The Sensual Skeleton
Cognitive Maps and Common Sense Reasoning in Stata Center on MIT Campus

He had brought a large map
representing the sea,
Without the least vestige of land:
And the crew were much pleased
when they found it to be
A map they could all understand.

Lewis Carroll, The Hunting of the Snark
(In Katharine Harmon, You Are Here: Personal Geographies and Other Maps of Imagination.
I. Common Sense Reasoning for Spatial Representations

A cognitive map can be described as “a person’s organized representation of some part of the spatial environment”. In cities, this environment comprises a large-scale space, which exceeds sensory comprehension from a single viewpoint. Despite this scope, people successfully complete daily trips using a “common sense” representation of space and a set of reasoning strategies for navigation. What triggers lead people to complete their mental representations of a complex environment? The following research applies Kuipers’s work on common sense artificial intelligence architectures for spatial navigation to an empirical study of one specific building on MIT’s campus, the recently completed Stata Center designed by architect Frank Gehry.

Kuipers’s Spatial Semantic Hierarchy (SSH) presents a model akin to the human process of cognitive mapping. The key characteristics of the architecture are:

1. its ability to function with incomplete quantitative and qualitative knowledge,
2. the multiplicity of knowledge representations it contains,
3. an update feature for the knowledge stored in the various representations.

Figure 1 shows an overview of the knowledge levels which also

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2 Benjamin Kuipers, Spatial Knowledge, A.I. Memo 359, (Cambridge, MA: Massachusetts Institute of Technology, Artificial Intelligence Laboratory, 1976), p. 1: “A large-scale environment is defined as one whose structure cannot be perceived from one location.”
4 Please note that the design intentions for the building are not of primary interest for this paper. For more information on the building of Stata refer to MIT Evolving Campus http://web.mit.edu/evolving/.
correspond to structures or layers in the mind.\(^5\)

In the case of way-finding, Kuipers suggests experts develop a robust "skeleton" which contains proven paths connecting certain nodes. Each path becomes reinforced over time depending – among other factors – on the number of boundary relations.\(^6\) Using this condition implies that paths demarcating separations between spaces are most likely to become essential elements in the skeleton. In the real world, many boundary relations can be confusing. For example, the Charles River divides Boston from Cambridge. When traveling east along the river Boston would normally be on the right, however, the twist and turns in the river make certain features located in Boston reappear on a person’s left making it difficult to operationalize the skeleton theory.\(^7\) Figure 2 shows how a skeleton representation assists a person, Mary, to complete a specific way-finding task. First, Mary starts her trip from a specific area; then she moves to a node within her skeleton representation; she travels down several paths until she reaches the general vicinity of her destination; finally she maps an appropriate route to her final destination.

\[\text{Fig. 2. Diagram representing how the skeleton representation is used to navigate large-scale space.}\]

Kuipers implemented and empirically tested a system that relies solely on the presence of boundary relations for strengthening specific paths in the skeleton. (Kuipers 2003) The results proved the importance of boundary conditions but do not explain why do residents of Boston navigate their confusing city so successfully. In the absence of boundary relations, will a person still develop a skeleton representation of her most favored paths? Which factors other than boundary relations reinforce paths in the skeleton representation of the expert way-finder? And are these paths reinforced by emotional

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\(^5\) This architecture resembles Model 6 suggested by Minsky in the *Emotion Machine* in Chapter 5, “Levels of Mental Activities,” as a way of understanding the hierarchical structures for thinking in our minds. While Kuipers’s focus is spatial information his strategy for representing knowledge separately and linking these layers throughout the cognitive process echoes Minsky’s concept for how we think. Marvin Minsky, *The Emotion Machine*. (forthcoming). \url{http://web.media.mit.edu/~minsky/}

\(^6\) The boundary relations of a path are the number of clear cut separations it delineates. For example, a hallway with specific openings onto other spaces has a set of very distinctive boundary relations separating rooms from each other.

responses that have as yet not been recognized as common sense\(^8\) reactions to complex architectural settings?

The Stata Center on MIT’s campus provides an excellent environment for studying factors beyond boundary relations because Gehry purposefully blurs them to generate heightened interaction among building users.\(^9\) The nine-story, two-tower building includes public and private research spaces that are interconnected through elevators, hallways, and stairwells. Each origin-destination pair in the building poses a potentially challenging way-finding problem.

From May 4 through May 10, 2005, fourteen 20-45 minute interviews were conducted with respondents working in the building or participating in research projects and classes that involve regular use of the upper floors. The mix of respondents includes staff, students, different age groups, and representatives from most floors (with the exception of 7 and 8), though Dreyfoos tower is more heavily represented as a result of time constraints. The first portion of the interview schedule asks respondents to draw two maps, one of the ground floor of and one of the pathway to their office or main work area. The remaining sections are divided into three areas and were filled in by the interviewer. The first parts asks about routines in using the building (facilities used, preferred entrances, landmarks on ground floor). In the second section, two questions focus on giving directions and path selection (elevators vs. stairwells). The final group of questions inquires how much respondents “enjoy” the building.\(^10\)

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\(^8\) Please refer to the glossary in Appendix 1 for a definition of common sense as it is used in this paper.

\(^9\) The MIT Evolving Campus website describes these goals in more detail, for example: “The interior of the Stata Center emphasizes flexibility, connectivity, and collaborative workspaces.”

II. Interview Results

The cognitive representations and descriptions of static locations and paths within Stata Center indicate how users build mental maps of this a-typical building. The following discussion provides five examples of how these representations evolve in the absence of clear boundary relations and as a result of other common sense factors related to emotional aspects of the spaces.

Multiple Paths Lead to the Same Destinations

The interview sample includes three people working in the same area of Dreyfoos tower. Their paths in detail are:

| Respondent 1: | arrives from the parking garage underground on level 1, the ground floor. Then takes a short staircase through a glass door to level 2. Follows a corridor to another stairwell at the center of an open area. Takes these stairs up to level 3 where the office is situated within another open lab space. |
| Respondent 2: | arrives from Vassar Street, takes the same short staircase through the glass doors as respondent 1 to level 2. Follows a corridor (described as being next to a glass wall) to another stairwell at the center of an open area. Takes these stairs up to level 3 where the lab space is located. |
| Respondent 3: | arrives from Vassar and Main Streets. Proceeds directly up to the 3rd floor public platform area. Enters through double doors next to an elevator bank. Continues down a confusing hallway which opens onto the same open area where the stairway from the preceding descriptions is located. Turns right and proceeds to the lab space. |

The respondents rely predominantly on stairs for practicality and additional exercise. An alternative pathway exists near Dreyfoos Tower which leads directly to the 3rd floor and into the open area nearest to the lab space yet neither respondent 1 nor respondent 2 had considered this option. In one case, the respondent mentioned that it would be further from the office, though overall the stairs leading straight to the 3rd floor could be considered practical for directness.

The boundary relations for entering from Dreyfoos Tower vary. The first segment of the path, the stairs to the 2nd floor, clearly separates the public ground level from the CSAIL (Computer Science and Artificial Intelligence) labs indicating a very strong boundary relation. The corridor beyond leads along a glass wall that presents several ambiguous situations until one reaches the open atrium area. As soon as the stairs are within view the path is unobstructed until one ascends to the next level where again there is no sense at all how to proceed. One must circle around the platform to reach the final destination.

From the other entrance near Gates Tower, the path presents an equally confusing moment after the first set of double doors. A curving hallway passes through several open, unused research areas lacking any sense of destination or a visible separation between zones. In other words, moving through
the spaces it is easy to question the direction at each intersection or breakaway until the open atrium appears.

The respondents learned and honed their paths over time. In one case, the respondent modified the path to accommodate the specific desire to walk. Another respondent follows the same path every time in order to prevent confusion and delayed arrivals. Finally, one respondent cites the path as the most efficient and therefore sees no more room for improvement. The described path selection has resulted in a very strong sense of moving between at least two nodes within the building, an entrance and an office area. In each case, the description implies the type of skeleton an expert way-finder develops over time, but it does not stem from clear boundary relations. Instead, the skeleton seems to be a relatively conscious attempt to learn a particular path according to landmarks (such as stairs and specific walls) and specific goals (efficiency, exercise). These factors have led to ingrained cognitive maps that the respondents easily reproduced in the interview sessions at least as compared to the representations of the building’s ground level.

**Significant Landmarks**
The ground floor or Student Street provides shared public and private space for Stata Center occupants, MIT community members and visitors.

![Fig. 5. Map of key functions on Student Street public floor of Stata Center.](image)
With one exception, all participants drew an outline or shape and added detail to the framework gradually or simultaneously. The shapes selected by respondents varied along a spectrum from a rectangular abstraction through to a very elongated floor plan (see Figure 6). The latter group tended to add detail while drawing the outline which most likely impacted the shape of their floor plan. Respondents were not prompted to fill in landmarks until after completing the first stages of the drawing. With very few exceptions, this fact did not stop anyone from marking their drawing.

The highlighted landmarks were very similar across respondents, though overall many diverse elements emerged in conversation. In his study of Ciudad Guayana, Appleyard identified three principle attributes of locations that increase likelihood of recall for specific buildings: distinctiveness of form, visibility, and use or symbolic significance.\(^{11}\) In the case of the ground floor of Stata, appearance, visibility and function recur as attributes of the most-cited landmarks.

\begin{align*}
\text{appearance (A):} & \quad \text{how different is the feature from the surroundings} \\
\text{visibility (V):} & \quad \text{is the feature in full view from the ground floor} \\
\text{function (F):} & \quad \text{does the location fulfill an important function (the equivalent of an architectural program)}
\end{align*}

Figure 7 summarizes all the landmarks cited by respondents in response to the free map recall exercise and the specific question asking for key landmarks (Q7, Q8, Q13):

<table>
<thead>
<tr>
<th>Landmark</th>
<th>Frequency</th>
<th>Attributes of Landmark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Café/Cafeteria</td>
<td>14</td>
<td>F, V</td>
</tr>
<tr>
<td>Question Mark Info Desk</td>
<td>11</td>
<td>F, V, A</td>
</tr>
<tr>
<td>Gym</td>
<td>11</td>
<td>F</td>
</tr>
<tr>
<td>Library box</td>
<td>10</td>
<td>F, V, A</td>
</tr>
<tr>
<td>Dreyfoos Elevators</td>
<td>8</td>
<td>F</td>
</tr>
<tr>
<td>Child care</td>
<td>8</td>
<td>F, A (tricycle on wall)</td>
</tr>
<tr>
<td>Gym</td>
<td>11</td>
<td>F</td>
</tr>
<tr>
<td>Gym</td>
<td>11</td>
<td>F</td>
</tr>
<tr>
<td>Library box</td>
<td>10</td>
<td>F, V, A</td>
</tr>
<tr>
<td>Dreyfoos Elevators</td>
<td>8</td>
<td>F</td>
</tr>
<tr>
<td>Child care</td>
<td>8</td>
<td>F, A (tricycle on wall)</td>
</tr>
<tr>
<td>Tables and benches</td>
<td>6</td>
<td>F, V</td>
</tr>
<tr>
<td>Pillars</td>
<td>6</td>
<td>V, A</td>
</tr>
<tr>
<td>Lecture halls</td>
<td>6</td>
<td>F</td>
</tr>
<tr>
<td>Large auditorium</td>
<td>6</td>
<td>F</td>
</tr>
<tr>
<td>Gates Elevators</td>
<td>5</td>
<td>F</td>
</tr>
<tr>
<td>Stairs to 3rd floor mezzanines</td>
<td>5</td>
<td>F, V</td>
</tr>
<tr>
<td>Bathrooms</td>
<td>4</td>
<td>F</td>
</tr>
<tr>
<td>Amphitheater</td>
<td>3</td>
<td>F, V, A</td>
</tr>
<tr>
<td>Water fountains</td>
<td>2</td>
<td>F</td>
</tr>
<tr>
<td>Art murals</td>
<td>2</td>
<td>V, A</td>
</tr>
<tr>
<td>Chalk boards</td>
<td>2</td>
<td>F, V, A</td>
</tr>
<tr>
<td>Colors on walls</td>
<td>2</td>
<td>V, A</td>
</tr>
<tr>
<td>ATM</td>
<td>2</td>
<td>F</td>
</tr>
<tr>
<td>Corner of CSAIL research area by Dreyfoos</td>
<td>1</td>
<td>V</td>
</tr>
<tr>
<td>Mailboxes</td>
<td>1</td>
<td>F</td>
</tr>
<tr>
<td>Skylight</td>
<td>1</td>
<td>A</td>
</tr>
<tr>
<td>Telephones (by Gates)</td>
<td>1</td>
<td>F</td>
</tr>
<tr>
<td>Trash cans</td>
<td>1</td>
<td>F</td>
</tr>
<tr>
<td>Radar “shrine”, memorial for building 20</td>
<td>1</td>
<td>V, A</td>
</tr>
</tbody>
</table>

Key
- **appearance (A):** how different is the feature from the surroundings
- **visibility (V):** is the feature in full view from the ground floor
- **function (F):** does the location fulfill an important function (the equivalent of an architectural program)

Fig. 7. Landmarks identified by respondents (Q7, Q8).

The only landmark or feature mentioned by every respondent was the café (also referred to as Forbes Café or cafeteria). The information desk or giant question mark (“imagine the Riddler from Batman set up a desk in the Stata Center”) was also mentioned by most respondents (11 mentions). The gym was mentioned with the same frequency (11 mentions) because it fulfills an important function even though it is not highly visible from the street. Six of the 25 features do not fulfill a specific function for building users, e.g. colors on the wall, skylights, art murals. The other 19 features are all destinations with a specific function (café) or interactive (chalk boards). Two of the most-cited elements, the library box and the question mark, unite all three attributes used to categorize the landmarks: high visibility, distinct appearance and functionality. The sample size is too small to extrapolate a real correlation nevertheless 12 of the 25 features fulfill two or more of the attributes. And those purely “architectural” landmarks such as the pillars (6 mentions), the corner of the CSAIL 2nd floor research lab (1 mention) or the skylights (1 mention) were cited much less frequently. Similarly, six of the 25 features do not fulfill a specific programmatic function like the large-scale art work.
Getting In and Out

The questionnaire asked respondents which entrance they use predominantly. With the exception of one respondent (“I don’t think of this building in terms of exits.”), all respondents identified their regular ingress/egress choice and their preferred exit to reach particular destinations. All the exits seemed equally used with the exception of the so-called “airlock” exit (a small atrium entrance with two doors) nearest the childcare center which evoked a negative connotation with some. Every respondent mentioned one example of a convenient exit-destination pair. The ability to determine the best exit or entrance for a specific destination indicates the presence of a skeleton representation that may be invisible from the drawings of the ground floor.

Selecting Paths: Stairs versus Elevators

In countless instances, the same destination can be reached via the elevator or the stairs. All respondents could cite examples of situations where either the stairs or the elevators are decidedly more convenient or comfortable. In most cases, the scenario involved traveling one flight up or down. Beyond the single flight, few respondents could place the location of certain stairs on other floors. In one instance, a respondent uses a rather involved combination of stairs that has been refined over time in order to maximize light and efficiency. At some junctures, there are no public stairs so the fire escape presents the only means of walking. It can be challenging to combine routes that pass through entirely open areas (highly defined) and closed spaces that do not give any visual cues about their orientation. These paths seem to indicate that respondents have developed cognitive representations based on sensual or experiential factors rather than destination goals or boundary relations.

Barriers to Way-Finding

A group of factors hinder movement through the building as shown in Figure 8. With the exception of elevator/stairwell placement and signage, barriers were personal to each respondent indicating that each user holds a unique skeleton representation of the building for way-finding determined by many factors such as destination and preferred movement patterns. The lack of boundary conditions likely reinforces the differences across responses because each user’s experience is unique and thus reveals the multiplicity of common sense strategies necessary to develop a skeleton from ambiguous spatial cues.

<table>
<thead>
<tr>
<th>Barriers to Way-Finding</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Signage within the building and for exits</td>
</tr>
<tr>
<td>2 Many building entrances</td>
</tr>
<tr>
<td>3 Paths that double back on themselves</td>
</tr>
<tr>
<td>4 The “mysterious 2nd floor”</td>
</tr>
<tr>
<td>5 No direct stairs</td>
</tr>
<tr>
<td>6 Lack of markers through the entire building</td>
</tr>
<tr>
<td>7 No commonalities among floors</td>
</tr>
<tr>
<td>8 Number of seemingly functionless mezzanines and stairs (“that go nowhere”)</td>
</tr>
<tr>
<td>9 The two towers</td>
</tr>
<tr>
<td>10 Walking through the narrow path between the information kiosk and the café</td>
</tr>
<tr>
<td>11 Inconsistent hallway widths</td>
</tr>
<tr>
<td>12 Public and private doors look the same</td>
</tr>
</tbody>
</table>

Fig. 8. Barriers to way-finding (Q14).
Emotional Experience of the Building's Spaces

The desire to engage a space may also result from the overall appreciation for the building. Most respondents rated the building positively (Q18) though they often mentioned how challenging it was to give one rating.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Fig. 9. User ratings (Q18).

The predominant feeling was that certain benefits generated negative side effects that were almost equally weighted. The most prevalent comment was that the fun or artistic features of the building were directly correlated with increased confusion and inefficiency. Even positive remarks about the excitement of the building reinforced the sense of a higher cognitive load imposed on users of the building. One respondent likened moving through the building with “taking a risk” and engaging a “dilemma like life”.

Whether positive or negative, all respondents held opinions and spoke articulately about their relationship to the building. In most cases, the presence of successful spaces outweighed the negative impacts though some respondents mentioned heightened stress levels resulting from the lack of clarity especially when maneuvering under time constraints. Figure 10 summarizes the positive and negative aspects enumerated:

Positive

general:
- unique
- fun
- active ground floor, “hustle and bustle of the student street”
- open space
- new and clean
- always engaging
- people always seem “happy”
- visibility across floors in some instances from mezzanines
- the “interesting outside”
- mix of users: research, community, education
- outside spaces like amphitheater
- impresses visitors

functions:
- integration of the gym and café
- café is convenient
- R&D pub on 4th floor
- multifunctional spaces like the library box (for eating, working and meetings)

qualitative aspects of the spaces:
- natural light
- high ceilings
- colors
- some common areas
- exciting offices (also considered negative by some respondents)
### Negative

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>signage:</td>
<td>- exits are not clearly marked</td>
</tr>
<tr>
<td></td>
<td>- signage is not programmable and cannot be scaled for special</td>
</tr>
<tr>
<td></td>
<td>functions</td>
</tr>
<tr>
<td>circulation:</td>
<td>- inconvenient, slow elevators</td>
</tr>
<tr>
<td></td>
<td>- traffic flow</td>
</tr>
<tr>
<td></td>
<td>- connections &quot;knowing that something is there, but not being</td>
</tr>
<tr>
<td></td>
<td>able to get to it is really frustrating&quot;</td>
</tr>
<tr>
<td>operations:</td>
<td>- more street furniture</td>
</tr>
<tr>
<td></td>
<td>- sometimes certain systems just shut down for no reason (one</td>
</tr>
<tr>
<td></td>
<td>respondent conjectured about the ghosts of the replaced</td>
</tr>
<tr>
<td></td>
<td>building 20)</td>
</tr>
<tr>
<td></td>
<td>- the management is too rigid for the building’s playful design</td>
</tr>
<tr>
<td>design</td>
<td>- bathrooms on upper floors alternate single and full</td>
</tr>
<tr>
<td>features:</td>
<td>- inconsistent climate control</td>
</tr>
<tr>
<td></td>
<td>- noise and security in open areas</td>
</tr>
<tr>
<td></td>
<td>- the layout of some spaces could be better to increase the</td>
</tr>
<tr>
<td></td>
<td>number of views to the outside</td>
</tr>
<tr>
<td></td>
<td>- impractical offices (also considered positive by some</td>
</tr>
<tr>
<td></td>
<td>respondents)</td>
</tr>
</tbody>
</table>

Fig. 10. Positive and negative aspects of Stata Center (Q18).

Interestingly, the positive experience of being in the building seems to be linked to a conscious engaging of the spaces. One respondent said, “If I don’t think I tend to get lost.” Another commented on the ability to continually discover new shortcuts over time in a game-like fashion. Other comments alluded to the negative aspects of increasing the cognitive load on people by complicating the simplest tasks. A respondent recommended that people should be less conscious of the task of reaching a destination. In both cases, the process of cognitive mapping seems more complex for users of the building because they require additional layers of knowledge to build their skeleton representation. Nevertheless, they develop a sense of place and common sense system for navigating their everyday lives there.

### III. Beyond Boundary Relations

The interview findings uncover that strong cognitive maps based on a skeleton of preferred paths can arise in the absence of clear boundary relations. Only one respondent articulated the frustration of seeing certain destinations and not being able to reach them, which is precisely the ambiguous experience Kuipers describes along the Charles River between Cambridge and Boston. Other respondents mentioned the need for clearer circulation patterns, signs where private areas begin, markers that reappear in the same location on multiple floors, and better hierarchies of hallway widths to indicate importance. Interestingly, the recommended changes would contribute to the density and clarity of boundary relations. Nevertheless most respondents did not mention frequently getting lost so they must be using a working cognitive map of their routes and the building. Other factors are contributing to their skeleton map and the reinforcement of certain major paths.
In the absence of legible boundary relations, users of Stata Center still maneuver to and from their destinations. Based on the interview results, some of the other common sense factors that contribute to the development of a skeleton map may be:

1. The **proximity to the final destination**, a characteristic Kuipers also identifies in his study. In the empirical test, respondents were slightly more likely to choose a path closer to their final destination boundary conditions held equal across options. (Kuipers 2000)

2. Along similar lines, **ease of use** or the degree of complexity a path presents likely contributes to its reinforcement. Depending on their priorities, some respondents prefer paths that are simple and others prefer complex routes as the stairs versus elevators discussion shows.

3. On a very different note, a group of characteristics comprises **aesthetic or comfort features** such as the amount of natural light. Several respondents like the amount of natural light throughout the building and consequently plot paths to benefit maximally from the light.

4. **Shared features** (one respondent suggested a "red column" through the building) could unify the overall impression of the building. Such commonalities provide a visual and physical connection along paths between floors.

5. A last group of characteristics is a less well-defined group which could be called the **degree of “adventure”** a path promises. Several respondents discussed the trade-off between efficiency (an engineering trademark deeply ingrained in MIT's culture) and the -- loosely used -- art or fun of the building. Respondents with simple paths and regular usage patterns seemed more likely to weight this trade-off positively; perhaps because their daily routines are unhindered by the confusing elements in the building. (Compare this situation with Figure 2.)

In Stata Center, boundary relations are highly ambiguous increasing the importance of other factors for creating a skeleton representation of key paths. The descriptors for the building interviewees used to characterize the building provide some revealing metaphors:12

> "It reminds me of my mind."
> "It reminds me of the forest near my home growing up. If you tried very hard you could chart a straight path."
> "Imagine going spelunking in an unknown cave."
> "The architecture invokes Dr. Seuss stories."
> "The building resembles a shopping mall."
> "The structure has a Disney-like quality."

Only one architectural space – the shopping mall – was mentioned while all the other metaphors are experiential or impressionistic. These metaphors reinforce that many factors beyond boundary relations impact users’ daily experience of architectural and urban spaces like Stata Center. And the most important factors for developing these representations or “sensual” skeleton maps may be the emotional aspects of common sense reasoning.13 These aspects relate way-finding strategies such as goal

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12 (Q18d) “Does this building remind you of any other building or location you have ever visited? 
13 Please refer to the glossary in Appendix 1 for a more detailed discussion of emotion.
orientation to the sensual experience of the building such as the degree of fun or adventure. In many cases, users modify paths over time, alternate routes and experiment with new ones according to these triggers and no doubt update their skeleton representations in the process. This paper argues a group of common sense emotional features such as adventure or fun can reinforce the paths expert way-finders frequent and should be considered an important component for modeling how cognitive maps evolve.

Acknowledgements

I would like to thank all the subjects who took the time to speak with me during the busiest time of the academic year. In respect of respondents’ privacy, names and distinctive characteristics such as office numbers are changed in the paper. For this reason, I also did not include the actual drawings created by respondents.

References


Appendix 1. Glossary

**boundary relations** of a path are the number of clear cut separations it delineates. For example, a hallway with specific openings onto other spaces has a set of very distinctive boundary relations separating rooms from each other.

**cognitive mapping** is the activity or process of developing a **cognitive map** defined as “a person’s organized representation of some part of the spatial environment.”

**common sense** is a term used by Minsky in *The Emotion Machine* to explain the most-used and least understood human mental processes. He writes: “We each use terms like ‘common sense’ for the things we expect other people to know and to regard as obvious. So it has different meanings for each of us.” In this paper, common sense is used as short hand for explaining the everyday experience of spatial conditions as opposed to a critical engagement of architecture for architecture’s sake. When a user of Stata navigates to her office on daily basis she is using common sense strategies for cognitive mapping.

**emotion** is defined in the Merriam Webster dictionary as “the affective aspect of consciousness.” For Minsky, emotion is also a “way-of-thinking” like our other reasoning capabilities.

**imageability** defined as “that quality in a physical object which gives it a high probability of evoking a strong image in any given observer.”

**landmarks** are described by Kevin Lynch as “the point references considered to be external to the observer.”

**metric attributes** of a spatial representation are quantifiable units like distance and direction.

**topological accuracy** describes the accuracy with which the relationship among landmarks or destinations is mapped.

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17 Ibid, p.78.
Appendix 2. Questionnaire and Interview Schedule

MAS.731J Society of Mind
Prof. Marvin Minsky
MIT Media Lab, Smart Cities Group, Susanne Seitinger, (susannes@mit.edu)

Please fill in the following questions as best you can about the Stata Building (#32)!

Part I:

1. Please circle your affiliation with MIT: undergrad grad postdoc staff visiting researcher

2. Please circle your gender: male female

3. Please circle which age range you fall into: <19 20-30 31-40 41-50 50-60 >60

4. How many hours do you spend in the building every day on average?
   (a) On weekdays:
   (b) On weekends:

5. When are you usually in the building? a.m. 12-4 4-8 8-12 12-4 4-8 8-12 p.m.

6. Where did you grow up?

Part II:

7. Please draw a map of the ground floor of Stata.

8. Please draw a map of the path to and from your primary destination in Stata (e.g. your office).

Part III:

9. Please specify where you work in the building (your office number or lab/research group)

10. What facilities do you use in Stata? (Try to rank them in order of importance.)

11. Have you participated in other functions in the building outside of work? Where in the building did those activities take place?

Part IV:

12. If you need to know anything about Stata who do you ask for assistance? Where are they located in the building? (Please make a note on your map in questions (7) or (8).

13. Please identify some of the primary landmarks you remember in this building? Please be as specific as possible. Include them on your map in questions (7) or (8) if possible.
(14) Are there any features about the building which you would describe as a hindrance in your navigation of the space? Please be as specific as possible. Include them on your map in questions (7) or (8) if possible.

(15) Which building entrance do you use most frequently?

(16) Have you ever given directions in Stata to others? yes no frequently

(a) If yes, how would you describe the route to a particular destination in Stata (use an example)? Please provide a detailed description or map.

(b) Does this recommended route differ from your daily routine? Why did you recommend a different one?

(17) Do you prefer taking the stairs or the elevator? Describe instances where you prefer either the stairs or the elevator to a particular destination.

Part V:

(18) Would you say that you like the Stata building? very much a little indifferent so-so not at all

(a) Please describe which aspects of the building you enjoy.

(b) Please describe which aspects of the building you do not enjoy.

(c) What would you change in the building?

(d) Does Stata remind you of any other building or location you have ever visited?

(19) If you have any other comments about the building please note them here.