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Blue Gyms

Assessing Outdoor Fitness Infrastructure as Urban Blue Space Design in Coastal San Diego

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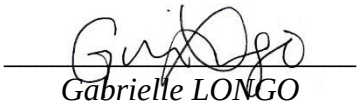

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The provision of natural spaces within the urban fabric has been advanced as a viable strategy for building resilience against the chronic lifestyle-related diseases associated with urbanization. Blue spaces have been a focus of interest in recent years for their mitigative, restorative, and instorative benefits, with the concentration on designing urban blue space for health promotion becoming increasingly relevant within the public health and urban planning agenda. Maximizing blue space potential is dependent on a complex relationship between the environment, the individual, and context-specific design features that provide opportunities for healthy lifestyles, but insufficient evidence exists regarding the real-world application of specific design solutions that promote physical activity within these spaces. This thesis draws on affordance theory to examine the provision of outdoor gyms within urban blue space design in Coastal San Diego. Utilizing behavioural observation and questionnaire analysis, study results found that outdoor gym use resulted in 28% of observed vigorous physical activity within the study site, indicating that outdoor gyms are a co-equal component of the physical activity affordance mix. Results also revealed community perception that the gyms are a cost-effective way to promote physical activity and add value to the blue space, but that specific design considerations impact their use. The analysis found that a view of the ocean and proximity to other amenities are enabling factors to outdoor gym use and that inclusion of more accessible equipment options is the most direct leverage point for their increased utilization. True to the study's pragmatic approach, these findings provide actionable insight for local stakeholders while highlighting the importance of community co-design for actualizing the health potential of urban blue spaces.

Keywords: blue space design, blue acupuncture, outdoor gym, physical activity affordance, affordance theory

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List of Abbreviations

BBAT: Blue Health Behavioral Assessment Tool
DALYs: Disability Adjusted Life Years
EU: European Union
GIS: Geographic Information System
IB: Imperial Beach
OG: Outdoor Gym
PA: Physical Activity
SOPARC: System for Observing Play and Recreation in Communities
WHO: World Health Organization

1. Introduction

As populations worldwide continue to shift toward metropolitan centers, it is more relevant than ever to understand the implications of the urban fabric on human health. Urbanization has been identified as a challenge to health and well-being and a significant contributor to the increasing prevalence of chronic lifestyle-related diseases such as obesity and cardiovascular diseases (Zhang, Nijhuis, and Newton 2022), impacted by the fast-paced and stressful environment, excessive noise levels, and unhealthy habits such as lack of physical activity (Völker and Kistemann 2015). Research has shown that the urban setting is a risk factor for poorer mental health outcomes as well (Bray et al. 2022). Indeed, studies have found that living in densely populated urban areas can lead to cognitive and emotional stress, with urbanization playing a role in the increasing prevalence of depression, slated to become the leading cause of DALYs in middle to high income countries by 2030 (Garrett et al. 2019). Despite these stressors, the economic opportunities, social networks, and healthcare services of cities continue to draw the masses (Smith et al. 2021). Currently, half of the global population already lives in cities and by 2050, over two-thirds of the world's people are projected to be urban residents (Bray et al. 2022). Given the ever-increasing scale of the problem, it is a pressing public health priority to identify leverage points for the mitigation of the negative human health impacts of urban living.

Findings from an expanding body of green and blue space literature indicate that incorporating the natural environment in cities presents one such leverage point, as the multiple benefits of these spaces to health and well-being are increasingly recognized (WHO Regional Office for Europe 2021). The literature offers a consolidated definition of green space as any open area partially or fully covered with grass, trees, shrubs, or other vegetation, encompassing dedicated

recreational spaces like public parks as well as other forms of greenery such as street trees, green roofs, forests, and community gardens (Bray et al. 2022; de Keijzer et al. 2019). The term 'blue space' instead is a collective term applied to all outdoor environments that prominently feature water or water elements and are readily accessible either through direct proximity or sensory experience. This includes both natural and man-made surface waters such as lakes, rivers, canals, fountains, and coastal water (de Keijzer et al. 2019; White et al. 2014). Although in practice green and blue spaces often overlap and studies of their benefits have historically been grouped together in research, there is recent evidence that blue spaces are particularly efficacious in influencing multiple dimensions of human and planetary health outcomes despite largely being understudied in comparison to green spaces. The promise of urban blue space research in this regard is especially relevant given the diminishing amount of urban green due to construction pressures and the continual increase in populations residing near large bodies of water (Grellier et al. 2017).

The reality of urban stressors underscores the fact that urban development does not inherently lead to sustainable development of cities but rather there is a need to understand, design, and manage natural spaces to achieve sustainable human and planetary outcomes. As academia and civil society at large become increasingly cognizant of the important role of natural spaces in the urban fabric, mature and emerging urban centers alike find themselves contemplating how best to harness the immense health potential of blue space to mitigate the inherent strain of urbanization on their residents while building resilience. Within this context, better understanding the relationship between blue spaces, health and well-being, and the design features of these spaces which support positive outcomes through the affordance of physical activity is critical for steering the development priorities of aspiring sustainable coastal cities.

1.1. Problem Definition and Research Aims

Given the high levels of inactivity and lifestyle-related diseases associated with urbanization, designing urban blue spaces which support the multiple health-promoting pathways of aquatic environments is a public health and urban design goal. Literature has found that the provision of natural spaces within the urban fabric appears to be a viable health promotion strategy for increasing physical activity, however, the existence of these spaces alone is not sufficient to create the desired public health impacts, but rather they work in tandem with context-specific design attributes that provide opportunities for active lifestyle participation (McCormack et al. 2010). Designing healthy blue spaces presents an opportunity to achieve sustainable human and planetary outcomes in coastal cities, but better understanding which specific physical activity design solutions support healthy lifestyles is necessary for realizing the health-promoting potential of blue space. One such public physical activity infrastructural element which has seen broad uptake in recent decades is the outdoor gym, yet insufficient attention has been paid to investigating its effectiveness in real-world contexts broadly, and in blue spaces in particular.

The aim of this study is to examine public outdoor gyms as physical activity affordances within urban blue space design using the city of Imperial Beach in San Diego, California as a relevant case study. This examination will be addressed through a targeted set of research questions relevant to this assessment:

RQ1 What are the current use patterns of outdoors gyms in Imperial Beach's coastal areas?

RQ2 What are blue space visitors' perceptions of outdoor gyms in Imperial Beach's coastal areas?

RQ3 What design factors are perceived as enablers and barriers to the use of outdoor gyms in coastal blue space?

In seeking to understand blue space visitors' usage, preferences, and perceptions of outdoor gyms through systematic behavioral observation and survey analysis, a secondary aim of this study is to contribute to the present knowledge of the evidence-based design of healthy blue space for practical application by urban planners, policymakers, and community stakeholders.

1.2. Disposition

This thesis is comprised of six chapters. The present chapter (Chapter 1) introduces the significance of the topic as well as the definition of the problem addressed and the research questions guiding its exploration within this thesis. Within Chapter 2, a comprehensive analysis of the research field and the contextual literature in which this thesis's specific focus is situated is presented through a literature review, in the process synthesizing central themes and identifying research gaps. Chapter 2 also provides context regarding the theories and frameworks framing this research. Chapter 3 presents and justifies the research design choices made in approaching an assessment of the research questions, beginning with a brief introduction to the study site, followed by a description of the worldview and methodological approaches taken, an explanation of the methods and tools used for data collection within the study, and finally an accounting of ethical considerations incorporated into the research design. Chapter 4 comprises a comprehensive presentation and analysis of the data collected, followed by a discussion of these findings as well as recommendations for future study in Chapter 5. Finally, the main body of the thesis will conclude with a reflection on this research and its practical relevance within Chapter 6.

2. Literature Review

The following literature review examines the current theory and research concerning public health impacts of blue space exposure for applicability in municipal planning and management of urban and peri-urban coastal environments. In this section, results of an exploratory review of the extant literature on the outcomes, pathways and design interventions related to blue space exposure and human well-being will be presented and analyzed. A diverse range of academic and grey literature will be synthesized to shed light on the relationship between blue space and health, and an overview of the state of knowledge regarding the design and implementation of healthy blue space on the local level will be addressed. After these elements are dissected, the knowledge gaps which frame the scoping of this research will be presented.

2.1. Methods Used for the Literature Review

In order to develop an overview of the relevant literature in the field, Google Scholar and LUBSearch research directory were used to identify publications based on several main search string criteria (blue space + human health; blue space design + human health; blue space interventions; outdoor gyms + blue space; physical activity + blue space). These searches were derived from literature recommendations from Professor Olga Kalantzi, blue/green space topic owner at the University of the Aegean, which served as foundational reading on the topic to direct a more substantive subsequent literature search using the terms outlined above. Abstracts were then reviewed and scanned for structure and key concepts to refine the sources based on relevancy, favorability for recent publications, and importance based on number of citations. Key themes across the literature were distilled using NVivo qualitative coding software and will be discussed in the remainder of this chapter from the broad to the specific to develop

sufficient context for this research and rationale for scoping toward outdoor gyms as blue acupuncture in coastal settings.

2.2. Literature Analysis

2.2.1. Health and Wellbeing Outcomes

Although blue space literature lacks the robustness of green space literature, research to date has consistently indicated the salutogenic potential of blue spaces for both people and planet despite noted risks. The identified well-being outcomes across the literature can largely be subcategorized into impacts on general physical health, mental health, and planetary health.

The studies which addressed physical well-being outcomes of blue space exposure spanned multiple proxy indicators, such as obesity, mortality, negative birth outcomes, physical capabilities, and overall health outcomes. As Smith et al report in their meta-analysis of quantitative studies on the topic, individuals living in closer proximity to blue spaces experience lower relative obesity levels and 1.4% less risk of all-cause mortality, although no significant bearing on birth outcomes and a negative association with children's health-related quality of life measurements (Smith et al. 2021). Studies conducted on both epidemiological and longitudinal grounds have provided evidence to suggest that individuals who reside in close proximity to the coast or have a view of it are more likely to have better physical health outcomes, and that blue spaces are more extensively utilized for promoting health and well-being than green spaces. Moreover, the beneficial effects of living near the coast are observed to be more prominent in people who belong to socioeconomically deprived sections of society, implying that living in such areas may help reduce health inequalities (Grellier et al. 2017). Other studies, however, have found that blue space use is more closely associated with mental

health benefits than physical health outcomes, which tends to be the domain of green spaces (Garrett et al. 2019; Völker and Kistemann 2015; Zhang, Nijhuis, and Newton 2022). A balanced assessment of blue space health impacts must also account for the unique hazards associated with exposure to bodies of water which have been much more deeply addressed in the academic literature than the blue space public health benefits (Grellier et al. 2017). These risks include bodies of water as vectors for diseases, drowning, flooding, gastrointestinal infections, and pollution (Grellier et al. 2017; Smith et al. 2021; White et al. 2020). While acknowledging the physical health risks, preliminary findings as to the potential physical benefits and their gaps provide a compelling case for their further exploration and documentation.

The literature associating mental health benefits with blue space proved more robust, with a recent WHO systematic review finding that experimental, cross-sectional, longitudinal, and qualitative studies consistently reported mental health benefits of the coast. This same review revealed that it was coastal exposure rather than simply coastal availability or proximity that demonstrated the greatest correlation with positive mental health effects (WHO Regional Office for Europe 2021). Commonly assessed well-being indicators such as self-esteem, self-confidence, resilience, self-efficacy, stress level, and mood showed positive self-reported outcomes in a review of therapeutic intervention studies carried out by Briton et al (Britton et al. 2020). One study which assessed the combined relationship between green and blue spaces and mental health argued that such settings enable mindfulness and impede rumination, consequently aiding in the mitigation of anxiety and depression in urban dwellers (Bray et al. 2022). Elsewhere, studies found an increase in total well-being score in relation to blue space exposure; positive associations between blue space emotional attachment, mental health, and memory; and the important role of water elements in the psychological benefits resultant from

human-nature experiences at large (Foley and Kistemann 2015; Marini et al. 2022; Völker and Kistemann 2015). Many of these positive psychological benefits relate to the unique stress reduction and restoration qualities of blue space, and coastal blue space in particular, which can mitigate stressful and cognitively demanding environments such as urban life. Indeed, intentional coastal exposure is more associated with stress reduction, happiness, and nature-connectedness than alternate natural settings such as green spaces (S. L. Bell et al. 2015; Grellier et al. 2017; White et al. 2020; Pasanen et al. 2019), and emerging evidence indicates that the most preferred sites to relax and restore are blue spaces (Völker and Kistemann 2015). Other studies approached blue spaces from a therapeutic landscapes perspective where the well-being (healing and health promoting) potential of a site is assessed by seeking to understand the subjective ways people engage with, interpret, and experience the natural setting (S. L. Bell et al. 2015). Such studies are usually qualitative in nature and indicate that, "the light, the soundscapes, the quickly changing patterns, and/or meaningful histories and personal associations are potentially important" to the reported reduction in stress around aquatic sites (White et al. 2020).

The last subcategory of benefits addressed within the literature can be grouped into the broad heading of planetary health and well-being. Many of the ecosystem services afforded by blue spaces are enjoyed jointly by people and planet, such as temperature regulation counteracting urban heat island effects, air and noise pollution potential, and a range of other well-recognized ecological benefits supporting biodiversity and habitat connectivity (Jakstis et al. 2023). Additionally, in a bidirectional fashion, valuing blue space as a health resource can lend to better management of aquatic areas (Foley and Kistemann 2015), more salutogenic and sustainable land/water use planning (Grellier et al. 2017), and the increased uptake of blue space planning as a nature-based solution (Jakstis et al. 2023). There is also some attention in the

research to the indication that blue space exposure is positively associated with pro-environmental behavior which in turn advances planetary health and well-being. Although consideration of this connection was admittedly limited within the sources consulted, White et al concluded that coastal living was associated with a closer psychological connection to nature which leads to a higher likelihood of pro-environmental behaviors such as recycling, eating seasonally and locally, and choosing more sustainable forms of transportation for short distances (White et al. 2020). Along a similar vein, Jakstis et al warn that the reduction in nature exposure from urbanization can lend to less nature-connectedness and thus less pro-environmental attitudes and behaviors, creating a negative feedback loop which amplifies both environmental degradation and reduction of nature contact (Jakstis et al. 2023). The opposite positive feedback loop is also true in which increase in blue space exposure increases pro-environmental actions, in turn supporting human health and well-being through better environmental conditions (White et al. 2020).

2.2.2. Pathways Mediating Blue Space Outcomes

Research on blue space has offered several different sets of mechanisms or pathways by which blue space exposure interacts with the planetary and human health outcomes enumerated in section 2.2.1. The most holistic organizing framework is advanced by White et al and will be adopted here as it can be seen to subsume the *five ways to well-being framework* (Anderson et al. 2017) and *therapeutic landscape framework* (Völker and Kistemann 2015) seeking to organize these relationships in alternate ways. The White conceptual model posits that the relationship between blue spaces and human health and well-being can be categorized into three pathways: mitigation, restoration, and instoration (figure 1).

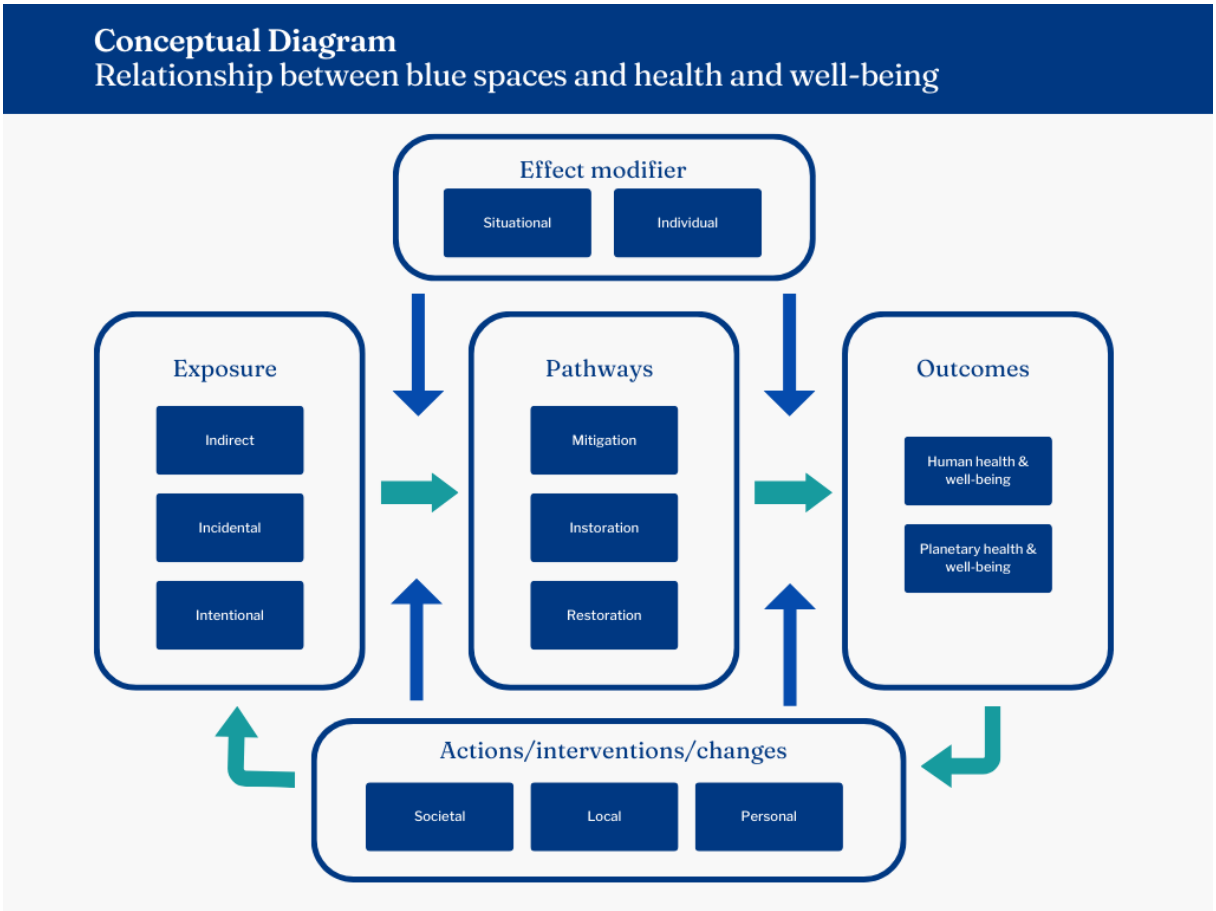

Figure 1. Relationships between blue spaces and health and well-being
Source: Own depiction after (White et al. 2020)

2.2.2.1. Mitigation

Mitigation in this context is broadly defined as human harm reduction achieved as a side effect of blue space ecosystem services. This is closely tied to the discussion of planetary health outcomes in section 2.2.1 and was given brief coverage in the literature in comparison to the other pathways. As addressed above, examples include the capacity of blue spaces to mitigate the urban heat island effect thus reducing heat-related mortality, the potential of coastal noise such as waves to mitigate urban noise pollution to positive psychological effect, and the dispersal of air pollution by sea breezes. White et al also offers tentative connections between taking in the aerosols from sea air helping to reduce breathing difficulties, marine aerosolized

toxins (in low concentrations) reducing inflammation, and the solar irradiance of blue spaces reducing the risk of poor mental health and some auto-immune and cardio-vascular diseases through higher vitamin D synthesis (White et al. 2020).

2.2.2.2. Restoration

Whereas we will later define the instoration pathway as blue space's potential to *facilitate positive* emotions, build resilience, and promote social connections, the restoration pathway instead aims to *provide relief from negative* emotions such as stress and mental fatigue. Research has identified several mechanisms through which exposure to blue spaces may restore individuals, including stress reduction, cognitive restoration, and mood improvement (Bray et al. 2022). For instance, a recent systematic literature review and meta-analysis found that exposure to blue spaces was associated with reduced stress and improved mental health outcomes such as reduced anxiety and depression (Georgiou et al. 2021).

Restoration theory posits that exposure to nature, including blue spaces, can restore cognitive functioning and reduce mental fatigue, leading to improved mood and well-being (Britton et al. 2020). The restoration pathway suggests that blue spaces can serve as a natural escape from the pressures of urban environments, offering a respite that allows individuals to restore cognitive resources that have been depleted by mental fatigue. In one systematic review of blue and green spaces (not disaggregated), the authors propose that the restorative effect is mediated by the absence of noise and the unique qualities of natural spaces which interrupt rumination and promote mindfulness, which taken together lessen the risk of depression and anxiety (Bray et al. 2022). This process of restoration may involve both physical and emotional restoration, as blue spaces offer unique opportunities for physical activity for *bodies of difference.* As one article illustrates this physically restorative property, "…blue space has the capacity to enable,

e.g. the capacities of disabled or unfit bodies for immersive and contemplative encounters that almost completely recast those capacities" (Foley and Kistemann 2015).

2.2.2.3. Instoration

The next identified pathway for positive health outcomes is instoration, defined as the capacity-building potential of blue spaces achieved through the various ways in which humans interact with these spaces. Within the instoration category, we can largely situate the therapeutic landscapes framework advanced by Völker & Kistemann in which green and blue spaces are conceived of as sites which promote health and healing. The study of therapeutic landscapes emerges from the contention that personal well-being is not a static measure of health that can be applied uniformly but rather is a subjective interpretation that varies from person to person and may change over time. It is argued research should focus on exploring individuals' personal experiences, emotions, and interactions with the world to gain a better understanding of their sense of well-being (S. L. Bell et al. 2015). Based on this logic, the therapeutic landscapes concept explores the interplay between the site's physical and built environment, its social well-being potential, and the ways in which users engage with, experience, and interpret the landscape (S. L. Bell et al. 2015).

Research conducted by Völker & Kistemann identified four interlinking processes of engagement which dictate the health promoting potential of blue space; activity space, experienced space, social space, and symbolic space (Völker and Kistemann 2015). White et al operationalize these dimensions into spaces to engage in physical exercise, to partake in positive emotional experiences and memories, to cultivate social connections, and to create sentimental bonds and personal meanings with specific locations, respectively (White et al. 2020). These processes of engagement were largely triangulated in the findings of a subsequent study by Bell

et al, in which the authors utilize the alternate terminology of 'achieving experiences' for activity space, 'immersive experiences' for experienced space, 'social experiences' for social space, and 'symbolic experiences' for symbolic space (S. L. Bell et al. 2015). This framework is illustrated in figure 2.

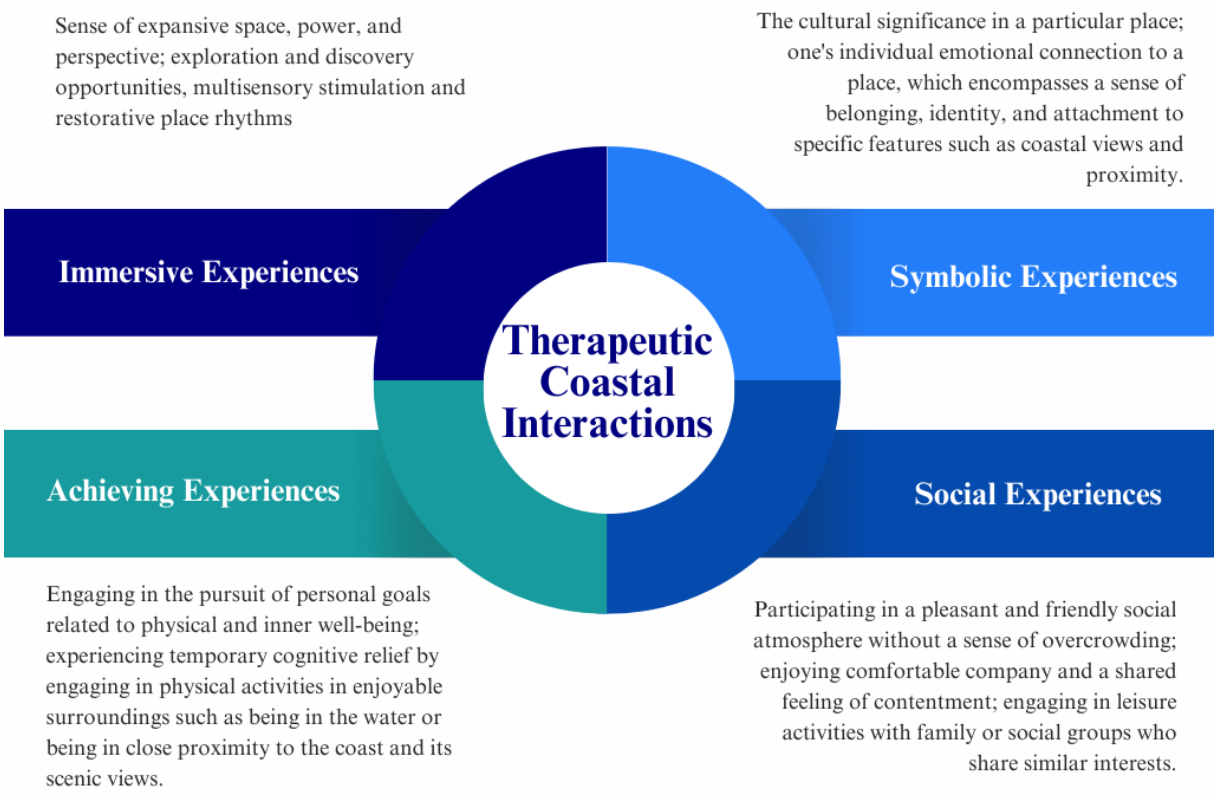

Figure 2. Dimensions of engagement with therapeutic landscapes
Source: Own depiction after (Bell et al., 2015)

Social Spaces

The narrative review of blue space undertaken by White et al uncovered the relative advantage of blue spaces over green spaces in facilitating positive social interactions. This is illustrated through evidence that blue space exposure is positively associated with increased quality time with friends and family (Georgiou et al. 2021), that social experiences are a key motivation for coastal and inland water visits, and findings from one study that indicated increased social

support for those with ready access to blue but not green spaces (White et al. 2020). Qualitative research sheds further light on the importance of the enabling social dynamics prized in the coastal setting, in particular the opportunity for friendly conversation, for connecting with others through common hobbies and activities, and the diverse prospects for family leisure (S. L. Bell et al. 2015). There are also indications that blue space exposure positively affects social cohesion, community participation, and attachment to one's neighborhood (Georgiou et al. 2021) which will be further expanded on within the symbolic space dimension.

Experienced Space

The experienced space dimension relates to the sensory experiences of being in and around blue spaces, including the sounds, smells, and visual aesthetics which have been linked to increased relaxation, deep contemplation, and stress reduction (Völker and Kistemann 2015). According to Bell et al., the immersive qualities of blue space related to their unique visual and sensory qualities such as the changing hues, intensities, brightness, and contrast of sea and sky can evoke feelings of uplift and absorption. Further, blue spaces provide a sense of spaciousness which clears the head, and the dynamic and ever-changing nature of the waves from their shifting patterns of reflective light, color, and movement leave a sense of continuity and flow which can be soothing, comforting, and absorbing (S. L. Bell et al. 2015). The dynamism of water appears to be a particular strength of blue space relative to green space, as its continuously moving and changing form is visually stimulating and aesthetically pleasing which results in greater affective-emotional responses than the more stagnant, constant nature of green spaces (Völker and Kistemann 2015).

Symbolic Space

Symbolic space refers to the cultural and personal meanings that are attached to blue spaces, such as their historical, spiritual, or emotional significance. This dimension has been linked to feelings of identity, belonging, and cultural pride. These attachment bonds are evident in quantitative and qualitative research which reveals coastal settings are among people's favorite places. Landscape preference research has consistently documented the strong preference for aquatic environments over all other landscape settings, with this preference actually being so consistently strong that some studies have intentionally excluded aquatic settings to minimize its distortion in the consideration of natural settings in general (White et al. 2016). Research has found that these are often places where people go to self-regulate their emotions, to feel better or less lonely, and to attain feelings of calmness through the sea's simplicity (S. L. Bell et al. 2015; White et al. 2020). These same studies described feelings of conscious emotional connection to seascapes from study participants, articulating that the waves are a strong reminder of a connection to something greater than oneself, and that blue space is central to their sense of belonging and identity to their coastal locality (which was notably present even when participants didn't engage with the coast on a routine basis).

Similar symbolic connections were found regarding inland blue, specifically Völker & Kistemann's study of the Rhine River in two German urban centers. Findings corroborated the fact that water acts as a central component of emotional place attachment, evoking strong feelings of spirituality, creativity, freedom, happiness, and positive contemplation (Völker and Kistemann 2015). Indeed, one survey participant relayed that the Rhine was a central aspect of quality of life in their city and was of huge symbolic importance to the city itself (Völker and Kistemann 2015).

The salutogenic effects of the coast through the 'symbolic space' dimension are linked to strong emotional nature connectiveness bonds, which appear to result from a range of diverse personal and/or collective experiences gained over time (S. L. Bell et al. 2015). While it is true that nature connectedness is a dispositional trait in which some people just inherently feel more affinity than others, research has also found empirical evidence that coastal dwellers exhibit higher affinity levels and that intentional exposure to (high quality) blue space also lends to higher trait nature connectedness (White et al. 2020).

Activity Space

The 'activity space' dimension of the therapeutic landscape framework refers to the attributes of natural spaces that enable or encourage physical activity (PA), which can be instrumental in promoting physical and mental health. Several studies have shown that increased exposure to outdoor blue spaces, including visits to the beach, is associated with higher levels of PA, and living closer to the coast increases the likelihood of meeting PA guidelines (Gascon et al. 2017; Grellier et al. 2017; Pasanen et al. 2019; White et al. 2020). Much of the literature posits that the positive health outcomes of coastal proximity may be related to higher levels of PA due to the proposed activity-promoting potential of urban blue spaces contributing to personal capacity-building (Pasanen et al. 2019). Blue spaces offer diverse and inclusive opportunities for activity, from rehabilitative and gently enabling water-specific activities such as swimming, bathing, sailing, rowing, and fishing, as well as land-based activities such as walking, biking, and skating (Foley and Kistemann 2015). The longitudinal nature of urban blue spaces such as rivers, coasts, and lakes can motivate engagement in dynamic activities (Völker and Kistemann 2015), and although some studies have found that blue spaces support primarily lower intensity activities such as walking (Foley and Kistemann 2015; Völker and Kistemann 2015) there is

also some initial evidence that people tend to engage in longer exercise sessions when they are in blue spaces compared to green or urban settings (White et al. 2020).

Although greater levels of PA has consistently been identified as a potential mechanism of health and well-being in relation to blue spaces, scant research exists delving into what specific types of activities might account for this as the majority of studies have not disaggregated between different activities taking place on, in, or near blue space (Pasanen et al. 2019). The few studies that could be found, however, identified on-shore PA as the predominant activity in these spaces (Pasanen et al. 2019; White et al. 2020), and walking in particular which had positive indirect effect on health and well-being (Pasanen et al. 2019). However, the types of activities assessed were not exhaustive and lacked inclusion of outdoor gyms, a notable feature within Southern San Diego's coastal fabric.

Maintaining an active lifestyle is considered to be a foundational element of health which contributes to the prevention and treatment of lifestyle-related noncommunicable diseases and is also independently linked to higher subjective wellbeing and mental health outcomes (Anderson et al. 2017; Marini et al. 2022). There is a contention that space affects human activity (Völker and Kistemann 2015), that outdoor PA presents greater affective benefits over indoor PA (Pasanen et al. 2019), and that blue space imbues the additional therapeutic landscape benefits enumerated earlier in this chapter. Therefore, searching for a better understanding of what elements and conditions are associated with the salutogenic potential of urban blue and encourage increased PA should be an urban design priority and a potent public health tool (White et al. 2014).

2.2.3. Theory and Practice of Blue Space Design

As discussed previously in this chapter, a growing body of literature has identified an association between blue space exposure and health outcomes, with research showing those with coastal access tend to experience higher subjective wellbeing, better general health, and fewer mental health symptoms. Given these associations there has been increasing interest from a diverse range of stakeholders - from academia, urban design, communities, and government entities - to incorporate data from this emerging field of research into practice. Health and wellbeing is increasingly considered a central factor in city planning (Smith et al. 2021) and so expanding the evidence-base for stakeholders seeking to maximize green and blue space potential in this regard is a priority (Grellier et al. 2017). Through this prism, green and blue space design is a nature-based solution which can address some of the identified challenges of the urban environment, particularly when designed in a context-specific manner targeting the specific socio-ecological landscape in which they are present (Jakstis et al. 2023).

Before delving into the state of blue space design practice, it is useful to have a preliminary introduction into the discourses and theories which frame it. Firstly, *healthy blue space* is an emergent concept in the literature, following on the heels of healthy green space literature, and conceives of blue space as health-enabling places where water serves as the dominant environmental feature and which possess some identifiable potential for wellbeing promotion (Foley and Kistemann 2015). The obvious distinction here between blue space at large is the natural quality of the blue space in question and/or the amenities located within the space which facilitate the health pathways covered previously, as not all urban blue spaces are inherently *healthy blue space* (Smith et al. 2021). The design and creation of healthy blue space then is conceptually closely tied to the *socio-ecological model of health* as well as *affordance theory*,

particularly when considering the role of these spaces in influencing the active lifestyle choices of users.

The socio-ecological model is a framework which considers the fact that multi-level factors influence health, meaning that health is not just shaped by individual attributes such as attitudes and biology but also social, institutional, and community factors (Sibson, Scherrer, and Ryan 2018; Van Dyck et al. 2013). It argues that the environmental context plays a significant role in determining health behaviors and presents a better leverage point for effecting change than merely focusing on individual attributes due to their relatively unmovable character of individual attributes. More directly put, modifying or improving the physical and constructed surroundings in which people recreate is argued to produce more probable long-lasting changes than individual level interventions seeing as many individual factors are relatively unchangeable (Cranney et al. 2016; Schipperijn et al. 2013; Van Dyck et al. 2013).

Affordance theory can be seen as the operationalization of the socio-ecological model. Affordances are the physical or perceived properties of the environment which create opportunities or illicit beneficial user behavior (S. Bell et al. 2020; 2021). For example, designed affordances within blue space can range from the inclusion of a picnic table as a functional signifier for social activities to an open design with sweeping aquatic views to afford positive emotional perceptions and thereby encourage visits (S. Bell et al. 2020). Affordance theory serves as an increasingly utilized theoretical framework for stakeholders seeking to design public spaces which incorporate an understanding of the "link between the environment, human behavior, and human needs fulfillment" (Mehan 2017) and has been argued to be an apt systematic framework through which environmental policy-makers can analyze human behavior within socio-ecological systems, helping to translate sustainable concepts into actualized sustainable behaviors (Kaaronen 2017). It is not the mere presence of specific

infrastructure that defines an affordance, but rather the complex interplay between individual characteristics of a potential user (such as their abilities), their perceptions, needs, and intentions, and whether these elements match the opportunities afforded by the features present in the built or natural environment (Mehan 2017). Based on this theory, the physical, social, symbolic, and experiential opportunities offered within an environment cannot be studied solely based on the functional properties of the built environmental features, but also on the perceptions and behavioral responses of individuals interacting with those environmental features (Mehan 2017), which is impacted by dimensions such as perceived aesthetics, design quality, meaning, and suitability to user needs and intentions (Mishra et al. 2023). Affordance theory and the socio-ecological model will be revisited in the subsequent chapter as they are foundational concepts to the design of outdoor space for the affordance of physical activity.

In practice, blue space design exists at many different spatial scales and contexts. Cataloguing the limited (though expanding) knowledge base within the field of healthy blue space design is the EU-funded BlueHealth project, which serves as a pillar and impetus for studies assessing the impact of design interventions encouraging the use of blue space in health promotion (S. Bell et al. 2020). The BlueHealth project and its multi-method standardized tools (Grellier et al. 2020) have contributed to the mapping and quantification of health associations for natural blue spaces and their associated infrastructure (Grellier et al. 2017), with particular focus given to, "planning, infrastructure, quantity of, and distance to, blue space, the attributes of blue space and the means of contact and activities which potentially affect the impacts on health" (S. Bell et al. 2020). Knowledge generated from BlueHealth case studies to date has allowed for the recent publication of the book *"Urban Blue Spaces: Planning and Design for Water, Health, and Well-being",* an extensive tome deriving lessons from applied research related to 180 case studies, spanning extensive redevelopment projects of significant scale and cost to modest

design solutions at minimal cost. These smaller scale solutions have been deemed *blue acupuncture* points (a derivative of the term *urban acupuncture)*, which are small-scale designs applied tactically to transform the urban fabric (S. Bell et al. 2021).

Blue acupuncture is a concept of considerable interest to this research for several reasons related to the triple bottom line of sustainability. Firstly, *blue acupuncture* specifically focuses on small interventions within urban blue spaces with the potential to return a much greater effect in comparison to the investment needed to implement it (S. Bell et al. 2020). This means that blue acupuncture elements can present a more accessible and immediate leverage point for under resourced or underfunded communities to catalyze health promoting changes in their blue spaces when more extensive blue space design is not economically feasible. Secondly, large scale blue space redevelopment can be associated with gentrification and the marginalization of certain user groups which would otherwise have access to the benefits of smaller scale solutions (S. Bell et al. 2021). Despite their often modest scale, acupuncture elements can be seen to combat the effects of urban decay and the negative perceptions of an area, thus revitalizing the urban fabric and community well-being without causing exclusion of marginalized groups (S. Bell et al. 2021). Lastly, the small-scale approach tends to have a smaller carbon footprint (Chow and Wu 2019) and take into greater account the maintenance of the genius loci of an area, seeking to respectfully fit a health-enhancing element into the existing landscape to uncover or highlight the potential of an area while leaving the larger urban nature surrounding it largely untouched (S. Bell et al. 2021). In the end, the scale and nature of blue space design is necessarily context specific, but the accessibility and sustainability dimensions of *blue acupuncture* as a tool for creating healthy blue spaces demonstrates great potential. In this way, the confluence of natural and targeted urban design features can influence

user behavior in blue spaces, and this knowledge can then be utilized to maximize engagement pathways associated with health and wellbeing.

2.2.3.1. Designing for Physical Activity in Blue Space

Given the levels of inactivity and lifestyle-related chronic disease associated with urban life, designing green and blue spaces which not only attract sustained visitation but also encourage physical activity within these spaces is a public health goal (Veitch et al. 2018) and indeed, recent physical activity research supports the notion that high-quality urban design may contribute to well-being (Anderson et al. 2017). As discussed earlier, the socio ecological model advances the contention that health behaviors, including physical activity patterns, are influenced by the interplay between individuals and their physical landscape and that designing the built and natural environment for physical activity affordances has been positioned as a much more permanent and effective approach to increasing active lifestyle choices across a population than targeted clinical or individual intervention programs (Chow, Mowen, and Wu 2017; Cranney et al. 2016; Sibson, Scherrer, and Ryan 2018).

Studies in this domain have consistently found that parks and natural spaces present a viable strategy for health promotion through physical activity affordances (Cranney et al. 2016; Payne et al. 2005; Sibson, Scherrer, and Ryan 2018) and that it is not access to these spaces alone that increase physical activity expenditure but infrastructural and design attributes that potentially attract more people and increased exercise within these spaces (McCormack et al. 2010; Sibson, Scherrer, and Ryan 2018). Indeed, the built environment of blue and green spaces can alternately enable or limit active lifestyle participation (McCormack et al. 2010) and result in underutilization or the use of mainly sedentary activities if not intentionally designed (Cranney, Shaw, and Phongsavan 2019). Since people have a strong preference for blue space and are

already willing to visit them for the restorative benefits outlined earlier, understanding blue infrastructure initiatives that encourage more active forms of recreation is crucial for compounding their disease prevention and health promotion potential (Grellier et al. 2020). Affordance theory provides an appropriate framework through which to examine the functional properties of the physical activity infrastructure and the perceptions and behavioral response which drive their use or under-use (Mehan 2017).

As it turns out, however, very few studies within the blue space literature sought to identify the potential health associations from *specific* physical activities and physical activity affordances in blue spaces in a disaggregated manner. Of the limited findings that exist, it appears that on-shore activities (rather than immersive aquatic activities) and walking in particular account for the bulk of physical activity undertaken in these settings (S. L. Bell et al. 2015; Grellier et al. 2017; White et al. 2020; Völker and Kistemann 2015; Pasanen et al. 2019). Developing a broader knowledge base of how users engage with a range of potential physical activity affordances could identify leverage points to encourage higher intensity activities as a complement to the walking that already takes place. One systemic review of blue space interventions targeting therapeutic/rehabilitative blue care initiatives identified interesting findings regarding 'challenging' activities that may logically be extended to members of the general population. Findings from this review identified 'challenging' activities as a contributing factor to enjoyment and linked to greater sustained well-being measures (Britton et al. 2020). This, combined with the fact with that government health guidance recommends the incorporation of moderate to vigorous intensity fitness and strength training activity to see health risk reductions (Cranney et al. 2016; Fernández-Rodríguez et al. 2020), means that design elements creating affordances for higher intensity physical activity are of considerable

interest. One such design element that has been increasingly applied in blue and green spaces in recent decades is the outdoor gym.

2.2.3.2. Outdoor Gyms as Physical Activity Affordances

Outdoor gyms, also known as outdoor fitness equipment or OGs, are clusters of weather-resistant exercise machines or exercise stations that enable individuals to perform physical activity in open spaces (Lee et al., 2018). OGs have become increasingly popular worldwide as a potential public health strategy, promoting structured physical activity in green and blue spaces in urban and peri-urban environments (Marini et al., 2022).

Several studies have investigated the role of OGs in influencing structured physical activity and the health outcomes of their users. Resistance training using outdoor fitness equipment has been shown to improve body muscular strength, aerobic fitness, functional mobility, systolic blood pressure, and waist circumference (Marini et al., 2022). However, the results of studies on the health outcomes of OGs are mixed and context specific (Marini et al., 2022), and lack studies specifically considering OGs in blue space.

Despite mixed results, OGs have been found to be an affordable and accessible way for urban residents to participate in structured physical activity and find social connectedness (Lee et al., 2018). Health was found to be a central theme of users' experiences with OGs and they also tend to attract users who perform other types of exercise and engagement with the given space in addition to OG activity (Lee et al., 2018), which could plausibly allow the user to engage with the additional health-related dimensions of blue space (symbolic, social, and experienced space) although this does not appear to have been the focus of any studies.

Overall, OGs are seen as environmental infrastructure with interesting potential for further research and have the potential to provide activity space opportunities for large numbers of people in natural settings (Cohen et al., 2012). By understanding users' experiences, perceptions, and usage of OGs in different cultural contexts, a better foundation of knowledge can be built regarding the potential of OGs as cost effective blue acupuncture points, for utilization by urban planners, policymakers, and communities alike (Lee et al., 2018). Further research is also needed to explore the design parameters of OGs that will elicit the intended human health benefits, behaviors, and user satisfaction (Lee et al., 2018).

2.2.3.3. Key findings and research gaps

The research on blue spaces and their potential health benefits has grown in recent years, but there are still several research gaps that have been consistently identified within the literature. While much research has focused on the health and well-being benefits of green space proximity or exposure, until recently there has been limited research into how specific design interventions for blue spaces may contribute to making a difference in levels of physical activity, positive effects on health, social and environmental outcomes (Gascon et al., 2017; Grellier et al., 2017; Marini et al., 2022; Völker & Kistemann, 2015). To close this gap, researchers advocate for combining quantitative and qualitative methods to evaluate blue space as a public health resource to be sustainably developed and managed (Foley & Kistemann, 2015). The general health-related value of blue space and the role of physical activity within blue spaces have also attracted less attention to date in comparison to mental health- focused studies (Britton et al., 2020).

The growing interest in evidence-based design may be hindered by inadequate research on the effects of specific design solutions, resulting in unsatisfactory outcomes and a failure to fully

realize the intended social benefits of the investment (S. Bell et al., 2020). This issue is particularly prevalent in studies on blue spaces, where practical exploration from a design standpoint is lacking; indeed, most studies focus on identifying health outcomes and pathways, with insufficient attention given to the translation of blue space health evidence into concrete design concepts and implementing them in real-world projects (Zhang et al., 2022). Overall, there is a need for more interdisciplinary work using qualitative, multi-faceted, and quantitative methods (Foley & Kistemann, 2015) to capture potential links between blue space design and human and planetary wellbeing (Anderson et al., 2017). Although current research highlights the health benefits of nature exposure, further investigation is needed to identify effective design interventions in real-world situations following the example of EU's BlueHealth project.

Assessing the design, use, and perceptions of outdoor gyms in blue space could present one such leverage point for practical application of blue space research. Seeing as little is known about the types of PA undertaken by coastal residents (Gascon et al., 2017; Pasanen et al., 2019) nor the context-specific use of OGs despite widespread municipal investment in public OG installation (Nałęcz, Ostrowska-Tryzno, and Pawlikowska-Piechotka 2018; Chow, Mowen, and Wu 2017; Stride et al. 2017; Scott et al. 2021; Sibson, Scherrer, and Ryan 2018), applied research assessing the functional role of OGs in coastal settings would build an important knowledge base to support or deter the increased uptake of this form of environmental infrastructure by policy makers, urban planners, and other relevant stakeholders (Lee et al., 2018).

3. Research Design and Methods

The aim of this research is to assess the potential of outdoor gyms as physical activity affordance in Imperial Beach, California. To do this, this study seeks to answer three research questions:

RQ1 What are the current use patterns of outdoors gyms in Imperial Beach's coastal areas?

RQ2 What are blue space visitors' perceptions of outdoor gyms in Imperial Beach's coastal areas?

RQ3 What design factors are perceived as enablers and barriers to the use of outdoor gyms in coastal blue space?

I will attempt to answer these questions through a systematic analysis of quantitative data obtained through validated observational tools using momentary time sampling and adapted to the context of the study site, coupled with cross-sectional non-random sampling survey data. This chapter will describe and justify the research design choices made in conducting an assessment of the aforementioned questions. We will start with a brief description of Imperial Beach as an appropriate study site for this research, followed by a description of the worldview and methodological approaches taken, an explanation of the methods and tools utilized for data collection, and finally an account of ethical considerations.

3.1. Imperial Beach

Imperial Beach, located in San Diego County, California, emerged as an appropriate case study through which to examine the research questions at hand. This self-purported 'classic surf town'

(City of Imperial Beach 2023) offers a unique combination of peri-urban and natural environments given its proximity to the city of San Diego and its natural setting highly characterized by the presence of blue space owing to being enclosed by water on three sides; Pacific Coast to the West, Tijuana River Estuary to the South, and the San Diego Bay to the North East (see figure 3). In recent years, public officials have expressed a priority in expanding health-promoting infrastructure and resources within the Imperial Beach community and the city is in the midst of a years-long, phased redevelopment process. This chapter will explore the suitability of Imperial Beach as an appropriate and timely study site for this research by presenting its socio-demographic traits, municipal priorities, and the unique challenge of its location and natural environment.

Imperial Beach forms the most southwesterly extremity of the San Diego metropolitan area, a city which the most recent census data ranks as the eighth most populous city in the United States (US Census Bureau 2021). Imperial Beach itself houses a more modest population of 27,334 and can be classified as peri-urban or urban periphery (County of San Diego 2022). It is a diverse majority-minority community composed of 51.5% Hispanic, 32.4% Non-Hispanic White, 5.5% Black, and 6.3% Asian, a demographic profile in fairly dramatic contrast to the coastal communities to the North of San Diego County where the percentage of non-Hispanic white represents from 69-86% of the population composition. Although boasting 3.5 miles of white sand beach, to this point Imperial Beach has lagged behind the economic trajectory of all of San Diego's county's other coastal areas as evidenced by county socio-economic data. With a median household income of $59,795, Imperial Beach sits well below San Diego's median household income of $82,426 and far below the $161,705 median household income of the most wealthy coastal community in the county (San Diego County 2023).

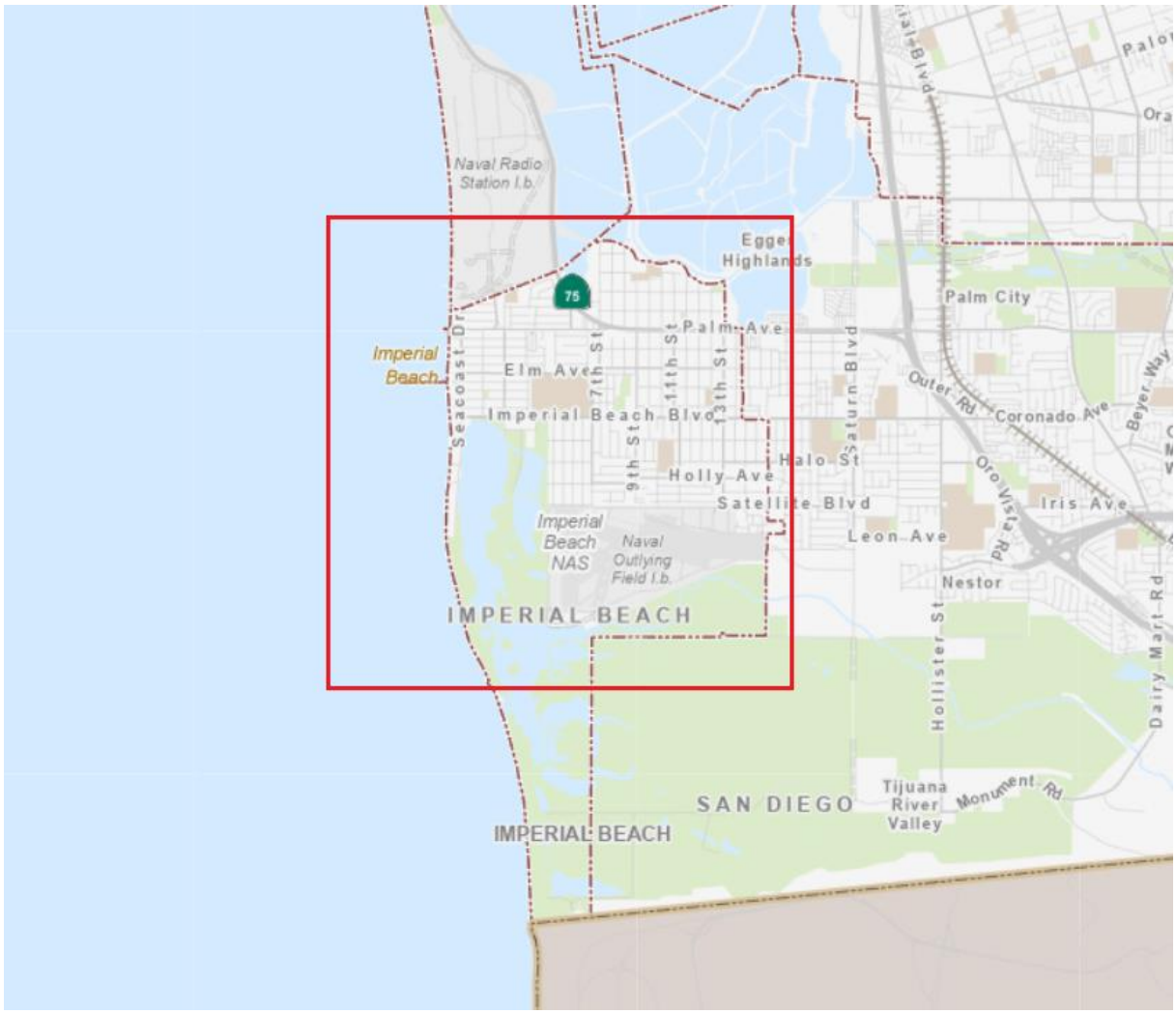

Figure 3. Map of Imperial Beach and surrounding blue space

According to a 2022 county report exploring health disparities, Imperial Beach is categorized as a *low socioeconomic* group (the second lowest on a five level scale) which is associated with higher relative burden of certain cancers, adjustment disorders, mood and psychotic disorders, compounded with the higher burden of chronic diseases such as hypertensive disorders and diabetes found to be associated with San Diego's urban peripheral zones in the same report (County of San Diego 2022). Given evidence of the health and wealth inequalities within San Diego's coastal zones, a focus on the potential of free physical activity-focused infrastructure in an area of relative disadvantage was deemed apt given the previously discussed tendency for blue acupuncture points to revitalize urban decay and support community well-being without

excluding existing and marginalized groups (S. Bell et al. 2021). Further, focusing on Imperial Beach as a study site heeds calls from within environmental justice discourse to combat the tendency of urban nature to serve as assets primarily for the urban elites by better incorporating areas of, "concentrated ethnic minorities and economically disadvantaged populations" within the research agenda to address disparities (Kato-Huerta and Geneletti 2022).

Municipal authorities have sought to combat Imperial Beach's historic economic challenges by embarking on a multi-phase community development plan which they have dubbed *The Big Picture*. This general development plan voiced a commitment to a resilient and sustainable transition to increased economic stability, seeking to leverage Imperial Beach's natural assets and 'classic southern California character' towards a redevelopment plan which attracts greater tourism and supports higher resident quality of life (City of Imperial Beach 2019). In the city's 2019 Local Coastal Program Land Use plan, there is a clear emphasis placed on valorizing the area's blue and green spaces, both in terms of parks and coastal open space preservation, as a pathway of community public health and tourism-focused development. As evidence of this commitment, Imperial Beach has resurrected a dedicated Parks and Recreation Department which had been dissolved in 2014 due to budget cuts. Within the previously referenced Local Coastal Program Land Use Plan, this newly reformed Parks and Recreation Department lists its goals as four-fold:

1. A city with abundant public beaches, parks and recreational amenities to support a healthy environment and high quality of life for residents and visitors.
2. Preservation and enhancement of public beaches and coastal resources that contribute to the city's identity and scenic beauty.
3. Recreational amenities that support a healthy community and a strong economy.

4. A city that provides access to beaches and parks that supports the enjoyment of recreational opportunities for all (City of Imperial Beach 2019).

Within these goals one can see priorities which, if properly executed, directly advance the *experienced space*, *social space*, *active space*, and *symbolic space* potential of blue space previously discussed in Chapter 2. In line with the reestablishment of the Parks and Recreation Department, city leadership (spearheaded by the former mayor and city manager) have leaned into the installation of outdoor gym infrastructure, indicating their hope that "expanding the types of amenities [available] will lead to better health in the community and use of the parks by more residents with different interests" (Hernandez 2018). In their efforts to support public community health and make Imperial Beach "a total fitness city" through built environmental design in green and blue spaces, the city has installed 10 pullup bars across various coastal and inland areas and secured the 2018 installation of a seven station *fitness court* based on full-body bodyweight exercises in a beachfront park (Hernandez 2018). Given the municipal authority's purported dedication to a sustainable human health development pathway as a central part of the city's redevelopment process, a study assessing the current use patterns and perceptions of built physical activity infrastructure can provide useful data to guide future blue space design interventions as the next phase of *The Big Picture* comes into focus. This is particularly true in the case of outdoor gym equipment, whose relatively small spatial and carbon footprint may offer a minimally invasive design intervention for coastal areas where maintaining the genius loci is prioritized and for a historically underfunded Parks and Recreation Department seeking cost efficient measures to support the physical activity needs of the community. As the literature review revealed a gap in the understanding of specific physical activity design solutions implemented in real-world projects (S. Bell et al. 2020; Zhang, Nijhuis, and Newton 2022) and given Imperial Beach's uptake of various outdoor gym infrastructure in coastal spaces, it

appears particularly timely to seek a better understanding of their current use and preference patterns so as to build a context-specific body of evidence-based design knowledge informing the future trajectory of physical activity affordances.

Lastly, Imperial Beach is an appropriate study site due to the unique and entrenched environmental challenges because of its location and geopolitics. On one hand, it sits at the terminus of the binational Tijuana River Watershed, which is comprised of the Tijuana River National Estuarine Research Reserve, Tijuana River Valley Regional Park Preserve, Tijuana River Mouth State Marine Conservation Area, San Diego Bay National Wildlife Refuge, and the Coronado Islands (Aguirre, n.d.). Together, these areas constitute some of the most ecologically significant ecosystems of the Pacific Coast (Aguirre, n.d.), and the inherent human health benefits derived from an area of such diverse blue space types would seem logical after findings within the literature review presented in Chapter 2.

And yet, this picture is muddied considerably by a contentious cross-border conflict over recurrent environmental disasters. As the most southwesterly city in the continental United States, Imperial Beach directly abuts the Mexican metropolis of Tijuana, with the aforementioned ecological zone encompassing the border area between the two countries (and cities). Tijuana's inadequate city infrastructure has led to frequent sewage leaks into the Tijuana River which naturally drains through the estuarine and coastal ecosystem, fouling coastal waters. An additional source of marine pollution can be traced to Tijuana's ineffectual Punta Bandera sewage treatment plant several miles south of the border which discharges over 40 million gallons of raw sewage into the surf which contaminates beach water quality for large stretches up and down the coast, affecting human and planetary health in both countries (Aguirre, n.d.). This protracted issue is the cause of considerable frustration and concern to municipal authorities and community members alike in the targeted study site resulting in the

city of Imperial Beach threating legal action against the governing agency in charge of binational water issues (Mendoza 2017). Given the complicated cross-border governance issues, addressing the root cause of this environmental damage will continue to be slow to be addressed and is outside of the scope of this study.

What does pertain to this study's is the reality of frequent beach closures due to water contamination and thus the inability to rely on aquatic physical activity affordances to support the *activity space* dimension of human health benefits for Imperial Beach residents. These continual swimming closures, such as the closure in effect during this thesis study (see figure 4), mean that the usual higher-intensity aquatic activities (swimming, surfing, surf-kayaking etc.) are often not accessible for realizing the instorative benefits of physical activity in this particular coastal area. Given this unfortunate reality, it becomes even more pertinent to seek ways to leverage onshore physical activity affordances. Thus, understanding the use, acceptance, and perceptions of outdoor gyms will help municipal authorities understand whether outdoor gyms are possible blue acupuncture points for higher intensity physical activity to maximize the health potential of blue spaces while mitigating health risks of this particular blue space.

The confluence of socio-economic factors, municipal priorities, and cross-border environmental challenges addressed within this section support the suitability of Imperial Beach as an appropriate and timely study site for this research.

Figure 4. Notification of swimming closure at the study site during research period

3.2. Worldview and Methodology

The influence of a researcher's worldview on the development of the relevant research design is significant and therefore warrants initial discussion. Defined as "a basic set of beliefs that guide action" (Creswell and Creswell 2018), a worldview embodies the general philosophical orientation from which the researcher approaches the world and research itself, and influences how research problems are framed, how research methods are selected, and how data is analyzed and interpreted (Creswell and Creswell 2018). Thus, establishing the orientation of my worldview and its operationalization within the methodological decisions made, I hope to illustrate the coherence between the elements of my research design.

This study was informed by and approached from a pragmatic worldview, a philosophy which is concerned with, "actions, situations, and consequences rather than antecedent conditions" and is characterized by "a concern with applications -what works- and solutions to problems" (Creswell and Creswell 2018). Indeed, the development of the three research questions underpinning this study are closely informed by the problem-centered philosophy of the pragmatists. By seeking to understand real-world use patterns and perceptions of outdoor gyms as blue acupuncture, my research seeks to inform design solutions of blue space physical activity affordances in a specific context.

Research based on pragmatism is not inherently tied to any definitive system of assumptions or methods but rather affords the researcher a certain freedom of choice to employ the techniques and methods deemed most appropriate to the purposes of the research. According to Creswell and Creswell, mixed methods approaches are often associated with this worldview, but ultimately, the pragmatic approach empowers the researcher to apply methods and techniques that are deemed most likely to approach the intended consequences given the context.

With this pragmatic worldview serving as a basis, the research questions and research aims of this study are best served by a quantitative design composed of a systematic observation study of current outdoor gym use patterns complemented by a cross-sectional survey questionnaire based on convenience sampling to probe reported use patterns, opinions and perceptions of outdoor gym benefits and design. Although qualitative semi-structured interviews would have undoubtedly offered additional rich description and insight, a quantitative study of outdoor gym use and perceptions was deemed more generalizable and feasible for the purposes of the study: to illicit community-level insights to inform the direction of blue space design.

3.3. Data Collection and Methods

To adequately address the research questions posed in Chapter 1, quantitative data from blue space visitors in a defined coastal area of Imperial Beach will be collected in two phases, with a systematic non-participatory behavioral observation method first employed to assess RQ1 and a survey questionnaire of blue space users employed to address RQ2 and RQ3. In this way, RQ2 and RQ3 are designed to build on RQ1 by providing a base of generalizable data which may lend insight into associations between observed use patterns and blue space user perceptions. In a bidirectional fashion, the systematic observation technique employed for RQ1 embeds a measure of triangulation regarding self-reported use-patterns to check for social desirability bias potentially emergent from the survey questionnaire. This combination of methods- behavioral observation and cross-sectional survey- aims to augment the credibility of this study through methodological triangulation, an approach which literature associates with higher confidence in results (Rau 2022).

3.3.1. Systematic Observation

As emerged through the literature review, the provision of public outdoor gyms has become increasingly widespread as PA infrastructure. This increased uptake can be considered a public health strategy for combatting the lifestyle-related diseases associated with urban living based on affordance theory. And yet, the literature review revealed a gap in knowledge around how outdoor gyms are actually used in real-world situations, and studies that did assess use factors indicated that results are highly context specific. Thus, the purpose of RQ1 is to provide valuable insight into the current use patterns of outdoor gyms in Imperial Beach's coastal areas. In this way, RQ1 seeks to set a basis of the real-world use patterns of outdoor gyms in the

context of Imperial Beach's specific characteristics for further contextualization through RQ2 and RQ3.

To establish actual use patterns, this study will use a non-participatory direct behavioral observation method through momentary time sampling using two validated and reliable tools to capture and map user behavior in the study site; the Blue Health Behavioral Assessment Tool (BBAT) and System for Observing Play and Recreation in Communities (SOPARC). Blue Acupuncture sites have thus far largely been studied through the lens of pre-post experiments which measure relative use patterns before and after the design intervention (i.e., the installation of an outdoor gym) using these tools. Due to the time constraints of this study and the fact that no outdoor gym installation occurred during the study period within the study site, a pre-post observational design was not possible. Nonetheless, identifying how people *currently use existing* public space is also extremely useful, as understanding the demographics and physical activity patterns of blue space users in relation to blue space design attributes can inform programming, planning, and management of these spaces and future design priorities (S. Bell, Vassiljev, and Wilczynska, n.d.; Evenson et al. 2016). Thus, rather than a pre-post intervention approach, this study will apply a direct behavioral observation method based on momentary time sampling to map and analyze current use of the outdoor gyms in relation to other activity affordances present in the study area (S. Bell, Vassiljev, and Wilczynska, n.d.).

Direct behavioral observation using momentary time sampling is an appropriate methodology for investigating physical activity behavior for several reasons. First and foremost, direct observation methods offer an objective, systematic, and non-intrusive measure of physical activity behavior, reducing the reliance on self-reported measures that may be subject to recall and response bias and triangulating findings (Prince et al. 2008). Additionally, direct systematic observation has proven feasible as a population-level assessment method due to its ability to

efficiently evaluate physical activity levels in a sizeable sample size within a short timeframe, without imposing any burden on participants (Cohen et al. 2011). Direct observation in the context of physical activity studies involves in situ mapping of defined demographic, social, and physical activity attributes (type of activity and intensity) of outdoor space users to record behavior in a design setting (S. Bell, Vassiljev, and Wilczynska, n.d.).

Momentary time sampling, which involves systematic left to right scans and recording of each participant within a defined target area at particular time periods throughout the day, has been verified as a reliable and valid technique for yielding accurate behavioral samples from direct observation, and is applied widely in physical activity research in blue and green space (Evenson et al. 2016; McKenzie et al. 2019). Tools such as BBAT and SOPARC which are based on momentary time sampling, essentially provide a snapshot of hourly counts at different times of the day and days of the week and is a sufficiently robust sampling technique to generalize overall usage patterns of the observed spaces (Cohen et al. 2011). Studies have found that when continuous direct observation of a study area (requiring 14 hours of daily observation for 7 days) is not feasible due to time or resource constraints, momentary time sampling in which behavior is observed, "4 times a day for 2 days, or 3 times a day for 3 days, or twice a day for 5 days allow[s] for accurate estimation of the sum of all target areas" when incorporating both weekdays and weekend days into the observation schedule (Cohen et al. 2011). The aforementioned reliability findings informed the observation schedule adopted for this study and is expanded on in the *procedure* section below.

System for Observing Play and Recreation in Communities

SOPARC is a widely applied methodological tool used to assess physical activity levels and contextual factors in public recreation spaces. It involves systematic and periodic scans of

individuals within pre-determined target observation areas within a larger public space, allowing for momentary observations of park users and their physical activity intensity and has been shown to produce acceptable reliability and validity for measuring park user attributes and physical activity patterns (Cohen et al. 2011; Cranney, Shaw, and Phongsavan 2019; McKenzie et al. 2019). According to the description and procedures manual, during systematic left to right scans of the target area, every individual's activity level is mechanically or electronically coded as either sedentary, moderate/walking, or vigorous and the gender, age grouping, and additional optional variables dependent on study research question are also recorded. The data resultant from the SOPARC method allows for comparisons of PA levels across the varying built and natural features of the park in question and allows for an analysis of estimated energy expenditure in varying park areas (McKenzie et al. 2019).

BlueHealth Behavioral Assessment Tool

The BBAT strengthens the validated theory and approach of traditional, paper-based behavior observation by transitioning the tool to a Geographic Information System (GIS)-based software application which provides for increased precision, accuracy, recording speed, and amount of observed data points in a tool specifically developed for blue space settings (S. Bell, Vassiljev, and Wilczynska, n.d.). Developed as part of the EU's BlueHealth toolbox, the BBAT methodology is a technique that employs direct observation to capture the actions and essential demographic features of users in a specific location, allowing information to be collected on how users interact with different design affordances. It is implemented on-site, and the exact location, weather, and time variables, along with the type of activity and social context are noted using a portable GIS-enabled device. The collected data uncover the most frequented and less popular locations and activities within the space and determine variances in spatial distribution,

lending to later visual and statistical analysis. The BBAT tool is suitable for use with the SOPARC tool but provides more detailed information on the location and types of activities as well as information on blue space interactions and affordances (S. Bell, Vassiljev, and Wilczynska, n.d.); in this study, the BBAT and SOPARC method were jointly used to capture additional data for analysis.

To apply the BBAT tool, the observer marks the position of each user in a scanning zone on a map, followed by entering a sequence of drop-down menu selections on a tablet computer's GIS interface to reflect subject's age range, gender, social context (alone, in pairs, in a group), and primary activity (S. Bell, Vassiljev, and Wilczynska, n.d.; S. Bell et al. 2020). This scanning and recording procedure is conducted within three scheduled time periods per day. The BBAT procedure entails modifications to the drop-down menu variables based on site-specific attributes; the modifications made to the BBAT to fit the context of the Imperial Beach study site and to incorporate the SOPARC tool within the application will be explained next in the *procedure* section.

Procedure

The data collection and analysis procedure to assess RQ1 was carried out in accordance with the BlueHealth Behavior Assessment Tool protocol manual and sequential steps involved in this methodology (Vassiljev, n.d.).

1. Background data collection

   An initial overview survey was conducted to identify suitable blue space target sites within Imperial Beach for data collection. The inclusion criteria for site selection were:

   - Contains outdoor gym(s)

- Contains outdoor gym(s) installed more than a year prior to research to avoid novelty bias (Sibson, Scherrer, and Ryan 2018)
- Contains multiple natural and built affordances to allow for comparative analysis of outdoor gyms against multiple passive and active activities
- Situated along the Pacific Coast side (rather than bay side) of the city, whose waters are more heavily affected by sewage contamination and thus more pressing a study site for reasons enumerated in section 3.1
- Manageable size for direct observation by one researcher

The Seacoast Drive waterfront area comprised of commercial features, natural beachfront, and two built coastal parks each containing an outdoor gym was selected based on these criteria. The characteristics of the study site were first observed to identify likely zones within the site where activities were concentrated and to delineate focus areas of the larger Seacoast Drive waterfront. The coastal park and adjacent beachfront areas of both Pier Plaza and Dunes Park were identified as activity zones (see figure 5). Pier Plaza is fashioned as the iconic symbol of Imperial Beach and contains shade arbors, bike racks and paths, a pier, picnic tables and benches, a grass field, children's play zone, wooden pullup bars, and sandy beachfront. All affordances within Pier Plaza provide a direct view of the Pacific Ocean. Dunes Park, a 5-minute walk north of Pier Plaza, contains a half-court basketball court, picnic tables, children's playground, grass area, seven-station calisthenic outdoor gym (installed in 2018), and sandy beachfront. The basketball court and grassy areas of Dunes Park possess a direct ocean view while the children's playground and outdoor gym area do not.

Figure 5. Study site and activity zones

2. Preparation of site maps and observation routes

A digital aerial image of the study site was obtained from the United States National Oceanic and Atmospheric Organization (NOAA) in GeoTiff format compatible with QGIS, the free and open-source GIS software for which the BBAT application was built. Pier Plaza was subdivided into six observation zones and Dunes Park was subdivided into five observation zones. A systematic observation route was established, starting at Pier Plaza and rotating clockwise through each zone and then walking to Dunes Park for a clockwise rotation through each zone so that all eleven zones were systematically observed at each scheduled time period. Since the observational design is non-participatory in nature, during this preparatory phase, fixed observation points in each zone were selected with a focus on being as unobtrusive as possible to the blue space

users and allowing data collection with minimal attention drawn to the surveyor (Vassiljev, n.d.).

3. Design site-specific coding system for BBAT application

Each observation period consists of collecting behavior data which is entered for each individual present during a systematic scan of an observation zone, entering in only one primary activity for each. The BBAT application is pre-set with pre-defined drop-down lists of active and passive activities common to blue space settings. The coded activities and additional demographic attributes pre-set into the BBAT application were modified based on the background data collected in step one to reflect the context-specific affordances present at Pier Plaza and Dunes Park. Given the study focus on *on-shore* rather than *aquatic* physical activity comparison, coding for any activities in or on the water were excluded and the on-shore activity codes within the BBAT were updated to exclude any activities which were not possible or present in the study area (i.e. the coding for horseback riding was deleted). Additions to the BBAT application included programming in a distinct activity code for *outdoor gym*, an additional dropdown to indicate which specific calisthenic movement group of the outdoor gym was being used (core, push, pull, bend, lunge, squat, agility), and an additional dropdown for SOPARC intensity rating. Figure 6 depicts the BBAT behavior data interface in QGIS.

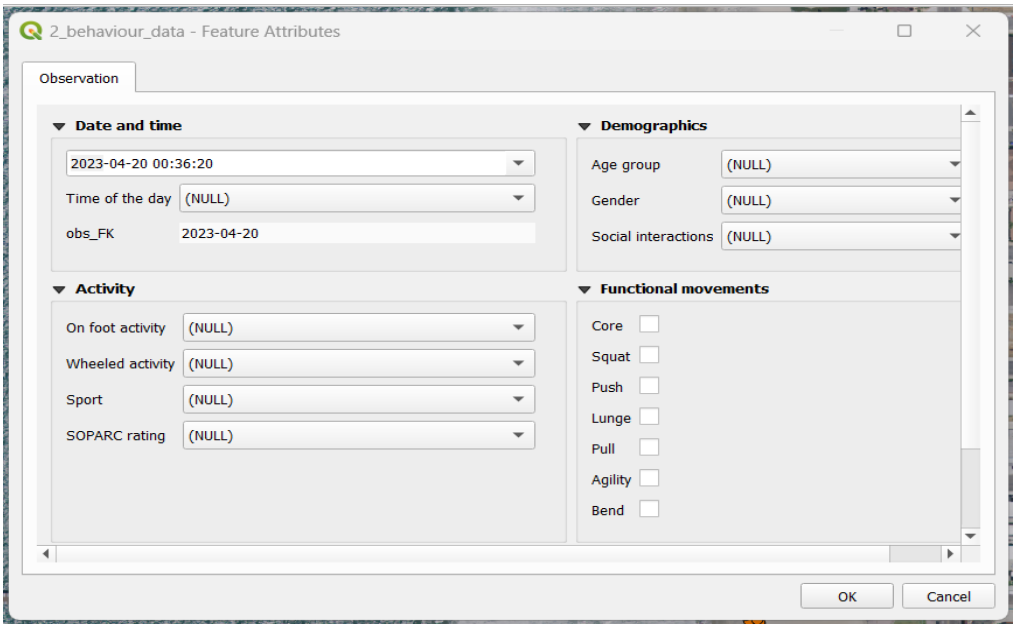

Figure 6. Modified BBAT Interface for behavioral data collection

4. Sampling Schedule

Data was collected over the course of two weeks in April, incorporating weekdays and weekend days into the schedule. Following BBAT protocol, observation periods were broken up into morning (7:00-11:00), lunch (11:00-15:00), and afternoon (15:00-19:00) time blocks, with one complete rotation of all eleven observation zones carried out within the constraints of each respective time block. Given findings reported in relevant momentary time sampling literature as to the minimum observation periods and days needed to achieve reliability (three days of three sampling periods) (Cohen et al. 2011), the sampling schedule adopted for this study amounted to three daily samplings over the course of five weekdays and two weekend days resulting in 971 total observation data points recorded between April 3 to April 15, 2023.

5. Visual and Statistical Analysis

   The collected observational data was analyzed in QGIS 3.30.0 to reveal outdoor gym usage patterns both independently and in relation to other physical and active activities performed in the blue space study site. Visual and descriptive statistical analysis was used to compare the mapped data and analyze spatial and affordance attributes, the relative physical activity intensity of difference design affordances, and to understand the behavior and interaction of different demographic segments to different design features.

3.3.2. Cross-Sectional Quantitative Survey Questionnaire

Quantitative data collection through a survey design was utilized to address RQ2 and RQ3. The purpose of this portion of the study is to evaluate blue space visitors' perceptions of outdoor gyms within the study site and to elicit which of a range of design factors impact the use of outdoor gym in Imperial Beach's coastal areas. A survey method was deemed an appropriate approach for the identified research questions since the aim is to develop community-level knowledge within the constraints of a thesis semester where cost-effectiveness and a feasible turnaround time for data collection are necessary considerations within the study design. A cross-sectional survey design will provide a "…description of trends, attitude, or opinions…with the intent of generalizing from a sample to a population" (Creswell and Creswell 2018), allowing this study to gather data from a relatively larger sample of individuals within a short period of time and to identify relationships between variables of interest. Given the timescale of the study period and the aim of the research, a cross-sectional rather than longitudinal approach was inherent, with data collected within one defined window of time to

provide a snapshot of community-level opinions of outdoor gym affordances and design factors in the target community of Imperial Beach.

Generalizable information on the perceptions and preferences of the local community were deemed more aligned with the pragmatic worldview of this study than alternate qualitative designs would have allowed within the timeframe; although this decision sacrifices the rich description and meaning that qualitative semi-structured interviews may have provided, deriving broader community-level trends and opinions are a more appropriate to the task of developing evidenced-based design insight that may inform future blue space interventions in the Imperial Beach community. A cross-sectional survey design lends well to the aims of the study, affords considerable benefits in terms of research feasibility, and also echoes the model of the EU BlueHealth project discussed previously which pairs the BBAT observational tool with a standardized community-level survey (Grellier et al. 2020).

Survey Design

The survey developed for the purpose of RQ2 and RQ3 is a structured online questionnaire built using professional Qualtrics survey software and incorporating a mix of direct validated instruments and instruments derived from existing literature which have been modified to the context of the study site and scope of this study.

To holistically approach the research questions, the questionnaire is subdivided into four sections: practices, opinions/perceptions, design preferences, and personal data. These sections were designed to function together to evaluate self-reported blue space use as well as outdoor gym use in relation to other affordances within the study site, perceptions of the potential benefits/drawbacks of outdoor gyms in the study area as well as perceptions of the design

attributes of the current outdoor gyms, and finally design preference factors which impact use of outdoor gyms in this particular coastal community setting. In order to explore relationships between personal attributes of respondents and their practices, perceptions, and preferences, pertinent demographic data such as age, gender identification, and general health and well-being were also collected within the questionnaire.

The questionnaire is composed of 17 total questions, of which 3 are conditional based on previous question response. Implementing dynamic conditional survey questions through Qualtrics' display logic function ensures that the question progression of the survey was customized to the extent possible to the respondent to minimize survey abandonment and collection of meaningful data. Additionally, in order to reduce response bias, the questionnaire is designed to include a range of question types which occasionally repeat in alternate forms. To this end, the questionnaire developed includes open, closed, dichotomous, multiple choice and multiple-answer, and Likert-style scaled response questions.

To gather data on blue space and outdoor gym use practices within the study site, the survey question design included:

- Closed questions, where respondents reported on frequency of blue space visits for the purpose of leisure/recreation in the past 12 months. A validated and reliable instrument from the EU BlueHealth community level survey was adapted to the study site context. This standardized EU BlueHealth question is based on the British Monitor of Engagement with the Natural Environment survey, with this specific measure serving as an inference for the respondent's general amount of contact with the blue space environment in the preceding year (Elliott, n.d.). A closed multiple-answer question to illicit usual active and passive activities performed during blue space visits were also adapted from the EU BlueHealth community-level survey to fit the affordances within

the study site in line with adaptations made to the BBAT within the behavioral observation phase of this study conducted prior. This question has also been validated as a tool within similar study designs consulted at the literature review stage (Schipperijn et al. 2013; Sibson, Scherrer, and Ryan 2018).

- Closed dichotomous (yes/no) question regarding outdoor gym use adapted from Sibson et al's questionnaire on stretch stations in green spaces (Sibson, Scherrer, and Ryan 2018).
- Conditional multiple answer questions aimed at understanding motivations or barriers accounting for respondent's use (or lack of use) of the outdoor gym equipment in the study area. This question was adapted from a study by Fraser et al and incorporated thematic motivation and deterrent options commonly reported in relevant literature (Fraser, Munoz, and MacRury 2019). This question also included an open entry option for further contextualization.

To gather data regarding perceptions as to the about benefits and drawbacks of coastal outdoor gyms in the study site in a general sense and perceptions about the specific attributes of the outdoor gyms in question, the survey question design incorporated:

- 5-point Likert-type questions (Strongly disagree – strongly agree) and dichotomous (yes/no) questions adapted from Sibson et al and the EU BlueHealth community-level survey perceptions as to the about benefits and drawbacks of coastal outdoor gyms in the study site in a general sense and perceptions about the specific attributes of the outdoor gyms in question (Elliott, n.d.; Sibson, Scherrer, and Ryan 2018).
- 5-point Likert-type question regarding satisfaction with the two individual outdoor gyms within the study area and a conditional open ended question probing for what

improvements would improve the respondent satisfaction of the coastal outdoor gym if the level of satisfaction reported was at a 3 or below of the question's 5 point scale.

To capture data on design factors which impact the use of coastal outdoor gyms in the study site, the survey design incorporated:

- A ranking question, where respondents report on which of a list of design factors they believe are most likely to positively impact outdoor gym use in the study site. The design factor categories included in this ranking question were largely derived from themes emergent in the outdoor gym literature and adapted to the context. Thematic ranking options for design factors were proximity to the ocean, co-location to other amenities (restrooms etc.), aesthetic appeal of equipment, surrounding landscape, quantity of exercise stations, types of exercises available and availability of shade in addition to an open-ended option to insert and rank a design factor not included in the themed list. Response options were randomized within the Qualtrics software to minimize potential researcher bias within this question.
- A closed multiple choice, multiple answer question where the respondents could indicate which exercise equipment they would most likely use from six illustrated options of common exercises types consistent with the basic human movements of calisthenic body weight training. Due to the infeasibility of incorporating all possible equipment types within the scope of this study, the movements and equipment selected for inclusion within this question serve as proxies for major movement categories (i.e. a sit-up bench serves as a proxy for the larger category of equipment targeting abdominal/core movements). This is a conditional question based on the Qualtrics display logic function and was presented to respondents only if they ranked the

importance of ‘types of exercises available’ within the top 3 options for the preceding survey question.

Lastly, 9 questions were built into the personal information section of the survey, incorporating validated and reliable Qualtrics survey bank questions capturing age and gender identification, validated questions directly applied from the EU BlueHealth community level survey to capture general health, well-being, and physical activity levels, and a final question regarding preferred environment for physical activity (indoors, outdoor green space, or outdoor blue space) adapted from a green space questionnaire to the context (Fraser, Munoz, and MacRury 2019). In this way relationships between perceptions, practices, and design preferences can be analyzed in relation to different demographic and self-reported health variables.

Population and Sampling

The target population for this study is Imperial Beach residents 18 years and older. Flyers explaining the research study and providing a QR code to the online survey were posted in the target parks and digital postings were simultaneously made in multiple Imperial Beach-specific online forums to broaden the potential participant base and increase the respondent pool. The online dissemination of the survey questionnaire amounts to a non-random convenience sampling of Imperial Beach residents, who participate on a voluntary and self-directed basis. This sampling technique provided significant feasibility advantages for the study and allowed for a more robust sample number. Additionally, the self-administered online format reduces social desirability bias of reporting physical activity practices which may result from researcher administered face to face surveys and allows. Although data from a non-random sampling is considered less-generalizable than random sampling, there exists established precedent within

green space and physical activity research for the utilization of convenience sampling (Furber et al. 2014; Sibson, Scherrer, and Ryan 2018).

3.4. Ethics Statement

This research was carried out in accordance with the ethical guidelines of Central European University (CEU) which are the guidelines of record for MESPOM theses undertaken at the University of Aegean. The study and data collection procedure complied with CEU Official Document P-1012-1v2201: Ethical Research Policy and thus did not require submission to the Ethics Review Board.

The research conducted for this study uses the BBAT and SOPARC non-participatory behavioral observation method to observe physical activity patterns in public coastal settings. In non-participatory behavioral observation research, obtaining consent from every individual is neither practical nor feasible so to ensure compliance with ethical guidelines, no personally identifiable information was documented, and individuals were recorded as anonymous data points. The BBAT and SOPARC observational tools do not utilize any pictures or videos for observations and the subject's privacy and anonymity are maintained through the research process. Data collection was conducted only in public contexts where those observed would reasonably expect to be observed by strangers.

For the survey questionnaire portion of the study design, data collection was based on voluntary participation from respondents with prior informed consent. No personally identifiable information was collected to maintain anonymity and protect the privacy of participants. To ensure that participants were informed before providing consent, the written questionnaire explained the nature and objectives of the research, that the responses collected will be used

only for purposes of research carried out for fulfillment of a thesis requirement and under the supervision with the University of the Aegean, Department of the Environment. Findings derived from survey responses to close-ended questions were presented in aggregate statistical form where anonymity of participants was ensured and responses to open-ended survey questions were reported maintaining individual confidentiality. The anonymous nature of observational and survey data prevents any potential unforeseen disadvantage or damage resulting from participation in this study.

This research was not funded by any external organization or individuals which inhibited the free expression of findings and a reflexive approach was employed throughout the research process to minimize subconscious personal bias to the extent possible.

4. Results and Interpretation

4.1. RQ 1 Usage Patterns

To give the analysis of outdoor gym usage proper meaning and context, the collected observational data was assessed comparative to all passive and active onshore activities conducted at the blue space study site. The results, presented within this chapter, were analyzed geospatially through QGIS and using descriptive statistics.

4.1.1. General Usage Patterns

Data collection conducted at Dunes Park and Pier Plaza resulted in a total of 971 data points, of which 442 (46%) were female and 529 (54%) were male. In line with the BBAT procedure, demographic data on age was collected based on a coding scheme broken down into *child* 0-12 years old, *teenager* 13 to 20 years old, *adult* 21 to 59 years old, and *seniors* 60 years and older.

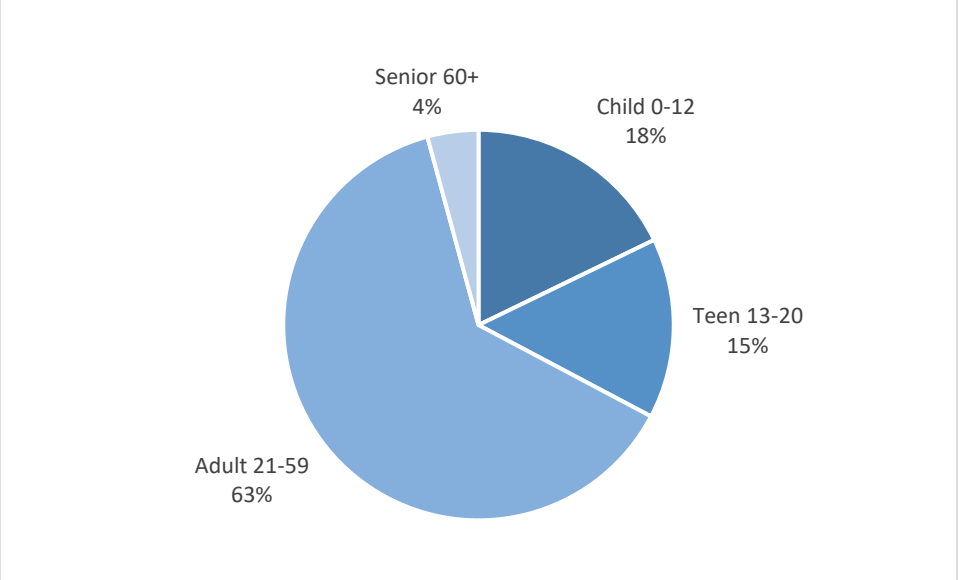

Figure 7. Share of overall blue space observations by age

Following this coding, the data revealed that the parks in question are predominantly used by adults at 63% of observed data points followed by much smaller shares of children, teens, and a minority of seniors (see figure 7). The overall breakdown of park users by age and gender is presented in figure 8.

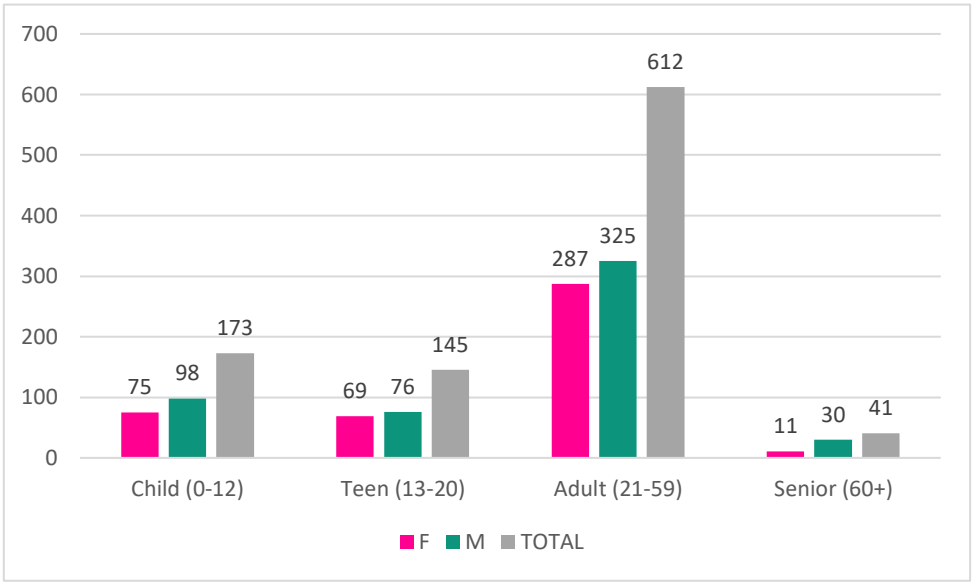

Figure 8. Overall blue space observations by age and gender

The behavior data collected revealed a diversity of passive and active behavior in the blue spaces under study, but clear activity preferences immediately emerged (see figure 9). The results show that the most prevalent activities were sitting/crouching, walking (from strolling to moderate gait), and standing. S*itting or crouching* is a coding which encompasses a range of sedentary positions which were predominantly observed along built ocean-facing seating affordances, grassy areas with a view to the ocean, and on the sand beach itself. Notes collected with the BBAT software (and supported by the geospatial analysis presented next) connect the *standing* coding with blue space visitors standing in positions allowing direct observation of the seascape. The popularity of the *sitting* and *standing* coding within the observed blue space is unsurprising given the well-researched nature of the coast as *experienced space*, one of the

four prongs of the therapeutic landscape framework discussed previously, in which the immersive sensory attributes of the blue space bestow positive affective-emotional responses associated with uplift and relaxation. *Strolling* and *walking at a moderate pace* emerged as the most prevalent of the 'active' typology of activities, which is again consistent with findings from related blue space literature discussed in chapter 2 (White et al. 2014; Pasanen et al. 2019).

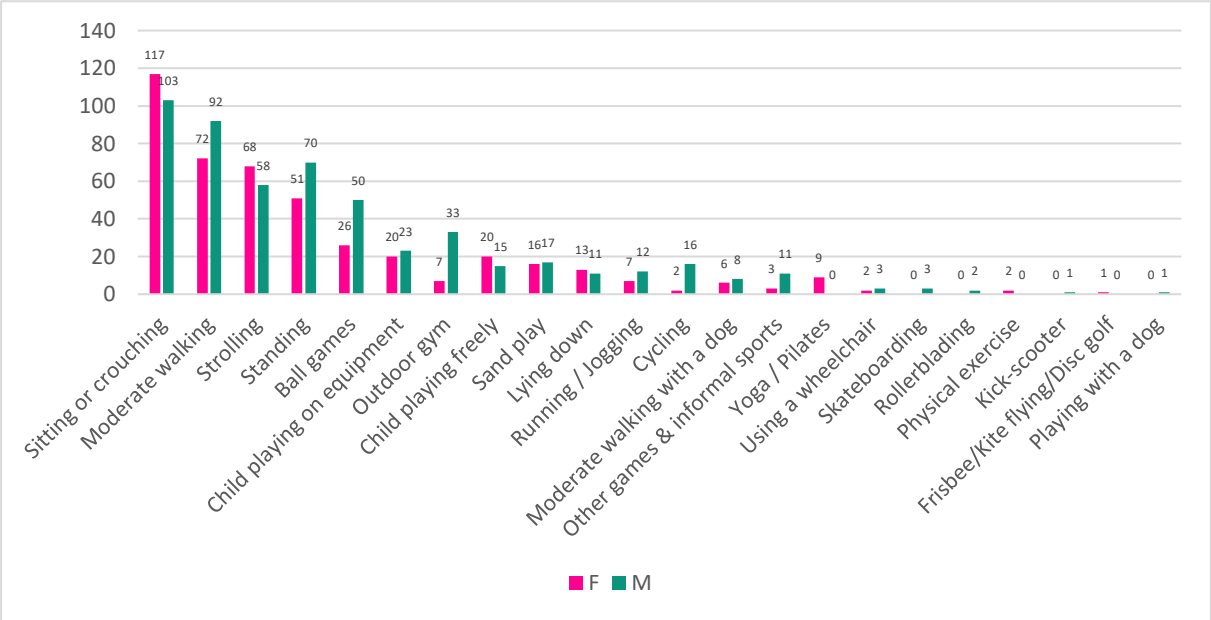

Figure 9. Prevalence of observed passive and active behaviors

Next, a heat map analysis was performed in QGIS to allow for the visualization of patterns in the spatial data. A heat map analysis aggregates the data points to create a color-coded map of areas of high and low intensity usage, providing a baseline understanding of the spatial distribution and concentration of blue space users to identify areas of high usage and cool zones of low or dispersed usage. This is an especially useful tool when approaching the data from the conceptual basis of *affordances*, as the resultant heat map provides valuable baseline insight into the relationship between the passive and active behaviors being performed and the utilization (or underutilization) of a range of design features present in the blue space. The

resultant heat maps illustrating usage patterns at Pier Plaza and Dunes Park are shown in figure 10 and figure 15, respectively.

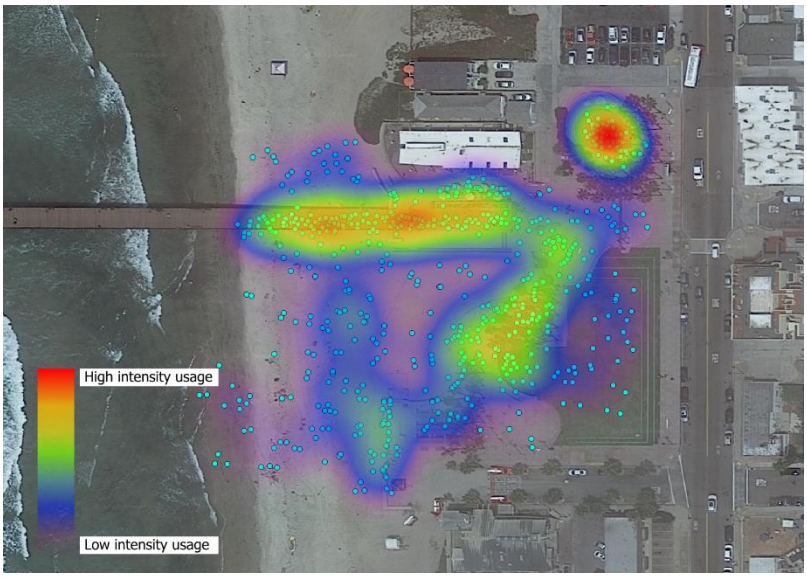

Figure 10. Heat map showing distribution and intensity of usage at Pier Plaza

The heat map of Pier Plaza, depicted in figure 10, presents clear usage intensity trends in relation to the design features of the blue space. Results show that the pier walkway elicits moderate to high usage while the children's playground elicits the highest usage intensity of the natural and built affordances in the Pier Plaza study site. A more modest usage intensity is evident near the Pier Plaza outdoor gym (figure 11), shaded seating area immediately adjacent to the gym (figure 12), and stone boulders near the entry pathway from the street (figure 13). More dispersed but still evident usage trends can be noted along the beach wall which offers direct standing views of the ocean scape (figure 14), as well as dispersed in a lower density throughout the natural sand beach immediately in front of the built design features of Pier Plaza. Although aquatic activities are outside of the scope of the study, observational notes from fieldwork report frequent sightings of individuals surfing in proximity to the pier, despite the

Imperial Beach waters being closed by municipal authorities during the study period because of water contamination.

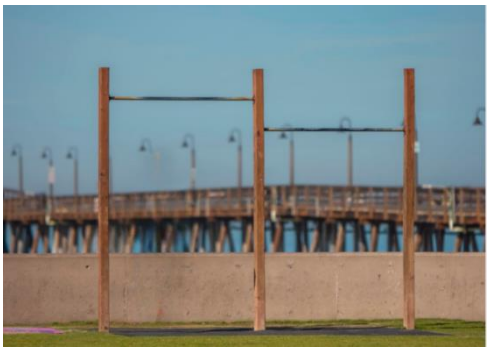

Figure 11. Pier Plaza outdoor gym

Figure 12. Seating area adjacent to outdoor gym

Figure 13. Boulders near park entrance

Figure 14. Beach wall

The heat map of Dunes Park resulted in more clearly defined high usage zones, as shown in figure 15. The heat map analysis clearly shows high usage intensity in three main nuclei geospatially linked to the children's playground (figure 16), multi-station outdoor gym (figure 17), and half court basketball court (figure 18). More moderate but notable centers of usage are linked to a grassy hilltop overlooking the beach and seascape (figure 19), as well as the natural beach area immediately in front of the built design features of Dunes Park. The natural beach usage intensity area is the sole high usage intensity area not linked to a built design affordance, as volleyball games were observed in the identified location absent of built

infrastructure for that usage. Dispersed, low intensity trends are noted throughout the rest of the sand beach.

This heat map analysis provided useful initial insight into the spatial distribution and intensity of usage patterns in Pier Plaza and Dunes Park. Although the heat map provides keys to *where* blue space users are most commonly interacting with the natural and built affordances of the sites, further analysis is required to unveil *how* blue space users are interacting with affordances within the site, which will be assessed through an analysis of physical activity intensity patterns.

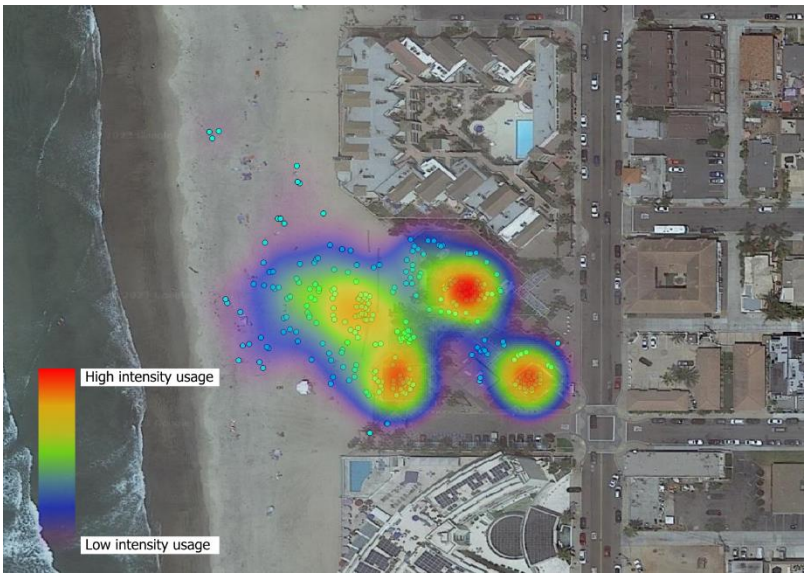

Figure 15. Heat map showing distribution and intensity of usage at Pier Plaza

Figure 16. Dunes Park playground

Figure 17. Dunes Park outdoor gym

Figure 18. Dunes Park basketball court

Figure 19. Grass hill

4.1.2. Physical Activity Usage Patterns

Given this research's scoping toward physical activity as one of the central prongs of the instorative pathway linking blue space with human health, a consideration of the collected data proceeded with an analysis of PA intensity within the study site. Here again, descriptive and geospatial statistics will be presented showing overall PA intensity level, activity type, and geospatial distribution of PA intensity levels.

As described in the methodology section, the standard GIS-based BBAT interface was modified for this study to include additional coding for SOPARC rating. Thus, each data-point entered was geospatially located, assigned a primary activity, and coded for a SOPARC PA intensity level of either *sedentary*, *moderate*, or *vigorous*. The results show that the observed behavior within the studied blue space reflect nearly equal proportion of sedentary and moderate intensity PA behavior at 39% and 38% respectively, while vigorously rated PA accounts for 23% of observed behavior (figure 20). Female and male coded data points showed a negligible difference for sedentary and moderate activity, while vigorous activity was observed more in males (63%) than in females (37%) (figure 21).

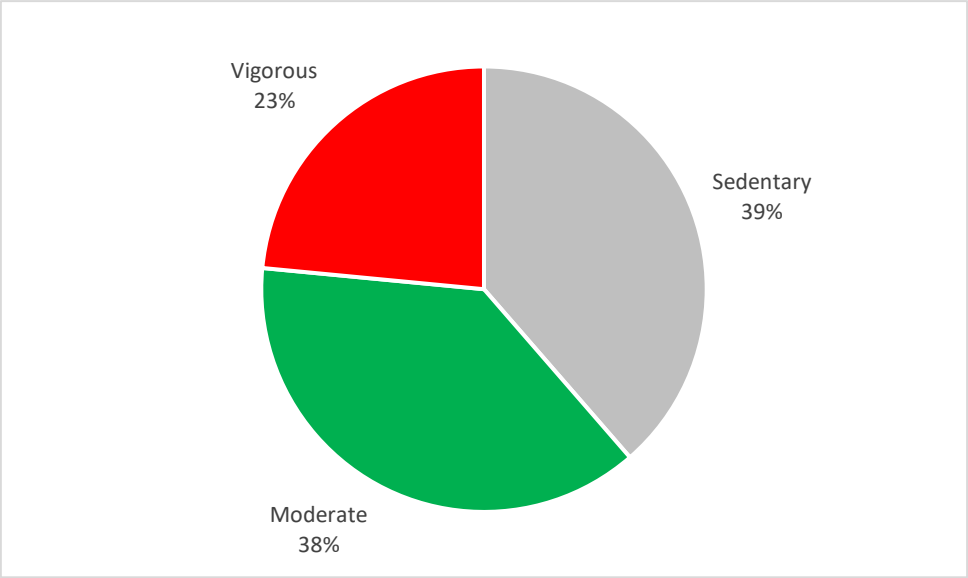

Figure 20. Physical activity intensity of observed blue space users by SOPARC rating

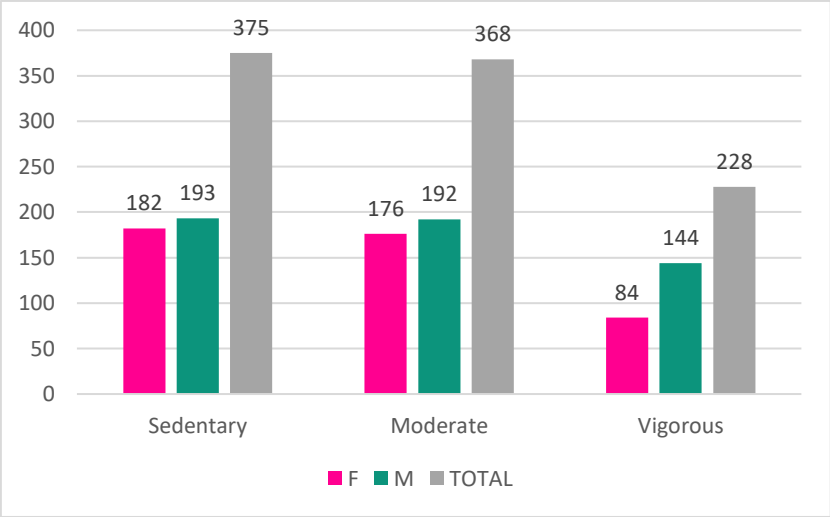

Figure 21. PA intensity of observed blue space users by SOPARC rating and gender

To assess the PA intensity data against the blue space affordances present in the study site, QGIS was again utilized for geospatial analysis. The data points were first color coded based on SOPARC rating to help identify initial visual trends (figure 22). A hot spot analysis, which identifies spatial clustering of targeted attributes within the collected data, was necessary to draw statistical connections between the visual overview of PA intensity presented in figure 22 and specific affordances.

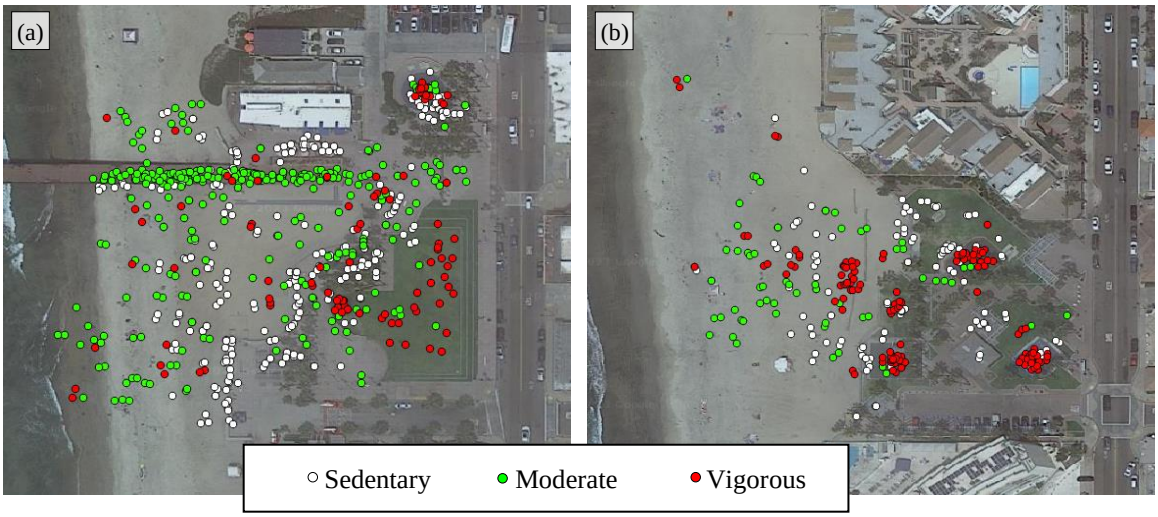

Figure 22. Data points by SOPARC rating at (a) Pier Plaza and (b) Dunes Park

To visualize potential connections, the hot spot analysis tool within QGIS was used to investigate the degree of spatial association between individual SOPARC ratings and their adjacent environment, the rationale being that an isolated high SOPARC rating may be of consequence, but it does not indicate a statistically significant hot spot unless surrounded by similarly high SOPARC values as well (Esri 2023). Thus, the hot spot spatial analysis tool identifies areas of the blue space with high SOPARC attribute values co-located with other high SOPARC attribute values, compares them against the studied area, and indicates the statistical strength of the spatial clustering. Results of this analysis show statistically significant hot spots within the blue space for sedentary activity (figure 23), moderate activity (figures 24), and vigorous activity (figure 25).

The results from the hot spot analysis revealed distinct behaviour zones within each park and insight into the relative effectiveness of design features within and between the two coastal parks.

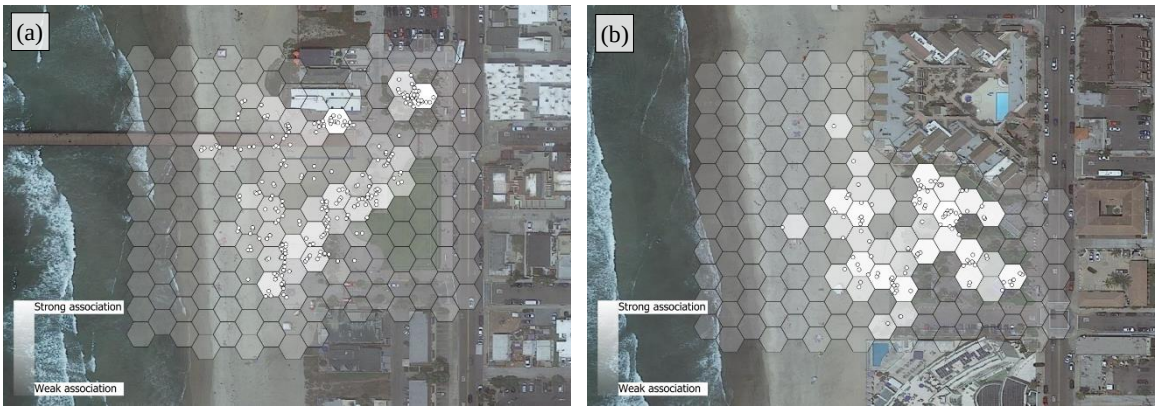

Figure 23. Hot spot analysis of sedentary activity at (a) Pier Plaza and (b) Dunes Park

The hot spot analysis for sedentary behaviour shows that passive activities such as sitting, laying, and standing are relatively diffuse throughout the Pier Plaza coastal park with strong spatial associations near the children's playground (where adults sit on a low curved platform to supervise children playing), the seating area in front of the boardwalk cafes, and more modest but nonetheless noteworthy spatial associations along the seawall, dispersed benches fanned out along the beachfront, and along the pier itself. All these zones provide seating and lookout points for *experienced space* affordances, and indeed blue space visitors appear to be using them accordingly. The sedentary behaviour within Dunes Park shows much stronger spatial significance and is associated with seating in proximity to the children's playground, covered tables, a beach wall overlooking the basketball court and the ocean, and the grass areas overlooking the ocean. A notable variable within Dunes Park is the observed presence of individuals experiencing homelessness who were observed on every observation day performing sedentary behaviour in the grass area in direct proximity to the outdoor gym and on the grassy hill.

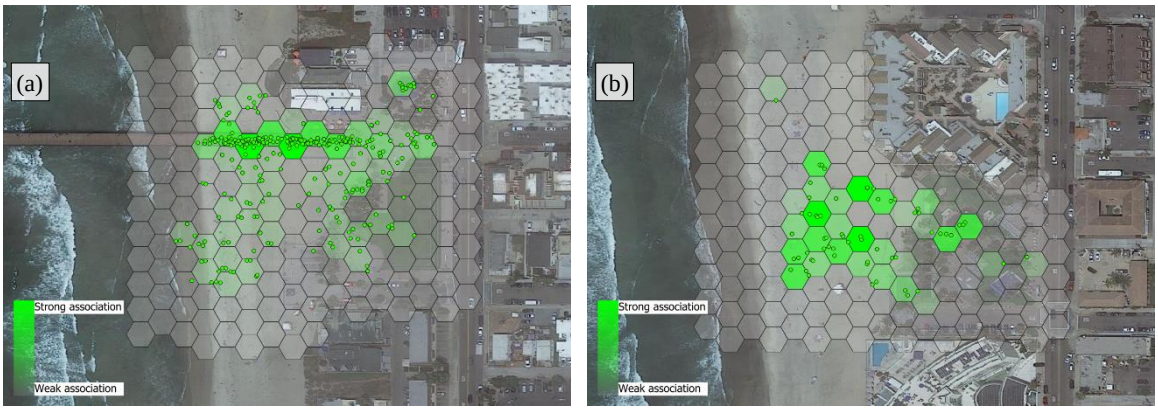

Figure 24. Hot spot analysis of moderate activity at (a) Pier Plaza and (b) Dunes Park

Moderate physical activity behaviour zones again expressed themselves differently between the two coastal parks within this study's scope (figure 24). Pier Plaza shows a strong spatial association between moderate intensity physical activity and the pier itself, indicating that it serves as a highly utilized affordance for walking. Interestingly, the Dunes Park moderate activity hot spots with the strongest spatial associations did not appear to be explicitly associated with built design affordances other than the children's playground. Moderate activity hot spots were noted in the sand beach immediately in front of the built features of Dunes Park, likely as a thoroughfare for walking between the beach and the coastal park. Weak associations with moderate activity were also noted at the basketball court.

Again, a different picture emerges between the two blue space parks when considering vigorous physical activity hot spots (figure 25). Results for the Pier Plaza hot spot analysis identify limited hot spots with strong statistical associations for vigorous activity, the sole affordance being the children's playground. Elsewhere, moderate spatial association is identified at the outdoor gym and the grass area around it where observations of ball and running games were recorded. At Dunes Park, instead, there are very strong hot spots of vigorous activity clearly spatially associated with the outdoor gym, basketball court, children's playground, and grass hill overlooking the beach and ocean. Apart from these affordances related to built design

features, there is an additional hot spot of vigorous activity in the natural sandy beach area immediately in front of Dunes Park associated with volleyball (but in the absence of built infrastructure for such use).

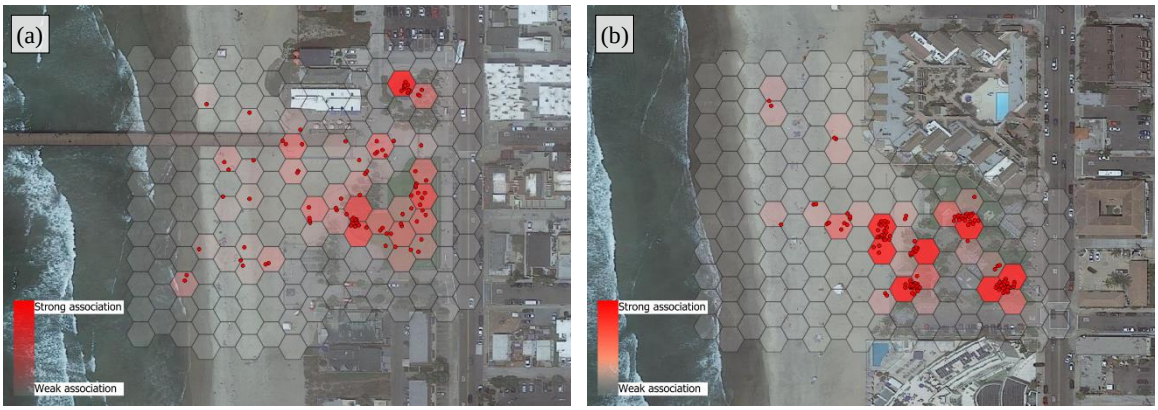

Figure 25. Hot spot analysis of vigorous activity at (a) Pier Plaza and (b) Dunes Park

The higher proportion and intensity of vigorous PA hot spots in Dunes Park as compared to Pier Plaza relates to the concept of affordances elaborated on in the literature review; Dunes Park contains more PA design affordances which elicit higher intensity exercise, whereas Pier Plaza's design features provide mostly sedentary and moderate activity affordances (ample seating, interconnected walkways, pier) which lend to the *experienced space*, *symbolic space*, *and social space* elements of the instorative pathway but limited infrastructure lending to the affordance of higher intensity PA. In Pier Plaza, apart from the playground aimed explicitly at children's PA, design elements affording for vigorous PA are limited to the outdoor gym. It should be noted here again the design differences between the two outdoor gyms present in the study area which were introduced in the methodology section; the outdoor gym at Dunes Park is a multi-station rig with equipment targeting each of the seven basic calisthenic movements and installed in 2018, while the Pier Plaza outdoor gym is comprised of a more dated two station pull-up bar. The heat map and hot spot analysis show that the Dunes Park outdoor gym is both more highly utilized and is more strongly associated with vigorous PA than the Pier Plaza gym.

Next, this study sought to understand the demographic attributes of blue space users engaged in vigorous PA, shown in figure 26. Within the study site, children accounted for 42%, adults 32%, teens 24%, and seniors 2% of observed vigorous PA. Given the focus of RQ1 on outdoor gyms in Imperial Beach, of which the recommended age of use is 14 years or above, further analysis of vigorous physical activity will exclude data points representing children. With this blue space user group excluded, a different, though not unsurprising picture emerges of observed vigorous intensity activity being performed 55% by adults, 42% by teens, and 3% by seniors (figure 27).

It is also relevant to understand what specific behaviour codings account for vigorous intensity physical activity in the blue space study area and to what degree. Figure 28 shows that the most observed behaviour coding for vigorous activity was *ball games*, followed by *outdoor gym use*, and then much smaller shares of *running/jogging*, *cycling*, *yoga*, *physical exercise* not related to outdoor gyms (such as bodyweight exercises in the grass), *other games and informal sports*, and *playing with a dog*.

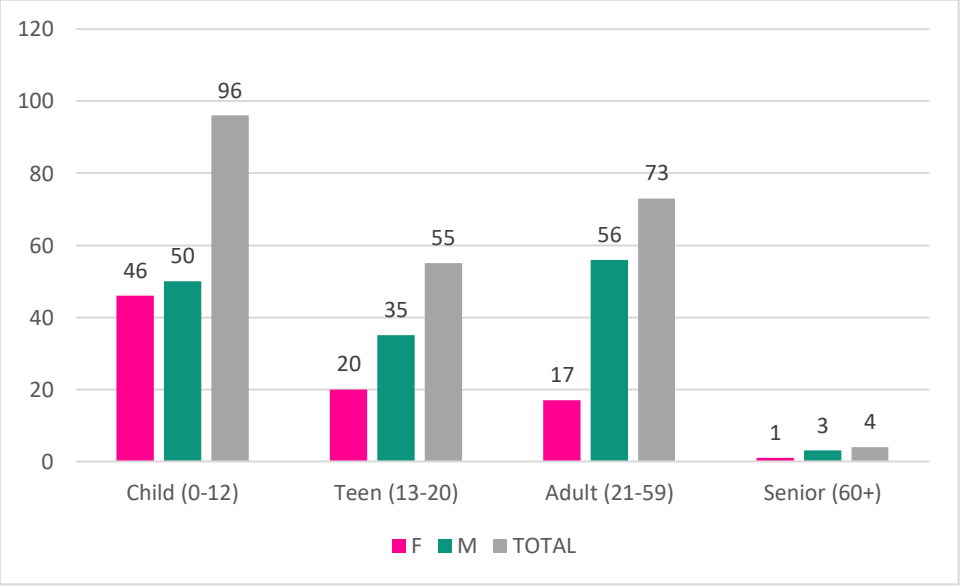

Figure 26. Vigorous activity observations by age and gender

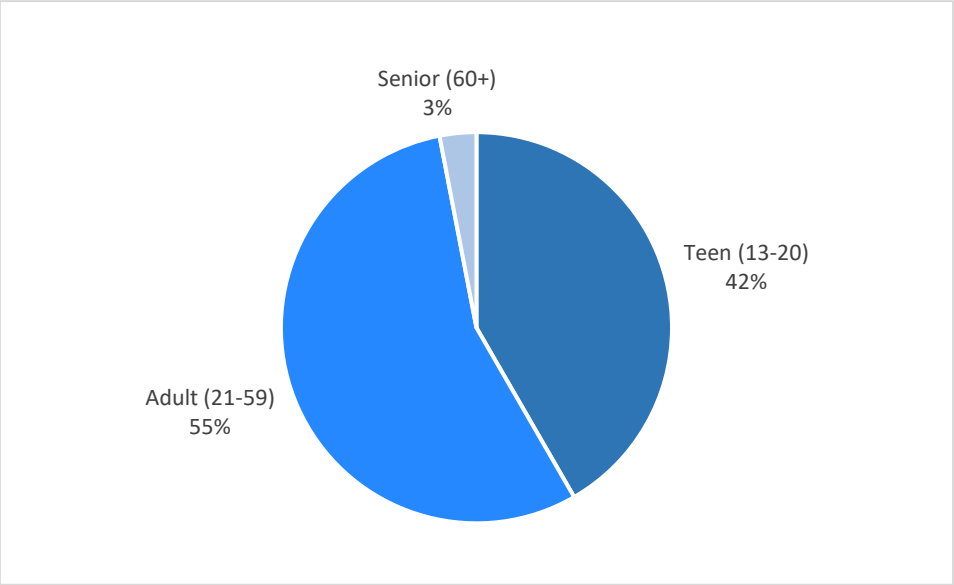

Figure 27. Vigorous activity observations by age group, children excluded

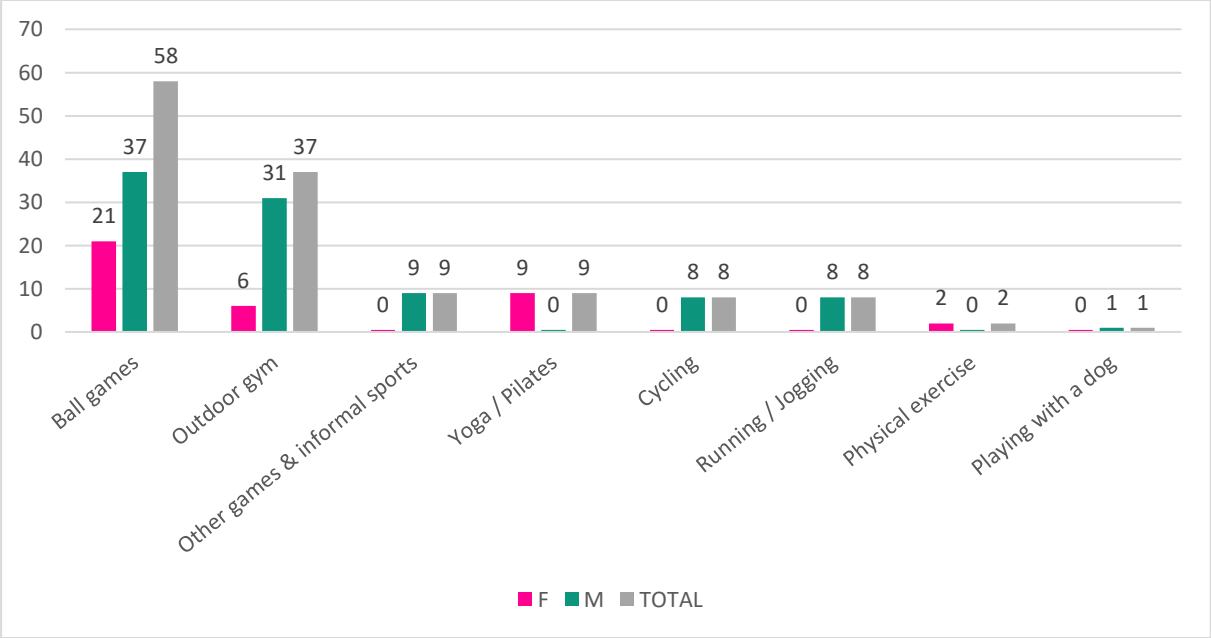

Figure 28. Vigorous intensity observations by activity type and gender

Figure 28 also shows clear delineations in vigorous behaviour activity by gender, with outdoor gym use by males far outpacing females, and yoga observations exclusively comprised of females, for example. Further, although outdoor gym usage behavior represents a modest 4.1% of all observed behavior, when analyzed against other adult vigorous physical activities

observed in the blue space, outdoor gym use was the second most observed activity (after individual and group ball games), amounting to 28% of all vigorous intensity physical activity behavior in the study site (figure 29).

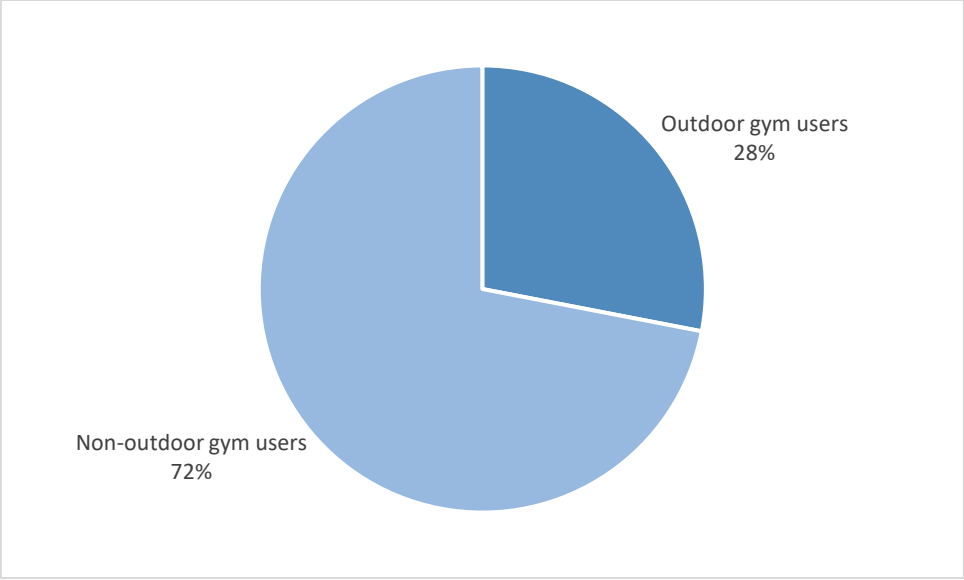

Figure 29. Outdoor gym use as a proportion of all observed vigorous PA behavior

For the purposes of this study, the BBAT interface was modified to also allow for the collection of information on which functional movement was being performed by each observed gym user during data collection in line with the momentary time sampling technique (figure 30). This allows more precise insight into important equipment design aspects of outdoor gym usage and preferences. The analysis of outdoor gym use revealed that the *pull* and *push* movements and their associated equipment (for example pull up bars and modified pull up bars for the pull movement; parallel bars for dips and modified pushups) were the most utilized. Notably, although the *pull* movement was the most common functional movement observed in males, it far outweighs observances of females performing the same movement. It again must be noted that the Pier Plaza outdoor gym is comprised exclusively of a set of double pull up bars; given the noted trend of low use of the *pull* functional movement by female blue space users, this may

imply that the design considerations of the outdoor gym at Pier Plaza provide higher vigorous physical activity affordance for males than for females. The higher intensity of usage and greater spatial association between the Dunes Park outdoor gym and vigorous activity in comparison to the Pier Plaza outdoor gym is also noteworthy. Further study of potential factors influencing this trend and the perceptions of outdoor gyms as blue acupuncture in Imperial Beach will be further investigated through a community survey measuring blue space user practices, opinions, and design preferences impacting outdoor gym use.

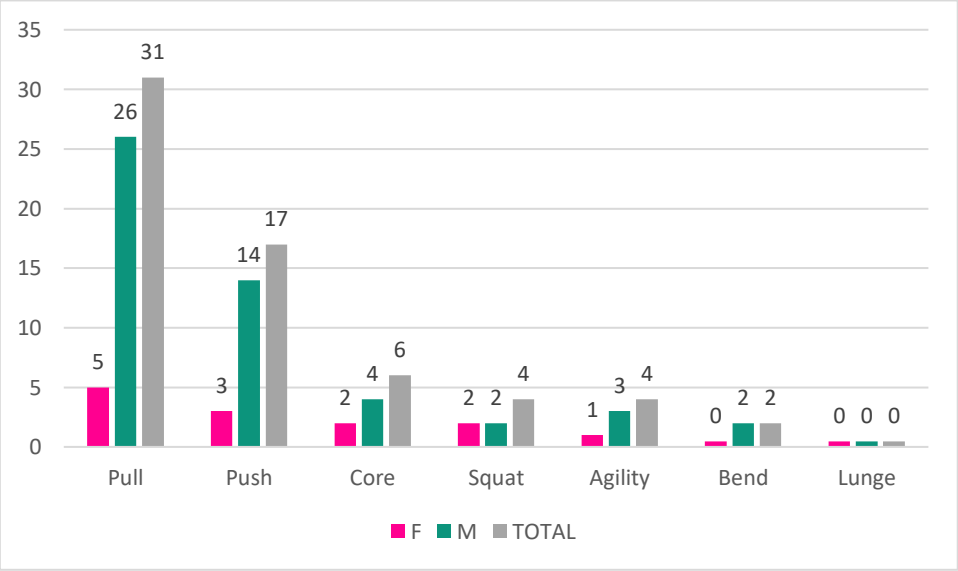

Figure 30. Observed functional movement of outdoor gym users by gender

4.2. RQ2 and RQ3

To address RQ2 and RQ3, a questionnaire probing practices, opinions, and design preferences was analyzed using descriptive and inferential statistics. This section will proceed from an analysis of respondent blue space behavior practices both generally and specific to outdoor gym use, an analysis of perceptions regarding outdoor gyms as blue space physical activity design affordance, and an analysis of design preferences. A total of 131 questionnaires were collected

and after undergoing preliminary data integrity, accuracy, and internal consistency checks, 87 completed questionnaires were considered for further analysis. Table 1 depicts the demographic attributes of the respondents captured in the convenience sample.

Demographic	**%**
Gender (*n=84*)	
Female	70.2
Male	28.5
Non-binary / third gender	1.1
Age group (*n=87*)	
18-24	10.3
25-34	17.2
35-44	20.6
45-54	27.5
55-64	14.9
65+	9.1
Race/Ethnicity (*n=87*)	
Asian	6.9
Hispanic, Latino, or Spanish Origin	31.0
Middle Eastern or North African	1.1
Native Hawaiian or Other Pacific Islander	1.1
White	52.9
Highest level of education (*n=87*)	
High school diploma or GED	9.1
Some college, but no degree	19.5
Associates or technical degree	14.9
Bachelor's degree	35.6
Graduate or professional degree	20.6
Gross yearly household income (*n=87*)	
Less than $25,000	8
$25,000-$49,999	11.4
$50,000-$74,999	12.6
$75,000-$99,999	14.9
$100,000-$149,999	16
$150,000 or more	21.8
Prefer not to say	14.9

Table 1. Demographics of questionnaire respondents

4.2.1. Blue Space Practices

Respondent self-reported participation in a range of blue space behaviors (table 2) revealed a picture broadly consistent with findings from the BBAT behavior observation portion of this study. Namely, the most commonly reported behaviors align with findings that this particular blue space is used predominantly for *immersive, social, and symbolic space* dimensions associated with the restorative and instorative nature of blue space. In response to the survey question "*Which of the following activities do you usually participate in when you visit [the blue space study site]"*, the most frequently reported activities were walking (93.1%, n=81) and appreciating the scenery (91.9%, n=80), followed by socializing (67.8%, n=59), and quiet restorative activities (51.7%, n=45). All these activities are associated with well-documented human health benefits, but they are also characterized by sedentary to moderate physical activity intensity.

			Frequency					
	Activity	**# People who engage in each blue space activity**	**Not in the last 12 months**	**A few times in the last 12 months**	**Once or twice a month**	**Once a week**	**Several times a week**	***Total***
Sedentary / moderate	Walking	81	0%	13%	24%	20%	**43%**	*100%*
	Appreciating the scenery	80	1%	9%	27%	18%	**45%**	*100%*
	Socializing with friends	59	2%	18%	29%	16%	**36%**	*100%*
	Quiet activity	45	0%	10%	**41%**	13%	36%	*100%*
	Playing with children	32	3%	17%	**38%**	17%	24%	*100%*
Moderate / Vigorous	Running/Jogging	22	0%	10%	**35%**	20%	**35%**	*100%*
	Wheeled activity	22	0%	9%	27%	23%	**41%**	*100%*
	Informal games and sports	21	0%	25%	**40%**	10%	25%	*100%*
	Using the outdoor gyms	18	6%	13%	25%	13%	**44%**	*100%*
	Aquatic activity	18	6%	24%	**29%**	12%	**29%**	*100%*

Table 2. Respondent self-reported activity patterns in blue space under study

The *activity space* dimension of blue space emerges in a second tier of behaviors in which *running/jogging* and *wheeled activity* were each reported by 25.2% (n=22) of respondents, *informal games and sports* by 24.2% (n=21) of respondents, and *outdoor gym* use and *aquatic activities* each by 20.7% (n=18) of respondents. Self-reported outdoor gym use amounted to a greater proportion of use (20.7% of sample) as compared to the observational study (4.1% of sample) which may indicate a measure of respondent social desirability bias, but these results are nonetheless consistent with findings that this blue space is predominantly associated with sedentary to moderate intensity behavior, and that outdoor gyms are a mostly coequal component of the vigorous physical activity affordance mix of the coastal parks in question. Moreover, of the respondents reporting use of outdoor gym equipment, 44% reported their frequency of use to be 'several times a week', the highest use frequency of the moderate/vigorous physical activities.

To probe reasons behind outdoor gym use, respondents received a conditional question based on their response to the question "*Have you ever used the outdoor gyms at Pier Plaza and/or Dunes Park?"*, with those reporting 'no' receiving a follow-up question regarding barriers preventing their use of the OG(s) and those responding 'yes' receiving a follow-up question regarding motivations driving their use of the OG(s). Both conditional questions allowed multiple selection as well as an open-ended fill-in option. Unsurprisingly, outdoor gym use is most motivated by health and fitness (72%), but the second most cited motivation was the free and financially accessible nature of the fitness infrastructure (64%), followed by an enjoyment of the outdoors (44%) and by extension the coastal blue space environment in which the outdoor gyms are situated (table 3).

Ever used the outdoor gym? (n=87)	
Yes	28.7% (count=25)
No	71.2% (count=62)
Motivations for OG use in IB (n=25)	
Health and fitness	72.0%
Cost (free)	64.0%
Enjoyment of the outdoors	44.0%
Stress relief	32.0%
Socializing with others	8.0%
Barriers to OG use in IB (n=60)	
Lack of interest	48.3%
Unsure of how to use the equipment	18.3%
Lack of equipment which fits my needs or abilities	15.0%
Location	10.0%
Safety concerns	6.7%
Other	21.7%

Table 3. Motivations and barrier of outdoor gym use within study site

At the other end of the spectrum, nearly half of the respondents who had never utilized the OGs in the study site indicate the barrier to use as a lack of interest (48.3%). Importantly to this study's focus on affordances is the fact that the next most cited barriers relate to issues with equipment itself; 18.3% of people report uncertainty of how to use equipment as a barrier while 15% indicate that the current equipment does not fit the needs or abilities of the respondent blue space user. Although 'other' was selected as an option by 21.7% of the respondents, only four people provided additional context through a written answer to this selection; these open-ended answers showed additional barriers to use as distance from the OG, access to household gym space which serves the respondent's strength-training needs, and "low self-esteem, body embarrassment" of working out in a public space. Of the closed and open-ended results for this

survey question, addressing the barriers of the cumulative 33.3% who don't use the gyms for reasons that may be reasonably ameliorated through design interventions within the blue space site such as different/additional equipment options and explanatory signage may be a leverage point of interest.

The blue space practices portion of the questionnaire also allowed for insight into demographic attributes of outdoor gym users (and non-users) through descriptive statistics (table 4). Notable findings show the low use of outdoor gyms by females, the higher use within younger age groups 34 and under, the higher use by individuals of Hispanic, Latino, or Spanish Origin as compared to White respondents and higher relative use within lower income categories. No results can be drawn from other racial/ethnic categories given the bias resultant from their low representation within the convenience sample. The low rate of use amongst women is consistent with findings from the observational study, and higher use amongst lower income categories is logically consistent with earlier results showing the cost-free nature of outdoor gyms is a main motivation for outdoor gym use. Logit regression was run to ascertain whether outdoor gym use is affected by demographic variables (gender, age, income, life satisfaction, health, exercise habits). The results, provided in table 5, show that age has a negative marginal effect on outdoor gym use while the number of days engaged in physical activity and muscle strengthening activities have a positive marginal effect. Additionally, the logit regression shows that females are significantly less likely than males to use outdoor gyms.

Demographic	Current use of outdoor gym	
	Yes	**No**
Gender (*n=84*)		
Female	13.6%	86.4%
Male	37.5%	62.5%
Non-binary / third gender	100.0%	0.0%
Age group (*n=87*)		
18-24	44.4%	55.6%
25-34	40.0%	60.0%
35-44	11.1%	88.9%
45-54	16.7%	83.3%
55-64	15.4%	84.6%
65+	0.0%	100.0%
Race/ethnicity (*n=87*)		
Asian	50.0%	50.0%
Hispanic, Latino, or Spanish Origin	25.9%	74.1%
Middle Eastern or North African	0.0%	100.0%
Native Hawaiian or Other Pacific Islander	0.0%	100.0%
White	15.2%	84.8%
Prefer not to say	16.7%	83.3%
Highest level of education (*n=87*)		
High school diploma or GED	25.0%	75.0%
Some college, but no degree	23.5%	76.5%
Associates or technical degree	38.5%	61.5%
Bachelor's degree	9.7%	90.3%
Graduate or professional degree	22.2%	77.8%
Gross yearly household income (*n=87*)		
Less than $25,000	28.6%	71.4%
$25,000-$49,999	40.0%	60.0%
$50,000-$74,999	36.4%	63.6%
$75,000-$99,999	23.1%	76.9%
$100,000-$149,999	14.3%	85.7%
$150,000 or more	15.8%	84.2%
Prefer not to say	0.0%	100.0%

Table 4. Demographic attributes of outdoor gym users and non-users

Logit regression of outdoor gym use (*0 = No, 1 = Yes*)			
	beta	*s.e.*	*p-value*
Gender (*0 = M, 1 = F*)	-1.13394	0.53945	0.03555
Age	-0.50683	0.21019	0.01590
Income	-0.24152	0.16700	0.14812
Well-being	0.10105	0.15249	0.50756
General health	0.35667	0.37965	0.34749
Days of physical activity	0.50275	0.17561	0.00420
Days muscle strengthening	0.46805	0.14649	0.00140

Table 5. Regression of outdoor gym use on demographic variables

4.2.2. Perceptions and Opinions of Outdoor Gyms

Blue space visitors' perceptions were assessed both in terms of community acceptance of outdoor gym infrastructure as a health-promoting affordances in general as well as perceptions of the Dunes Park and Pier Plaza outdoor gyms specifically. Table 6 reports the mean scores and standard deviation of agreement with a range of statements using a 7-point Likert-scale (where 1 is strongly disagree and 7 is strongly agree). Respondents were shown to agree more strongly with the statements that '*outdoor gyms provide an opportunity for social interaction*' (mean = 4.13) and '*outdoor gyms are a cost-effective way to promote physical activity*' (mean = 4.11). Additionally, respondents were more in agreement than not with the notion that outdoor gyms *add value to the area* (mean = 3.92) and *are worth the investment* (mean = 3.91). Respondents were shown to disagree more than not with the statements '*I prefer IB's (Imperial Beach) coastal parks free of outdoor gyms*' (mean = 2.48) and *outdoor gyms are unsuitable for community needs* (mean = 2.26).

Outdoor gym perceptions			
	n	*mean*	*SD*
Outdoor gyms add value to the area	87	3.92	1.07
Outdoor gyms are a cost-effective way to promote physical activity	87	4.11	1.02
Outdoor gyms are unsuitable for community needs	85	2.26	1.29
Outdoor gyms are worth the investment	87	3.91	1.17
Outdoor gyms provide an opportunity for social interaction	86	4.13	0.99
I prefer IB's coastal parks free of outdoor gyms	86	2.48	1.35

Table 6. Respondent perceptions of outdoor gyms generally

4.2.3. Design Preferences

These results show a respondent acceptance of outdoor gym infrastructure generally within the local blue space fabric as a cost-effective, health-promoting affordance. Next, opinions regarding specific attributes relating to the existing outdoor gyms at Dunes Park (figure 31) and Pier Plaza (figure 32) were measured through a series of binomial responses to statements. The statements solicited respondent opinions regarding a range of design dimensions of the gyms in question; whether they are of good quality, user friendly, aesthetically pleasing, well-maintained, well-located, and contain equipment options appropriate to respondent fitness level.

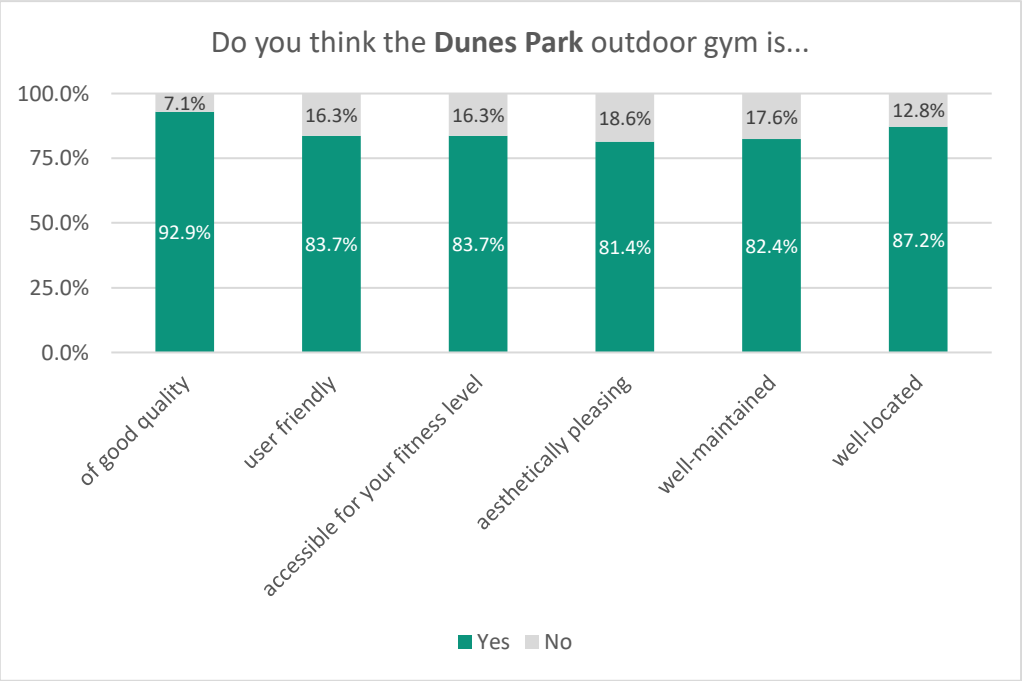

Figure 31. Respondent opinions of the outdoor gym in Dunes Park

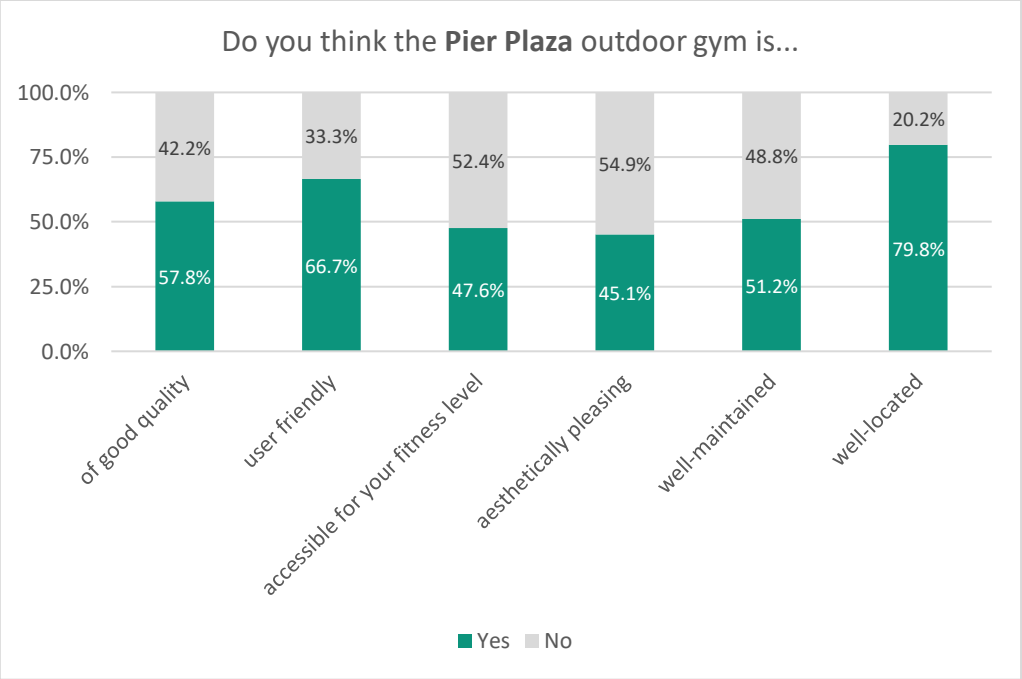

Figure 32. Respondent opinions of the outdoor gym in Pier Plaza

The results show that the Dunes Park gym scores highly in each of these categories, with the highest level of agreement with the statement *the outdoor gym is of good quality* (92.9%, n=85)

and *the outdoor gym is well-located* (87.2%, n=86). Lower (but nevertheless high) agreement was seen with the statements *the outdoor gym is aesthetically pleasing* (81.4%, n=86*)* and *the outdoor gym is well-maintained* (82.4%, n=85*)*. The Pier Plaza gym scored much lower than the Dunes Park gym in relation to each of the measured design dimensions. The results show that a majority of respondents believe the equipment options provided at the Pier Plaza gym are not aesthetically pleasing (54.9%, n=82) and not accessible for their current fitness level (52.4%, n=84). The Pier Plaza gym received the highest level of agreement to the statement *the outdoor gym is well-located* (79.8%, n=84). The notable discrepancy seen here between the scores of the two outdoor gyms in relation to the assessed design dimensions is logically consistent with the lower use frequency of the Pier Plaza OG as compared to the Dunes Park OG observed in the heat map analysis in section 4.1.

Indeed, respondent overall satisfaction with the design of the outdoor gyms reinforced findings regarding the discrepancy between the gyms. On a 5-point Likert scale, respondents were more satisfied by the design of the Dunes Park gym (M = 3.99, SD = 1.09) than by the Pier Plaza gym (M = 3.20, SD = 1.45). Those respondents who scored either OG at a 3 or lower satisfaction on the 5-point scale were further asked to provide their opinion as to what factors might improve their satisfaction of the outdoor gym in question. After manual coding using Qualtrics' Text iQ function, the open-text responses for the Pier Plaza outdoor gym (n=25) revealed several themes: equipment improvement, equipment variety and inclusivity, and location considerations.

Respondents unsatisfied with the current Pier Plaza OG design consistently expressed a desire for higher quality equipment, in particular requesting better and more aesthetically appealing materials and better maintenance. This theme focusing on better and more attractive equipment is exemplified in responses such as, "*Paint the darn thing [and] clad it in plastic…same blue*

as Dunes Park", *"[more variety of equipment and] not the ugly stuff that is there*", as well as numerous variations of a call for *newer/better/updated/better quality material*. The second emergent theme revolved around the exercise options offered, centering around more as well as more inclusive equipment options and design which accommodates different abilities. Illustrative of this code are the statements, "*Is it just the [pull-up] bars? They are too tall for many people to use*", *"…equipment that offers more exercise options…only option is pull ups, which many people can't do*", and a call for "*workout options appropriate for multiple fitness levels*". The last overarching theme revolved around location and space considerations, with some suggestions of alternate use of the space (i.e., family friendly or senior use) or the relocation of the equipment to Dunes Park. Given the higher satisfaction rating of the Dunes Park outdoor gym, fewer respondents received a follow-up question probing open-text suggestions for additional feedback (n=12) thus there was less thematic convergence apart from maintenance, with calls for "*newer equipment", "better equipment and better maintained", "cleaner facilities*", and "*It just needs some maintenance. It's been there a few years and some things are starting to wear out"*.

Given this chapter's coverage of respondent blue space use, perceptions of outdoor gyms both generally and in relation to the attributes of the specific OGs in question, the questionnaire next turns to the operationalization of these elements in line with this study's pragmatic worldview approach. This analysis seeks to understand which design factors are perceived to enable the increased use of outdoor gyms in Imperial Beach's coastal blue space, a dimension of this study which may provide insight for municipal and community stakeholders seeking to maximize the impact of potential future blue acupuncture interventions.

Results to the question *Which three factors do you think most impact the increased use of outdoor gyms in Imperial Beach* (n=87), found that the three most frequently cited design

factors perceived as enabling outdoor gym use are the presence of other amenities nearby such as bathrooms, water fountains, etc. (n=57), a view of the ocean (n=53), and the types of exercises available (n=51). These findings, illustrated in figure 33, indicate that future outdoor gym interventions in Imperial Beach's coastal blue space may benefit from co-location with other amenities, direct visual access to the ocean, and participatory decision-making regarding equipment options most fitting to the needs of the community to potentially maximize their use and thus the health promoting potential of both the gym and the blue space. As an aside, two of the three respondents who provided a text entry for their selection of 'other' stated that the presence of people experiencing homelessness in proximity to the equipment inhibits gym use, but as that is a multi-dimensional public policy issue rather than a design or affordance issue, those responses are out of the scope of this analysis.

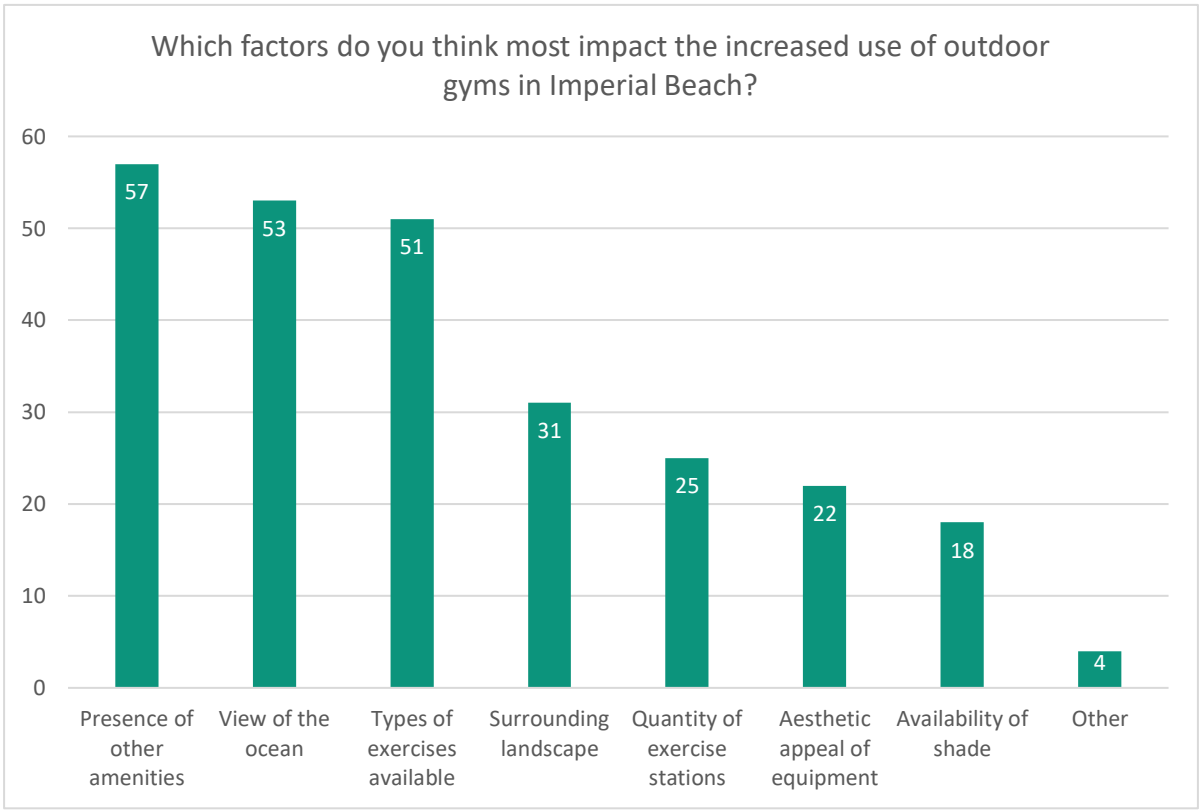

Figure 33. Enabling factors for outdoor gym use

Respondents who selected *types of exercises available* as one of the most impactful factors (n=51) were additionally asked to respond to the question *What type(s) of exercise equipment would you most likely use at an outdoor gym?* using a visual selection of six equipment options, where multiple answers were allowed. The equipment which received the highest frequency of selection were incline bench, exercise bench, and gymnastic rings (figure 34). This provides initial indications for equipment categories which may lead to wider use of outdoor gyms in the study site, but equally insightful is the fact that standard pull-ups bars resulted in the lowest frequency selection, given the fact that the Pier Plaza outdoor gym consists solely of pull-up bars. Logit regression was run to ascertain whether equipment preference is affected by demographic variables (gender, age, income, exercise habits). The only statistically significant results show that females are significantly less likely than males to use pull-up bars (beta = -1.97286 , s.e. = 0.61912, p-value = 0.00144) and parallel bars (beta = -1.47987, s.e. = 0.57182, p-value = 0.00965) and that age has a negative marginal effect on pull-up bar use (beta = -0.47527, s.e. = 0.22317, p-value = 0. 03320).

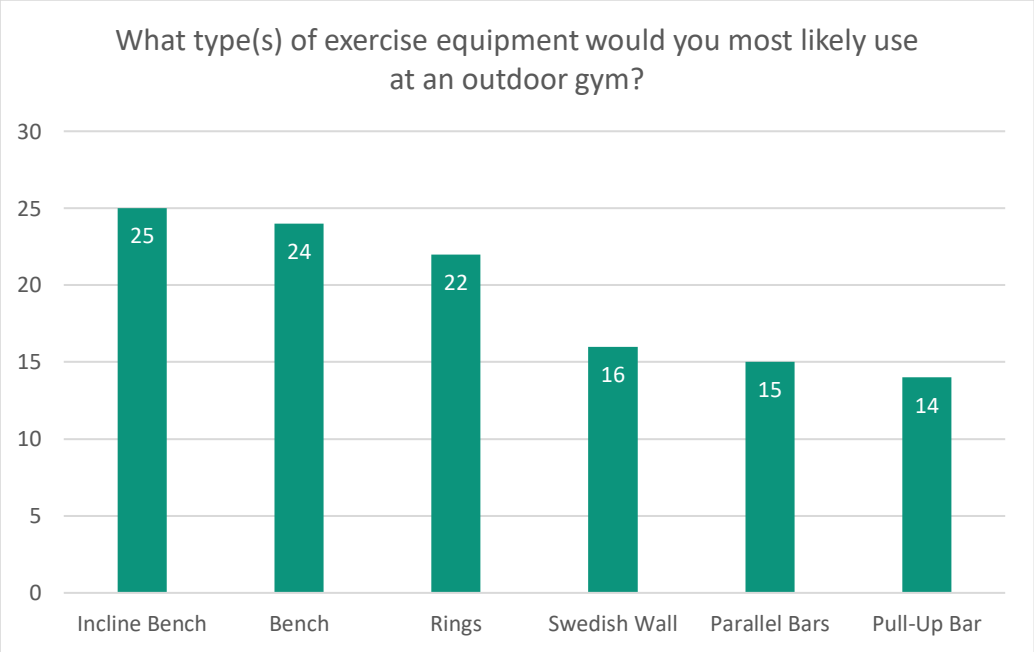

Figure 34. Respondent exercise equipment preferences

These results indicate a potential mismatch between the current Pier Plaza design affordance and equipment preferences, especially if the municipality is interested in leverage points to increase outdoor gym use by females and older residents. Further, analysis of data from the questionnaire's *perceptions* and *design preferences* subsections demonstrates respondent favorability for outdoor gyms as cost-effective, health-promoting physical activity design affordance, but also indicates that the actual use of outdoor gyms in practice may be impacted by context-specific design considerations.

5. Discussion

Blue and green spaces have been identified as important tools in combatting the negative human and planetary health outcomes of urbanization thanks to their potential to mitigate harm, provide restoration from urban stressors, and build instorative capacity. Relevant literature has advanced the case that blue space is particularly efficacious in bestowing salutogenic benefits, yet blue space research has lagged behind that of green space, particularly in regard to physical activity studies (Britton et al., 2020).

With the public health and urban planning agenda increasing centering the consideration of human health benefits in its design of public spaces (Smith et al. 2021), a better understanding of physical activity design affordances in blue space is timely. And yet, the literature revealed a gap in the practical exploration of specific design solutions which translate health promoting priorities in real world projects (Zhang, Nijhuis, and Newton 2022; S. Bell et al. 2020). A lack of research on the implications of specific design solutions, such as outdoor gyms, may result in a failure to maximize on the health benefits possible through such investment (S. Bell et al., 2020). This research sought to contribute to the currently limited body of knowledge regarding outdoor gym use, perception, and potential in blue space to support evidenced-based design of health-promoting physical activity affordances in coastal settings.

5.1. Addressing the Research Questions

In assessing RQ1 "*What are the current use patterns of outdoors gyms in Imperial Beach's coastal areas?",* this study took a necessarily broad to narrow scoping approach towards the data to develop sufficient context for the analysis. The results show that the blue spaces in question are used predominantly for sedentary experienced space behavior and moderate

walking, findings in line with previous research (S. L. Bell et al. 2015; Grellier et al. 2017; White et al. 2020; Pasanen et al. 2019) and which imbue their own health benefits through the restorative and instorative pathways discussed in the literature review.

At first glance, behavior observation of outdoor gym usage represents a modest 4.1% of all observed behavior, but when analyzed against other adult vigorous physical activities observed in the blue space, it amounted to 28% of all vigorous intensity physical activity behavior in the study site. This finding was corroborated by the questionnaire analysis which reaffirmed this trend, while not directly replicating use percentages. Further, self-reported use measures showed that of the blue space visitors who used outdoor gyms, 44% used them frequently (several times a week). This use frequency was amongst the highest of all behaviors. This indicates that, although outdoor gyms are not used broadly by blue space visitors in Imperial Beach (whose visits are instead characterized predominantly by restorative activities and walking), they are used co-equally to other vigorous physical activity behavior and those blue space visitors who do use them do so frequently. Thus, although the studied blue spaces in Imperial Beach tend more strongly toward the *experienced* and *social space* dimensions (and plausibly *symbolic space*, although no data was collected to allow for such inference), outdoor gyms play an important role in the vigorous *activity space* affordance mix of these coastal beaches, with central motivations for OG use revealed to be health and fitness, it's cost-free nature, and the ability to engage with and enjoy the coastal environment.

Results from the heat map and hot spot analysis indicate the potential of outdoor gyms as physical activity blue acupuncture points in Imperial Beach and indeed, blue space visitor opinions of outdoor gym infrastructure support this perception. In addressing RQ2 *What are blue space visitors' perceptions of outdoor gyms in Imperial Beach's coastal areas*, the data revealed general support for the municipality's strategy of installing outdoor gyms as physical

activity affordance within their coastal setting, with the analysis showing respondent agreement that outdoor gyms are a cost-effective way to promote physical activity and that outdoor gyms add value to the area. As addressed in the literature review, blue acupuncture is an emergent concept within blue space design practice which has been advanced as a sustainable means of creating (or maintaining) *healthy blue space.* Blue acupuncture is a small-scale intervention with the potential to return a greater effect in comparison to the investment needed to implement it (S. Bell et al. 2020). This smaller-scale approach to design affordances and design interventions presents added sustainability benefits; the maintenance of the genius loci of the area, its smaller carbon footprint, and its more financially accessible nature for underfunded or under resourced communities seeking to catalyze health promoting benefits within their blue spaces and combat urban decay (S. Bell et al. 2021).

The fact that blue space users acknowledge the cost-effective, health-promoting nature of outdoor gym affordances and perceive the outdoor gyms as value-added to their coastal blue space lends strength to the contention that outdoor gyms serve as blue acupuncture. Given their modest scale, the outdoor gyms within the study site were observed to provide visual and sensory perception of the coastal environment to the instorative benefit of the user, while leaving the natural environment and larger urban nature surrounding it largely unaltered, a hallmark of sustainable blue acupuncture (S. Bell et al. 2021). Blue acupuncture also tends not to lead to the exclusion of marginalized and underprivileged user groups, a noted risk of larger scale blue space development projects which can cause gentrification (Smith et al. 2021). Given the high proportional use of Imperial Beach's outdoor gyms by individuals in lower income categories, this analysis shows that these outdoor gyms likely do not have an exclusionary effect on economically underprivileged community-members. Despite this identified alignment with blue acupuncture characteristics, both the behavioral observation portion of the study and the

questionnaire analysis revealed limiting factors which, if addressed, may increase outdoor gym use and maximize the health-promoting potential of outdoor gyms in coastal settings.

To address these factors, the study next considered RQ3 *What design factors are perceived as enablers and barriers to the use of outdoor gyms in coastal blue space* through the theoretical foundation of affordances. Affordance theory is the concept that a bidirectional relationship exists between user attributes and perceptions and the physical properties of the place or object within a space (Mishra et al. 2023). Essentially, the same physical object may present different affordances to different individuals depending on the perceptions or characteristics held by the individual, dictating their level of engagement with that object. Recent literature has shown that while children perceive the functional properties and actions available to them in an outdoor environment regardless of the affordance's appearance, adult blue and green space visitors consider additional properties such as, "form, pleasure, beauty, meaning and attractiveness of place, place design quality and attributes linking needs and intentions" (Mishra et al. 2023). The questionnaire portion of the study incorporated these additional considerations based on affordance theory, seeking to identify enablers, barriers, and leverage points for increased outdoor gyms use and reinforcing the instorative potential of Imperial Beach's blue space.

The questionnaire data assessed several measurable dimensions which affect adult perceptions of the functional properties of the outdoor gym as physical activity affordance; aesthetics, location, quality, maintenance, user-friendliness, and whether equipment fits the needs and abilities of the respondent. Several different iterations of these questions were posed throughout the questionnaire to triangulate and maximize coherence of the findings. The analysis showed high scores in all of these metrics in regard to the Dunes Park outdoor gym, which according to affordance theory likely accounts for the higher intensity use of this gym seen in the heat map and hot spot analysis. In contrast, the Pier Plaza gym received much lower scores in all

metrics save for location, but notably low scores in relation to quality, maintenance, aesthetics, and accessibility to the needs and abilities of the potential user, accounting for the lower use remarked upon by the GIS spatial analysis.

In considering enabling factors, it is evident the location of the outdoor gyms within the coastal environment plays an important role in perceptions of the affordance, given the high approval of the beachfront location of both pieces of equipment, the findings that enjoyment of the outdoor environment was noted as a main motivating factor for blue space visitors who use the equipment, and the fact that survey respondents ranked *view of the ocean* as the second most important design consideration encouraging use of the outdoor gym. Additionally, the data analysis revealed the high priority respondents place on co-location of outdoor gyms with other amenities (such as water fountains, bathrooms etc.) to support use of the affordance, findings consistent with studies of outdoor gyms in green space (Lee, Lo, and Ho 2018). The researcher's site observations found that both outdoor gyms are within direct proximity of such amenities and thus both location and amenities presumably serve as design enablers to current gym use patterns. It appears, however, that the strengths in location and amenities is where similarities in perceptions of the two outdoor gym designs end.

The Pier Plaza gym was noted by respondents to be of lower quality, less aesthetically pleasing, and less accessible to diverse needs, abilities, and priorities. Although affordance theory would indicate that these shortfalls serve as barriers to use by a broader subsection of blue space users, they can also be seen as clear indications of which leverage points would increase the health-promoting potential of the space and serve as initial guideposts for relevant stakeholders seeking to identify cost-effective design interventions to increase physical activity within the space. Perceptions and use-patterns of the Dunes Park outdoor gym have established the potential of outdoor gyms as blue acupuncture, but the gaps between community needs,

perceptions, and functional properties of the Pier Plaza gym impede its performance as a physical activity affordance.

Indeed, this analysis indicates an incoherence between the current Pier Plaza design affordance and respondent equipment preferences, especially if the municipality is interested in making the outdoor gym more accessible to females and older residents and in reinforcing the instorative potential of the physical activity affordances within Imperial Beach's blue space. Qualitative, open-ended survey responses highlighted calls for additional equipment options within the space, noting that pull-up bars alone do not fit their needs and are not accessible for diverse statures or fitness levels. These qualitative findings were reinforced by quantitative data showing that the majority of respondents do not believe the pull up bars currently at the site are accessible to their fitness level, that they rank *type of equipment* highly as a factor which increases outdoor gym use, and that pull-up bars received the lowest frequency of selection regarding equipment type respondents would most likely use (especially amongst female and older respondents).

According to this analysis, a leverage point for increasing the health-promoting potential of the Pier Plaza blue space would be a targeted intervention of the Pier Plaza outdoor gym design; since the outdoor gym already benefits from use-enabling factors such as a direct ocean view and proximity to amenities, stakeholders should configure additional equipment options to the existing site, prioritizing incline bench (proxy for core/bend calisthenic movements), exercise bench (proxy for push and squat calisthenic movements), and gymnastic rings (proxy for a range of modified pull and push calisthenic movements) in the design as these were options identified by respondents as equipment they would most likely use. Although respondents ranked quantity of exercise stations and aesthetic appeal of equipment as lower-level priorities when considering enabling factors to outdoor gym use, a design intervention to provide for the

preferred options above (incline bench/bench/rings) would naturally create an opportunity to select higher quality, more aesthetically pleasing equipment as part of the design. Thematic coding of open-text responses did reveal calls for *"better material*", "*better quality*", and not the "*ugly stuff that is there*", but further research and community consultation would be needed to identify what exactly is perceived to be better quality and more aesthetically pleasing in a context-specific manner.

This research has identified the blue acupuncture potential of outdoor gyms in Imperial Beach's coastal blue space. It has also reinforced calls from the literature that it is not access to natural spaces alone that causes increases in physical activity expenditure, but rather the confluence of environmental and designed attributes of these spaces that can either enable or limit participation in active lifestyle habits within the space (McCormack et al. 2010; Sibson, Scherrer, and Ryan 2018). As is illustrated in the disparity between the Dunes Park and Pier Plaza outdoor gyms in terms of use patterns, perceptions, and preferences, the blue space built environment can result in underutilization of physical activity affordances or the performance of mainly sedentary activities if it is not intentionally designed in a context-specific manner (Cranney, Shaw, and Phongsavan 2019). Indeed, calls from within the extant blue space field promote a community-led approach in order to increase physical activity within blue space (Smith et al. 2021), in a co-design process actively engaging local stakeholder communities and informed by evidence; such steps are argued to result in blue spaces which "offer greater user relevance for the design of outcomes and tend to lead to increased possibilities of actualizing intended affordances as well as some additional ones" (Mishra et al. 2023). The identified mismatch between community design preferences and the current design of the Pier Plaza outdoor gym can be argued to stunt the health promoting potential of the blue space and limit the use by some user groups, however, in line with the pragmatic worldview underpinning this

research, these findings also provide an initial roadmap indicating potential solutions for future interventions.

5.2. Limitations and Future Research

While findings within this thesis hopefully can be seen as contributing to a body of evidence-based design of healthy blue space, several factors can be seen to limit the broad application of the research findings. Firstly, this research is necessarily context-specific given the importance the literature placed on targeting the specific socio-ecological landscape in which the blue space is enveloped in order to most effectively address challenges. As perceptions of blue space and the affordances within them are highly impacted by the local perceptions, culture, and natural environment, the results which emerged in the case of Imperial Beach's coastal outdoor gyms may not be applicable to different cultural or blue space environments (riverine, for example). Case studies assessing outdoor gyms in additional cultural, socio-economic, and blue space contexts are fertile grounds for future research.

Another limitation for this study was the small sample size that resulted for the questionnaire portion of the study as well as the short timeframe in which observational data collection was conducted. Although both factors were largely dictated by the constraints of the thesis semester, future research may seek to replicate this research design across several seasons to measure use patterns across different times of the year. Further, with additional time and financial resources, a larger and more representative sample size would likely result from a more robust sampling technique instead of the hybrid in-situ and online convenience sampling approach employed in this study.

Suggestions for future research include developing further context for the enablers, motivations, and design preferences of outdoor gym equipment through qualitative interviews and participatory design. Due to the breadth of potential equipment configurations and styles, this research had to employ images of several common equipment types as proxies for analysis which can be seen as a limitation. Should future research or stakeholders decide to proceed with outdoor gym blue space intervention within the studied blue spaces, findings from this study may prove a point of departure for more in-depth investigation of design preferences or indeed data from this study could serve as a portion of a pre-post intervention design measuring the impact of design changes on physical activity patterns within the study site.

6. Conclusion

Considering the high levels of inactivity and lifestyle-related chronic disease associated with urbanization, the design of blue spaces which attract visitation for the restorative human health benefits of water but which also support physical activity within these spaces is a public health and urban planning goal. Research has indicated that the provision of urban blue space alone does not inherently lead to human and planetary health benefits, but rather there is a need to understand, design, and manage these spaces to support their status as *healthy blue spaces*. To do so requires operationalizing the health promoting pathways of blue space through specific design affordances which have been tested in real-world contexts (Zhang, Nijhuis, and Newton 2022).

By seeking to understand real-world use patterns and perceptions of outdoor gyms as blue acupuncture, this research sought to inform design solutions of blue space physical activity affordances in a specific coastal context. This study found that visitor behavior in the coastal blue space under study in Imperial Beach, California tends strongly toward sedentary *experienced space* behavior and moderate walking, but that outdoor gym use amounted to a co-equal component of vigorous *activity space* behavior. Outdoor gym use resulted in 28% of observed vigorous physical activity and the highest reported frequency of use of the physical activity affordances within the study area (44% of outdoor gym users reported using it several times a week). These results demonstrate that outdoor gyms are a significant component of the physical activity affordance mix within the site, and questionnaire analysis revealed respondent agreement that the gyms are a cost-effective way to promote physical activity and add value to the area. These findings highlight the potential of outdoor gyms as sustainable blue acupuncture in coastal settings.

The analysis also revealed discrepancies between both the use patterns and the blue space visitor perceptions of the two outdoor gyms within the study site. While a hot spot and heat map analysis showed higher intensity usage patterns at the Dunes Park outdoor gym as compared to the Pier Plaza gym, questionnaire analysis revealed perceptions of the Pier Plaza gym performing poorly in nearly all dimensions measured. Both quantitative analysis and qualitative coding of open-text questionnaire responses revealed perceptions that the Pier Plaza outdoor gym does not meet community needs and preferences and that introducing specific design interventions to the existing structure would positively impact outdoor gym use. The analysis showed that respondents prioritize a view of the ocean and proximity to other amenities as enabling factors to gym use, and that inclusion of more accessible equipment options (preliminarily identified as incline bench, exercise bench, or gymnastic rings) is the most direct leverage point for increasing use. Utilizing the conceptual basis of affordance theory, implementation of these design interventions would catalyze the health-promoting potential of the Pier Plaza blue space in Imperial Beach.

While these findings provide actionable insight for local stakeholders and practitioners regarding likely leverage points, they also highlight the necessity of a community co-design process to maximize alignment between the design of physical activity infrastructure in blue space and the relevance to the intended user. Evidence-based design and co-creation with stakeholder communities would increase the likelihood of actualizing the health benefits of the design affordance and the blue space alike.

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Annex: Survey questions

Start of Block: Section I: Intro and Practices

Thank you for agreeing to participate in this survey. This questionnaire will be used for research conducted in collaboration with the University of the Aegean, Department of Environment. The purpose of this research study is to investigate physical activity patterns in Imperial Beach's coastal areas. This questionnaire is anonymous, no personally identifiable information will be collected, and all responses will be used solely for the purposes of research. Participation in this survey is completely voluntary and you may discontinue at any time.

Instructions: Please answer all questions to the best of your ability. There are no right or wrong answers, and your responses will be kept anonymous and confidential. The survey should take approximately 5-10 minutes to complete.

The following section will ask questions specifically related to Imperial Beach's coastal parks along Seacoast Drive: Pier Plaza and Dunes Park.

Q1 How often do you visit the coastal areas along Seacoast Drive for leisure or recreation (not for work-related reasons)?

- ○ Several times a week (1)
- ○ Once a week (2)
- ○ Once or twice a month (3)
- ○ A few times in the last 12 months (4)
- ○ Not in the last 12 months (5)

Q2 Which of the following activities do you usually participate in when you visit these areas?

	Do you usually participate in this activity?		**If YES, how often do you participate in this activity?**				
	Yes (1)	No (0)	Several times a week (1)	Once a week (2)	Once or twice a month (3)	A few times in the last 12 months (4)	Not in the last 12 months (5)
Walking (1)	○	○	○	○	○	○	○
Running/Jogging (2)	○	○	○	○	○	○	○
Wheeled activity (cycling/skating/skateboarding etc.) (3)	○	○	○	○	○	○	○
Informal games and sports (frisbee, volleyball, basketball etc.) (4)	○	○	○	○	○	○	○

	Do you usually participate in this activity?	If YES, how often do you participate in this activity?					
Appreciating the scenery (5)	○	○	○	○	○	○	○
Socializing with friends (6)	○	○	○	○	○	○	○
Using the outdoor gyms (7)	○	○	○	○	○	○	○
Playing with children (8)	○	○	○	○	○	○	○
Quiet activity (reading, meditating, sunbathing) (9)	○	○	○	○	○	○	○
Aquatic activity (surfing, swimming etc.) (10)	○	○	○	○	○	○	○

Q3 Have you ever used the outdoor gyms at Pier Plaza and Dunes Park?

- ○ Yes (1)
- ○ No (2)

Display This Question:
If Have you ever used the outdoor gyms at Pier Plaza and Dunes Park? = Yes

Q4 What motivates you to use the outdoor gyms at Pier Plaza and Dunes Park? Please select all that apply.

- ☐ Stress relief (1)
- ☐ Enjoyment of the outdoors (2)
- ☐ Cost (free) (3)
- ☐ Socializing with others (4)
- ☐ Health and fitness (5)
- ☐ Other (6) _____

Display This Question:
If Have you ever used the outdoor gyms at Pier Plaza and Dunes Park? = No

Q4 What barriers prevent you from using the outdoor gyms at Pier Plaza and Dunes Park? Please select all that apply.

- ☐ Lack of interest (1)
- ☐ Lack of equipment which fits my needs or abilities (2)
- ☐ Unsure of how to use the equipment (3)
- ☐ Safety concerns (4)
- ☐ Location (5)
- ☐ Other (6) _____

End of Block: Section I: Intro and Practices

Start of Block: Section II: Perceptions

Q5 What is your level of agreement with the following general statements regarding the presence of outdoor gyms in Seacoast Drive's coastal areas.

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
Outdoor gyms add value to the area (1)	○	○	○	○	○
Outdoor gyms are a cost-effective way to promote physical activity (2)	○	○	○	○	○
Outdoor gyms are unsuitable for community needs (3)	○	○	○	○	○
Outdoor gyms are worth the investment (4)	○	○	○	○	○
Outdoor gyms provide an opportunity for social interaction (5)	○	○	○	○	○
I prefer IB's coastal parks free of outdoor gyms (6)	○	○	○	○	○

Q6 You will now be asked your opinion of the design features of the outdoor gym at Pier Plaza. A visual of the Pier Plaza outdoor gym is provided below for reference.

(Source: Port of San Diego)

	Yes (1)	No (2)
Do you think the equipment is of good quality? (1)	○	○
Do you think the equipment is user friendly? (2)	○	○

	Yes (1)	No (2)
Do you think the equipment options are accessible for your fitness level? (3)	○	○
Do you think the equipment is aesthetically pleasing? (4)	○	○
Do you think the equipment is well-maintained? (5)	○	○
Do you think the equipment is well-located? (6)	○	○

Q7 You will now be asked your opinion of the design features of the outdoor gym at Dunes Park. A visual of the Dunes Park outdoor gym is provided below for reference.

(Source: San Diego Union-Tribune)

	Yes (1)	No (2)
Do you think the equipment is of good quality? (1)	○	○
Do you think the equipment is user friendly? (2)	○	○
Do you think the equipment options are accessible for your fitness level? (3)	○	○
Do you think the equipment is aesthetically pleasing? (4)	○	○
Do you think the equipment is well-maintained? (5)	○	○
Do you think the equipment is well-located? (6)	○	○

Q7 How satisfied are you with the current design of the outdoor gyms at Seacoast Drive's coastal parks (where 1 star is not satisfied and 5 stars is extremely satisfied)?

Pier Plaza (1)	☆	☆	☆	☆	☆
Dunes Park (2)	☆	☆	☆	☆	☆

Display This Question:
If How satisfied are you with the current design of the outdoor gyms at Seacoast Drive's coastal par... [Pier Plaza] <= 3

Q8 What improvements would improve your satisfaction of the outdoor gym at Pier Plaza?

_____

Display This Question:
If How satisfied are you with the current design of the outdoor gyms at Seacoast Drive's coastal par... [Dunes Park] <= 3

Q9 What improvements would improve your satisfaction of the outdoor gym at Dunes Park?

_____

End of Block: Section II: Perceptions

Start of Block: Section III: Design factors

Q10 Which factors do you think most impact the increased use of outdoor gyms in Imperial Beach? Please select the three factors which you think have the most impact.

- ☐ View of the ocean (9)
- ☐ Presence of other amenities (restrooms, water fountains etc.) (10)
- ☐ Types of exercises available (14)
- ☐ Aesthetic appeal of equipment (11)
- ☐ Surrounding landscape (12)
- ☐ Quantity of exercise stations (13)
- ☐ Availability of shade (15)
- ☐ Other (16) _____

Display This Question:
If Which factors do you think most impact the increased use of outdoor gyms in Imperial Beach? Pleas... = Types of exercises available

Q11 What type(s) of exercise equipment would you most likely use at an outdoor gym? Click on the picture(s) to make your selection(s).

- ☐ Pull-Up Bar (1)
- ☐ Parallel Bars (2)
- ☐ Swedish Wall (3)
- ☐ Bench (4)
- ☐ Rings (5)
- ☐ Incline Bench (6)

End of Block: Section III: Design factors

Start of Block: Block 4 Personal Information

This final section asks you for some background information about yourself and your habits. The questions are not meant to be intrusive but will assist in understanding the characteristics of people who use outdoor gyms in coastal parks. Again, the survey is anonymous – we will not be able to identify you as an individual.

Q12 How old are you?

- ○ 18-24 years old (1)
- ○ 25-34 years old (2)
- ○ 35-44 years old (3)
- ○ 45-54 years old (4)
- ○ 55-64 years old (5)
- ○ 65+ years old (6)
- ○ Prefer not to say (7)

Q13 How do you describe yourself?

- Male (1)
- Female (2)
- Non-binary / third gender (3)
- Prefer to self-describe (4) _____
- Prefer not to say (5)

Q14 Which category best describes you? Please select all that apply to you.

- ☐ American Indian or Alaska Native (1)
- ☐ Asian (2)
- ☐ Black or African American (3)
- ☐ Hispanic, Latino, or Spanish Origin (4)
- ☐ Middle Eastern or North African (5)
- ☐ Native Hawaiian or Other Pacific Islander (6)
- ☐ White (7)
- ☐ I prefer not to answer (8)

Q15 What is the highest level of education you have completed?

- Some high school or less (1)
- High school diploma or GED (2)
- Some college, but no degree (3)
- Associates or technical degree (4)
- Bachelor's degree (5)
- Graduate or professional degree (MA, MS, MBA, PhD, JD, MD, DDS etc.) (6)
- Prefer not to say (7)

Q16 What was your total household income before taxes during the past 12 months?

- Less than $25,000 (1)
- $25,000-$49,999 (2)
- $50,000-$74,999 (3)
- $75,000-$99,999 (4)
- $100,000-$149,999 (5)
- $150,000 or more (6)
- Prefer not to say (7)

Q17 What is your U.S. zip code? Leave blank if you prefer not to say.

_____

Q18 All things considered, how satisfied are you with your life as a whole nowadays?

- 10 (extremely satisfied) (1)
- 9 (2)
- 8 (3)
- 7 (4)
- 6 (5)
- 5 (6)
- 4 (7)
- 3 (8)
- 2 (9)
- 1 (10)
- 0 (extremely dissatisfied) (11)

Q19 How is your health in general? Would you say it is…

- Very good (5)
- Good (4)
- Fair (3)
- Bad (2)
- Very Bad (1)

Q20 On an average week, how many days do you do a total of 30 minutes or more of physical activity at a level which is enough to raise your breathing rate?

- 0 (1)
- 1 (2)
- 2 (3)
- 3 (4)
- 4 (5)
- 5 (6)
- 6 (7)
- 7 (8)

Q21 On an average week, how many days do you perform muscle-strengthening activity?

- 0 (1)
- 1 (2)
- 2 (3)
- 3 (4)
- 4 (5)
- 5 (6)
- 6 (7)
- 7 (8)

Q22 What is your preferred setting in which to be physically active? Please rank the following categories in order of preference, where 1 represents "favorite" and 3 represents "least favorite" by dragging the options into your preferred order.

_____ Outdoor blue space (coastal park, waterfront etc.) (3)
_____ Indoors (gym etc.) (1)
_____ Outdoor green space (park etc.) (2)

End of Block: Block 4 Personal Information