

TOWARDS A PSYCHOLOGY OF SYNTACTICAL READINGS: The case of applying a Cognitive Task Analysis method in acquiring and utilizing configuration-related knowledge

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Abstract

This paper explores architecture and urban design process and thinking through a Cognitive Task Analysis method employing a procedural pedagogical strategy. The aim is to capture a description of the knowledge patterns that students tend to develop at the stage of the coding process and reflect their own understanding of the systematic relations among different space syntax categories and concepts. During a semester course, the effort to establish an analysis of the cognitive inferences in the decision-making processes that emerge during a syntactical inquiry of the spatial properties reveal the initiatory knowledge used by the students as they develop compositional strategies for their proposals related to the restoration of an open public space in historic context. At the beginning, the research discusses the significance of interrogating narrative statements and reflections in order to frame the cognitive task analysis project. Later, it attempts to generate detailed information on the nature of those schematizing and non-representational processes that mark the shifting between the codification and the understanding of site-related knowledge. It is proposed that the integration of the method with the issue of underlying knowledge elicitation during a design studio course can be described as the extension of traditional teaching strategies to yield information about the representations of situated positions and the cognitive functions behind the understanding and production of shapes, forms and spatial arrangements.

Keywords: *Situated positions, psychospatial, spatial reading, cognitive task, syntactical coding*

Theme: *Spatial Cognition and Behaviours*

1. Introduction

The architectural object is the perceptual stimulus, the mnemonic residue, and the trace is the Vorstellungsrepräsentanz, that which takes place of the representation, a written index that would supplement this perception. Such a trace would be understood to exist before perception, in other words, before a perception is conscious of itself. The trace ... is thus found between perception and consciousness, which in the vision of Lacan is the Gaze. (Hendrix, 2006, p.196)

The attempted psychological inquiry of the space syntax field refers to the use of the visual metaphors and symbolic connections often codified and communicated by different syntactic tools, like the visibility graphs and axial maps, in design pedagogy for accessing situated positions and modes of thinking the spatial context. During a project-based assignment, this approach can find application in different knowledge elicitation phases like the critical thinking of place-analysis, the concept formulation, the understanding of the form and the development of generative design processes. By relating the syntactic descriptions to the spatial knowledge they generate, the strengths and limits of studio pedagogy can increase as to explore the position of the participants within the understanding of the introduced ideas and identify some key cognitive tasks related to the act of *reading the space*.

The first section briefly presents the possibilities and limits of using a narrative analysis (Mishler, 1995; Polkinghorne, 1988; Smith, 2000; Wiles; Rosenberg & Kearns, 2005) for accessing the key turning points in the process of interpreting and codifying concepts stimulated by the act of reading syntactical and spatial properties (through visual means like graphs and diagrams). In examining this method, it will make sense to think not only in terms of the speculative narrative structure that these readings facilitate but also in terms of the position of the syntactic agent as thematic content for the narratives and its role in the critical cognitive decision-making processes. The recognition of this need will turn our attention to the case of applying a cognitive task analysis method for alternative forms of description towards a psychology of space syntax. The second section presents a case study from the department of Urban Design at the University of Stavanger, Norway, where a third year course for the design of an open public space in historic context was deliberately introduced to the act of *reading the space* from a given material with visual descriptions of syntactic properties and spatial configurations. Drawing on the closely related aspects of the narrative and cognitive analysis, the paper discusses the possibility of using a computational approach of representing spatial configurations (space syntax) to foster critical thinking in students and stimulate non-representational conceptual frameworks of knowledge during two crucial tasks: understanding the place and developing a design strategy for it.

1.1 Positioning the syntactic agent in the method

Over the past two decades, the critical analysis of space syntax research has explored at length how the notion of configuration reacts to emergent spatial dimensions and concepts, from connectivity and distance (Batty, 2004; Peponis; Bafna & Zhang, 2008), time and shape (Psarra, 2003), social function and type (Bafna, 2012; Hillier; Hanson & Graham, 1987) to spatial cognition (Kim & Penn, 2004; Penn, 2003; Peponis & Bellal, 2005). Situated within space's analytical account, these works have challenged the exploration of ways in which the perceiving human component can be embedded in the understanding of the spatial formulation and disposition. However, the position in *reading the space* which these interdisciplinary approaches sketch is often attacked from the viewpoint of the role that space syntax plays as a method of extracting social information. Here, as far as the nature of the effects that syntactic cues cultivate within us are concerned, we must draw upon Julienne Hanson's claim that space syntax is, in fact, "*a way of seeing that helps to phrase questions and may offer interpretations, but it rarely if ever provides definite answers*" (Hanson, 2012, p.91) Hanson's claim can be

understood in relation to the analogy of the perceiving subjects with the readers of a book “*who are active agents and generate additional meanings through their experience and interpretation of the written word*” (Hanson, 2012, p.82) We trace in her observations about the role of the syntactical studies of space, consequently, an attempt to dislocate the Space Syntax method from the field of spatial *physiology* and the use of logical tools, to a field of *psychospatial* examinations of space (Ioannidis, 2011), mind and time in which the method becomes itself a logical tool to access non-representational processes. Such a field that explores mental operations generated by the realm of the configurational meaning is not available to direct observation but is accessed by the mediation of further methodological steps that would be discussed later on.

Yet, while agreeing with the necessity of such dislocation, we have to draw the distinction that the *psychospatiality* in reading the space is generated from and informed by the role of the situated positions during the interpretation of the raw indications gathered from the represented realities. There is a fundamental Piagetian idea in this case since the study of the physiology of space seems to embody an exploration of the cognitive and psychological processes that characterize the system of value and meaning attribution of the interpretative operation. Therefore, the key point in this dislocation is that the subject matter in studying the spatial *physiology* works through a combined use of description and explanation, and is thus reducible to the objectness of the field. However, in the *psychospatial* exploration it is developed in accordance with our situated positions and the effects that the presignifying affective materiality of the field has on our cognitive states (Thrift, 2007)

Since my first contact with John Peponis’ *Χωρογραφίες* (1997) in which the spatial meaning was reintroduced to me as emerging from the succession of states unfolded by the study of the latent geometric formulation in both material (buildings) and notional (literary works) structures, I have come to think that the subject matter of the psychospatial approach in *reading the space* appears to have some more critical differences. While, for example, the position of the notion of configuration is methodologically analogous to the position of the notion in Peponis’ quantitative analysis of spatial patterns or in Hanson’s descriptive storytellings of space, the focus is in fact on the participation of the interpretative dimension in human cognition while reading the configuration. Starting from configurational aspects common to the above mentioned languages for space-description, we come to ask with a distinctively Hansonist inflection: what the syntactic readings do if we don’t approach them as tools for “space analytics” (Hanson, 2012) but, instead, for space *task* analytics in order to capture what we do or should we do for the competition of the task of *reading the space*. In responding to Hanson’s claim therefore, our intention here is to investigate the psychospatial extensions of the syntactic approach on the decision requirements and the psychological responses we develop during the act of translating its narrative content into cognitive thought. In the following sections the above mentioned dislocation is accessed through the method of a cognitive task analysis and the use of an empirical vehicle from a design studio course.

1.2 Analogical reasoning: from the Narrative to the Cognitive Task Analysis

In the discussion above, what is at stake is that the issue of non-representational concepts endowed with meaning works (or is developed) by considering the “private” and “subjective” dimensions in the context of reading the space. That is why narrative analysis doesn’t equal space syntax analysis. What the former is concerned with is a recognition that any syntactic layout comes inevitably with changes in local properties like elevations, colours, heights or shadows from its configurations that space syntax has difficulties in taking them into active account. Therefore by capturing the impact of *locational changes* (Ratti, 2004) on verbal statements, the narrative analysis relies for its success on the private or subjective sensibilities stimulated and developed by placing interest in concepts and dimensions like the configurational ones, when these are supplemented by causal explanations of the experiential aspect.

For describing the knowledge gained as students perform a syntactical reading of a given space and the strategies inspired for the design composition, I shall start by looking at the definition and position of the Cognitive Task Analysis method (Crandall; Klein & Hoffman, 2006; Hoffman *et al.*, 2009; Johnson-Laird, 1983; Klein & Militello, 2003; Militello & Hoffman, 2008) inside the present enquiry. While the narrative analysis presents us a sense of the vocabulary associated with the variety of the syntactic attributes, for the architectural pedagogy it is not enough just to observe what students say and do with the use of maps and graphs. It is more important to “*find out how they think and what they know, how they organize and structure information, and what they seek to understand better*” (Crandall; Klein & Hoffman, 2006, p.3) This is the principal reason why we go beyond the psycholinguistics of the narrative analysis and employ a different research method for systematically identifying skeleton cognitive guides in “*studying and describing reasoning and knowledge*” (*ibid.*, p.3) In these observations we recognize that both approaches do share one issue, that is the interpretative process of unfolding ideas and concepts in space and time. However, and from an architectural perspective, there are two additional aspects of the second approach to be considered as important components for understanding something more about the cognitive landscape it has been addressed to explore. These aspects deserve some attention because they reflect space syntax’s interest in the architectural knowledge of spatial configuration in a stepwise process of *codified knowledge*¹ (Amin & Cohendet, 2004) elicitation.

First, it attaches the generality of the analogical reasoning to specific organizational frameworks of spatial thinking (like the ideas of the *presumed position* and *physical accessibility* for example) that are generated by rather computational methods and techniques. In this way, it differs in the sense of the ability to develop an understanding of the abstract activity data (statements, concepts, diagrams, sketches) by means of other explanatory and legitimized frameworks or former findings and to put a manageable dimension forward. In our case, the notion of configuration, as studied through space syntax techniques like *isovists* and their overlap, is thus especially appropriate for proposing methodological coordinates for the interpretation and conceptualization of non-representational ideas. A cognitive task analysis aims at exploring some of the ways that these coordinates, generated by the topological representations of space, are finally concretized according to private and subjective interpretations.

The second aspect refers to the use of this method as an attempt to draw possible objective accounts from the subjective syntactical descriptions. It is recognized that, in general, the narrative analysis of the statements produced during the act of reading the space is often itself a product of subjective opinion. Downton (2003) proposes these necessary verbalizations often recorded for spatial analysis as the transpose of the understanding of design thinking, linking their subjectivity to the study of cognitive processes that are subsequently projected during the different steps of the design activity. Putting forward a similar view, the study and description of the space syntax reasoning tools can be objectified if we are able to identify and link the amount of the routine cognitive decisions that are prioritized during the performance of the spatial analysis task with their consequences during the design process. Such consequences are related to the way we more often use design tools like grids and patterns in order to structure our proposals.

Although the method cannot legislate for all critical decisions triggered by the act of “reading” spatial properties, it can encourage an objectification of the act based on the major decision-making frameworks that keep appearing as routine-choices during the accomplishment

¹ The theoretical framework of this paper for a psychology of space syntax can also be presented through the idea of the codification of knowledge. The process of codification “*aims at converting knowledge into messages. These messages can then be processed as information that will serve to ‘reconstitute’ knowledge at a later time, in a different place or by a different group of individuals*” A. Amin and P. Cohendet, *Architectures of Knowledge: Firms, Capabilities, and Communities* (Oxford University Press, USA, 2004), p.21 We argue that space syntax techniques facilitate the codification and exchange of architectural knowledge in a material way (i.e. it is rendered from within specific organizing frameworks) This knowledge can be reconstituted during the critical cognitive decisions of the design process.

of a given competition. To begin the process of capturing critical thinking in the design studio, a logical starting point is to identify the sequence of the tasks that link the interrogation of the syntactical representations of space to interrelated aspects of the design composite. This sequence represents the main features and focus of the method. And looking more thoroughly at it, we can observe similarities and differences between ways of processing information from configurational properties to design intentions.

2. Objectifying syntactic traces: Spatial Readings and Design Thinking

In this session, we explore the context in which a cognitive task analysis unfolds during a design studio course. While working with third year students for an urban renewal design project, the aims of this course represent a conceptual exploration of how tools like diagrams and maps are treated by the participants, as a case study to access the human-agency of personal sensibilities termed “situated positions”. By this, in turn, the course explores how configuration and space syntax methods can be used to understand the mental grouping of principles like *organisation* and *coherence* in students, focusing on legitimized interpretations for the cause of design thinking. While the project was both applied in the analysis of the historic context and the submission of design proposals for the re-signification of the area, the students have used the opportunity to narrate the syntactical properties of the given tools to drive a psychospacial approach of reading the space that most likely would not be an option outside of an academic module.



Figure 1: Tissue study of the Holmen area illustrating different spatial configurations. The figure shows three contrasting walks performed by the student groups, each cultivating different descriptions on the effects of the spatial structure.

The study of the Holmen area (figure 01) involves the analysis of the storytellings evoked by the act of reading the configurational properties of the space between the historic buildings and the sea. In their assignment, students were engaged in expressing their thoughts for the area from evaluating the material presented to them at the beginning of the semester and submitting

descriptions for aspects like grouping and order principles, recognition of built or movement patterns (Hillier & Iida, 2005), views, connection and integration. The task of *reading the space* takes three weeks and provides the necessary psychoanalytic background of the research (based on approaches related to the Gestalt theory) to access the cognitive processes occurring during the mental grouping of different elements read from the visual means, like the tissue study maps, the isovists diagrams and graphs, into *synoptic units* (Von Meiss, 1990). Afterwards, the most dominantly identified units are textually treated – based on a *content analysis* (Smith, 2000) – and interrogated in terms of their significance in conscious, unconscious, intuitive or reflexive thought.

In accordance with the conceptual framework presented in the previous session in terms of the interpretative nature of the method, it is the purpose of this case study to explore the role of the narrative descriptions in accessing students' situated positions for the given material. This is attempted by structuring our approach along the three most general steps² of the dominant cognitive task analysis methods: *first*, by extracting knowledge from the material using techniques that can also identify the sequence of the tasks asked from the students during the first three weeks of the course; *second*, by gathering, sorting and representing the recorded information of the psychological content found in the statements; and *third*, by identifying the cues and patterns that generated crucial decision points along the chronology of the act of *reading the space* and their cognitive inferences. What follows is the above-mentioned three-stage process broken down into brief descriptions that demonstrate the methodological -and psychospacial- conception of the course.

2.1 Using syntactic maps for knowledge elicitation

In the previous part, the need to employ a narrative analysis of the representational syntactical content to inspire analogical reasoning during the beginning of the design process was emphasized. The limits of this approach were criticized in one major way: while in the course of this method we can gather a significant amount of personal descriptions that externalize in a degree the subjective understanding of the given space, we have difficulties in sorting and implementing the outcomes as to highlight the cognitive content of the process while retaining the focus on the configurational and spatial properties of the assigned task. "*Reading the space*" marks a position and indicates the intention of the cognitive task analysis to overcome this limitation.

In this first phase, the research attempts to identify the tasks that will be used in order to access and group different situated positions and modes of thinking the spatial context. The goal is to read the configurational qualities of the area and document descriptions of the dynamics within them. The initial tools at the students' disposal are a series of maps and diagrams that provide specific syntactical information to each group (figure 02). While there are two general keystones inside the space syntax theory - the structure of the urban grid (spatial configuration) and the movement patterns (bodily presence) - we ask the students to stand *between* these two aspects and read the space. We introduce them with the idea that the spatial configuration, by means of relations like the visual permeability for instance, determines other aspects such as the "potential movement" (Peponis & Bellal, 2005). This means that *movement-to* and *movement-through* cannot have high potentiality to occur without awareness of the possibilities for spatial encounters that the configuration itself generates. Based on this introduction, the analysis of space brought in by the individual groups seems to reflect the Holmen's cognitive understanding born out of the two domains – moving *from* the urban layout

² Although we can review a variety of methods in the literature associated with the issue of the "cognitive task analysis", a rather in-depth discussion is provided in the *Working Minds* Beth Crandall, Gary Klein, and Robert R. Hoffman, *Working Minds: A Practitioner's Guide to Cognitive Task Analysis* (Cambridge, Mass.: MIT Press, 2006). According to the authors, some of the most common steps of this method are performed in the following sequence: knowledge elicitation, knowledge representation, data analysis and representation. These general frameworks were adjusted as to serve the purpose of a strategic design process in an academic environment and received descriptions that differ from those initially presented in the *Working Minds*.

to the position *inside* the urban layout. This was translated into the following broad questions that frame the cognitive task analysis approach: “How do we move in this space and how are its sub-areas connected? How easily can we reach a specific place and how do we describe the level of its centrality? How visible is an area and how does this relate to the presence of activities there?”

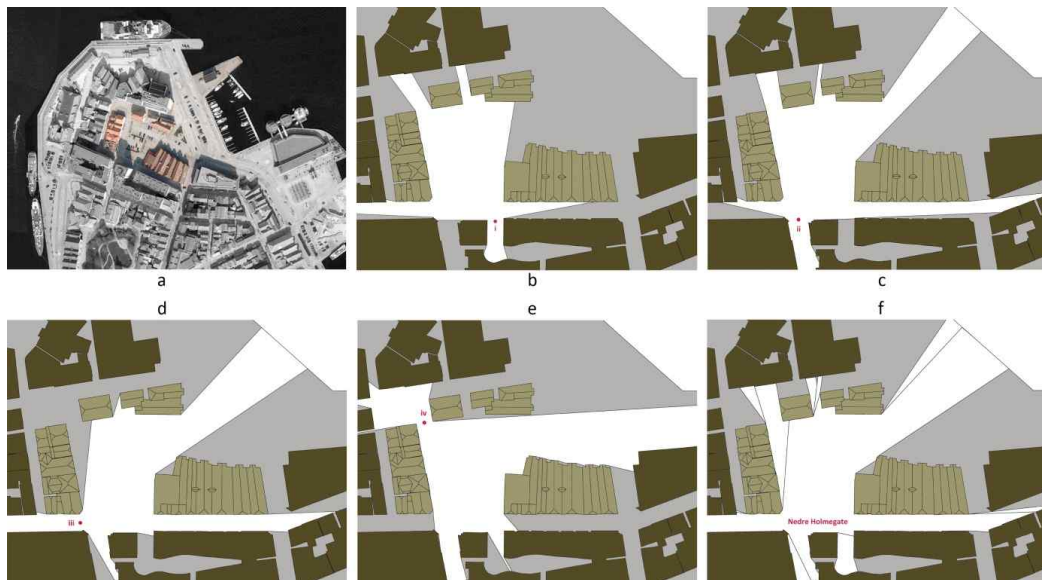


Figure 2 sample of the given material. (a) The Holmen area from above. Its well-enclosed space suggests an outdoor room for the city, (b-e) the diagrams show isovists from each of the most frequently visited entrances of the area (related to it as an “enclosed entity” and excluding the major opening to the sea). Figure f shows the overlapping of all the above isovists.

Using these questions as a starting framework, the answers were not expected to be matter-related – for example, “I cross a two-meter wide pedestrian street” or “this elevated element stands in front of me”. The answers encouraged here were meant to be concept-driven as students process the presented information to understand the configuration of space. In this way, each of these questions had a distinctly different focus that led students to understand different cognitive issues in order to respond to the initial task of *reading the space*. The most frequently noted of them were referring to connectivity cues; how to identify the immediate neighbours of a spatial arrangement; alternative connections and their mental grouping; knowing the relation between traversed elements and integration; how to group entities based on similarities, proximities or closure principles; abstraction and synthesis of the “lines” presented in the graphs; and spotting ideas related to movement and activity patterns.

One of the most important and challenging means of eliciting knowledge at this stage proved to be the degree of difficulty in the study of an already made material. Students didn’t have the opportunity to use computer programs in order to insert metrical data and produce the maps by themselves. The study of such a non-routine task, a rather tough case for third-year students in our department, resulted in useful observations especially when students were asked to describe what makes the map so difficult to read. For example, the degree of integration in terms of colour and the correlation of the colour with potential movement and activity proved to be a critical incident for this phase. In addition to the structured observation of how students read the maps and diagrams, how they react to the information presented and what behaviours, judgments or verbal thoughts this task cultivates, some other techniques were also used to obtain data about what students learn from the material and how they have obtained, organized and categorized this knowledge on the syntactical relationships. These include weekly discussions (group and individually), drawings above the given material and abstract concept modelling, and self-reports in an open-ended format like diagramming and hierarchical sorting of initial reflections from the visual source. In the next step, the research continues

independently of the course and its task is to access and extract the psychological content (cues and patterns) from the gathered data, to identify themes triggered by the syntactic reading and to represent the cognitive processes and sequences behind their formulation.

2.2 Concept mapping and representation

In using the cues and patterns students mentioned during the analysis phase, we are not attempting to simply list a series of concepts brought up during the discussions. Many issues were put on the table and, at this phase, the collected material in no more than a registered database of personal statements. What we will do in examining the tasks of reading the syntactical maps is use pertinent extracts from the storytelling database to identify and access the mental states in the occasions that students seemed to have made a decision or evaluated a situation. To illustrate the potentially useful knowledge required from the participants in order to make the decision (and perform the requested task) we will use concept maps and narrative representation formats. The first aims at providing us with an image of the knowledge structure within the task of *reading the space*. The second are mostly focused on highlighting some cognitive aspects of the analysis. However, concept maps appear to be a stronger type of graphical representation (diagram) since they express a sequential sum of logical statements stemming from underlying narrative constructs – thus they bring a rather tangible way to display different situated positions on particular aspects.

Table 1: Example of interrogating narrative statements (analysis and representation)

Student Statement	Elicited Knowledge
<p>Since warehouses have such a special position in the history of Stavanger, and because their design layout is as distinctive as it is, you feel that you are surrounded by a real cultural heritage of Stavanger.</p>	<p>Depicts specific use and type of spatial object. Captures a comprehensible aspect (or quality) of the environment.</p> <p>In the literature associated with "space syntax" the relationship between local visual cues (e.g. the architectural configuration of the sea houses) and the global aspects of space (e.g. sense of a distinctive historical/cultural context) elicits the degree of the property of "intelligibility". This extract depicts a strong degree that assists the subject to identify and understand it as something distinctive.</p>
	<p>However, there seems to be a link between the above mentioned aspects, their abstract spatial description and their cognitive mapping in subject's mind. It can be described as a personal <i>reading-logic</i> underlying both the descriptive and interpretative qualities of the environment.</p>
<p>This is actually the case. The sea houses remind us how we used the ocean in the past, and how the former coastline was configured.</p>	<p>The subject treats his observations in a clear empirical way.</p> <p>Moreover, the subject's relationship to the statement implies the inquiry of a trace with geometrical order. In this sense, the subject locates his mental conception of space between shared memories of the past in order to legitimize the syntactical existence and mapping of the encountered objects.</p> <p>The visual (distinctive forms) and the spatial cues (coastline configuration) are fused in the cognitive adaption of the concept of <i>imageability</i>.</p>

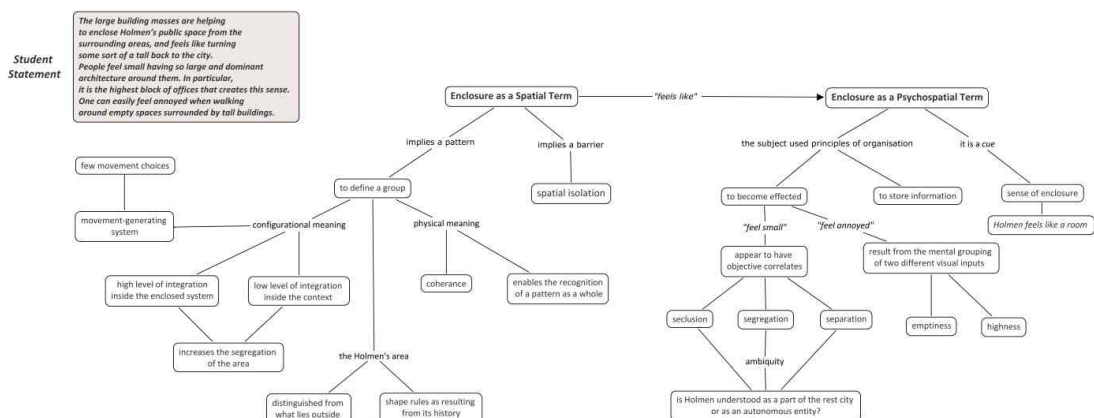
Developing *concept maps* has become a significant tool not only in capturing what people know and believe about a specific field of study but also the concepts and personal positions evolved during critical decision-making phases. Crandall et al. (2006) make the useful distinction between using concept mapping for eliciting *and* representing knowledge. They focus on the significance of the second approach saying that it is an illustrative method for "user-friendly expression of meanings" that involves "their expressiveness (semantics and syntax), their shape (or morphology), shape-meaning interaction, and dynamics" (Crandall; Klein & Hoffman, 2006, p. 52) Another useful observation here about the use of such knowledge representation means comes from the writings of Novak and Cañas (2008) who have shown how the process of forming meaningful statements involves two or more background concepts-as-scaffolds for cognitive processing. Central to their argument is the idea that both the origins of these concepts and their assimilation into existing frameworks appear to have

psychological foundations.

Far more interesting than a simple accumulation of statements are the possibilities to examine how students develop and assimilate new syntactical concepts into the existing ordinary spatial concepts taught in previous years. At this phase, concept maps and semantic nets were mostly used in order to illustrate the elicited knowledge and provide direction and order to latter stages of the cognitive task analysis as well. For example, in the representation of the knowledge structure required for understanding the morphology of the surrounding buildings in the area of Holmen (table 01), we seize the opportunity to critique the concept of “imageability” (Lynch, 1960), and especially the idea of the spatial descriptors as regulators of the act of comprehending the spatial configuration and navigating within it. In unfolding the morphological properties and the qualities of the visual differentiation of space, we note a significant situated position within the initial description: the identification of the visually distinctive elements in Holmen along specific way finding paths seems to have devised certain subjective rules of spatial description that, in turn, raised in the student’s mind the awareness of the constructed assumptions of what “image of the past” and “characteristic encounter” mean.

In another case, an analysis of learning hierarchy was attempted (table 02). It began by asking a student to identify, according to her opinion, the most complex syntactical concept found in the given material. Ordering the ideas she mentioned from the more complex to the simpler ones, it was found that the idea of space as a volume *enclosed* by solid objects was at the top of the list. Representing her narrative extract as a chart of underlying concepts mentioned in her attempt to understand this complex idea, it was clear that the syntactical mapping of “the enclosed” was performed mostly upon certain basic notions describing solidity and scale. However, the graphically represented information has yet no meaning on its own. It is still a series of concepts linked with relationships indicated by connecting sub-concepts. All the data we have collected and created will obtain their significance from their use in the context of a design project. In the following sections, we continue our approach, capturing and examining the set of effects and potential conditions that the syntactical readings of the first part of the course generate through the design process of the second part.

Table 2: Extract from mapping cognitive awareness and emotional responses. The sample map uses a single concept (*enclosure*, for more see Llobera, 1996) to express and represent its content through which reasoning was based.



2.3 Discovering the meaning of the decision points

We have identified, sorted and represented some of the most recurring sensitizing concepts that emerged during the syntactical description of the given material. This method enabled us to visualize not only what students think about the main space syntax principles related to the understanding of the area but also the connecting relationships between two or more of them.

We intend now to move to the last phase of the research and discuss how the above-mentioned structured way of revealing important aspects of cognitive processes (mostly through concept assimilation) may relate to architecture and urban design process and thinking. To this end, we produce a list of the most recurring key syntactical cues that were associated with the prior spatial knowledge and used in the decision making of the students' site evaluation and concept formulation.

An overarching issue in cognitive task analysis and in Crandall's et al. sequential steps for finding cognition is the remark that people's thinking is goal-directed and that the mechanism of thought develops frameworks of sense-making and decision-making in order to define and clarify these goals. Within, a timeline exists that is created from the succession of the unstructured accounts of the task that each participant handled during the assigned reading. In the temporal experience of the syntactical reading, with students producing their own understanding of what space syntax concept is arguably related to the description of elements of the spatial configuration, we observe that most approaches consist of specific decision-making points in a chronology of narrated events. To an extent, this was encouraged from the adopted methodology of this research. However, as Polkinghorne (1988, p.:79) notes, the process of "drawing out from the continual flow of successive moments episodic patterns by marking off beginning and ending points" is critical to understanding how the key points in the timeline are either side of our decision requirements and psychological responses. That is how the use of unique cues or memorable and distinctive aspects of the performed reading comes to embody necessary decisions to be made in the incident and their cognitive inferences.

Table 3: Internal structure of description: narrative statements coded in a timeline analysis of the syntactical representations (from reading the axial line and the isovists diagrams)

1. agent	colour	volume	2. act	finding	seeing	3. object	view	volume
	15	23		15	23		32	13
	rythm	corner		moving	gathering		openness	density
	8	27		18	27		11	25
	edge	water		exploring	intersecting		distance	nearness
	21	19		11	9		18	27
street		encountering		accessibility				
	20		24		9			

List of actions (the *syntactical reading* artifact):

1. The initial visual input from the graph that structures/regulates the description (according to their mention frequency)
2. The associated verb that fuses the initial action generated by the reading of the graph.
3. The entity that changes in the experiential or perceptual field, such that the evaluation of space needs renegotiation. (Viewpoints, moving patterns or amounts of people can also be objects)
4. A spatial attribute interacting with the agent identified as crucial for the development of specific spatial relations (an architectural arrangement, a moving habit or a social activity can stand for a formulation)
5. The specific point or node at which a formulation is encountered and affects the object.
6. A setting where agents, objects and formulations interact to move awareness and attach attention on an identifiable spatial event (a shared belief or value can be a territory)

4. formulation	curves	conjunction	5. position	corner	axis	6. territory	function	between
	12	5		15	13		25	13
	facades	width		entrance	path		activity	grouping
	28	22		38	17		38	18
	introversion	centrality		pedestrian			gathering	attractive
	11	39		31			11	26
shape		opening		historicity	arch.style			
	34		34		9	35		

The Holmen area in Stavanger, Norway, provides an interesting part of the city within which we can think by using codings that imply systematic relationships among various syntactical cues. Previously, in asking students to read this area, we wanted to encourage them to produce storytelling spatial descriptions by relating the image of the graph or map to the archive of statements of which it is generative. A structured observation³ was then focused on noting how the eye of the participant isolates, selects and combines syntactic elements in order, afterwards, to attempt an understanding of how these elements were mentally grouped as to integrate their principles within the chronology of the verbal descriptions and make decisions in critical points of the timeline. To probe further into which syntactical descriptions can account for these, the verbally defined events were manually registered in the *Ethno*⁴ program from which implied groups of relationships between the narrated events were built up in the form of listed categories along the timeline (table 03).

To describe and organize the information from the visual stimuli of the tissue study map and the visibility graph (figure 03) for example, the use of the *Ethno* application was important in terms of guiding our attention not to the simple content of the narration (the perigraph⁵ of the visual data and the description of the intersections as nodes or the streets as edges) but to its structure: *how* the descriptive parts of the narration are organized in categories, *how* the statements are developed during observation (while sorting, grouping or recognizing patterns) and around *which* concept the individual's thought is evolved or concentrated. The idea behind this is, as Novak and Cañas (2008) point out, to *designate by label* the perceived regularities in events or objects, so we can refer to them. However, the danger here for architects is the possibility of this label being of little spatial consequence.

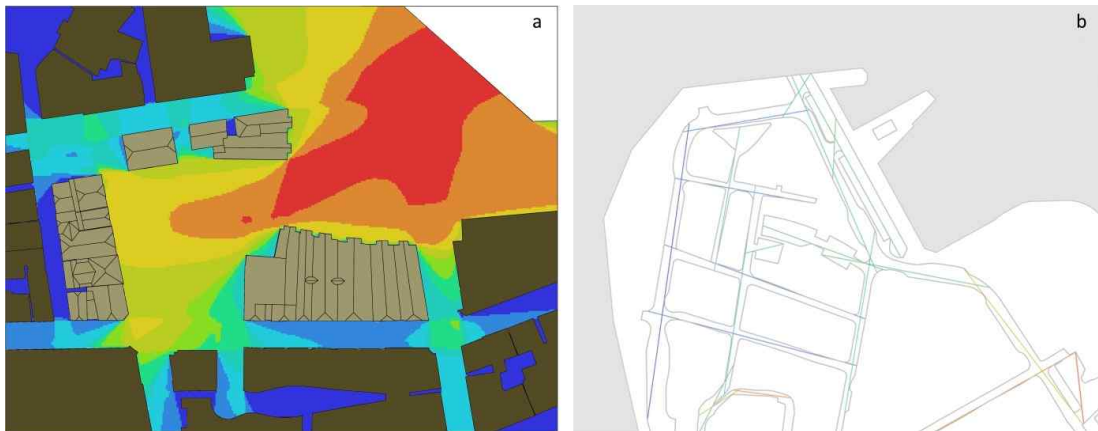


Figure 3: Representation of Holmen's layout: visibility graph (a) and axial map (b). The conception of the physical boundaries and the different levels of inter-visibility (Turner et al., 2001), connectivity and accessibility seem to imply cognitive correspondences to the way students organize the syntactical information

At the end of the analysis phase we found that students, while moving from coding to

³ To avoid uneven coverage in the produced data, Crandall *et al* *ibid.* argue that a structured observation with a predetermined format is preferable when research demands a degree of quantification. Since the attempted analysis would generate a broad range of subjective descriptions otherwise difficult to be handled, the research used a predetermined (structured) procedure: the tutor preselected and presented to all the students the same given and space-specific material (diagrams and maps) asking the same types of questions. In this way figuring out the coding descriptions and categories of the cognitive analysis was a more tangible task, considering that all participants were aware of the same significances depicted on the graphic tools.

⁴ *Ethno* is an on-line Java program developed by David Heise Ethno, Event Structure Analysis Ver. July 2012, Indiana University, Bloomington, Indiana. and the University of Indiana in order to analyze sequential actions. By entering the subsequent events of the narrative data, the program uses logical principles like time and succession to construct a list of events and their interrelationships.

⁵ From Greek *peri – graphé* that denotes a general outline or inaccurate delineation of something.

interpretation, generate narrative statements referring, among others, to the flow of centrality between the historical buildings, the square and the waterfront of Holmen. In order to think about these statements in a new way, a method of creating a "list of categories" of the sorted interpretations prior to the implementation of the data into the design process enables us to identify the mental structure of the emplotment related to the idea of "centrality" and the interface of the graph to cognitive processes. The aim of this method is to help analysis make explicit the implicit assumptions built into the verbally defined descriptions of the Holmen area made while reviewing the graph. The students could in fact use the image of the graph to interpret the non-representational dimensions of centrality (flowing from the sea towards the enclosed public space) and to synthesize different frameworks of knowledge for the concept. Built on Porta's *et al* (2008) idea of different centrality-families, we then found that these situated positions were attached to three very distinctive understandings of the notion of "being central", each described by a different group⁶ of narrative statements: *being central as being close to others* (closeness centrality); *being central as being between others* (betweenness centrality); and *being central as being straight in relation to all others* (straightness centrality) (Porta; Crucitti & Latora, 2008)⁷. Turning to the structural units of this phase, we can see how different situated positions might be applied to this extract of categorical thinking: it was clear that students' narratives began by reflecting the synthetic ability of making simple or complex associations between the graphic data, the space attributes and their meaning.

Although such reflections on the idea of centrality also lead us to reflect on the kinds of cognitive frameworks the students are most often engaging with during their introduction with the issue of *reading the space*, the narrative analysis can make a more important contribution to our understanding whenever complex decisions are required, such as when multiple contributing variables appear during the interpretation of syntactic inputs. Adopting a psychoanalytic approach to capture this understanding, according to Wiles et al. (2005), can help the research to open up interesting directions for the analysis of such cues. In other words, from the space-descriptions embedded within the narrative structure researchers can capture snapshots or records of what would otherwise be inaccessible and maybe depended on observer's inductive conclusion-making process. However, one of the limitations in using this sort of analysis is that we lack a system of reference, a thematic coding or retrieve technique, in order for the results from the narrative data gathered to generate detailed and precise information on the nature of understanding and thinking about the spatial configurations found in a given setting. It is thus suggested that space syntax tools can serve to highlight such a thematic coding.

3. Summary: A design-relevant coding scheme

This paper has shown how the syntactical readings of space can be used as a framework for acquiring a design-relevant coding scheme as a dimension of cognitive processes that include attention, interpretation, reasoning and decision making. We have not attempted to provide a rigorous discussion of the whole range of the psychospacial dimension of the space syntax tools. The purpose in this research has been to examine, through the regularity or peculiarity of situated positions, how the reading of different syntactical information affects the comprehension of spatial references in students. The main area of interest was concentrated on the understanding of referential relations in acquiring and utilizing configuration-related knowledge; how it emerges through a stepwise design methodology and a language-space

⁶ At this phase, the effort was initially placed in extracting meaning from students' verbal expressions by identifying within their arguments frequencies or covariance of used terms and concepts related to centrality. Associating the sum of the relevant situated positions with the notions of *closeness*, *betweenness* and *straightness* help us to formulate the three main clusters of spatial information generated by the interpretation of the inputs from the visual display of the graph.

⁷ S. Porta, P. Crucitti, and V. Latora, "Multiple Centrality Assessment in Parma: A Network Analysis of Paths and Open Spaces," *Urban Design International* 13, no. 1 (2008). also consider a forth category related to the type of informational centrality (that is *being central as being critical for all others as a group*) However no critical amount of statements were finally noted that could possibly sketch such a fourth cognitive mapping of the notion.

interaction; and how the ability to understand syntactical cues, such as space's formulation and shared attention to specific spatial encounters, develops in the course of cognitive processes. Towards a psychology of syntactical readings, we followed the most significant phases of conducting a cognitive task analysis in order to capture and reflect the cognitive inferences from reading the syntactic properties of a given setting. This approach enabled us to categorize a part of the cognitive activity that surrounds the elicitation of configuration-related knowledge during a design studio.

Having identified themes like "centrality" and "enclosure", we can further explore the potential of the psychospacial dimension of space syntax analysis as a critical design tool by examining the sequential steps that students follow when making decisions to build up their design proposals. More specifically, and for the development of the design proposal for Holmen area, we are able to interrogate the main actions that might be considered as the beginning of the design process and thinking in terms of being initiated by a number of remarks made on the space syntax maps: the *concept listing* (task of concept formulation), the *transformative activity* (tasks of grid study and development, diagrams and sketches making etc.) and the *scenario technique* (task of program formulation, textual analysis etc.) By inquiring narrative constructs in a variety of ways, the research can suggest an alternative explanation of the decision making process during these actions as an extension of the general problem-solving activity model and as a growing theory that integrates space syntax with psychology and the *logic of design making*: the development of the above mentioned design tasks appeared to operate as a consequence from underlying cognitive components primarily serving the syntactic concept assimilation process, considering the fact that it was the first time that students were introduced with space syntax techniques. This points towards a productive revision of the syntactical dimensions - the use by the design methodology, for example, of analytic frameworks without having to sacrifice creativity and innovation, or the inclusion of psychological data into generative design resources.

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