The indirect experience of nature: biomorphic design forms in servicescapes

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Abstract

Purpose – This paper aims to introduce the concept of biomorphism (i.e. indirect experience of nature) in servicescape designs and validates its impact on consumer responses. Using the stimulus-organism-response (S-O-R) framework, this study explores the relationship between biomorphic servicescape designs and the servicescape preference. Further, it explains how biomorphic designs can help users to get better connected with the servicescapes by introducing the mediating role of attention restoration and place identity (emotional and cognitive), as explained by attention restoration theory.

Design/methodology/approach – Two empirical studies were carried out to test the hypothesised relationships: an exploratory pre-experimental design with one-shot treatment using 200 images as stimuli and 3,680 responses; and a 3 x 2 factorial design with three-dimensional images with about 654 responses for three service contexts chosen a priori: fashion retail, restaurant and hospital lobby.

Findings – This study conceptualises the role of biomorphism – elements that mimic natural forms – in servicescape designs and establishes that, akin to natural elements, the indirect experience of nature in servicescapes also has a positive influence on attention restoration, perceived place identity and servicescape preference of the consumers. This implies that the effects similar to that of a biophilic servicescape can be achieved through servicescape elements that mimic natural forms.

Originality/value – Extending the idea of biophilia, this research adopts the concept of biomorphism from architecture and environmental psychology domains and introduces biomorphic servicescape designs, which could be more practical at times compared to biophilic servicescapes. It establishes the influences of biomorphic servicescape designs on consumer preferences. Grounded in the S-O-R model, it further explains this relationship through mediating effects of attention restoration and place identity. Being new to marketing and management domains, this research may trigger a series of research studies on biomorphic service environment designs, with desirable implications for services marketing and services operations functions.

Keywords Retail, Atmospherics, Experimental design, Servicescape, Behavioural insight, Service environments, Biomorphism, Attention restoration theory, Place identity, S-O-R model

Paper type Research paper

Introduction

Service delivery environment or a servicescape (Bitner, 1992), which plays a crucial role in the services marketing mix, is gaining increased attention in services marketing studies. Servicescape designs can be strategically used by businesses to create a favourable impression on the customers to improve their consumption experience (Yu et al., 2015), to develop their service preference and to generate their loyalty (Eroglu and Michel, 2018; Rosenbaum et al., 2017). For instance, the recently opened Microsoft store in London is designed to combine retail, entertainment and education services, whereby making it more experiential for customers (Wong, 2019). As a marketing action concerning physical evidence and service retailing, designing a suitable servicescape has become a critical activity. Consequently, many studies have explored the role of various design and aesthetic aspects of servicescapes, such as colour (Bellizzi and Hite, 1992; Tantanatewin and Inkarojrit, 2016), music (Biswas et al., 2019; Morin et al., 2007), lighting (Biswas et al., 2017; Summers and Hebert, 2001), layout and design (Ang et al., 1997; Bäckström and Johansson, 2017), ambient scent (Mazharov et al., 2015; Spangenberg et al., 2006), interior design and personality (Orth et al., 2012), holistic aesthetics (Kumar et al., 2017; Lin, 2016) on generating desired consumer responses, such as connecting with their self-image (Breazeale and Ponder, 2013), service preference (Kumar et al., 2017), approach/avoidance behaviour (Bitner, 1992) and enhancing social support (Rosenbaum, 2008).

Despite several research studies focusing on the aesthetic aspects of servicescape designs, not much work has been done...
on exploring the overall character or identity reflected by the service environment in marketing literature. Place identity is an important concept well explored in landscape architecture and environmental psychology literature and can also be applied to servicescapes. Several companies have focussed on developing a specific character to provide a sense of the place to its customer groups by designing thematic service environments (Palmer, 2019). It is important to recognise that geographical spaces quite often contribute to a social bonding that accounts for community formation. As a place visited by customers, servicescapes can generate favourable consumer attachment with it (Brocato et al., 2015), which may lead to emotional bonding (Waxman, 2006). This attachment further tunes consumers’ service expectations and satisfaction with service experiences (Nilsson and Ballantyne, 2014). Customers often try to match themselves with the character of a place that they visit, which is referred to as place identity (Rosenbaum and Montoya, 2007). This sense of place developed through place identity results in favourable place attachment with servicescapes (Lalli, 1992). Such attachments can also foster long-lasting relationships with the customer (Brocato et al., 2015). Particularly in the light of increased competition from e-retailing and similar online shopping modes (Biswas et al., 2019), developing place attachment may become quite pivotal for customer retention. However, Eroglu and Michel (2018) suggest that overemphasis on place attachment can lead to undesirable consequences of patronage avoidance. So, a clear understanding of how servicescape designs can generate a desirable place identity is of supreme importance for marketers.

Similarly, yet another aspect of servicescape as the place of service delivery is attention restoration among consumers (Rosenbaum et al., 2016). While some customers look forward to exploring servicescapes for elevating their mood states (“retail therapy”), whenever they are under stress (Rick et al., 2014) this, coupled with attention fatigue, can result in avoidance behaviours (Purani and Kumar, 2018). Further, dull servicescapes can induce boredom in customers, causing service usage avoidance (Dennis, 2018). This impact would be more pronounced for certain servicescapes, which are emotionally demanding, such as hospitals (Berry et al., 2015). Fatigued attention can inhibit a person’s ability to filter out other external distractions (Emfield and Neider, 2014), thus generating a poor service experience. Many studies have explored attention restoration along with stress recovery (Mirkia, 2018; Purani and Kumar, 2018; van den Bogerd et al., 2018). Stress recovery theory (SRT) explains how contact with nature reduces the psychophysiological stress level of individuals (Ulrich et al., 1991); while attention restoration theory (ART) focusses on the cognitive benefits of attention restoration while interacting with nature (Kaplan, 1995). The idea of ART revolves around directed attention – the ability of an individual to focus on an object or environment effortlessly by blocking external distractions – which gets fatigued by intense usage (Joye and Dewitte, 2018). Exposure to natural environments will help individuals not only to restore their attention but also to help concentrate and relax and make the environment more enjoyable, which leads to preference (Kaplan and Berman, 2010; Kaplan and Kaplan, 1989). Attention restoration, thus, becomes important while designing servicescapes. Yet, the full potential of servicescape designs in enhancing attention restoration of users is underappreciated in the studies.

With increasing efforts in green marketing, bringing elements of nature to service environments is becoming popular among marketers and interior designers. Such biophilic servicescape designs can provide a different character to the service environment. These biophilic elements include greenery, water, natural finishes, ambient lighting conditions or a combination of these. For instance, Timberland added different design elements such as rain room and greenery to enhance their customers’ experience in the store servicescape (Tiffany, 2018). Arguably, several servicescape studies have attempted to explore the role of natural or biophilic elements on place identity and restoration (Brengman et al., 2012; Ortegón-Cortázár and Royo-Vela, 2019; Rosenbaum et al., 2016; Rosenbaum et al., 2018). However, an increase in urbanisation across the world has resulted in inhibiting humans’ innate tendencies to connect directly with nature (Joye, 2006). So, bringing biophilic features (such as greenery or natural lighting) may not be actionable for all servicescape types owing to space and layout constraints, cost considerations and strategic positioning issues. Hence, any alternative design features that can trigger similar responses could be of great use to marketers. Researchers in environmental psychology and architecture (Joye, 2006, 2007; Mirkia, 2018) have explored an alternative approach to using the indirect effect of nature – biomorphism. Biomorphic design forms resemble organic shapes and forms (Joye, 2006) and can generate similar psychological responses in viewers, like that of biophilic ones (Joye, 2007; Mirkia, 2018). Although the concept of biomorphism is explored in domains such as environmental psychology and architecture, it has not yet been introduced to the marketing domain.

Grounded in the stimulus-organism-response (S-O-R) framework (Mehrabian and Russell, 1974), this study introduces the idea of biomorphism as a design approach to service marketers and argues that biomorphic servicescape designs can help marketers in enhancing place identity and attention restoration of the servicescapes, leading to a servicescape preference.

Conceptual background and hypotheses development

According to Bitner’s (1992) servicescape model, the design aspects of a servicescape presented as space function, sign, symbols and artefacts influence the internal responses and behaviours of both customers and employees. Subsequently, many researchers have explored the influence of different servicescape design aspects on consumer responses, such as the impact of colours (Bellizzi and Hite, 1992; Roschak et al., 2017), lighting (Reynolds-McInnay et al., 2017; Van Oel and van den Berkhof, 2013), shapes and layouts (Varlander and Yakhlef, 2006; Liu et al., 2018), crowding (Machleit et al., 1994) and artefacts (Rafaeli and Vilnai-Yavetz, 2004; Wechsler and Schweitzer, 2019). Another set of empirical studies focussed on holistic aesthetics variables in servicescapes, such as complexity, coherence, legibility, mystery and novelty on preference (Kumar et al., 2017); design complexity and novelty on loyalty (Murray et al., 2017); contextual complexity on the customers’ package designs evaluation in a retail space (Orth
behind the attention restoration effects of servicescapes. Table 1 summarises the works related to restorative effects and place identity in services marketing studies. As can be seen from Table 1, attention restoration theory has been a widely applied theoretical framework in many studies (Rosenbaum, 2009; Rosenbaum and Massiah, 2011; Rosenbaum and Smallwood, 2011; Rosenbaum and Wong, 2015; Rosenbaum et al., 2016; Rosenbaum et al., 2018), while a few studies have explored place identity in servicescape context (Brocato et al., 2015; Rosenbaum and Montoya, 2007). Barring Rosenbaum et al. (2007), the combined influence of attention restoration theory and place identity is less explored in literature. Further, in terms of stimuli, most of the studies have explored the direct effect of nature such as the influence of greenery and green elements (Brengman et al., 2012; Rosenbaum et al., 2016; Rosenbaum et al., 2018) and biophilic elements (Ortega-Cortáz and Royo-Vela, 2019; Purani and Kumar, 2018). Also, researchers have also validated the role of a specific context such as casino (Finlay et al., 2006; Rosenbaum and Wong, 2015), commercial “third places” (Rosenbaum, 2009; Rosenbaum et al., 2009), speciality health care (Rosenbaum and Smallwood, 2011) and non-medical transformational servicescapes (Glover and Parry, 2019) on restorative effects. However, the indirect effect of nature – biomorphic servicescape designs – on restoration and place identity has not been examined in servicescape designs.

Biomorphism – indirect experience of nature

Biomorphic designs are defined as designs that imitate natural or biological forms and shapes and patterns and textures that connect human beings to nature (Kellert et al., 2011; Kuhlmann, 2011). It incorporates the visual features of natural things such as shapes and forms that are inspired by organic elements (Kellert et al., 2011) and living things (Vincent, 2009). Although biomorphism can be seen as a specific subdimension of biophilic designs (Kellert et al., 2011), it differs from biophilia. While biomorphism focusses on mimicking natural form and shapes, biophilia is mostly about incorporating natural elements such as greenery, sunlight and water in designs (Coburn et al., 2019). Significant work has been done in architecture on incorporating biomorphic patterns (Coburn et al., 2019; Ryan et al., 2014). For instance, biomorphic trends have been reflected in the design of many iconic structures across the world, such as Lotus temple, India; 30 St Mary Axe, London; Sagrada Familia, Barcelona; Helix Bridge, Singapore, etc [1]. Many studies in architecture discuss different aspects of biomorphism. Table 2 below provides a review of select literature on biomorphism’s effect on cognitive, affective and behavioural responses of individuals. As is evident from the Table 2, a few studies have explored the holistic effect of biomorphic stimuli (Coburn et al., 2019; Joye, 2006; Vincent, 2009), while others have looked at specific biomorphic elements such as curvilinear forms and layouts (Dazkir and Read, 2012; Liu et al., 2018; Mirkia, 2018), warm lighting (Park and Farr, 2007; Van Oel and van den Berkhof, 2013), livable elements (Abdulkarim and Nasar, 2014), natural patterns and posters (van den Bogerd et al., 2018), etc.

Further, in terms of a theoretical framework, the most widely used ones are attention restoration theory (Abdulkarim and Nasar, 2014; Mirkia, 2018; van den Bogerd et al., 2018), Mehrabian and Russell’s S-O-R framework (Dazkir and Read, 2012; Park and Farr, 2007) or Whyte’s framework on liveable spaces (Abdulkarim and Nasar, 2013, 2014). Most of the studies have explored the role of exterior architectural designs (Abdulkarim and Nasar, 2014; Joye, 2006; Sevinc Kayihan et al., 2018) and only a few are on interiors (Dazkir and Read, 2012; Van Oel and van den Berkhof, 2013).

Biomorphism influences designs at three levels: form, process and ecosystem (Benyus, 1997). Accordingly, the application of biomorphic forms in space design can be categorised based on two dimensions, namely, similarity (which can be considered as a continuum that varies from abstract representations to a full resemblance) and utility (which also is a continuum that ranges from functional to significant social or cultural associations; Shelley, 2015). Human beings have an intrinsic predisposition towards natural elements, structures and forms, as it contributes to survival, and thus generates positive emotional responses (Larsen et al., 1998; Ulrich, 1986). Studies have shown that even abstract figurative natural forms evoke stronger emotional and aesthetic responses in the viewers (Barsukova, 2018). According to sensory functional theory, the perception of organic things by an individual is a function of the perceptual semantic subsystem and for non-organic things, it is a function of functional semantic subsystems. Furthermore, the use of biomorphic ecosystems can result in better sustainable energy-efficient and adaptable environments (Arslan, 2014; Kerbeile and McLennan, 2004). Biomorphism has been applied in space design studies such as architecture and interior design to solve problems related to human-environment interactions (Benyus, 1997). However, it should be noted that, for any positive effect on the viewer, a holistic feel by incorporating multiple biomorphic factors is crucial (Padmanabhan, 2013). Finally, studies related to anthropomorphism – one specific type of biomorphism – is proven to have multiple benefits for marketers such as positive brand evaluation and preference (Aggarwal and McGill, 2011; Landwehr et al., 2011), loyalty and word of mouth (Guido and Peluso, 2015), positive impacts on brand love (Rauschnabel and Ahuvia, 2014) and even forgiveness in the event of product wrongdoings (Puzakova et al., 2013).

Extending these benefits to the context of servicescapes, it can be assumed that incorporating biomorphic designs in servicescapes can create positive emotional and aesthetic responses, a sense of sustainable consumption, positive brand evaluations and servicescape preferences in customers. As stated above, unlike in architecture and environmental psychology, biomorphism is still underappreciated in the...
Table 1: Review of key literature on restorative effects and place identity

<table>
<thead>
<tr>
<th>Study</th>
<th>Theoretical framework</th>
<th>Context/Manipulation</th>
<th>Independent variables (IV)/dependent variables (DV)/ mediators (ME)</th>
<th>Sample</th>
<th>General findings</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rosenbaum and Montoya (2007)</td>
<td>“social” servicescape; place identity</td>
<td>Survey study – based on the respondents’ favourite restaurant.</td>
<td>Physical servicescape, place identity (IVs); loyalty, price resiliency and satisfaction (DVs)</td>
<td>Study-01: 20 students and faculty in a university in Hawaii; Study-02: 100 (Hispanic) and 100 (Homosexual)</td>
<td>This paper evaluates the influence of ethnicity of the customers and employees (place liking) on place identity</td>
<td>Context-specific “social” – retail space considered; direct/indirect nature not explored</td>
</tr>
<tr>
<td>Rosenbaum (2009)</td>
<td>Attention restoration theory</td>
<td>Study 1 – survey based on video arcade; Study 2 – survey based on commercial third place</td>
<td>Being away, fascination, compatibility, coherence (IVs); perceived restoration (ME); satisfaction, loyalty and word of mouth (DVs)</td>
<td>Study-01: 172 teenage customers in the USA; Study-02: 437 undergraduate students Midwestern University</td>
<td>This paper introduces the concept of restorative servicescapes of third place</td>
<td>Context-specific third places – commercial space considered; direct/indirect nature not explored</td>
</tr>
<tr>
<td>Rosenbaum et al. (2009)</td>
<td>Attention restoration theory and place identity</td>
<td>Café – “hybrid third place” – a survey with customers of the existing restaurant.</td>
<td>Socially- supportive destructive score (IV); place attachment (ME); place dependency, place commitment, place identity and place lifestyle (DVs)</td>
<td>84 customers from a Chicago restaurant</td>
<td>This paper discusses the influence of Café Servicescape on personal and mental fatigue restoration</td>
<td>Context-specific third places – Cafe considered; direct/indirect nature not explored</td>
</tr>
<tr>
<td>Rosenbaum and Massiah (2011)</td>
<td>Attention restoration theory</td>
<td>Natural dimension in servicescapes</td>
<td>A conceptual model with ambient conditions (IV); physical, social, symbolic and natural dimensions (MEs) and perceived servicescape (DV)</td>
<td>NA (conceptual paper)</td>
<td>This conceptual paper extended Bitner’s (1992) model by incorporating natural dimension</td>
<td>Direct effect of nature considered</td>
</tr>
<tr>
<td>Rosenbaum and Smallwood (2011)</td>
<td>Attention restoration theory</td>
<td>Restorative cancer resource centre servicescapes – survey at Chicago-based LivingWell (LW) Cancer Resource Centre</td>
<td>Being away, fascination, Compatibility (IVs); perceived restorativeness, fatigue reduction (MEs); cognitive, emotional, physiological, approach and social interactions (DVs)</td>
<td>70 LW patients randomly chosen</td>
<td>This paper discusses the influence of “not for profit” third places on public health and well-being</td>
<td>Context-specific – speciality health care considered; direct/indirect nature not explored</td>
</tr>
<tr>
<td>Brengman et al. (2012)</td>
<td>S-O-R model</td>
<td>Retail store environment with manipulation of complexity (lean vs complex), with and without in-store vegetation</td>
<td>In-store vegetation (IV); pleasure, stress, excitement (MES); approach and avoidance (DVs)</td>
<td>4293 participants from online consumer panel in the Netherlands</td>
<td>This paper discusses the influence of in-store vegetation on the emotional responses of consumers</td>
<td>The direct effect of nature considered</td>
</tr>
<tr>
<td>Brocato et al. (2015)</td>
<td>Place attachment; a sense of place and social bonding</td>
<td>Retail servicescape; Study 1: local bars and clubs as the context for the survey; Study 2: respondents 50% about a restaurant they were attached to and 50% about a restaurant they were not attached to</td>
<td>Study-1: place identity, place dependence, social bonds (IVs); place attachment (ME); WoM and switching intentions (DVs). Study-2: valuation, distinction, continuity (IVs); place identity, place dependence, social bonds (MEs); strength of physical and social attachments (DVs)</td>
<td>Study-1: 196 US students from a public US University; Study-2: 907 respondents of US regional population</td>
<td>The study shows that creating a sense of place leads to attachment, which influences behavioural outcomes</td>
<td>Context-specific – Speciality health care considered; direct/indirect nature not explored</td>
</tr>
<tr>
<td>Rosenbaum and Wong (2015)</td>
<td>Attention restoration theory</td>
<td>Field study at Macau-based casino complexes, such as the Hard Rock Casino, Galaxy, Wynn and the Venetian</td>
<td>Being away, fascination, compatibility (IVs); perceived restorativeness (ME); well-being, planned expenditures, trip value and revisit intentions (DVs)</td>
<td>370 respondents from China, 118 from Hong Kong and the rest from other Asian regions, (Taiwan, Singapore and Malaysia)</td>
<td>This paper discusses how socially unacceptable services influence human well-being</td>
<td>Context-specific third places – Casino considered; direct/indirect nature not explored</td>
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(continued)
management and marketing domain. A clear understanding of the role of biomorphism in servicescape designs can benefit the managers in multiple ways. Biomorphic models give greater flexibility for designing the servicescapes, even in contexts where other biophilic features such as greenery and natural lighting, are neither feasible nor possible. Some biomorphic features like shapes and lighting types can be easily incorporated in interior designs without doing any structural alterations in the buildings. Biomorphic designs could be more cost-effective than biophilic servicescapes. Finally, biomorphic elements like images of nature can be incorporated in servicescapes where direct exposure to nature may not be practicable, such as in sterile hospital interiors (Gillis and Gatersleben, 2015).

Out of the many biomorphic elements available in the environmental psychology literature (Gillis and Gatersleben, 2015; Sevinc Kayihan et al., 2018), we chose the following four design attributes with the help of three experts (practicing architects) that are relevant to servicescape designs:

### 1 Curvilinear layout forms: All natural elements possess curvilinear forms and human beings prefer contours, mostly because of an evolutionary function (Leder et al., 2011). Also, sharper and linear shapes are usually perceived as a threat by humans (Bar and Neta, 2006). Again, these preferences towards curvilinear forms are mostly due to the intrinsic property of the stimuli (Bertamini et al., 2016). Curvilinear layouts can generate positive affective responses (Dazkir and Read, 2012) and warmth (Liu et al., 2018) in humans and they tend to rate curvilinear interior layouts as more beautiful (Vartanian et al., 2013, 2019).

### 2 Presence of liveable elements: Liveable elements are those elements in the environment, which make it livelier, vibrant and visitable (Whyte, 1980). Such features help people to take a break from their environmental exploration activity. Sculptures are one liveable element, which can serve as a landmark, and their presence enhances the restorative qualities of exterior environments (Abdulkarim and Nasar, 2014). They are also found to improve the visitability of a place (Abdulkarim and Nasar, 2013).

### 3 Presence of nature wall posters and finishes: Another indirect effect of nature can be in the form of images of nature (Sevinc Kayihan et al., 2018). Nature wall posters in interiors have been found to have a positive impact on people’s preferences (van den Bogerd et al., 2018).

### 4 Warm lighting: Warm looking servicescapes can induce a sense of intimacy for the users (Baek et al., 2018). Warm
Table 2: Review of literature in biomorphic designs

<table>
<thead>
<tr>
<th>Study</th>
<th>Context/ theoretical framework</th>
<th>Research methodology</th>
<th>Independent variables (IV)/ dependent variables (DV)/ mediators (ME)</th>
<th>General findings</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joye (2006)</td>
<td>Architectural designs</td>
<td>The study is based on a review of key architectural designs that have used biomorphic designs.</td>
<td>Biomorphic patterns – fractal architectural and designs (IV) and cognitive and neurophysiology (DV)</td>
<td>Humans are equipped with cognitive structures that can easily process information related to living forms, which applies to biomorphism too.</td>
<td></td>
</tr>
<tr>
<td>Park and Farr (2007)</td>
<td>Architectural designs</td>
<td>The study is based on anecdotal evidence of biomorphic architectural designs.</td>
<td>Cultural group, color rendering index, and color temperature (IV)</td>
<td>The study explores how building designs can aid connectivity with nature for users.</td>
<td></td>
</tr>
<tr>
<td>Vincent (2009)</td>
<td>Architectural designs</td>
<td>The study is based on anecdotal evidence of biomorphic architectural designs.</td>
<td>Biomorphic applications at three levels; direct copying of biological forms, pattern recognition for problem-solving and theory of inventive problem-solving (IV); design characteristics (IVs) and preference and perceived restorativeness (DV)</td>
<td>Biomorphism teaches that shape is the most important parameter in the design process.</td>
<td></td>
</tr>
<tr>
<td>Dazkia and Read (2012)</td>
<td>Biomimicry and architecture</td>
<td>The study is based on anecdotal evidence of biomorphic architectural designs.</td>
<td>Biomorphic elements – livable elements (IV); direct experience of nature, indirect experience of nature, the experience of space and place, nature in the space, natural analogues and nature of the space (IVs), memorability and pleasantness (DV)</td>
<td>The study explores how building designs can aid connectivity with nature for users.</td>
<td></td>
</tr>
<tr>
<td>Van Oel and van den Berkhof (2013)</td>
<td>Biomimicry and architecture</td>
<td>The study is based on anecdotal evidence of biomorphic architectural designs.</td>
<td>Various biophilic architecture dimensions in city designs</td>
<td>Various biophilic architecture dimensions in city designs</td>
<td></td>
</tr>
<tr>
<td>Sevinc Kayihan et al. (2018)</td>
<td>Biomimicry and architecture</td>
<td>The study is based on anecdotal evidence of biomorphic architectural designs.</td>
<td>Various biophilic architecture dimensions in city designs</td>
<td>Various biophilic architecture dimensions in city designs</td>
<td></td>
</tr>
<tr>
<td>Mirkia (2018)</td>
<td>Biomimicry and architecture</td>
<td>The study is based on anecdotal evidence of biomorphic architectural designs.</td>
<td>Various biophilic architecture dimensions in city designs</td>
<td>Various biophilic architecture dimensions in city designs</td>
<td></td>
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</tbody>
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van Den Bogaard et al. (2018) | Biomimicry and architecture | The study is based on anecdotal evidence of biomorphic architectural designs. | Various biophilic architecture dimensions in city designs | Various biophilic architecture dimensions in city designs | |

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<tr>
<th>Study</th>
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<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liu et al. (2018)</td>
<td>Social judgements – warmth and competence in servicescape designs</td>
<td>Experimental studies (2 x 2) on fast-paced servicescape using photographs as stimuli. Three experimental studies using photographs of naturalness designs in architecture as stimuli</td>
<td>Biomorphic shape – curvilinear vs rectilinear layout (IV); warmth, competence (ME); satisfaction and loyalty intention (DVs)</td>
<td>The results suggest that curvilinear layout increases customer satisfaction through warmth and competence</td>
<td>Explores the influence of crowding on the customer evaluation of shapes</td>
</tr>
<tr>
<td>Coburn et al. (2019)</td>
<td>On architectural designs (interior and exterior) that are inspired by natural forms</td>
<td>Three experimental studies using photographs of naturalness designs in architecture as stimuli</td>
<td>Biomorphic patterns – low-level sensory properties of stimuli (level of scale, contrast) (DV); naturalistic aesthetics (ME) and aesthetic preference (DV)</td>
<td>The preference for natural forms are generated through naturalistic aesthetics</td>
<td>Tests the effects of perceived naturalness in designs on the aesthetic responses of customers</td>
</tr>
</tbody>
</table>
light connotes the natural element of fire and has been found to influence customers’ emotional states and preferences in servicescapes (Park and Farr, 2007; Van Oel and van den Berkhof, 2013). Further, warm lighting also helps users to connect well with the servicescape identity (Tantanatewin and Inkarojrit, 2016).

With the above understanding, for this study, we consider biomorphic servicescape design as the one which has the presence of all four elements discussed above. Using the S-O-R framework (Mehrabian and Russell, 1974), we propose that a biomorphic servicescape design can influence the viewers’ overall perception in terms of perceived attention restoration (Kaplan, 1995), perceived place identity – emotional and cognitive (Rosenbaum and Montoya, 2007) and eventually servicescape preference, as depicted in the conceptual model in Figure 1. The next section discusses the effect on biomorphic designs on attention restoration, followed by the impact on place identity.

**Influence on attention restoration**

According to Kaplan’s (1995) attention restoration theory, individuals possess the ability to recover from mental fatigue by spending time in environments. Attention restoration is the process by which an individual regains his/her ability to focus his/her attention on thought and perception to any environmental condition is a biological mechanism, which gets fatigued with use (Rosenbaum, 2009). The limited resource of the directed attention of consumers in today’s world is easily depleted due to life complexities, resulting in adverse consequences such as irritability, distractibility, indecisiveness, lack of satisfaction and negative emotions even during service consumption in servicescapes (Basu et al., 2019; Hartig et al., 2003; Purani and Kumar, 2018). Hence, attention restoration is particularly vital in servicescapes. It provides health benefit for consumers by improving the mental health and overall well-being (Korpela et al., 2001; Rosenbaum and Massiah, 2011), irrespective of the servicescape types (Rosenbaum et al., 2016). It aids self-regulation (Kaplan and Berman, 2010), emotional well-being (Rosenbaum and Wong, 2015) and elevates the mood states (Brengman et al., 2012) of consumers in the servicescapes.

**Figure 1** Conceptual model

Note: H6, H8 and H9 are mediation hypotheses.

![Conceptual Model](image)

**Note:** H6, H8 and H9 are mediation hypotheses.

Attention restoration has five perceptual environmental characteristics: being away, fascination, scope, coherence and compatibility (Berto et al., 2008). Being away is the quality of the environment, which can take the viewer away from unwanted distractions and engage him/her effortlessly in the contents (Staats et al., 2003). In contrast, fascination is the quality of the environment that reduces the inhibition mechanism of the viewer and facilitates exploration (Berto et al., 2008). Scope indicates the connectedness aspect of the environment, which stimulates the viewer to enter and spend more time (Laumann et al., 2001). Coherence refers to the harmony of the elements available in the environment, which reduces the cognitive load of an individual in processing the stimuli, thus aiding the attention restoration (Pals et al., 2014). While compatibility is the environmental quality which makes one feel that the environment is suitable for the intended purpose (Herzog et al., 2011).

The physical characteristics of the environment, such as the presence of natural elements can influence the restorative attributes of the environment and can aid attention restoration in servicescapes (Purani and Kumar, 2018). It could be in terms of greenery (Brengman et al., 2012; Rosenbaum et al., 2018) or biophilic elements (Purani and Kumar, 2018; Rosenbaum et al., 2016). According to attention restoration theory, interaction with nature is an involuntary action, without any conscious effort from the viewer (Kaplan, 1995). Similarly, the presence of fractal structures can also make an environment more restorative because the perceived naturalness enhances the viewers’ processing fluency (Joye et al., 2016). Hence, biomorphic designs can also influence attention restoration, as it mimics organic shapes and forms (Kellert et al., 2011), which makes it easy for viewers to process the same. So, we hypothesise that:

**H1.** Perceived biomorphic servicescape designs will have more attention restorative effect than non-biomorphic servicescape designs.

**Influence on place identity**

Place identity refers to the congruency between an individual’s personality and that of the environment, which causes a feeling of attachment (Rosenbaum and Montoya, 2007). This concept originated in environmental psychology studies (Proshansky et al., 1983), which also discuss many related constructs such as the sense of place – which is one’s interpretation of the setting (Brocato et al., 2015) and place attachment – which is the emotional bonding developed with an environment over time, leading to place bonding (Kyle et al., 2004). However, place identity is suggested to be a superior multidimensional construct over others, such as place attachment (Lalli, 1992). Barring Rosenbaum and Montoya’s (2007) study on the influence of ethnicity of employees in place identity and Brocato et al.’s (2015) study on the sense of place on behavioural intentions, the concept of place identity has been sparsely explored in servicescape studies. A conceptually similar concept is brand attachment. Brand attachment is the bonding between oneself and the brand (Park et al., 2010). Unlike physical goods for which
brand attachment is often driven by the functional and symbolic aspects (Belaid and Temessek Behi, 2011) when it comes to services, facilities become a significant element of the marketing mix as physical evidence contributing to the brand’s positioning. As servicescapes play a vital role in the service brand experience, place attachment becomes crucial and contributes to brand attachment. It is found that contexts such as flagship stores positively moderate the influence of servicescape aesthetics on brand attachment (Dolbec and Chebat, 2013).

In contrast with the attention restoration approach (Kaplan, 1995), place identity could be looked at as a top-down approach, where one could feel a nostalgic attachment or an emotional bond (Ratliff and Korpela, 2018). The physical qualities of servicescapes can drive the perceived place identity of users (Brocato et al., 2015). Classical identity theory suggests that place identity formation has both cognitive and emotional components (Knez, 2014). The cognitive part includes thinking, remembering and reasoning, while the emotional part includes emotional attachment towards certain places (Knez et al., 2018). The cognitive place identity formation includes processes of personal temporality (“mental time travel”), self-coherence, correspondence, reflection and agency (Conway et al., 2004; Klein et al., 2004), corresponding to the thinking, remembering and reasoning about a place. The emotional place identity formation happens through a sense of belongingness, closeness and attachment with a place (Hidalgo and Hernandez, 2001; Knez, 2005). Perceived naturalness in an environment can generate emotional liking for that place (Eisenhauer et al., 2000). Nature can be a part of an individual’s life story (Knez, 2014) and so natural and nature-like elements can help a viewer to relate with his/herself (Knez and Eliasson, 2017). It can generate a sense of familiarity, which further induces affective responses in them (Ratliff and Korpela, 2018).

Furthermore, according to affect transfer theory, congruency between two objects helps in the transfer of effect from the environment to the observer (Andersen and Baum, 1994). People acquire a sentimental attachment with a place due to their emotional liking for the environment (Jorgensen and Stedman, 2001). Similarly, viewers often think about their affective responses and tend to revisit the place for which they have developed an attachment for their well-being (Tyrvänien et al., 2014). As biomorphic designs visually resemble nature, we hypothesise that it can also visually elicit the same level of affective and cognitive responses in the customers:

**H2.** Perceived biomorphic servicescape designs will generate higher perceived place identity (emotional) than non-biomorphic servicescape designs.

**H3.** Perceived biomorphic servicescape designs will generate higher perceived place identity (cognitive) than non-biomorphic servicescape designs.

**Influence on servicescape preference**

Several studies related to natural environmental stimuli in environmental psychology have considered preference as an outcome measure (Herzog and Miller, 1998; Steg et al., 2014; Van den Berg et al., 2003; Wang et al., 2016). Environment preference is a well-researched variable in landscape contexts also (Huang and Lin, 2019; Stamps and Nasar, 1997). From an evolutionary perspective, preference is considered as the immediate response by the individual to any environment that decides his/her further plan of action or behavioural intentions (Purani and Kumar, 2018). Preference has been proven as a significant response to any environmental stimuli, as it can influence the approach (or avoidance) behaviour of viewers (Ulrich, 1986). In marketing studies also, to evaluate the designs of products (Olson, 2013; Veryzer and Hutchinson, 1998) and services (servicescapes) (Kumar et al., 2017; Purani and Kumar, 2018) preference is found to be an appropriate dependent variable, which directly influences consumer choice. These choices based on preference could be in terms of revisit intentions and loyalty (Mende et al., 2013).

In both landscapes (Meidenbauer et al., 2019; Van den Berg et al., 2003) and built environments (Van den Bogerd et al., 2018) with natural stimuli, preference is found to be a suitable variable that can discriminate the influence of natural elements from others. The perceived naturalness of the environmental elements present in an environment can lead to preferences for that environment (Kardan et al., 2015). This has been established in the context of biophilic stimuli – the direct influence of nature (Purani and Kumar, 2018). Just like biophilic stimuli, human beings have an affinity towards biomorphic forms and they prefer environments with curvilinear shapes (Vartanian et al., 2019), liveable elements (Abdulkarim and Nasar, 2014) natural finishes (van den Bogerd et al., 2018) and warm lighting (Van Oel and van den Berkhof, 2013). So, this affinity towards biomorphic forms can result in a preference for servicescapes that have these forms present, which substantially impacts a positive approach behaviour. In the servicescape context, the approach behaviour could be in terms of a desire to explore the environment (Donovan and Rossiter, 1982), revisit intentions and loyalty (Kotasz, 2006), willingness to pay or to spend more time (Donovan et al., 1994) and satisfaction in servicescapes (Ridgway et al., 1990). Thus, we hypothesise that:

**H4.** Perceived biomorphic servicescape designs will generate higher servicescape preference than non-biomorphic servicescape designs.

We also explore the mediating roles of attention restoration and place identity in the link between biomorphic servicescape designs and preferences. According to Bittner’s (1992) model, the affective and cognitive responses to any servicescape stimuli positively influence behavioural intentions, which have then been validated in the context of biophilic servicescapes (Purani and Kumar, 2018). Studies in natural settings have shown that restorative qualities of any environment can drive people’s preference towards the same (Staats et al., 2003). Also, attention restoration has been considered as a prime reason for preference due to its visually perceived attributes of natural environments (Staats and Hartig, 2004). Hence:

**H5.** The perceived attention restorative effects will positively influence the perceived servicescape preference.
H6. Attention restoration will mediate (either partially or totally) the relationship between biomorphic designs and the servicescape preference.

Similarly, for place identity, natural and natural-looking elements are often associated with individual identity and memory (Knez and Eliasson, 2017). Due to the emotional bonding that place identity can create; viewers find more natural places as favourite, which, in turn, leads to their preference (Knez, 2014). According to the theory of self-regulation, human beings tend to proactively regulate behaviours to maximise positive effect (Mann et al., 2013), which is usually aided by nature and nature-like environments. Hence, it can be inferred that the relationship between perceived naturalness and preference will be mediated by the psychological mechanisms of people–place bonding or place identity, which has both emotional and cognitive components (Knez, 2014). Further, this mediating role of place identity in the link between perceived naturalness and preference is validated in multiple contexts with nature-related qualities such as urban greenery (Knez et al., 2018), mountain landscapes (Knez and Eliasson, 2017) and climatic conditions (Knez, 2005). Hence, by extending these arguments to the context of biomorphic elements, we hypothesise that:

H7. The perceived a) emotional place identity and b) cognitive place identity will positively influence the perceived servicescape preference.

H8. Place identity (emotional) will mediate (either partially or totally) the relationship between biomorphic designs and servicescape preference.

H9. Place identity (cognitive) will mediate (either partially or totally) the relationship between biomorphic designs and servicescape preference.

Research methodology

Across two studies, we tested the influence of biomorphic servicescape designs on consumer evaluations. In line with many studies in servicescape designs (Baek et al., 2018; Purani and Kumar, 2018), we also made use of servicescape images as stimuli in both studies. Study 1 was an exploratory pre-experimental design study followed by Study 2, an experiment design (3 × 2 factorial mixed – between and within subject-design), where the chosen four design attributes were manipulated.

Study 1: one-shot treatment study

The objective of this study was to test the role of biomorphic design elements in inducing a sense of naturalness in the viewers. Keeping the broader applicability of the research, we tried to test our model on three servicescapes contexts: fashion retail, restaurant and hospital lobby. Firstly, a pool of images (n = 200; 65 of fashion retail; 65 of restaurant and 70 of hospital lobby) related to all these servicescapes was collected from different online sources [2]. Three experts (all practicing architects), after briefed with the objective of the study, were asked to select a subset of images (n = 60; 20 each for the three contexts) that were high and low on biomorphic qualities. In this second stage, five different experts (three practicing architects and two interior design experts) were asked to independently rate the subset of 60 images with respect to the four biomorphic design attributes (curvilinear layouts, liveable elements, natural posters/finishes, warm lighting) and overall level of biomorphism on a seven-point Likert scale (1 = strongly disagree, 7 = strongly agree). For inter-rater reliability measures, we followed the standard procedures suggested by Rust and Cool (1994). PRL (proportional reduction in loss formula) reliability measures based on the proportion of inter judgement agreement, are believed to be superior to Perreault and Leigh (1989) measures in terms of usability with three or more judges. The ratings received from the five experts for the 60 images were compared for PRL reliability (precision). Evidently, all PRL reliability indexes (0.92 for curvilinear layouts, 0.91 for liveable elements, 0.70 for natural posters/finishes, 0.73 for warm lighting and 0.75 overall level of biomorphism) were found greater than the 0.70 thresholds recommended for exploratory research by Rust and Cool (1994). These 60 images were then used for the one-shot treatment pre-experimental study. For this, all 60 images were uploaded to three different Google Forms, along with the definition of biomorphism and five questions. A total of 184 post-graduate students from a prominent Indian university participated in the study for partial course credit. Each participant was randomly assigned with a Google Forms link; each form had 20 images; each image was followed by questions related to the perceived naturalness and their liking. Participants were told they would be viewing images of various servicescapes (total of 20 images) and imagining that they were going to visit those servicescapes. They were asked to evaluate the perceived naturalness of each image and their liking for each of them (both on the seven-point Likert scale). As responses to all questions were mandatory, there were no issues of missing values. A total of 3680 usable responses (1,240 responses, each from 62 respondents for the 1st and 2nd form and 1,200 responses from 60 respondents for the 3rd form) were finally available for analysis.

Analysis and findings

The first test was to check the degree of agreement between experts’ assessment of biomorphism and the viewers’ perceived naturalness. A Pearson’s correlation analysis between the perceived naturalness ratings given by participants and the overall level of biomorphism rating provided by experts show a significantly stronger correlation (r = 0.716; p < 0.001), suggesting that the participants and experts indeed agree on the biomorphic elements in the images.

The variance inflation factors (VIFs) and tolerance values of all independent variables with both perceived naturalness and liking as the dependent variables (DVVs henceforth) are, namely, curvilinear layouts (VIF = 2.22; tolerance = 0.451), liveable elements (VIF = 2.37, tolerance = 0.422), natural posters (VIF = 3.21, tolerance = 0.311) and warm lighting (VIF = 1.83, tolerance = 0.546). As all VIFs are less than the threshold of 5 (tolerance > 0.2), it means that there are no issues with multicollinearity (Hair et al., 2010). As the respondents saw the same set of images, to verify the data independence we did a regression analysis by applying the Cluster-Robust standard errors (White, 1984) in the Stata software. By considering the intragroup correlations, this technique relaxes the usual requirement that all observations be independent (Wooldridge, 2002). While this technique of vce-cluster changes the values of
the standard errors and variance-covariance matrix of the estimators, the estimated coefficients remain the same. The regression results with ratings on “perceived naturalness” given by the participants as a DV ($R^2 = 0.488, F = 482.57, p < 0.001$) and the expert ratings for the four design features showed that all of them curvilinear layouts (β = 0.307, t = 14.81, p < 0.001), liveable elements (β = 0.232, t = 11.61, p < 0.001), natural posters/finishes (β = 0.344, t = 13.78, p < 0.001) and warm lighting (β = 0.951, t = 4.12, p < 0.001) are significant predictors of perceived naturalness, thus providing support to our understanding of the design attributes that determine the level of biomorphism. Subsequently, yet another regression analysis ($R^2 = 0.350, F = 355.90, p < 0.001$) using participant ratings of “liking” given by the participants as the DV and the expert ratings for the four design features showed that all of them, curvilinear layouts (β = 0.313, t = 14.51, p < 0.001), liveable elements (β = 0.178, t = 9.62, p < 0.001), natural posters/finishes (β = 0.183, t = 8.70, p < 0.001) and warm lighting (β = 0.112, t = 5.61, p < 0.001) are significant predictors of liking, providing initial support to our proposed model. The effect size ($\eta^2$) for the first model with naturalness as a DV are: overall (0.49), curvilinear layouts (0.048), liveable elements (0.03), natural posters (0.05), warm lighting (0.005). For the second model with likability as a DV are: overall (0.35), curvilinear layouts (0.046), liveable elements (0.018), natural posters (0.012), warm lighting (0.006). Further building on these pieces of evidence, in Study 2, we experimentally tested whether biomorphic servicescape designs would lead to an increase in attention restoration, place identity (emotional and cognitive) and servicescape preference.

**Study 2: factorial experimental design**

To maintain the context of the study as the same with the previous one, in this study too, the same three servicescapes – fashion retail, restaurant and hospital lobby were chosen. As our objective was to assess the overall effectiveness of biomorphic design elements and not the individual design factors as studied by Purani and Kumar (2018), in line with Liu et al. (2018), we developed computer-generated three-dimensional (3D) images of each servicescape settings using Google Sketch Up software and the final manipulation was done using Adobe Photoshop CS3. 3D images of six servicescapes (3 contexts [fashion retail, restaurant and hospital lobby] × 2 designs [biomorphic and non-biomorphic]) were developed with the help of 3D visualisers and two practicing architects. They were briefed about the purpose of the study and except for the elements that were manipulated, all other design features (such as floor plan and area, ceiling height and the number of items present) were maintained as equal in both scenarios. In the non-biomorphic (biomorphic) servicescape images, the manipulations followed had linear (curvilinear) layout, non-liveable (liveable) elements, posters and finishes with artificial pattern (natural pattern) and cold (warm) lighting. The camera angle for all the images was also kept the same (average eye level of a standing viewer) to have a realistic feel while viewing the images. These images were developed to control for the possible influence of any other external factors (other than those factors that were manipulated) such as style, layout, etc. The sample set of images is provided in Appendix 1.

**Manipulation checks**

A manipulation test was conducted to examine the appropriateness of the intended manipulations. The images were shown to a set of respondents, chosen from the social media contacts of one researcher (n = 32; mean age = 27.44 years) who were asked to rate the naturalness and perceived attractiveness of the servicescapes. The manipulation check results suggest that biomorphic servicescape designs had a higher perception of naturalness ($\mu_{biomorphic} = 5.930$ vs $\mu_{non-biomorphic} = 2.931$, t = 19.603, p < 0.001) and higher perception of attractiveness ($\mu_{biomorphic} = 5.452$ vs $\mu_{non-biomorphic} = 2.786$, t = 15.921, p < 0.001) than the non-biomorphic servicescape designs. We also tested for the possible confounding effects of other aesthetic variables such as complexity and novelty. The results show that there was no significant difference in the perceived complexity (t = 0.120, p = n.s) and novelty (t = 0.882, p = n.s) between biomorphic and non-biomorphic images, suggesting that there are no significant confounding effects. Finally, the mean rating on the realism of all images was higher ($\mu = 5.05$; $t = 18.748$, p < 0.001, in comparison to the median value (4), indicating that the images can elicit effects closer to real-life servicescape experiences.

**Main experiment**

The methodology used in this research is an experimental design (3 × 2 factorial mixed – between and with-in subject-design). An online questionnaire using three Google Forms was created for the same; each form had two manipulations, each one followed by the corresponding measures. These forms were randomly assigned to a set of respondents (n = 500) identified through social media contacts of the researchers. The respondents were from nine prominent Indian cities, Coimbatore, Delhi, Chennai, Mumbai, Baroda, Ahmedabad, Bangalore, Pune and Cochin. A total of 327 people responded. The respondents were from the following age groups, namely, 18–23 years (17%), 24–29 years (20%), 30–35 years (14%), 36–41 years (16%), 42–47 years (15%), 48 or above (18%). Genders were almost equally represented, 43% were women and 57% were men. Each respondent evaluated two images, namely, one biomorphic and one non-biomorphic. Finally, a total of 654 usable responses were considered for analysis. We adopted the following scales for the study: 5-item Perceived Restoration Scale (PRS) by Rosenbaum et al. (2016) to measure restoration; the perceived place identity – emotional (5 items) and cognitive (5 items) were measured using the scale given by Knez et al. (2018); and Preference of the people towards the servicescape by 2-item scale by Purani and Kumar (2018). All responses were captured using a seven-point Likert Scale (1 = strongly disagree, 7 = strongly agree). Appendix 2 lists the scales and items used.

**Scale reliability and validity**

The reliability and validity analysis of all the scales are provided in Table 3. As is evident from Table 3, the collinearity VIFs are less than 5, so we conclude that all scales are devoid of multicollinearity issues (Hair et al., 2010). The values of Cronbach’s alpha and composite reliability for all scales are above the recommended value of 0.7 (Hair et al., 2010; Nunnally, 1978), thus confirming the acceptable reliability measures. Finally, the square roots of average variance extracted (AVEs) are higher.
than the correlations between the variables, showing acceptable limits for discriminant validity (Fornell and Larcker, 1981).

Findings
To test the hypotheses H1, H2, H3 and H4, the impact of biomorphic servicescape designs on customers’ attention restoration, place identity (emotional and cognitive) and preference, the data were analysed by a repeated-measure MANCOVA using SPSS 25.0. Servicescape designs (biomorphic and non-biomorphic) were treated as in-subjects factor and service type (restaurant, fashion retail, hospital) as a between-subjects factor. The four dependent variables were attention restoration, place identity (emotional), place identity (cognitive) and servicescape preference. We also considered gender as a covariate. The results support a significant main effect of servicescape designs (Wilks’ λ = 0.966, F = 2.795, p < 0.05) and service type (Wilks’λ = 0.936, F = 1.891, p < 0.05). Also, the interaction effect between the service designs and service type is significant (Wilks’ λ = 0.925, F = 3.967, p < 0.05), but gender as a covariate, does not have any significant impact on the dependent variables (Wilks’ λ = 0.984, F = 1.273, p = n.s). Further, as given in Table 4, significant differences were observed for the mean scores of perceived attention restoration, emotional place identity, cognitive place identity and preference, as shown in Figure 2 through Figure 5, providing support to H1, H2, H3 and H4.

Based on the pre-test results presented in Kumar et al. (2017) and Purani and Kumar (2018), we had chosen hospital as a utilitarian service (that help complete a task) and restaurant as a hedonic service (that provide pleasure) for better generalisability. However, given the opportunity, we chose to examine the role of the service setting (hedonic vs utilitarian) as well, although not hypothesised. A repeated-measure MANOVA with servicescape designs (biomorphic, non-biomorphic) as within-subject factor and responses for service types of restaurant and hospital as hedonic and utilitarian, respectively, (between-subject factor) shows that in line with the results of Purani and Kumar (2018) biomorphic designs in hedonic service contexts are found to be more attention restorative [µbiomorphic = 5.70 for hedonic services vs µbiomorphic = 5.51 for utilitarian services] and generates higher levels of emotional place identity [µbiomorphic = 5.03 for hedonic services vs µbiomorphic = 4.54 for utilitarian services]. However, in the case of cognitive place identity, there were no considerable differences between the two contexts.

Next, a multiple regression analysis (with clustered standard errors by clustering the responses based on a respondent’s ID

Table 3 Scale reliability and validity analysis

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>SD</th>
<th>Collinearity VIFs</th>
<th>Cronbach’s α</th>
<th>Cronbach’s Reliability</th>
<th>PRS</th>
<th>PI-E</th>
<th>PI-C</th>
<th>PREF</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRS</td>
<td>5.041</td>
<td>1.404</td>
<td>2.038</td>
<td>0.883</td>
<td>0.914</td>
<td>(0.825)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PI-E</td>
<td>4.249</td>
<td>1.730</td>
<td>3.339</td>
<td>0.930</td>
<td>0.948</td>
<td>(0.886)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PI-C</td>
<td>4.314</td>
<td>1.712</td>
<td>3.170</td>
<td>0.947</td>
<td>0.959</td>
<td>0.811***</td>
<td>0.908</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PREF</td>
<td>4.709</td>
<td>1.688</td>
<td>2.543</td>
<td>0.917</td>
<td>0.960</td>
<td>0.684***</td>
<td>0.688**</td>
<td>0.672***</td>
<td>(0.961)</td>
</tr>
</tbody>
</table>

Notes: ***p < 0.001; square root of average variance extracted (AVEs) are shown on diagonal; PRS: perceived restoration scale; PI-E: place identity – emotional; PI-C: place identity 0 cognitive; PREF: a preference

Table 4 Summary of findings

<table>
<thead>
<tr>
<th>SI no.</th>
<th>Hypotheses</th>
<th>Analyses</th>
<th>Test Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>H1: Biomorphic to non-biomorphic (attention restoration)</td>
<td>Repeated measure MANCOVA – within subject factor (biomorphic – non-biomorphic) between subject factors</td>
<td>[µ_{biomorphic} = 5.615 \text{vs} \ µ_{non-biomorphic} = 4.468, \text{SE} = 0.058*** ]</td>
</tr>
<tr>
<td>2</td>
<td>H2: Biomorphic to non-biomorphic (place identity – emotional)</td>
<td>(service type); Gender (covariate)Wilks’ λ = 0.943, F = 6.519***</td>
<td>[µ_{biomorphic} = 4.697 \text{vs} \ µ_{non-biomorphic} = 3.801, \text{SE} = 0.106*** ]</td>
</tr>
<tr>
<td>3</td>
<td>H3: Biomorphic to non-biomorphic (place identity – cognitive)</td>
<td>(service type); Gender (covariate)Wilks’ λ = 0.943, F = 6.519***</td>
<td>[µ_{biomorphic} = 4.655 \text{vs} \ µ_{non-biomorphic} = 3.973, \text{SE} = 0.115*** ]</td>
</tr>
<tr>
<td>4</td>
<td>H4: Biomorphic to non-biomorphic (preference)</td>
<td>Multiple regression; [R^2 = 0.571, F = 366.97***]</td>
<td>[\beta_{Attention\ restoration} = 0.488, t = 1 0.57*** ]</td>
</tr>
<tr>
<td>5</td>
<td>H5: Attention restoration → preference</td>
<td>Multiple regression; [R^2 = 0.571, F = 366.97***]</td>
<td>[\beta_{Place\ identity – emotional} = 0.315, t = 6.41*** ]</td>
</tr>
<tr>
<td>6</td>
<td>H7: (a) Place identity – emotional/(b)place identity – cognitive → preference</td>
<td>Mediation test – multiple mediators using PROCESS macro 3.3 (Hayes, 2017) – Model 4</td>
<td>[\beta_{Place\ identity – cognitive} = 0.205, t = 4.43*** ]</td>
</tr>
<tr>
<td>7</td>
<td>H6: Biomorphic → attention restoration → preference</td>
<td>Mediation test – multiple mediators using PROCESS macro 3.3 (Hayes, 2017) – Model 4</td>
<td>[\beta_{Place\ identity = 0.296*, \text{SE} = 0.0570} ]</td>
</tr>
<tr>
<td>8</td>
<td>H8: Biomorphic → place identity – emotional → preference</td>
<td>Mediation test – multiple mediators using PROCESS macro 3.3 (Hayes, 2017) – Model 4</td>
<td>[\beta_{Place\ identity = 0.163***, \text{SE} = 0.046} ]</td>
</tr>
<tr>
<td>9</td>
<td>H9: Biomorphic → place identity – cognitive → preference</td>
<td>Mediation test – multiple mediators using PROCESS macro 3.3 (Hayes, 2017) – Model 4</td>
<td>[\beta_{Place\ identity = 0.120***, \text{SE} = 0.0395} ]</td>
</tr>
</tbody>
</table>

Note: ***p < 0.001
using the `vce-cluster` command in the Stata software) shows that perceived attention restoration, place identity (emotional) and place identity (cognitive) are significant predictors of servicescape preference, \( R^2 = 0.571, F = 366.97, p < 0.001 \), thus supporting H5 and H7. Further, the coefficients (\( \beta \)) for perceived attention restoration (\( \beta = 0.488, t = 10.57, p < 0.001 \)) is higher than place identity (emotional) (\( \beta = 0.315, t = 6.41, p < 0.001 \)) and place identity (cognitive) (\( \beta = 0.205, t = 4.43, p < 0.001 \)), suggesting a higher increase in servicescape preference for every unit increase in attention restoration as compared to emotional and cognitive place identities.

To test the mediation hypotheses H6, H8 and H9, we applied Hayes (2017) approach for mediation tests, using PROCESS Macro, version 3.3, for SPSS (Hayes, 2017) Model 4 with 5000 bootstrapping resamples. The results suggest that the total indirect effect is significant (IE = 0.579, 95% CI = [0.394, 0.774], SE = 0.0966), suggesting that all three mediators collectively mediate the effect of the biomorphic servicescapes on servicescape preference. Further, biomorphic servicescapes designs have a significant indirect effect on servicescape preference through perceived attention restoration (IE = 0.296, 95% CI = [0.189, 0.415], SE = 0.0570), providing support to H6. For place identity also, the results show that biomorphic servicescapes designs have a significant indirect effect on preference through emotional place identity (IE = 0.163, 95% CI = [0.081, 0.261], SE = 0.046) and cognitive place identity (IE = 0.120, 95% CI = [0.053, 0.208], SE = 0.0395), thereby supporting H8 and H9, respectively. Table 4 below provides a summary of the findings.

**Assessment of mediation effects**

A comparison of the indirect effects shows that, of the mediators examined, perceived attention restoration is the most important mediator, followed by emotional place identity and cognitive place identity. Further examination of pairwise contrast of indirect effects (Preacher and Hayes, 2008) shows that specific indirect effect through perceived attention restoration is higher than a) specific indirect effect through emotional place identity (IE (contrast) = 0.082, 95% CI = [0.071, 0.160], SE = 0.0394) and b) specific indirect effect through...
cognitive place identity (IE\textsuperscript{contrast} = 0.1085, 95\% CI = [0.037, 0.183], SE = 0.0378). However, no significant differences were observed between specific indirect effects through emotional place identity and cognitive place identity (IE\textsuperscript{contrast} = 0.0262, 95\% CI = [−0.038, 0.094], SE = 0.0335). Also, service type and gender were included as covariates in the model but were found to have no effect on the dependent variable. Hence, it can be concluded that perceived attention restoration has the strongest mediating influence between biomorphic servicescapes and servicescape preference. Furthermore, although both emotional and cognitive place identities mediate the relationship between biomorphic servicescapes and servicescape preference, there is no significant difference between them, possibly implying that the mediating influence of place identity is more holistic.

**Discussion**

**Contribution to theory and practice**

In a highly competitive business environment, as customers’ experience becomes a vital driver of the customers’ value, service brands are paying significant attention to the design of servicescapes. Such designs need to be effective in delivering a superior experience and emotional bonding while maintaining efficiency for services marketing firms. Preference towards nature is a well-established phenomenon in architecture and environment psychology literature. However, using natural elements in servicescapes may not always be feasible and practical; hence, by extending the biophilic stream of research in marketing, this study focusses on the indirect experience of nature that mimics natural forms, known as biomorphism. This research introduces and establishes that, similar to natural elements, applying biomorphic designs in servicescapes also has a positive influence on the attention restoration, perceived place identity and servicescape preference of consumers.

Prior research studies in services marketing (Brengman et al., 2012; Purani and Kumar, 2018; Rosenbaum et al., 2016) have largely focussed only on the role of biophilia – the direct influence of nature in servicescape designs. While some studies may be found to have explored the role of individual nature-like stimuli in servicescapes like curvilinear shape (Liu et al., 2018), warm lighting (Baek et al., 2018), this research is the first to explore the indirect effects of nature in servicescape designs by introducing the holistic concept of biomorphism to marketing and management scholars. The research, through multiple studies, establishes that biomorphic designs lead to higher customers’ preference. Distinguishing from the attention restoration theory (Kaplan, 1995) and stress recovery theory (Ulrich et al., 1991) that are commonly applied in biophilic studies, this study establishes a new theoretical framework by synthesizing the S-O-R framework (Mehrabian and Russell, 1974), attention restoration theory and classical identity theory (Knez et al., 2018) to explain how biomorphism is related to customers’ preference of a servicescape. The extant studies on attention restoration are either focussed on the direct influence of nature (Brengman et al., 2012; Rosenbaum et al., 2016; Rosenbaum et al., 2018) or on specialty servicescapes (Glover and Parry, 2019; Rosenbaum, 2009; Rosenbaum and Wong, 2015). This study establishes that by incorporating biomorphic servicescape designs, attention restoration among customers is possible without introducing the direct influence of nature. Another significant contribution of this research could be the effects of biomorphic servicescape design on place identity. Although place identity has been discussed in marketing (Brocato et al., 2015), this study discusses place identity at two levels – emotional and cognitive, which is again new to the marketing domain. As hypothesised, the result shows that biomorphic designs compared to non-biomorphic ones in servicescapes generate a higher place identity, at two levels: as stronger emotional place identity (in terms of closeness or belonging with the servicescape) and stronger cognitive place identity (in terms of remembrance and thinking about the servicescape). It implies that in the absence of direct presence of nature, mimicking natural forms in designs can also increase customers’ liking as they find a match between the place and themselves and, in turn, develop a preference for the servicescape, whereby increasing the probability of revisit intentions and loyalty, willingness to pay or to spend more time and satisfaction in servicescapes. Future studies related to servicescape restoration can also think of considering place identity theory to explain consumer preferences.

The findings have implications for service marketing managers who often have to balance providing superior customer experience and the cost of the service. This study implies that managers should go beyond looking at servicescapes as just physical pieces of evidence in the service marketing mix and understand its strategic role in attention restoration and emotional bonding among customers. The results show that traditional design approaches may be easily revived for positive results with the addition of biomorphic elements in the built servicescape irrespective of the service type. In today’s context of urban densification with built environments, this study provides confidence to managers to think beyond biophilia. Bringing natural elements in an in a built environment like a servicescape where several visits from diverse customers are expected, bringing natural elements may not always be easy and efficient. With the evidence of indirect experience of nature influencing servicescape preference, managers can invest in biomorphic servicescape designs to have desired effects and improved return on investment. The findings of the first study, indeed, confirm the fact that biomorphic designs can generate a sense of naturalness among visitors, and thus it empowers managers to create more inviting servicescapes with design elements that appear more natural. Further, in the highly competitive business environment, establishing biomorphic servicescapes can also be a source of competitive advantage for them, as it can generate unique place identity for firms. Services marketers who engage with attention-deprived, highly stressed customers or who wish to position their service brands for a customer segment that identifies itself well with nature may find it useful to consider biomorphic designs of servicescapes. The study shows that managers can create place identity in servicescapes by introducing biomorphic properties in design. For services where servicescapes play a major role, such as restaurants and retailscapes, place identity helps in developing a better emotional and cognitive bonding with the customers, which, in turn, contributes to brand attachments too. As place identity improves the revisit intentions, it may create word of mouth publicity. Managers, hence, must give increased attention to the design, in order to enhance the place identity of servicescapes. Finally, it should also be noted that creating a
luxurious servicescape is not what might be desirable for all customers; rather a tacit application of biomorphic design principles can provide better outcomes.

**Limitations and future research**

Although the effect sizes for Study 1 are smaller, according to Cohen’s (1988) threshold, due to the fact that the model is backed with the proper theoretical framework, it can be considered informative (Fern and Monroe, 1996) and can have substantial implications for practical applications also (Prentice and Miller, 1992). Future research may provide stronger evidence. Another limitation could be the respondents seeing the same set of images in Study 1. To account for possible independence of errors owing to the independence of observations, we applied Cluster-Robust standard errors (White, 1984) and also did the Runs test scores (amongst 10 random respondents’ scores) and ran the Durbin–Watson statistics (Anderson et al., 2011). We found that no assumption of independence of observations seems to be violated. Similarly, for the regression analysis in Study 2 also, we used the Durbin–Watson statistics (Anderson et al., 2011) and Chow’s test (Chow, 1960) for structural stability of regression equations and both showed acceptable results. Future studies, however, may try to improve on the data collection methods. Although images to some extend can generate similar responses as that of actual servicescapes in viewers, they are still limited to only visual appeal, whereas actual servicescape would have other sensory inputs also. Future studies can explore the effects of biomorphic designs in an actual setting, using field experiments. Apart from methodological improvements to strengthen the findings, an obvious extension of this research would be to examine the moderating effects of various service contexts. For example, our results point to such effects in the case of hedonic vs utilitarian services which may be explored further. As service types such as hedonic and utilitarian are likely to influence the customer evaluation of services (Jiang and Wang, 2006), in line with the findings in the case of biophilic servicescapes (Purani and Kumar, 2018), future studies can explore if biomorphic designs in hedonic service contexts, too, are likely to generate higher attention restoration, place identity and servicescape preferences than in utilitarian service contexts. In addition, the differential effects of biomorphism between other service contexts may also be examined.

As the research borrows the idea of biomorphic designs from architecture and environmental psychology and introduces it to the marketing context, it may trigger a series of studies in management discipline such as how nature can be used to have desired effects on customers, employees and other stakeholders with whom a business organisation engages within a physical environment. Effects of biomorphic servicescape designs on different outcome variables such as customers’ re-visit intentions, time spent and purchase behaviour would further strengthen the understanding of the role that biomorphism plays as a driver of customer experience. Future research studies can also go beyond marketing and examine the effects of biomorphism on employees’ productivity, retention, work climate, etc. Like attention restoration in this study, future studies can explore the influence of biomorphism on stress using stress recovery theory (Ulrich et al., 1991) which explains how contact with nature reduces the psychophysiological stress level of individuals.

Although the two studies in this research increase the validity and generalisability of the results, assessment of the mediation effects indicate that attention restoration is the most important mediator, followed by emotional place identity and cognitive place identity and that the mediation effects by emotional and cognitive place identity have no significant difference. This, however, may vary with the type of customer groups who could vary in terms of their level of identification with nature. Thus, an extension with a different demographic and psychographic profile of customers may be required to generalise the results to all customer groups. Also, the two studies rely on self-reported measures. Future studies can explore the possibility of using more precise measures using physiological measures or neuroimaging tools. Another possible research direction could be to explore the influence of biomorphism in enhancing mood states and cognitive functioning.

**Notes**


**References**


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Appendix 1

Summary of scales used in Study-2

1 Perceived attention restoration scale (Rosenbaum et al., 2016):

- Being away: This servicescape appears to take me away from the everyday crowd, where I would be able to relax and think about what interests me.
- Fascination: This servicescape is fascinating; it is a place where I can spend a large amount of time.
- Scope: This servicescape is spacious enough that I can move freely.
- Coherence: This servicescape is where the items are neatly arranged and organised.
- Compatibility: The servicescape draws my attention without effort.

2 Place identity – emotional (Knez et al., 2018):

- I am keenly familiar with a similar servicescape.
- I miss a similar servicescape when I am not around.
- I feel strong connections to a similar servicescape.
- I feel proud of a similar servicescape.
- I feel a similar servicescape is a part of me.

3 Place identity – cognitive (Knez et al., 2018):

- I feel I can relate to a similar place over a long period.
- I feel there is a link between a similar place and my current life.
- I feel connected physically and mentally to a similar place that I have visited.
- I have strong memories attached to a similar place.
- These thoughts about the place are a part of my experience with similar servicescape.

4 Servicescape Preference (Purani and Kumar, 2018):

- I like this servicescape very much.
- I prefer this servicescape over any other servicescapes.

Appendix 2

Figure A1. 3D images developed and used in Study-2

Notes: (a) Biomorphic hospital lobby; (b) non-biomorphic hospital lobby; (c) biomorphic restaurant; (d) non-biomorphic restaurant; (e) biomorphic retail; (f) non-biomorphic retail