell

Cognitive complexity as stand-in for cognitive adequacy. A literature review suggested some parameter types.



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*



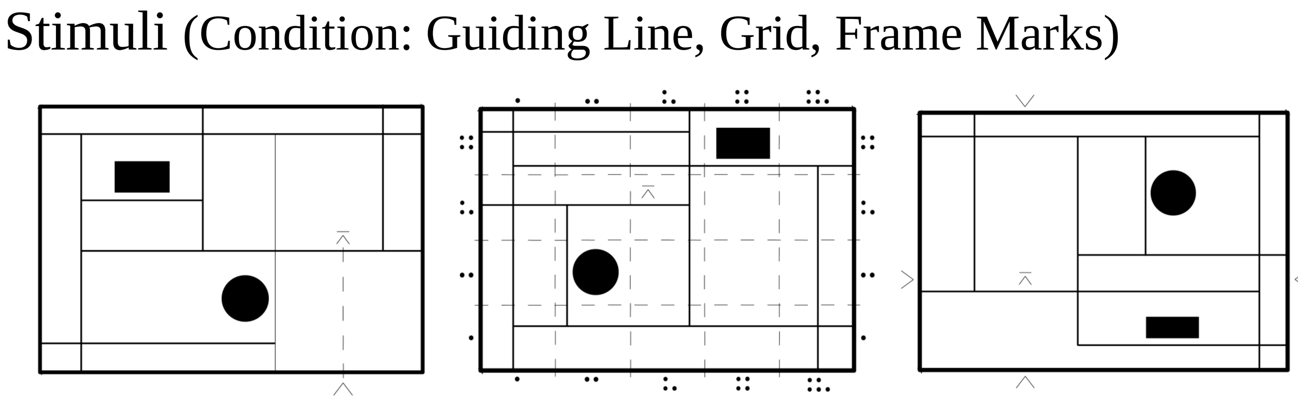
Study about one Geometric Parameter

Evaluation of the effects of three different geometry and usage styles of location indicators in YAH TEMs that have the qualitatively same network of tracks.

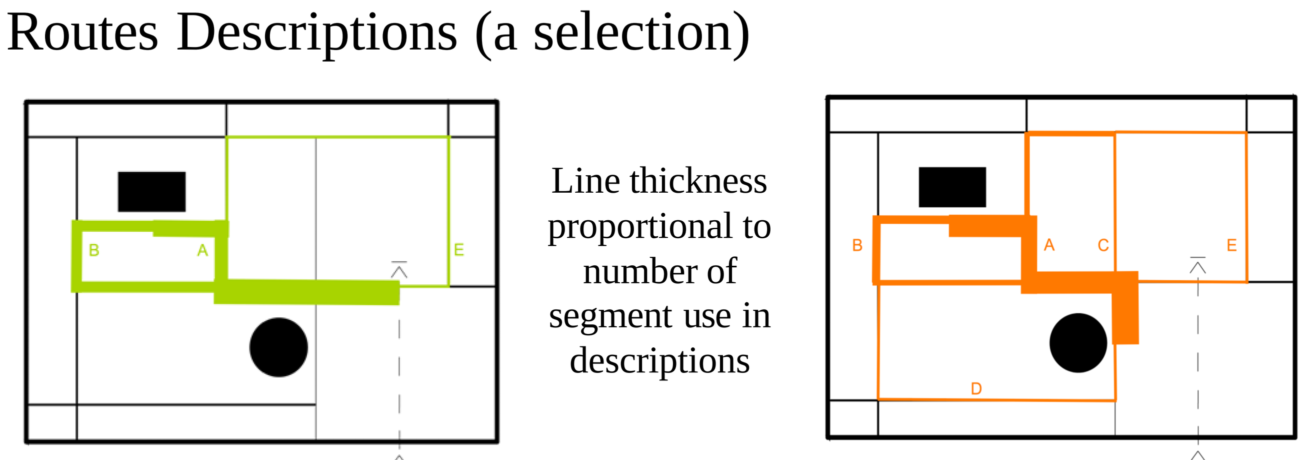
Q1: Is there a difference (in terms of search time) in locating the YAH symbol?
Q2: Is there a difference in the acquisation of survey knowledge?
Q3: How satisfied are the map users with the indicators?

A1: Statistical significant difference in search times for YAH symbol: Guiding line most efficient
A2: Statistical significant difference in survey knowledge acquisation: Grid most hindering.
A3: Highest subjective satisfaction in the frame marks condition.

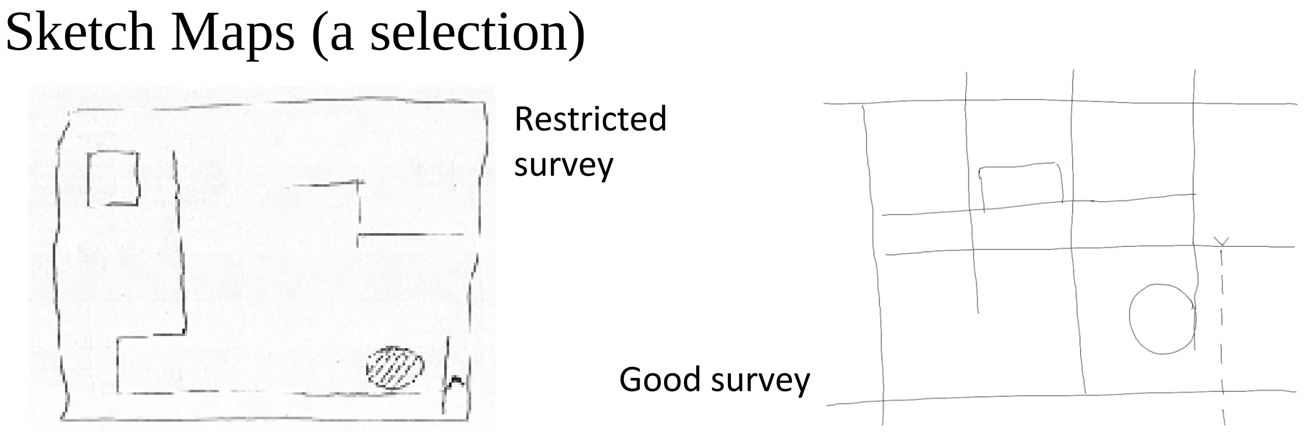
Stimuli (Condition: Guiding Line, Grid, Frame Marks)



Routes Descriptions (a selection)



Sketch Maps (a selection)



Discussion

- Map size might be an additional factor
- 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

Future Work

Principles for constructing CATEMs will be proposed as candidates for implementation in schematization frameworks to advance the (semi)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.

Graf, C. (2010), Verbally Annotated Tactile Maps: Challenges and Approaches. Proceedings Spatial Cognition 2010.

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.

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