Embedded Intelligent Empathy: A Systematic Review Towards a Conceptual Framework

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Abstract. This paper is part of a feasibility project aiming to expand computational design processes to include design empathy. The project is in response to recent valid criticism of computational design overlooking the empathy of the designer. Computational design has a heavier emphasis on the optimization process, inhibiting designers' rational and empathic input. This preliminary phase of the study aims to provoke debates through a systematic literature review (SLR) and hypothesize that empathy could be systematically integrated into computational design rather than disjointed processes. The SLR identifies gaps in knowledge in this transdisciplinary domain. Found current research suggests that technology can abstract and quantify ephemeral design qualities such as soundscape design to generate rich, intelligent designs. To achieve this, we will establish a list of indices/indicators found in literature, as a data set embedded into an algorithm that derives a computational tool.

Keywords: Designer's empathy · Computational design · Soundscape

1 Introduction

Design is a complex problem-solving process that involves high contextual interdependence requirements. In the past two decades, the advancement in generative decision-aiding tools has facilitated the design process to solve complex design problems. However, one of the critical challenges of this methodology is designing spaces and products that trigger emotional connections resulting from the designers' capacity to empathize with the users' potential needs.

This paper aims to realize the central hypothesis of a feasibility project that considers the development of computational algorithms that can create empathetic links with humans and generate designs that trigger emotional connections is possible. By investigating the current state of knowledge and revealing research gaps through a Systematic Literature Review (SLR) to explore if it is possible to embed empathy in computational design systematically? To that end, the objectives of this paper are to 1) identify the extent to which the answer to the research question can be found in the current literature, 2) fine-tune and adjust our hypothesis based on the data avail-able relevant to the topic, and 3) collate relevant evidence from a pre-specified database.

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The ultimate goal is to develop a computational tool to embed ephemeral design qualities into computational methods built on a developed theory that can potentially impact practice.

1.1 Design and Science

During the 20th century, design considerations moved from a craft-oriented phenomenon to an emphasized '*scientized'* design [1], a design process based on objectivity and rationality. In the 1960s, Buckminster Fuller proposed "*radical thinking about the future,"* where he claimed that comprehensive design-science innovations are vital for a utopian future [2]. By the mid-20th century, objectivity had already become an inextricable part of the design, regarded as a field of enquiry with its terms, and is independent yet interlinked with science. The "*design methods movement"* aimed to strengthen the basis of the design process on objectivity and rationality. This movement supported developing a robust and scientifically ground-ed design methodology that can establish the design process as discreet steps with a specific goal.

During the 1980s, the Design Research Society conference proposed that it was time for design to stop learning vicariously from science and perhaps vice versa [3]. There remains confusion regarding the de-sign/science relationship and divided opinions on whether it is a scientific or a non-scientific domain. However, there is a consensus that design could be the subject of scientific investigation, making the process of design a scientific activity (i.e., systematic, reliable investigation).

1.2 Empathy in Design and Interrelationship Between Subjectivity and Objectivity

Design is a discipline with its own rigorous culture distinguishing it from sciences and the arts and humanities due to its empathic values. Science values are often subjective and rational, and art values are subjective and imaginative, where the field of design is concerned with the importance of appropriating empathy in practice. Devecchi and Guerrini [4] characterize Design Empathy as a qualitative human relationship model (i.e., intersubjective model) that is needed to establish an empathic conditions experience. Although many scholars have written about empathy in design, it remains challenging due to its complex and subjective nature. Design practitioners and researchers have extensively explored the links between design solutions and empathy [5], which occurred in tandem with the development and prefiltration of Computational design practices. It can be argued that these two design paradigms have grown apart.

"A computational approach enables specific data to be realized out of initial abstraction – in the form of codes which encapsulate values and actions" [6] to solve complex problems that would have been arguably impossible using conventional design methods. The design community has long criticized such generative design processes due to algorithmic thinking dominance over the designer's empathy. A large body of research focuses on incorporating design parameters that can be easily measured and processed through computer optimization and simulations. There is a gap in research focusing on more subjective and less tangible values of design. Although the analogy of swarm behavior and the study of social logics [7] was a tipping point into computational

design research and human-centric architecture, empathic, emotional and experiential values have not been tested within the computational framework potentially due to their perceived unquantifiable characteristics.

Current research aims to quantify ephemeral soundscape qualities that create rich designs and incorporate them into an intelligent system [8]. Accordingly, this project identifies Soundscape design as a suitable testbed of ephemeral design qualities. The ISO [9] defines Soundscape as "*sound at the receiver from all sound sources as modified by the environment [namely acoustic environment] as perceived or experienced and/or understood by a person or people, in context.*"

This project argues that empathy could be more systematically integrated into computational design than a disjointed process. To that end, this paper presents an SLR to develop a robust theoretical framework on the role of empathy in computational design.

2 Literature Review (SLR)

This Systematic Literature Review (SLR) explores epistemological paths of implementing empathy in design. SLR was initially introduced in the medical field to encourage evidence-based knowledge development [10] and has been adopted by other fields, e.g., the management sciences [11] and information systems research [12]. This paper adopts the Preferred Reporting Items (PRISMA) flow to generate a systematic review plan as part of the protocol and establish inclusion criteria. Here, the SLR data provides a systematic flow towards answering the research question that is narrowed to Soundscape design, a testbed or rather a case study to consider the empathy-oriented design. Accordingly, the identified inclusion criteria of this SLR is grounded in three distinct yet interrelated topics, i.e. Computation, Empathy, and Soundscape.

To ensure that only the highest quality academic literature is part of this study, multiple online databases, including Scopus, IEEE Xplore, google scholars, UWE library's database, and connectedpapers.com. Only peer-reviewed journal papers, reviews and books/book chapters in English were filtered in all searches. The search fields for the advanced research strategy were set to "Article title, Abstract, Keywords" unless otherwise stated, which means that selected research terms should be placed within the article's title, abstract or keywords to qualify for the screening. The initial identification phase using all three design fields (i.e., Empathy, Computation and Soundscape) could not yield a single study. Accordingly, each two research terms were considered independent of the third term (i.e., Empathy AND Computational design; Computational design AND Soundscape; Empathy AND Soundscape). The three search returns shown in Table 1 are referred to as Search 1, 2 and 3. Search 1 investigates literature relevant to Empathy and Computational design. Search 2 focuses on computational design and Soundscape, and Search 3 explores Empathy and Soundscape.

A variation of these terms was tested using the selected databases' advanced search option. Table 1 lists the search terms and interventions used in this study, namely 1) Empathy, Emotion, feeling, perception; 2) Computational design, generative design, Parametric Design, Design Algorithms; 3) Sonic, Aural, subjective, or Ephemeral.

The flow chart in Fig. 1 illustrates the returns from 9 different searches with 17 search terms, resulting in 112 documents in the first round of screening. Papers that

Table 1. Search terms and interventions

Search categories	Search terms and interventions
Search 1	Empath* OR Emotion* OR feeling OR perception AND "Computational design" OR "generative design" OR "Parametric Design" "Design Algorithms"
Search 2	"Computational design" OR "generative design" OR "Parametric Design" "Design Algorithms" AND Soundscape OR sound* OR ephemeral OR Aura* OR sonic*
Search 3	Empath* OR Emotion* OR feeling OR perception AND Soundscape OR sound* OR ephemeral OR Aura* OR sonic*

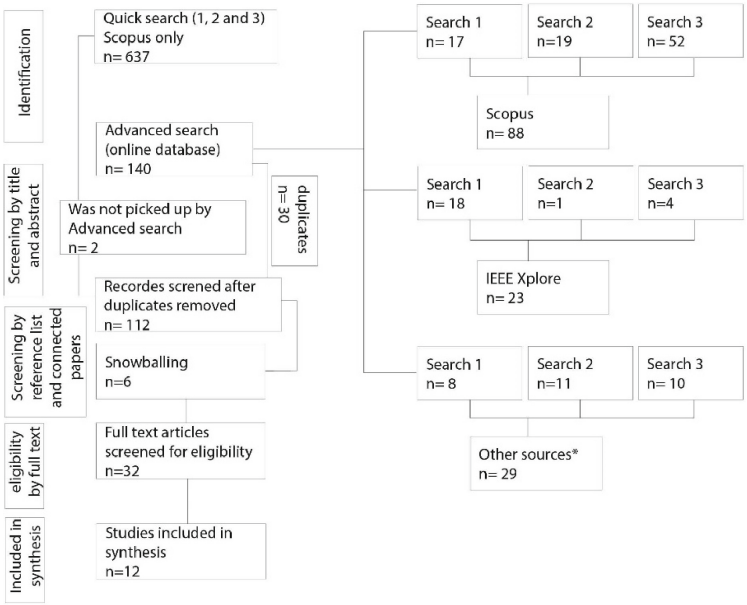

Fig. 1. Flow chart of the systematic review (adopted from PRISMA)

did not fit the conceptual framework and were outside this study's scope were excluded through screening by title and abstract. Further backwards and forwards snowballing using reference lists and citations[1] identified additional six papers. The full-text screening selection was decided based on 1) reviewing the abstract and conclusion and 2) screening conceptual frameworks and methodological approaches. Papers that did not fit into the conceptual framework were excluded, and 12 papers were included in the final synthesized set.

[1] By systematically looking at where papers have been published and what they have referenced. Also, where they have been cited in other papers. (Connectedpapers.com was proven to be the most effective for this stage of SLR).

2.1 Empathy in Design

Empathy was first introduced in the field of psychology and philosophy before its introduction to design practice. Within the design discipline, the implementation of empathy had not been a systematic operation. Theodor Lipps' [13] concept of empathy was rooted in the correlation between a cognitive subject and external objects' internal structure. A universally agreed definition and framework of "*Empathy in design"* could not be found in the literature. The discord is about the definition of empathy and the method of implementation in the design process. The scholars' point of agreement is that empathy is a quality of design and supports the process where the inseparable issues of rational and practicality issues are interwoven with personal experiences and private context. To design with empathy, a designer needs to "step into the other's shoes," which seems to be an analogy prevalent in literature.

Since its introduction in design, empathy has been regarded as a design skill that should be considered by designers [14]. Davis [15] views a designer's empathy through two dimensions: 1) affective and 2) cognitive empathy. Affective empathy can be an instinctive, mirrored experience through the designer's feeling of how others experience it [16]. It is a reactive emotional distress and sympathetic feeling for someone at their sight of distress. The cognitive dimension is the designer's understanding of how others experience the designed intervention [17]. Two scales of cognitive empathy being Perspective-Taking (i.e., assuming another's experience) and Fantasy (i.e., experience as a fictional character) [15].

2.2 Methods of Implementing Empathy

There is a variety of methods and tools for helping designers to approach empathy in design practices, such as user-centered design (UCD), human-centered design (HCD), participatory design (PD), and co-design (Co-D) [4]. Found studies look at Socially Responsible Design (SRD) and the inclusivity factor, which is different from empathy [14]. A large body of research develops HCD toolkits to gain empathy from communities to design according to their needs (e.g., IDEO toolkit 2009). Many of these techniques and toolkits rely on the Perspective-Taking skills from a designer's cognitive empathy. These methods are time-consuming and require many resources [5], highlighting the importance of qualitative research to inspire designers to create '*more useful and enjoyable'* products for potential users the de-signer might never meet.

Devecchi and Guerrini [4] determined empathy as the skill to design with another and accepting and acquainting their otherness. The intersubjective relationships are the tools and skills required to develop an empathic experience. The authors indicate that empathy values are intersubjective and sociable dialogue, suggesting a shift from "*design with empathy"* to "*design for empathic experience"*. It can be assumed that to design 'with' empathy, there is a need to devise tools to enable empathic experience conditions to occur [4]. Manzini [18] indicates that these missing tools can be seen as part of the design culture capable of catching a profound sense of sociality.

McDonagh-Philp and Denton [19] coined the term "*empathic horizon"*, which refers to the limitation of a designer's ability to empathies beyond specific characteristics outside their group boundaries such as age, nationality, culture, education and experience

[20]. Literature acknowledges that individuals have different "*emotional intelligent quotient"* at various levels. Indeed, Baron-Cohen and Wheelwright [21] refer to empathy as the measurable Emotional Quotient (EQ) factor that can be changed or improved through training and experience if individuals are willing to engage with empathic values. The ability (EQ) and the willing-ness both play an essential role in "*design empathy"* [22]. The designer's willingness, commitment, or/and claiming responsibility for the project can be based on the empathic horizon and connection with the potential users [20].

The tools and techniques developed in the literature support designers to "*step into the other's shoes"* and "*walk the user's walk"* to design products and spaces that fit the user's life. Various tools have successfully engaged communities through participatory sessions, and design toolkits have also made significant progress in HCD methods. These methods follow purely qualitative processes and heavily rely on individuals' perception.

2.3 Designing Human-Centric (Empathic) Spaces Through Computation

The introducing of computation design provoked new theoretical frameworks on the systemic design processes. August Schmarsaw's [13] concept of "*kinetic perception"* refers to movement through space as essential to gather sensorial experience. With the introduction of design algorithms in the 1960s, many tried to systematize architectural design, where algorithms automatically generated geometric patterns and form. Paul Coates and John Frazer's of the AA School of Architecture searched for space autonomy and developed self-organizing systems through algorithmic thinking. Christopher Alexander's [24] mathematical framework at Cambridge proposed objective representations of topological space, a theory of the process of design. He claims that a form is adapted to the context of human needs and demands the structure of the problem itself, which correspond to the adaptive process's subsystems [24]. Later, Frieder Nake [25] used a Markov chain matrix to generate emergent spatial aesthetics (e.g., a walking algorithm see Fig. 2). Schmarsow's theory, Alexander's mathematical model, and Frieder's algorithmic thinking are all proven conceptual frameworks. Derix and Izaki [26] claim that these frameworks were missing the fundamental definitions of systemic design, developed through computational systems, spatial cognition and spatial analysis.

During the 70s-90s, the interaction between the space and user extended beyond the machine-like closed system, arguing the environment is equally intelligent as the user. Towards the end of the 20th century, swarm intelligence and social animals models became an integral analogy for embedded intelligent design. During this period, space syntax theory was established by Bill Hillier and Julienne Hanson [27] at UCL, encompassing techniques for the analysis of spatial configuration to develop a systemic relation between society and space.

Rudolf Arnheim's [28] Perception of Environmental Form through Gestalt Theories followed a tandem strand of computation design rooted in spatial cognition's psychological aspects. Through physical interaction, Jean Piaget's spatial dimensions, Schmarsow's kinetic perception and Gibson ecological perception all rooted in the psychological theory of 'enaction'. Network analysis and graph theory have been adapted and applied to model spatial phenomena, such as Kevin Lynch's mental map simulation [26]. Juhani Pallasmaa [29], the Architectural theorist, in his essay "Empathic Imagination: Formal and Experiential Projections", refers to the embodied emotional experience as the true

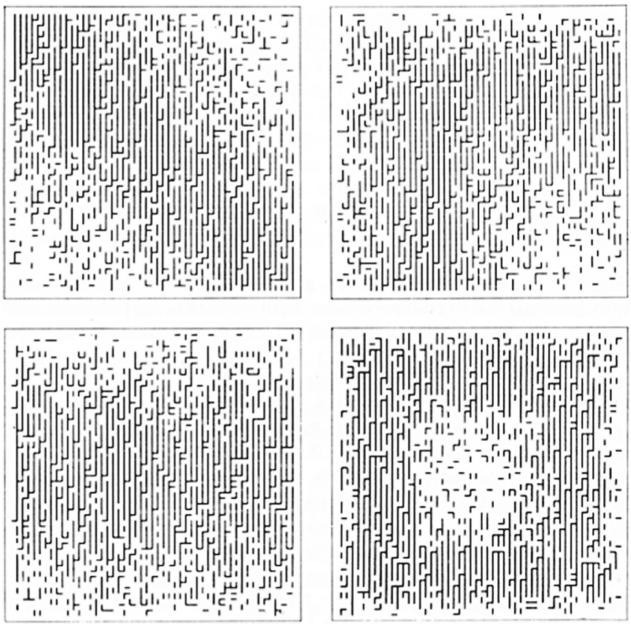

Fig. 2. Walk-Through-Raster, series 2.1, four realizations, 1966, plotter drawings [25].

quality of architectural space. The association between spatiality and experience can generate phenomenological descriptors that define feelings towards space. These preceptive attributes from spatial phenomena lead to design methodology, which, according to Derix and Izaki [26], is vital for evaluating human-centric computational design.

2.4 Design-Machine

Cross [30] claimed that designing with computers could have an adverse effect, but the apparent benefit was the speed at which a decision is made. He [31] continued to question the use of computers in design and conducted a reverse experiment of the 'Turning Test' to search for understanding limitations and requirements (at the time) for future computer-aided systems, entitled "*Can a Machine Design"*. The experiment used human participants (designers/architects) to simulate the way computers are used to design. A team of architects and engineers attempted to answer design questions posed by other participant designers in a separate room who were given a small brief to produce a sketch concept. The participants could ask questions using cards and closed-circuit TV cameras and receive answers. Ten similar experiments were carried out in search of potential emergent systemic behavioral patterns. According to the brief, the designer participants and the helping team's messages were recorded and classified into themes and topics. The data gathering method helped establish the designer's pattern of activity.

One of the surprising conclusions made was that the human-machine interaction produced the least desirable result compared to un-aided human or fully automated

designs. Another argument that emerged was the question, "*can a machine make an aesthetic judgement*". A set of implicit rules of aesthetic judgment that establish a 'bad' design instead of constructing aesthetically 'good' design rules was devised. The rules to evaluate the design and define the 'bad' elements were collected from experts' comments. The conclusion was that a set of simple rules embedded in a system was an effective way to help designers create better designs. Perhaps a more surprising observation was that human experts were inconsistent in applying their 'own' rules. A machine could do/or could help with aspects that are regarded as uniquely human attributes (i.e., making aesthetic judgment) more consistently than the human experts.

While scholars critically questioned the use of the machine, the works of MIT's Architecture Machine Group Cedrick Price (Nicholas Negroponte, Cedric Price, and Christopher Alexander) imposed two questions: 1) whether the designer is a consultant or the author; and 2) if the computer is a tool or the designer. The authorless design was being explored as algorithmic thinking emerged from self-organizing systems of forms. As Coates argued in 1966 "*architects […] to be systems designers [and] think algorithmically to be able to propose algorithms to a computer in order to develop their thoughts by observing the outcome*" [32]. The argument is that the designer oversees and observes the outcomes. Therefore, the designer's autonomy is intact, but the outcome is not under the designer's authority, expanding the authorship question. It can be argued that to protect the design's autonomy in controlled conditions, the solutions to the same design problem must be isomorphic. An algorithm can control the condition by embedding the rules into a system design rooted in sensorial experiences and structural isomorphism. Thus, the solutions to the same design problem are isomorphic, but the design outputs are not necessarily identical.

No universally agreed answer to the question of the machine's or the designer's role can be found in the literature. It appears that the lack of clarity on these answers has hampered the process of empathic design through computational methods.

2.5 Soundscape as a Testbed

Soundscape design is the field that considers the human response to the sonic environment that is among the major contributing factors of people's perceptual experience of places. Since this research aims to examine data-driven empathy, Soundscape is a good candidate to be a testbed to investigate the concept of intelligent empathy in design.

The Handbook for Acoustic Ecology defines 'soundscape' as "*an environment of sound or sonic environment with an emphasis on how it is perceived and understood by the individual, or by a society*" [33]. In the 2010s, soundscape design evolved as an interdisciplinary field, where the majority of research agrees on the emphasis on perception and interpretation of the society or individuals [34, 35]. Several scholars have attempted to model soundscape perception to identify the sonic environment ephemeral dimensional attributes [8, 36, 37]. Earlier studies tested a limited number of soundscapes and perceptual attributes, finding that preference and pleasantness were the Soundscape's primary characterizations. Some of the later studies added activity and variability as secondary dimensions [38, 39, 40].

Axelsson, Nilsson and Berglund [36] tested a comprehensive set of soundscape excerpts to derive an empirical model of Soundscape based on a large set of descriptive

perceptual attributes (e.g., pleasant, calm, eventful, annoying). The study investigated the relationship between perceptual dimensions and physical soundscape properties. Fifty soundscape recordings of ten different locations (urban courtyards, urban motorways, schoolyards, suburban parks, and residential areas), and technological sounds (car alarms, airplane). Three members of the research team independently listened to all fifty excerpts to assess the dominance of either natural, technological and human sound in each of these recordings. Listeners were asked to score these binaural recordings of urban outdoor Soundscape against the 116 characteristics that deemed appropriate soundscape perception attributes. These attributes were selected from a more extensive list of adjectives (n = 189) obtained from an earlier study [41], indicating primary attributes determinants of aesthetic appeals of photographs. Axelsson, Nilsson and Berglund [36] found that the urban outdoor soundscapes are represented by two principal components (un)pleasantness and (un)eventfulness. Their result corresponded with Russell's circumplex model of effect devised based on emotions and environmental psychology [42, 43, 44].

Soundscapes dominated by human sounds (like children playing) were more eventful. Natural sounds where more pleasant, and soundscapes dominated by technological sounds were found to be generally unpleasant - acknowledging that unpleasant natural sounds or pleasant technological sounds probably exist. Cain, Jennings and Poxon [37] used five semantic descriptors from a list of emotional soundscape dimensions. The list of different soundscape dimensions came from three different sources obtained by earlier studies. 1) A lab-based experiments extracting 25 listeners' emotional responses to 6 soundscape recordings. 2) The data source came from sound-walk transcripts from 5 different locations, emphasizing the urban Soundscape description concerning the location and context. 3) The source came from many responses to the question "*what is your favorite sound and why"*.

As a result of a multidisciplinary conversation, five emotional dimensions and their relative semantic descriptors were shortlisted and used in two experiments. In the first experiment, participants listened to 8 different binaural soundscapes recordings and were asked to use semantic descriptors from the five identified dimensions to describe their feelings towards the soundscapes. For each response, the participants would score the recording with the associated descriptor using an SD rating scale of 1–9. The second experiment was set up similar to experiment 1 with different recordings but representative of similar urban settings. Half of the jurors were presented with images of the context while listening to the soundscape recordings (experiment 2A). The other half listened to the audio-only (2B).

After conducting a Principal Component Analysis (Varimax rotation) on rating data, two factors were underlying the five identified semantic descriptors. The two principal dimensions explaining 80% of the variability amongst the original five dimensions were Calmness and Vibrancy. Although the two principal components were referred to as calm and vibrancy, the full semantic descriptors should be used to describe emotions accurately. Therefore dimension 1 (Calmness) also include adjectives such as Relaxation, Comfort and reassurance and intrusiveness. Moreover, Dimension 2 (vibrancy) can refer to arousal. The study concluded that most of the emotional soundscape dimensions could be plotted in a 2-D perceptual space. It is worth noting that different emotional responses

from different demographic groups can be a significant factor in defining soundscape perceptions which were not mainly cover in Cain et al. [14]. The study claimed that although Soundscape's emotional component analysis is a qualitative evaluation of the Soundscape, there is a need for quantitative measurements of the sound to be included in the analyses.

Another point that is particularly useful for the study of intelligent empathy was the impact of Soundscape's emotional dimensions and the significant impact on people perceiving a space. An earlier study by Axelsson [41] looked at measuring another aspect of human perception. That is to analyze the aesthetic appeals of photographs. He used MDS through two interlinked experiments. One experiment was a large group of participants assorting Photograph into groups of similar aesthetic appeal. The participant then scaled each photograph based on a scale from zero to 10, indicating the photographs' aesthetic appeal. Attributes with scale were obtained from an experiment I based on a subset of photographs and the MDS method. The resulting attributes with scales were used in Experiment II to explore the reason for the similarity in photographs' aesthetic appeal by analyzing the relationship between the attribute's scales and MDS dimensions [36].

Experiment I included three phases of data collection, sorting scaling an interview; each phase was conducted individually for each participant. There were no time limitations, generally taking two to three hours. 189 attributes were obtained from 564 photographs. The 50 photographs were analyzed through MDS and used as stimuli for EXP II. Exp 2 used these 50 photographs with scales to determine dimensions underlying similarity in aesthetic appeal. Experiment II included 100 participants. Ten different participants assessed each scored five photographs out of the 50 batches, meaning each photograph. The scaling was based on 168 attributes (141 improved sets of attributes + 20% repeated for validation [141 + 27 = 168]). As a result, six principal components were identified to explain all the attribute scales. These components included Hedonic Tone, Expressiveness, playfulness, Amusingness, Eroticism and the six components was not possible to identify at first (after oblique rotation component 6 was identified as familiarity). Hedonic tone and familiarity were the two strongest predictors of the first MDS dimension.

The combined outcome of two interlinked experiments predicted two MDS dimensions (EXP I) and the photographs' average appeal value (Exp I). Three MDS dimensions underlying similarities in photographs' aesthetic appeal were Hedonic tone – Familiarity, absence of color, and expressiveness-Dynamics. Axelsson, Nilsson and Berglund's [36, 37, 41] work is a valuable framework for identifying the necessary attributes that affect soundscape perception. The Soundscape model that emerged from these studies can be used to measure soundscape design for the current project.

Many studies that investigated subjective qualities in search of measuring human perceptual dimension used MDS method. Kerrick et al. [45], Gabrielsson and Sjögren [46], and Bjork [47] used semantic differential scaling to scale perceptual ephemera such as sounds. Cain et al. [37] deployed semantic differential (SD) rating scales (developed by Osgood [48]) to establish emotional dimensions of a soundscape using principal component analysis. Other studies used both techniques (MDS and SD) to identify human psychological dimensions, such as visual perception. However, there is no direct

translation from these ephemeral values methods into computational and algorithmic thinking.

3 Conclusions

Designing objects and spaces with the awareness of user behavior and spatial organization has been an essential aspect of design over the past few decades. In recent years computational platforms have enabled designers and architects to create complex forms and architectural spaces. The vast pool of data-enabled design techniques through computational plug-ins means that architects and designers can systematize the design solutions based on the objectives embedded in plug-ins. Computational tools assist designers with structural integrity, spatial configurations, environmental simulations, and more. However, there is no such mechanism to internalize users' experience or create an emotional understanding of the designers.

The interplay between psychology, art theory and computational design is arguably a promising crossroad in creating a future generation of empathic, intelligent spaces. The potential for implementing empathy in computational design requires a reasonable degree of understanding perceptual frameworks within a psychological context. To improve an empathic design process, Kouprie and Visser [20] suggested a psychological framework. They reviewed the definition of empathy within the psychology discipline in the search for further support for the empathic design process.

The SLR presented in this paper reveals specific points that limit conventional methods of designing with empathy. This paper is the initial phased of a project built on the argument that design limitations can be resolved through systematic, algorithmic thinking (i.e., computational design) by quantifying qualitative design values. The project asserts that empathic values can be facilitated or better structured using computational platforms, similar to experience and training. Such a platform can converge a logical nexus into a unique generative process that stimulates designers' ability and willingness to design according to a user's emotions but improving the EQ.

Computational design literature shows the fast development and pervasiveness of the field during the past 20 years. However, the SLR presented in this paper identified a scarcity of research in systematically embedding the user's empathy in the design methodology. In searching for the interconnectedness of the topics and a link (if any), the paper only identified early studies of computational design that are contemporary to when empathy in design was introduced. The SLR indicates that it seems that both methodologies bifurcated early during the end of the 20th century. It also seems that there is a very recent renewed interest in returning computational design to include the ephemeral aspects of design.

This paper aims to open up the discussion amongst peers and canvas more connections that may have yet been published through dissemination and discourse.

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