

Social and Technical Challenges to the Use of Space Syntax Methodologies as a Planning Support System (PSS) in American Urban Design

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Abstract

Space syntax (SSX) as a theory and methodology has been widely applied in Europe and the UK, yet is perceived to be relatively unknown and underused in American professional practice. Why is this the case? In what ways has it been influential, why has it not been more influential (if indeed it has not), and what practical lessons could be learned from this comparison for the improvement of both SSX and American urban design? This paper uses qualitative interviews with a series of American and UK architects and urban designers familiar with space syntax to explore this question, in particular several key New Urbanist practitioners. It does so in two ways; first by exploring technical barriers within the software and methodology itself, and then by examining the social context within which tools like SSX are used in the design profession. In the latter case that paper draws from literatures on the diffusion of innovation in general and Planning Support Systems (PSS) in specific. The paper argues that there are significant barriers to the use of SSX in America, yet significant gains to be made should these barriers overcome. The paper concludes with several proposed improvements to both the method and the presentation of space syntax, as well as a brief comparison between space syntax and other modelling approaches to pedestrian movement such as agent based modelling (ABM).

1. Introduction

The virtues of space syntax theory and practice have been fully explored elsewhere (Hiller, 1999; Hillier et al, 1993) To summarise, space syntax has been recognized as a key development in the study of urban morphology and the analysis of urban spatial form and function (Gauthier and Gilliland, 2006; Carmona and Tiesdell, 2007; Carmona et al., 2003; Cuthbert, 2003, 2006). It is recognized in the United Kingdom as a valid standard of evidence for assessing the impact of planning applications, is taught in many universities and professional master-classes and has become a component of policy evaluation for many local governments seeking to address issues of movement and public space in urban design (CABE, 2008; ODPM, 2004; DETR, 2000). It has also been applied on over 1,000 different urban design projects internationally (Space Syntax Limited, 2008); garnering a reputation for functional evaluation and successful public space design in the professional realm. Space syntax also enjoys academic influence as a theory of space and society, of spatial network analysis, and as a means of understanding human way-finding and spatial perception (Hillier, 1996, 2002; Montello, 2007; Seamon, 2007).

Despite recognition in the UK and other parts of Europe, space syntax tools and theories remain relatively marginal to the planning profession elsewhere. This is particularly the case in American planning and design circles, where little effort has been made to incorporate space syntax knowledge into either research or practice. Notable exceptions include the work of long time space syntax researchers such as Peponis and Wineman (1998, 2008), as well as relative new comers such as Barran, Rodriguez and Khattak (2008), Matthews and Turnbull (2007), and Raford et al.. (2003, 2004, 2005, 2006). Unfortunately relatively little of this work has been published in high

impact journals such as the Journal of the American Planning Association (JAPA) and the little which has been published pales in comparison to the amount of effort devoted to other aspects of built environment - behavior studies, such as those related to obesity and physical fitness.

The purpose of this paper is to explore the technical and social factors that might stand in the way of understanding and adopting space syntax in North American planning and design circles. The goal of this paper is provide an "informed outsiders" critique in a way that offers concrete value for researchers and practitioners operating in the United States; as well as those operating under similar conditions elsewhere.

A series of semi-structured qualitative interviews were conducted with American and UK researchers, architects and designers familiar with space syntax in order to accomplish this goal. The issues raised by the interviewees fell into two main categories; technical issues relating to the software, technology, and method itself, and social issues relating to the context within which tools like space syntax are learned and applied. This paper presents these issues in the context of theories of innovation and adoption in general, and of Planning Support Systems (PSS) in specific. It then concludes with a discussion of how these barriers may be addressed.

2. Theoretical Background: Factors influencing the diffusion of innovation

Space syntax can be reasonably viewed as an innovation in the way that urbanism is understood and practised. There has been a significant amount research into the diffusion of innovation in other other industries, and of the adoption of innovative practices in quantitative, evidence-based settings in particular. I use Everett Rogers' Innovation-Decision model of knowledge diffusion (2003) to explore the first case and Weiss and Bucuvalas' "Truth Tests" and "Utility Tests" in the later.

Everett Rogers' Innovation-Decision model of knowledge diffusion (2003) is the most widely known and well utilised framework for understanding why innovations spread through an industry. Rogers argues that the process of adoption and diffusion involves five stages; Knowledge, Persuasion, Decision, Implementation, and Confirmation. The first phase involves the exposure of the innovation to individuals and organizations. This phase deals with several related issues, including social networks of communication, mass media exposure, and people's openness to new ideas. Rogers then argues that exposed individuals form an opinion of the innovation through social and behavioral cues, their perception of the innovation's usefulness to their life, etc. This is called the Persuasion stage, which leads to the Decision stage where the individual chooses to adopt the innovation or not through a process of active or passive rejection. If they accept the innovation, then they enter into the Implementation phase, whereby they actively put the innovation to use in their life through a process of experimentation and possible modification. Finally, the individual undergoes a Confirmation stage where they seek reinforcement for their decision to adopt the innovation.

Rogers' work has been complimented in the field of public policy decision-making through the work of Weiss and Bucuvalas, taken form their work on social science research and decision-making. Their concepts of Truth Tests and Utility Tests amongst organizational decision makers has been successfully applied to evaluate why some public policy proposals are more successful than others, particularly amongst those influenced by scientific or evidence-based decision-making. In their seminal study of decision-makers in the field of mental health, they outlined five frames of reference by which decision makers evaluate and apply new knowledge. These frames were the relevance of the research topic, research quality, conformity of results with expectations, orientation to action, and challenge to existing policy.

Weiss and Bucuvalas found that all of these frames positively influenced a decision maker's perceived likelihood of using a new study. Interaction between the frames were also found to be very important, in particular the quality of the research and how well it conformed with their prior knowledge and expectations (the so called "truth test") and how feasible and useful it may be for immediate action and / or current policies (the so called "utility test"). They also highlighted an important trade-off between these dimensions, whereby action oriented studies were more likely to

be accepted when they didn't challenge the status quo and challenging studies were more likely to be deemed useful when they weren't action oriented. They write,

"When a study suggests radical redirection of policy or program, explicit direction for implementation adds relatively little to usefulness; respondents are receptive to its ideas, but they are not prepared to take immediate steps to carry out its recommendations."

This distinction adds value to Rogers' framework by taking account of a more complex relationship between novelty and the status quo. It also offers a nuanced and perhaps more realistic understanding of the pressures of cognitive dissonance that are likely to influence individuals' acceptance of new things. Rogers acknowledges the importance of cognitive dissonance in the Persuasion and Decision stages. Weiss and Bucuvalas' framework offers a possible explanatory mechanism for how this operates and, in the following sections, I will argue that this may be key to understanding the diffusion of space syntax amongst American urban practitioners.

There has been important research conducted in a third field, that of Planning Support Systems (PSS), which is relevant to this argument. This research will be presented in more detail in the Discussion section, where it will help better explain the Findings from the interviews. The following section briefly introduced the Methodology used, followed by a summary of Findings and then an in-depth Discussion. The paper's Conclusion presents next steps for this research and how these barriers may be overcome to positive effect in the future.

3. Methodology

Nine semi-structured interviews were carried out over a period of two years with respondents of varying backgrounds. Five interviewees were directors or senior managers at architectural or urban design firms, two were professors or senior researchers in planning or design at major universities, and two were independent consultants with extensive knowledge of space syntax. All were at least generally knowledgeable about space syntax methods and theory, as well as extensively knowledgeable about American urban design. Four subjects had particularly in depth experience through past research or design projects and were also experienced in professional practice or research in both the United States and Britain or Europe.

Informants were selected based on their professional or academic affiliation, the recommendation of others, or through opportunities provided through professional contact. Six out of the nine interviews were recorded, with extensive notes taken in the remaining cases. Interview duration lasted between 45 minutes and two and half hours, with the average interview lasting approximately 1 hour and 15 minutes. Follow up questions were solicited via email or phone in five of the nine interviews. All interviewees were conducted on an anonymous, non-attributable basis, except where interviewees gave permission for specific quotations.

An additional twelve, shorter, less formal interviews were conducted over the same period with architects, designers, and students encountered in space syntax projects, workshops and training. These interviews were not recorded and notes were not taken, so are thus not formally included in the findings of this paper. The feedback from these mini-interviews echoed many of the sentiments expressed in the formal interviews, however, and are thus used as background to inform the overall argument of this paper.

The small sample size of this research is a clear limitation, preventing meaningful comparison of small N statistical differences. Despite these limitations, it is suggested that the depth and specificity of these findings may be of relevance to the space syntax research and design community and are thus presented below.

4. Findings

Respondents identified a wide range of issues affecting their understanding, attitude, and potential adoption of space syntax in the United States. These themes are grouped below into technical and social categories.

4.1. Technical themes

Respondents reported four main technical obstacles that influenced their attitude towards the adoption of space syntax. First, the use of axial lines to represent spatial relationships was identified as a stumbling block. Second, reliance on complex software for which specialized skills and training were required was a prohibitive many users, especially when this required the adoption of less common file formats and programs (such as MapInfo vs. ArcGIS, for example). Third, respondents felt that the use of mathematical terms and concepts (most notably from graph theory) was difficult to translate into the language of design. Finally, two of the more sophisticated interviewees observed that space syntax techniques are analytical in nature, not prescriptive, and thus require additional interpretation and data analysis (often statistical in nature) to produce the desired output. This added layer of complexity was reported to be an additional technical barrier.

Regarding the first issue, many acknowledged that space syntax's strength is its ability to objectively measure spatial structure and relationships. Axial networks are a key aspect of this strength and have been the subject of extensive debate within the literature (Batty and Rana, 2004; Ratti, 2004; Hillier and Penn, 2004; Jiang and Claramunt, 2002). Axial lines have been theorized to represent the way people understand and navigate their environment better than other forms of topological representation (Penn, 2003; Kim and Penn, 2004). Extensive comparison has been conducted between axial line graphs and other forms of network-based spatial representation, including road centre-lines (Turner, 2005, 2007; Dalton et al., 2003; Batty et al., 2002). Proof has also been offered that a unique "least-lines" topological set exists for any given spatial configuration (Turner et al., 2004).

Yet despite extensive research and rigorous discussion, nearly all subjects interviewed agreed that axial line was somewhat confusing and difficult to understand. One interviewee stated "what exactly is an axial line, and why all the fuss? Can somebody show me one? Why not use road centerlines and be done with it?" Another replied, "the use of axial lines seems like unnecessary complication. I understand that they are supposed to be different and important, but is the difference all that different?" While their are correct responses to both questions (and similar ones posed by other interviewees), it is clear that axial representation remains a significant stumbling block for non-expert users of space syntax. Confusion surrounding the nature and use of axial representations is therefore the first technical barrier which emerged from the interviews.¹

The second theme repeated by seven of the nine interviewees was that space syntax software itself is either unavailable for commercial use, too complex or difficult to use, and that it was incompatible with many industry standards. The fact that no space syntax software exists with a commercial license was seen as a limitation by the majority of the design practitioners interviewed. Design professional interviews also pointed out that most architects and urban design offices use CAD programs such as AutoCAD or MicroStation, not GIS. Space syntax software does not run native in AutoCAD or other similar packages and was thus observed to required learning additional skills or hiring additional staff, even if it were available for commercial license.

Those familiar with various space syntax software packages from an academic standpoint (four out of the nine interviewees), observed that although there are several space syntax software programs available for use, most were either stand-alone packages with unique user interfaces, commands, and custom file formats, or complex GIS plug-ins. Three interviewees were frustrated that space syntax software seemed biased towards the GIS platform MapInfo, which has significantly lower market penetration in the United States when compared to ESRI's ArcGIS. One interviewee correctly noted that it was possible to translate files from the more common "shapefile" format into MapInfo's formats, but that the need to do so imposed an additional barrier in terms of time and complexity and, "almost made me decided not to use [space syntax] on my project." Thus software issues and file formats were found to pose the second barrier to its adoption.

Third, there was confusion over the language and terminology used in space syntax; both in terms of how it relates to other disciplines such as transport demand modeling and network analysis, as well as to how it relates to the daily tasks performed by architects and urban designers. Space

syntax uses a variety of terms adapted from graph theory and network analysis that can be confusing for planners and urban designers. Terms such as "integration" and "choice" represent abstract topological relationships, not physical objects that people can see and experience directly. One respondent interviewed, a professor of urban planning familiar with graph theory applications in other fields, argued that space syntax uses terms different from those more commonly used in standard graph theory. "Integration" and "choice", for example, are similar to the more standard "centrality" and "betweenness" terms used in most network analysis, but called something different within space syntax. Several other respondents that were more oriented towards professional practice observed that in any case, both space syntax terminology and graph theoretical terms were confusing for planners and urban designers and not adequately linked to their training, backgrounds, and daily tasks. This combination of lexical and task mismatch was found to be a third issue raised by the respondents.

The fourth and final technical theme was associated with the output of space syntax analysis, and how this related to the tasks American urban designers were required to perform. All nine interviewees believed that one of the major practical strengths of space syntax was its ability to model pedestrian movement (although four out of the five were also familiar with its other applications, such as in crime and property analysis). Five of the respondents observed however that unlike commercial modeling packages from other disciplines such as TransCAD or Legion, space syntax software was not just a simple "black box" tool that could be used to produce straightforward forecasts of desired outcomes. One respondent stated that, "it seems necessary to have a fairly advanced level of training to design, execute, analyze and interpret a space syntax study. Sometimes all you want to know are 'where are the people going to be?' and this can be a barrier sometimes, I think." This theme was summarized by another respondent, who said that, "the fact that statistical analysis is required to produce useful outputs [such as pedestrian volume, retail activity, or land values, etc.], makes space syntax a lot more complicated than most people have time for." The need for additional "post-processing" as one respondent called it, was the fourth technical theme which emerged from the interviews.²

4.2. Social themes

Four additional themes were also identified as potential barriers from the interviews. These were competition with other, more well known forms of connectivity measurement in the United States, political "turf" battles relative to other urban design agendas, distrust of urban modeling in the policy making and urban decision-making process, and epistemological differences between space syntax and how design is taught and practiced in America.

Four respondents identified a tension between space syntax and other more well known forms of network and connectivity measurement in the United States. Space syntax made rapid progress in the UK during the 1980's but did not begin to appear in the US literature until the late 1990's. During that time, many less sophisticated techniques for analyzing street connectivity came into use, particularly amongst built environment – physical activity researchers (Ewing and Certero, 2001; Handy, et al, 2003, Frank, et al., 2001). Examples range from simply counting the number of intersections per square mile to even more simplistic application of 5 minute walking buffers from key points. Although less powerful than space syntax (Barran et al, 2007 give a good summary), these measures nonetheless became the analytical standard because they were more simple, easier to understand, and achieved prominence in the United States at least a decade before space syntax arrived. One respondent interviewed, a director of a major built environment - physical activity research center in America, wrote that, "the advanced walkability concepts [of space syntax] are very promising... but do not seem to be directly relevant to the main goals of [our research organisation], which is the facilitation of common measurement standards." Thus other measures may have derived a "first mover's" advantage (Lieberman and Montgomery, 1988) by virtue of their earlier development in North America, leaving less room for new measures and techniques.

Along similar lines, the second issue identified by the respondents related to the political context of urban design practice in the United States. The pace and scale of suburbanization in the United States has produced well known problems of urban sprawl. A variety of specialist political

movements have arisen to change this, each focusing on different proposals and solutions. Perhaps the most successful of these, in terms of urban design, is New Urbanism. Although space syntax theories of urban growth and function are largely complimentary, one respondent stated that, "New Urbanists are too busy hustling their own game to learn about or pay for a new one. Although they might believe in it, it's just too complicated and challenging for them to actually take it on board." This response was echoed for other groups as well, not just New Urbanists. Four other respondents commented that American designers and planners could be resistant to learning about and using space syntax for similar reasons.

The third theme, identified by three of those interviewed, connected space syntax to the larger history of digital planning support systems (PSS) in the United States. One respondent with extensive experience in public engagement and the use of digital media, suggested that, "American planning is highly sensitive to public involvement. If digital tools help this process along, then they'll be used. If not, then people won't trust it and they won't be used at all." Another said, "people don't trust what they don't understand, no matter what the evidence, especially if it goes against what they already believe in. And space syntax is kind of hard to understand - people can't get their hands on it - so either they trust you because you're an expert or ignore whatever you have to do."

Brail and Klosterman (2001) provide background to this trend when they discuss how the hopeful early days of urban modeling gave way to pessimism about such approaches in the 1970's. Gary Brewer's (1973) famous modeling "horror stories" and the subsequent backlash describes how this process gave rise to "deliberative planning" and the more community oriented, less technological approaches advocated by Forester (1989). Although most respondents clearly believed space syntax worked and added value to the public process, several commented that the lack of direct citizen involvement and collaborative decision-making was another potential barrier towards its adoption. One respondent commented, "in so far as space syntax appears like a complicated tool for the elites, it will likely continue to fall short of facilitating the kind of community deliberation that is necessary today." This sentiment supports the findings of other PSS researchers asking similar questions, such as Batty (2003) and Klosterman (2001).

The fourth and final element identified and discussed in depth by three of the respondents related to the nature of design education in America and how this informed the culture of professional practice. They observed that there may also be fundamental epistemological reasons that space syntax and the type of "evidence-based design" it champions are not more widely accepted. One respondent commented, "the evidence-based approach [taken by space syntax] is inherently positivist in nature. It privileges observable, empirical and measurable evidence over other forms of analysis. Not everyone is comfortable with this way of thinking." Thus the very strength of space syntax may also be a weakness for many; it can appear threatening to audiences of planners and designers less comfortable with the use of evidence in their profession.

This comment parallels findings from theories of design research. Lawson (1990) argues that design thinking does not work in a linear, logical, evidence-based fashion. He argues that design is inherently synthetic and exploratory, often non-linear, sometimes mysterious and intuitive, and subject to a different set of evaluation criteria (Simon, 1969; Cross, 2006). Thus there may be a fundamental tension between these two ways of knowing that can produce hostility between space syntax and creative designers (Goldschmidt, 1993). This theme was reinforced by another respondent, who wrote, "it could seem to some architects that you're telling them how to do their job, in a way that is totally foreign to them." Architect and urban designers may thus feel threatened by the implied authority of analytical techniques like space syntax, leading to possible subtle (or overt) conflict between such approaches.

5. Discussion

This section discusses the themes raised by the interviews in relation to classical theories of innovation diffusion (Rogers) and managerial decision-making (Weiss and Bucuvalas). Are there any similarities? If so, what can be learned from patterns in other industries that could be of use for the development and application of space syntax?

Rogers outlined five phases that influence the adoption of new innovations. These stages are the Knowledge, Persuasion, Decision, Implementation, and Confirmation stages. The first area to compare the interview findings with Rogers' framework is the Knowledge phase. A full account of the space syntax related exchange between UK and American urban designers would be difficult to quantify and is beyond the scope of this paper. The personal experience of the author and the feedback from those interviewed suggests that although large-scale exposure has not occurred (through mass media outlets, for example), extensive exchange has occurred through Rogers' "cosmopolite communication channels" with certain key groups, such as New Urbanist conferences and various academic workshops at key universities. For example, Hillier (2006) has given keynote lectures at Congress for the New Urbanism conferences, various other researchers have presented space syntax results at various walking and urban sustainability conferences, and there have been frequent contacts between UK space syntax practitioners and various influential opinion leaders in the US, such as senior staff at the Prince's Foundation for the Built Environment.³ It is likely that a lack of exposure is a major factor influencing space syntax's uptake in the United States, but these facts suggest that specialist design movements such as New Urbanism would likely have had sufficient exposure to be aware of space syntax. A critical "tipping point" has not yet been reached within lay planning and design communities, but it is likely that sufficient contact has occurred to satisfy the Knowledge phase of Rogers' diffusion model.

If urban designers are aware of space syntax then, why might they not adopt it? The second stage of Rogers' model is the Persuasion stage. It is possible that despite their exposure, designers have not been persuaded of space syntax's value in their work. Rogers notes that "cues-to-action" are often required to crystallize attitudes into concrete behavioral change. Such cues could be verbal, such as through face-to-face communication with trusted peers, or through secondary sources such as media, publication, or high profile events. Several of those interviewed cited multiple examples where they thought space syntax would be useful and saw opportunities to use it, suggesting that there was an awareness of its possible benefits. A lack of key events which act as cues-to-action is one possible explanation for why American planners have not adopted space syntax (such as Trafalgar Square in the UK).

Rogers' next stage, the Decision stage, is another useful place to look for reasons why space syntax has not been more widely adopted. Rogers talks about the importance of being able to "try-out" an innovation before deciding to adopt it. This allows for the user to test other dimensions of the innovation's perceived attributes, most notably its relative advantage, complexity, trialability and compatibility. All of those interviewed expressed a sense of value and advantage to using space syntax over current methods. One senior urban designer mentioned how he "wished he could use it on all [my] projects" and another spoke about its usefulness in defeating criticisms raised by other forms of quantitative analysis such as traffic modeling. Complexity and trialability, however, were reported to be significant issues by those interviewed. Although there are several free and open source space syntax application on the web, space syntax analysis and software nonetheless remains complex to learn and apply. Space syntax techniques also require substantial theoretical background to interpret and apply correctly. This combination puts up a barrier to casual experimentation and demands a steep learning curve – thus reducing the trailability of its application. Several interviewees emphasized this point, suggesting that they preferred hiring the relatively expensive services of the Space Syntax Limited consultancy as opposed to learning it themselves. This is likely one major reason that the innovation has not caught on in American New Urbanism.

The fourth and fifth phases of Rogers' model are called Implementation and Confirmation. If a user has decided that an innovation is worth adoption, they will then seek to implement it in their own lives and evaluate its "compatibility" with their goals and values. It is in Rogers' discussion of compatibility where Weiss and Bucuvalas' work becomes useful and adds a critical dimension to this analysis.⁴ When evaluating the perceived usefulness and stated adoption preference of new research, Weiss and Bucuvalas found that there was a tension between innovations that offered actionable suggestions and simultaneously challenged the status quo. They found that innovative studies in mental health research were report to be more likely to be used if they were high on the scale of either actionable suggestions or challenge to the status quo. Weiss and Bucuvalas'

subjects appeared to indicate a distrust of studies that were both. Perhaps this was because such studies represented "too much change, too quickly" or required the adoption of too much risk. This is an important distinction. Although the philosophical intentions of space syntax and progressive design movements in America such as New Urbanism may be similar (understanding the dynamics of successful urbanism, creation of walkable neighborhoods and human scaled development, etc.), the actual practice of evidence-based design presents a significant challenge to the status quo of current design practice. In most urban design and architectural practice, "artist's vision" is privileged over almost any other form of thinking. The ability to produce a visually exciting rendering or a compelling printed image is often considered sufficient amongst designers for its implementation. cursory analysis or no analysis at all is often acceptable, as long as the final product looks convincing.

This is very different then the evidence-based design approach advocated by space syntax. Similar to many other forms of peer-reviewed science, evidence-based design assigns varying degrees of validity to a hypothesis, depending on how that hypothesis was generated and what evidence is used to support it. Different pieces of evidence are also given different levels of validity depending on how they are collected. In an article on evidence-based design Stonor and Stutz write,

"The findings of a single primary research study are considered to be less reliable than those substantiated by a systematic review of a number of primary research studies. As for primary research, randomized experiments (where participants are randomly placed in a control group and given placebo measures) are preferable to quasi-experiments (where membership in the control group is not random). However, evidence from any kind of experiment takes precedence over observation, and observation takes precedence over personal experience, not to mention rigorous, peer-reviewed analysis and argumentation." (Stonor and Stutz, 2005)

Anyone trained in the social or physical sciences is likely to recognize the rules of evidence outlined above. Such an approach is strange to the architecture and design world, however, where an attractive image combined with strong conviction is often enough to get a good grade or to sell projects to clients. Lawson believes that this is due the structure of design education, which emphasizes visual display over analytical reasoning (Lawson, 1990). Salingaros goes further, arguing that such an attitude is intentionally reproduced by an architectural elites seeking to maintain their exclusive social and political positions as "starchitects" (Salingaros, 2004).

The result is that many American designers and planners, including the New Urbanists, are hostile to such an approach. Several of those interviewed related stories where planners reacted defensively or felt threatened when confronted with the evidence-based design process. Coming back to Weiss and Bucuvalas, space syntax clearly represents a "challenge to the status-quo" of American urban practice, even though their approaches are philosophically aligned. Weiss and Bucuvalas argue that this would not be such an obstacle, however, if it were not also coupled with specific action-oriented recommendations for change. Several of those interviewed emphasized that that the adoption of space syntax and other evidence-based techniques would require a change in the architect or designers' technical approach to urban design. One example given was the use of the 5-minute walking buffer. The use of this approach, more graphical than analytical, is widely considered sufficient for creating walkable neighborhoods by many contemporary urbanists interested in walkable form. Space syntax techniques reveal that simply placing a dot on a map and drawing a 400 meter buffer around it is insufficient to produce walkable conditions however – conditions which rely upon a wide variety of other factors. Acknowledging space syntax's validity would render the five minute buffer technique obsolete, removing a quick and easy tool of analysis in common use by American designers and requiring a more complex, nuanced analysis to take its place. This is a clear example of action oriented change similar to the kind outlined by Weiss and Bucuvalas.

The result is that although space syntax may meet the "truth tests" of Weiss and Bucavalas, it is likely to fail the "utility test" simply because it requires the adoption of both a new culture of evidence-based decision making and the use of a tool set then those with which they are already

familiar. Thus while the interview data suggests that three of Rogers' five stages of innovation adoption may have been met, it is the fourth stage where American design practitioners may encounter the most resistance.

These findings parallel those in other literatures, particularly that on the use and adoption of Planning Support Systems (PSS) (Batty, 2003; Klosterman, 2001; Brail and Klosterman (2001). In a survey of 96 planning professionals, Vonk et al. (2005), found that the top five most important issues blocking the accepting of PSS's were 1), lack of experience with the tool in an organizational setting, 2) poor user friendliness of the system, 3) lack of awareness of the system's potential, 4) overly complex or elaborate data requirements and 5) lack of access to the system itself. Brail and Klosterman (2001) also remind us of the political history urban modeling. They point out that the hopeful early days of urban modeling gave way to pessimism about such approaches in the 1970's as many models were over-promised and under-delivered. Brewer (1973) relates the sense of cynicism and distrust which resulted from these early failures; a sense of distrust which may continue to this day (Batty, 2003). All of the interview subjects expressed views which were consistent with these findings and offer additional evidence of support.

6. Conclusion - Opportunities for improvement

This paper presented social and technical barriers to the adoption of space syntax amongst American planning and design professionals, derived from a series of interviews exploring this question. It then compared these findings against two theoretical frameworks of innovation adoption offered by Rogers and refined by Weiss and Buchalvis. It argued that this combination of new ways of thinking and new techniques for action are the most significant barrier to the adoption of space syntax approaches in American urban design practitioners. The paper then argued that these frameworks offered useful context for the themes raised in the interviews and that these findings paralleled those found in other PSS literatures. Even though American urbanists may be aware of space syntax (the Knowledge stage) and convinced of its value (the Persuasion stage), most fail to take it past the Decision phase to Implementation and Confirmation because of the cognitive challenges described by Weiss and Bucuvalas in their model. This is compounded by the technical difficulties outlined by the interviewees. Put more pragmatically by one of the interviewees (in reference to New Urbanism in particular), "New Urbanists are too busy hustling their own game to learn about or pay for a new one. Although they might believe in it, it's just too complicated and challenging for them to actually take it on board."

Several strategies could be employed that would enhance the value and acceptability of spaces syntax. First, a more robust ability to read and write Shapefiles would have an important impact on the uptake of space syntax related concepts. Second, decoupling the processing engine from the user interface and creating an open source API with customizable UI's for every major CAD and GIS package would eliminate the need to learn new software and build upon existing skills. Significant improvements could also be made to the process of analysis through the use of semi-automated routines custom tailored to basic analytical tasks. Such tasks might include design relevant outputs such as "identify local centers", "identify route hierarchies", "locate isolated areas", etc. These would help to leverage the basic insights of space syntax in commonly understood design terms, thus reducing the need for complex jargon or sophisticated statistics. The issue of the axial line as spatial representation is somewhat more difficult, although progress has been made using road centerlines in place of axial lines (Dalton et al., 2003; Turner, 2005, 2007). Assuming that there are not special features of axial maps that cannot be reproduced through other representations, the use of road centerlines could be an appropriate solution. This depends on the scale of the analysis needed, however (regional, citywide, neighborhood, or public place). Where not feasible to use road center lines, automated axial line generation algorithms exist for computing small systems or, worst case scenario, a more simplified explanation of what axial lines are and how to draw them would be an improvement. With regards to the social barriers mentioned, it would helpful to create online case studies and training courses that would support the dissemination of research and project work in a friendlier format, allowing those interested in learning more to do so without having to become experts in the technical literature. A rigorous academic comparison of space syntax against other forms of urban form metrics would also help.

The main strength of space syntax is its ability to measure design relevant variations in layout and street configuration at the master planning (neighborhood) level, in disaggregate detail. Focusing on this issue and exploring how it related to other interesting outcome variables (such as rent and property values) (Rickard and Netzel, 2008; Mathews and Turnbull, 2007), would focus on its strengths and help avoid competition. Finally, it is important that space syntax become integrated into a more deliberative, participatory simulation approach. Developing native support for common packages such as CommunityViz and INDEX would be a useful step towards this goal.

A closing note on space syntax and agent based models (ABM). Space syntax is essentially a series of rules for representing space and understanding how people navigate these relationships. In this respect these rules can (and have) be embedded in spatially aware agents to simulate the movement of pedestrians in urban environments (Turner and Penn, 2002). Space syntax is fundamentally a model of spatial relationships however, and it is only because people use these relationships to navigate urban space that it correlates with pedestrian movement. As a statistical model it is relatively simple and robust, allowing for quick analysis of a range of cases and outcomes. But it is fundamentally static and falls short of many of the advantages that ABM provides, particularly dynamic activity over time, complex agent interaction, goal following, social learning, and emergent behavior (Manson, 2006; Miller and Page, 2007; Epstein, 2006; Gimblet, 2002; Batty and Jiang, 1999). As a research tool, the integration of space syntax with agent-based approaches is surely one of the most promising directions for future research, not just a means to better simulate pedestrian movement, but as a more flexible way for exploring the role of space and accessibility in a variety of dynamic processes such as land use change, urban transportation, shopping, crime, and other forms of social behavior.

Notes

- 1 One researcher remarked on the Space Syntax Mailbase, "if geographers spent as much time defining road centre lines [as the space syntax community spends debating axial lines], we'd never have a single map of anything."
- 2 This was the case despite the fact that the majority of respondents also acknowledged that this complexity was one of the strengths of space syntax as well.
- 3 Hank Dittmar, the current CEO of the Prince's Foundation for the Built Environment, is also the Chair of the Congress for the New Urbanism.
- 4 In his use of the word "compatibility" Rogers means compatibility with existing norms and values

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