SOFT SPACES

INVESTIGATING PAIN-SENSITIVE DESIGN IN PUBLIC BUILDINGS

Isabella Reynolds

TABLE OF CONTENTS

i. LIST OF TABLES AND CHARTS

ii. EXECUTIVE SUMMARY

The Soft Spaces project investigates how physical environments can positively affect people living with chronic pain in public spaces. The research invites designers to consider the impacts that public spaces have on people with chronic pain, and the potential for design decisions to positively affect a person's pain experience.

The study conducted qualitative interviews with 23 individuals experiencing various chronic pain conditions, using thematic analysis to identify common preferences. It also includes a literature review of clinical approaches to non-pharmacological pain management, including innovative healthcare approaches such as virtual reality (VR) programs.

In the interviews, common environmental preferences included comfortable seating, personal temperature regulation, ambient visual distraction, access to nature, quiet spaces, clear wayfinding, easy amenity access, soft lighting, and comfortable textures. The research finds that the preferences expressed by respondents are aligned with techniques and environmental conditions employed in VR pain management.

Based on these findings, the study proposes design considerations across nine categories: physical accessibility, lighting, visual stimuli, amenities, air quality and temperature, aspect and nature, materials and textures, noise and acoustics, and wayfinding. Specific recommendations included in the final chapter include providing a mix of open and intimate spaces, incorporating natural elements, offering various seating options, ensuring easy access to amenities, and creating areas with different temperature zones.

The findings suggest a need for a precise approach to inclusive design that considers sensory and emotional comfort alongside physical accessibility. Findings and recommendations range from commonly accepted "best practices" in architecture, such as outlook, aspect and clear wayfinding, to specific and detailed recommendations relating to material selection, location and design of amenities and rest spaces. The study also highlights potential benefits from increased collaboration between users, architects, designers, and healthcare professionals.

Future research directions include larger-scale quantitative studies to validate the proposed recommendations, assessing the long-term impacts of pain-sensitive design and the proposed considerations, and investigating cross-cultural factors influencing environmental preferences.

The project offers a set of considerations to prompt designers. In implementing some of these considerations, public spaces have the potential to become more responsive and comfortable for individuals with chronic pain, while potentially enhancing the experience for all users.

1.0 INTRODUCTION

> **"**
>
> People with chronic pain are 5 times as likely as those without to be limited a lot in daily activities.
> (Pain Australia, 2022)

1.1 INTRODUCTION

Chronic pain is a growing issue across Australia. According to the Australian Institute of Health and Welfare, over four million Australians live with chronic pain, defined as persistent or recurrent pain lasting longer than three months (Australian Institute of Health and Welfare, 2020). While pharmacological approaches are efficient in pain management, the side effects of traditional pain medications such as opioids necessitate longer-term pain management strategies for people with ongoing and chronic pain conditions (New South Wales Ministry of Health, 2024).

The large population living in pain is, in many cases, due to the fact that the ongoing and long-term use of medication to manage chronic pain is unsustainable, inappropriate, or ineffective (Ouyang, 2022). Daniel

Clauw, a Professor at the University of Michigan who oversees the Chronic Pain and Fatigue Research Center, emphasises the limitations of drug-based treatments, stating that there is not "any drug in any chronic-pain state that works in better than one out of three people." He advocates for non-pharmacological therapy to be at the forefront of chronic pain management instead of opioids or any other drugs (Clauw, 2022).

Given this context, the question arises: how can cities and public spaces be designed sensitively for the growing population that works, cares, plays, and commutes in pain?

The Soft Spaces project is an initiative to investigate

the potential for the physical environment to affect positively, and in some ways provide relief for, the experience of someone with chronic pain. It seeks to expand a conventional approach beyond compliance to consider the broad population that co-exists with pain. The research is based on qualitative reports from people living with a variety of conditions that result in frequent pain experiences, including endometriosis, spinal injuries, polycystic ovarian syndrome, migraines, Ehlers-Danlos syndrome, inflammatory bowel diseases, arthritis, and cancer.

1.2 PROJECT SCOPE

This study focuses on the environmental implications of the respondents' preferences for publicly accessible buildings and spaces rather than residential settings. The scope of this report is the collation of a set of environmental conditions through a series of qualitative interviews with people living in pain. The selection of interviewees presents a broad range of pain experiences, mobility levels and related symptoms. This research does not aim or purport to provide a holistic or representative cross-section of adults with chronic pain but rather to present initial findings based on a variety of experiences.
For the purposes of this research, interviewees were

selected who not only experienced chronic pain but also experienced pain that affected their daily activities most days. Many respondents also noted the correlation between pain and another symptom such as nausea, and as such, it is important to note that the pain experience described by interviewees and correspondingly their preferred environmental conditions may relate to a layering of experiences which is specific to that person.

The project is concerned with the environmental implications of these preferences on publicly accessible buildings and spaces, rather than residential dwellings. Also not included within the project scope are impacts of chronic pain on children, chronic illnesses broadly, preferences for environmental conditions within the home and general mobility considerations for respondents. The research recognizes the interplay between architecture, healthcare, and overall well-being, feeding into a broader, current conversation around person-oriented design, disability visibility, and inclusivity.

2.1 CONTEXTUAL HISTORY OF INCLUSIVE DESIGN

2.0 LITERATURE REVIEW

The utilisation of averages - average body types, average experiences, and average user motivations, is effective and even necessary in designing the built environment. The National Construction Code and Australian Standards utilise standardisation to ensure safety and compliance in Australian buildings.
Two significant approaches exist in design for disability and inclusivity within Australian architectural academia:

Universal Design (UD): UD is a practice that seeks to optimise the extent to which a built environment can be understood, inhabited and accessed through the conception of a cultural and physical "average user" (Mace, 1985). UD practices incorporate anthropometric data on how spaces are used to fit a range of user abilities, needs and physicalities.

Accessible Design (AD): AD looks to provide specific and separate design solutions such as ramps, low-rise elevators or accessible amenities (Keates and Clarkson 2018). These are often provided in addition to an existing design solution. Critics of an AD approach argue that the separation of mobility-enhancing features can feed social separation or exclusion of disability in the built environment (Chiland, 2020), (Goldin, 2019).

Both UD and AD approaches acknowledge that the built environment affects the physical, emotional and cognitive experience of its users, with the capacity to exclude and perpetuate not only inequalities but also the physical and emotional discomfort of the user.

Both approaches can facilitate outcomes that can mitigate pain experiences. This research does not advocate exclusively for either approach but instead seeks to demonstrate various forms of addressing inclusive design. While people with chronic pain have a variety of needs and requirements and therefore an "average user" approach does not encompass all user experiences, the reality of many design interventions require the utility of an average user. For example, seat heights, stair slopes, lighting temperatures and text sizing.

> " The effectiveness of distraction falls within the scope of cognitive-behavioural therapy (and has been found in 47 meta-analysis found to reduce pain episodes by up to 85%.)

(Fernandez and Turk, 1989)

2.2 ENVIRONMENTAL EFFECTS ON PAIN

Research in the clinical field has shown that the physical environment can play a significant role in pain modulation. Environmental enrichment (EE) refers to interventions and spatial conditions that can impact pain modulation by reducing stress and providing environmental distraction.

EE is defined as a combination of inanimate and environmental stimuli, as well as social interaction, aimed at improving overall welfare. It creates an environment that promotes sociability, cognitive functioning, and motor skills.

While the concept dates back to the late 1940s, it gained extensive attention in the 21st century regarding its relationship with pain. In clinical settings, EE has been utilised in areas such as acute postoperative pain management, demonstrating improvements in pain relief, reduced use of analgesic drugs, better surgical recovery, and lower stress levels for patients.

Recent studies have also explored EE protocols as adjuncts to standard care for patients with conditions like endometriosis. These protocols show promising results for managing surgical patients due to their safety, ease of implementation, and cost-effectiveness. EE interventions in these programs included virtual reality, digital games, educational materials, videos, aromatherapy, and music (Patel, Bates, and Patel, 2023).

Photograph: Alexander V Evstafyev via Shutterstock.

2.3 VIRTUAL ENVIRONMENTS FOR PAIN MANAGEMENT

To determine improvements to these spaces, it is helpful to examine environments that are favoured by patients and clinicians when practical limitations are removed from the environment.

Researchers in pain medicine, neuroscience, and design are investigating the use of virtual, digital environments as a pain management tool (Richtel, 2022). These environments, accessed through virtual reality (VR) headsets, are purpose-built with sights and sounds designed specifically for distraction from pain (Li, Montaño, Chen, and Gold, 2024).

An umbrella review of research across more than 17,000 patients in 274 studies concluded that virtual reality assists in managing pain conditions (Viderman et al. 2023). Some research focuses on distraction

as a mechanism for pain modulation; these rich and multisensorial, immersive virtual environments may decrease the patient's concentration on pain, which may result in a stimulus being perceived as less painful (Bordeleau et al. 2022).

For example, a patient may be virtually immersed in a grassy field with a rolling stream, complete with sounds of birds chirping and water running over rocks (Mahrer and Gold, 2009). These environments don't use a task or narrative to distract the user, as in a typical game, instead providing distraction through immersion, as well as seeking to soothe effects associated with pain, such as fear or anxiety (Teh et al. 2024). For many people, when they imagine VR environments, they picture the most popular blockbuster VR game environments, but these virtual realities are far from the virtual realities that come to mind from VR games like Red Dead Redemption, Half-Life or Resident Evil.

VR can also facilitate an environment where other alternative pain management strategies can be used, such as mindfulness, meditation techniques, guided imagery, or cognitive behavioural therapy to control stress, anxiety, and mood, which contribute to the pain experience (Godman, 2022). Dr. Binder of Spaulding Research Hospital, whose team is investigating the use of VR to manage chronic pain, writes "stress, anxiety, depression, and fear all contribute to pain; a lot of evidence suggests that if you're able to treat those, you can help reduce pain." Just as a patient's virtual environment can alleviate stress and anxiety which in turn affects pain, so too can the physical environment (Godman, 2022).

Much can be learned from the environmental conditions used within these VR programs that echo the ideal conditions noted by interviewees. How do we move these qualities from the realm of ideal conditions (in VR) into real-world structures and landscapes?

By identifying the specific conditions used within the VR environments, the research aims to consolidate a set of considerations for physical, and public spaces, combining the objectives and learnings from research into virtual environments designed specifically for pain relief, and best-practice public spaces identified by interviewees.

Environmental conditions used within VR environments designed specifically for pain modulation through distraction include:

- Natural visual environment, either a green or blue landscape
- Gentle movement throughout the experience
- Single point of experience - most VR environments utilise a fixed location (the user cannot move around the space, this is due to the potential to create or aggravate nausea when the participant moves in the virtual world, but stays still in the real world).
- Slowly changing natural environment through sights and sounds
- Most VR environments use very little narrative evolution throughout the experience, instead offering a slowly changing natural environment through sights and sounds.
- Some employ simple narratives to build resilience and coping skills

3.0 METHODOLOGY

3.1 INTERVIEW DESIGN

The structure of the interviews was focused on identifying environmental and physical aspects of spaces that interviewees found to be beneficial to their pain experience. The questions were grouped around particular topics, and the interviews were conducted in a semi-structured, responsive way, allowing for follow-up questions to be inserted where the respondent was more interested or responsive.

Commonly asked questions in the interviews are listed overleaf. Some questions prompt a specific answer with regards to a type of spatial condition, whereas others seek to facilitate a more open dialogue, which evolves in accordance with the interviewee's responses.

Common questions included:

- Do you find that you're affected by temperature when you're experiencing pain?
- If you were in public and you felt unwell, what would you usually do?
- How do you manage pain and discomfort on a day-to-day level?
- What kind of physical environment do you look for when you're experiencing pain?
- Or perhaps, where do you want to be when you feel the onset of your condition?
- • Do you find that you're affected by temperature when you're experiencing pain?
- Do you find that climate, temperature or air conditioning affects you?
- If you were in public and you felt unwell, what would you usually do?
- How do you manage pain and discomfort on a day-to-day level?
- What is your relationship like with pharmacological and non-pharmacological pain management?
- How do you deal with your condition in the absence of medication?
- If you found yourself in the city and you felt unwell, where would you seek to take refuge?
- What spaces do you find welcoming or accessible?

- What kind of environment do you create at home when you're feeling unwell?
- Does your experience of pain or discomfort contribute to feelings of anxiety? How does this affect your preferences for spatial or environmental conditions?
- Are there physical situations or places that you avoid because of your illness?
- Some people report that strong smells, cold temperatures, or hard surfaces can aggravate their pain experience. Is there anything that you find aggravates your pain?
- Some people report that distraction is a helpful pain management tool, and others report that soothing sounds or environments can calm their nervous system and help to mitigate pain. Do you look for distraction, or something else when you're feeling unwell?

3.2 INTERVIEW METHODOLOGY

Using thematic analysis, the qualitative data was examined to identify common themes across the responses. By assigning a code or tag to specific responses, segments of data or responses were categorized, summarised, and accounted for, allowing them to be grouped into common themes. This approach allows for the identification of initial patterns, which informs the development of initial recommendations for spatial design.

For example, many respondents mentioned lighting conditions, so those responses were coded with a "lighting" tag, relating to that theme. Some responses within this category would also relate to another category, such as "temperature", and the responses could be tagged with each category.

3.3 ETHICAL CONSIDERATIONS

The study adhered to ethical guidelines for research involving human participants. These guidelines were set out in written correspondence with interviewees prior to the interview. Informed consent was obtained from all participants, ensuring confidentiality and the voluntary nature of participation. While interviewee

anonymity is a critical part of the report, almost all interviewees consented to the use of their direct quotes throughout the report. Care has been taken to ensure that identifying information is not overlaid with information about that respondent's condition, such that the person could be identified.

3.4 LIMITATIONS

The research acknowledges limitations, including the non-representative sample and the subjective nature of pain experiences. The findings are preliminary and not intended to provide a comprehensive overview of all adults with chronic pain.

3.5 FINDING RESPONDENTS

For this research, 23 individuals were interviewed. This sample size was chosen to balance the depth of qualitative insights with the manageability of data analysis.

Respondents were found through a combination of community outreach and network referrals. Network referrals were the most successful avenue of sourcing for interviews. Efforts were made to contact local support groups in Sydney and Brisbane, healthcare providers, and a social media community dedicated to chronic pain.

This approach facilitated a relatively diverse pool of participants in terms of conditions reported. Women and people with autoimmune diseases were the most highly represented groups within the interview pool.
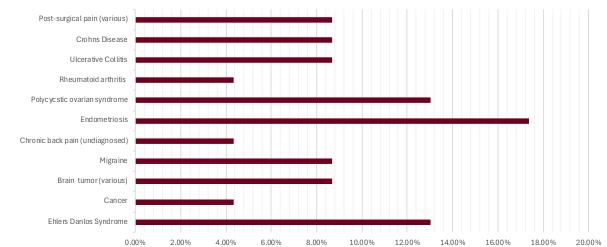
3.6 SELECTION OF INTERVIEWEES

Interviewees were selected based on the following key criteria to ensure a wide range of pain experiences and symptoms:

- That their pain frequently impacts their day-to-day activities
- That the respondent's conditions are not highly complex and layered, including significant mental health conditions such that it would make it difficult to respond to questions relating to chronic pain

- That the participant lives, works, commutes, or studies in an Australian city, such that they can speak to an experience of public space within the city context

Figure 1. Percentage of respondents reporting the condition

PERCENTAGE OF RESPONDENTS REPORTING THE CONDITION

SCHEDULE OF RESPONDENTS

Respondent	Condition	Location	Gender	Age range	Occupation Industry
1	Ehlers Danlos Syndrome	Melbourne	Woman	26-30	Student
2	Ehlers Danlos Syndrome	Previously Melbourne, now Berlin	Woman	19-25	Horticulture
3	Ehlers Danlos Syndrome	Brisbane	Man	26-30	Events
4	Cancer	Brisbane	Woman	61-65	Creative Industries
5	Pituitary Tumor	Brisbane	Man	66-70	Creative Industries
6	Brain tumor (location of tumor unknown)	Ipswich	Woman	61-65	Not working
7	Migraine	Brisbane	Non-Binary	26-30	Public policy
8	Migraine	Sydney	Woman	61-65	IT
9	Chronic back pain (undiagnosed)	Gold Coast	Man	31-35	Television & Media
10	Endometriosis (plus another overlaid condition - still seeking diagnosis)	Sydney	Woman	19-25	Creative Industries
11	Endometriosis	Brisbane	Woman	26-30	Construction
12	Endometriosis	Canberra	Woman	26-30	Education
13	Endometriosis	Sydney	Woman	31-35	Public service - council
14	Polycycstic ovarian syndrome	Brisbane	Woman	26-30	Education / Early Learning
15	Polycycstic ovarian syndrome	Canberra	Woman	31-35	Health
16	Polycycstic ovarian syndrome	Sydney	Woman	31-35	Health
17	Rheumatoid arthritis	Perth	Woman	31-35	Fashion & Media
18	Ulcerative Collitis	Perth	Woman	31-35	Viniculture
19	Ulcerative Collitis	Brisbane	Man	36-40	Health
20	Crohns Disease	Sydney	Man	41-45	Health
21	Crohns Disease	Previously Sydney, now London	Man	36-40	Construction
22	Post-surgical pain (following cranial surgery)	Previously Brisbane, now Kyogle	Man	71-75	Retired, previously education
23	Post-surgical pain (lower body pain, particularly hip)	Brisbane (working in Sydney)	Man	31-35	Finance

Figure 2. Schedule of Respondents

The above schedule details the occupation, condition, age range and location of each respondent.

Conditions reported by interviewees were endometriosis, various spinal injuries, polycystic ovarian syndrome, migraines, Ehlers-Danlos syndrome, Crohn's Disease, ulcerative colitis, rheumatoid arthritis, cancer, brain tumor, and unclear causes of pain following cranial surgery. The conditions of the respondents varied, with some experiencing chronic pain alone, while others had overlapping conditions such as nausea, fatigue, or anxiety. This layering of symptoms provided a complex picture of the challenges faced by those living with chronic pain.

4.0 FINDINGS

4.1 INTERVIEW FINDINGS

The interviews were deeply personal, with respondents eager to share their experiences; most interviews lasted for 1.5-2 hours in length. Many were generous in revealing intimate details about their pain and the environmental factors that impact their well-being, using specific anecdotal examples about places or experiences they'd had.

When asked about ideal environments for pain relief, most participants identified their own homes as containing the ideal spatial and environmental conditions. However, when asked about public buildings, participants frequently mentioned galleries, parks, museums, and libraries as ideal refuges.

4.2 COMMON THEMES AND PREFERENCES

Figure 2 (Environmental conditions preferenced by interviewees) displays the percentage of interviewees who expressed a preference for certain criteria. These preferences are organized into categories, which will be used to organise the recommendations in the last chapter of the report.

The most common responses include preferences for:
- Seating
- Temperature control
- Ambient visual distraction
- Other frequently mentioned preferences included:
- Access to natural environments or views
- Quiet spaces
- Clear wayfinding
- Easy access to amenities
- Soft lighting
- Comfortable textures

THEME   CRITERIA

PERCENTAGE OF RESPONSES PREFERENCING THE CRITERIA

Wayfinding
- Clear wayfinding to bathrooms — 61%
- Clear location of rest zones — 39%
- Clear access to exit — 26%
- Distances to exits and bathrooms are clearly understandable — 13%
- Bathrooms not visible from communal areas — 9%

Noise and acoustics
- Natural soundscapes — 65%
- Auditory distraction eg. Music, audiobook — 39%
- Ambient soundscape eg. White noise, café chatter — 35%
- Quiet — 26%

Materials and textures
- Soft materials and textures, eg. bedding, sofa — 78%
- No preference for materials — 43%
- Soft texture underfoot, eg. rubber playground materials — 22%
- No very hot or cold surfaces — 17%
- Cool, hard surfaces (for temperature regulation) — 13%
- No sticky or resistant textures, eg. Vinyl — 4%

Aspect and nature
- View to trees, greenscapes — 70%
- Preference for an enclosed space, privacy is highest priority — 35%
- No preference for view — 22%
- View to water, whether moving or still — 9%

Air
- No strong smells — 65%
- Cool (air conditioned) air temperature (18-22 degrees) — 48%
- Natural ventilation, air movement — 48%
- Low humidity — 17%
- Personal control over air temperature — 13%
- Warm air temperature (over 23 degrees) — 9%
- No preference over temperature, requirements vary — 4%

Amenity
- Quantity of bathrooms — 87%
- Plentifiul seating — 74%
- Provision of rest spaces or seating areas — 70%
- Space (social convention and physical conditons) allow for long periods of time seated — 61%
- Social convention and physical condiitons allow high level of privacy/ low supervision — 43%
- Space and furniture allow for lying down — 17%

Visual Stimuli
- Some ambient visual distraction — 74%
- Views to nature — 43%
- Calm, minimal uncluttered environment — 39%
- Minimal visual / auditory distraction — 39%
- No crowds — 26%
- High level of distraction, eg. Television — 22%
- Preference for slowly changing visual stimuli, eg. watching people outside, movement of water — 17%

Lighting
- Warm, soft lighting — 61%
- Soft dappled, moving light, eg. Through vegetation — 35%
- Uniform, consistent lighting — 30%
- No preference for cool or warm — 26%
- Personally controllable lighting — 22%
- Preference for darker/softer lighting — 9%

Physical accessibility
- Short distances between seats — 13%
- No steep slopes on ramps or stairs — 22%
- Preference for soft seating — 35%
- Space (social convention and physical conditions) allow for lying down — 17%
- Preference for shaded outdoor spaces — 17%
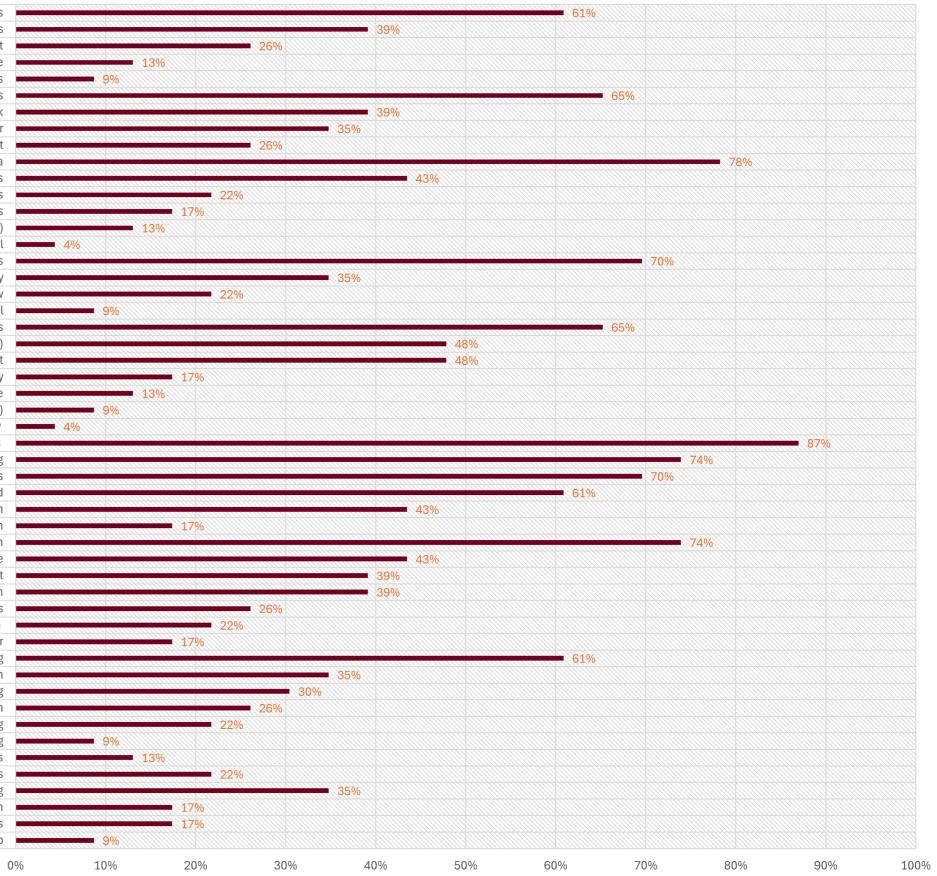- Undercover space for car pickup — 9%

Figure 3. Environmental conditions preferenced by interviewees.
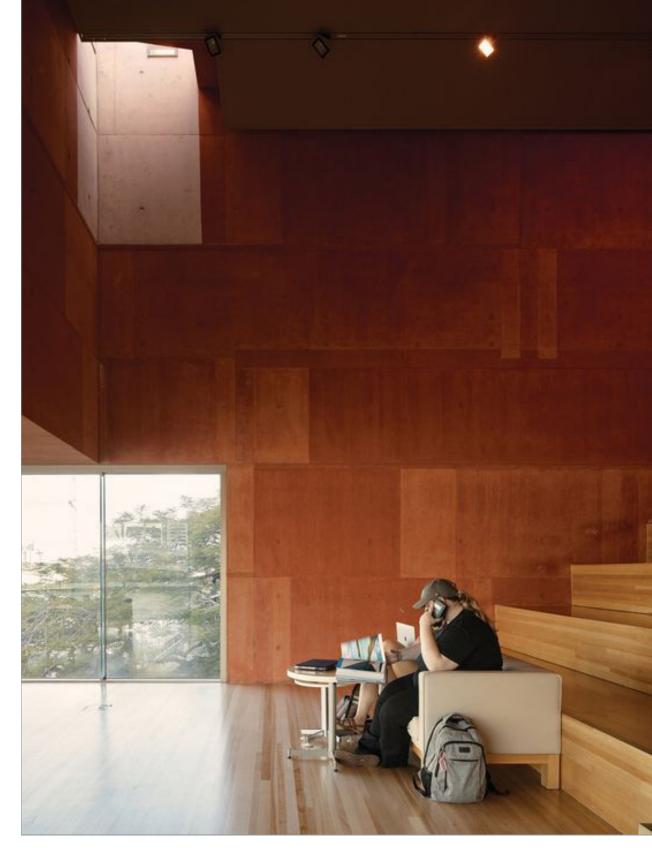
One respondent cited the Red Box at the State Library of Queensland as a place of reprieve for them.

4.3 DAY IN THE LIFE EXAMPLES

To illustrate the lived experiences of individuals with chronic pain, two "Day in the Life" scenarios were collected:

Example 1: A former professional athlete with chronic back pain
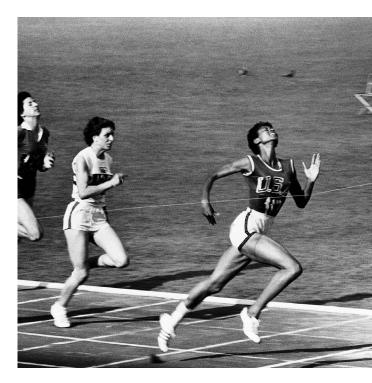
This interviewee has had remarkable life changes as a result of her chronic pain. Previously a professional competitor in field athletics, she retired from sport and is transitioning to a new everyday routine. In the interview, she described her pain as "chronic back pain predominantly stemming from my coccyx and sacrum".

Commuting:
Through a trial-and-error process, she determined that sitting down for long periods of time, or walking for long periods of time is most aggravating. As such, she reported starting her day with a short walk to the train to get to work. She would wake up early to allow extra time should she need to stop and rest during her commute. While walking, she would sit periodically on a bench but after 20-30 minutes would need to get up and keep walking. As she described, her movements

Photographs: Mark Kauffman The LIFE Picture Collection/Shutterstock
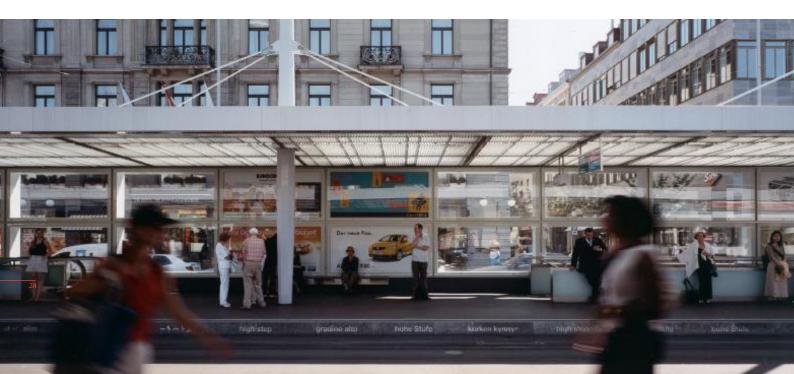
cycle between walking and resting, as both sitting for long periods and walking for long periods are both aggravating.

In the office:
She reports that being around other people, whether in the office or at a local cafe, can be helpful "if [she] really needs to get things done and can't "give in" to the pain. Having people around works as accountability, but sometimes if the pain is too much, then I need to be alone and will generally have to go home to find this."

Getting home:
Should she need to go home, this respondent highlighted the importance of the environment in facilitating an easy exit. For her this means leaving where she is and waiting for a tram or calling a cab. She listed some ideal conditions for this exit, including: short wait times for elevators, a clearly located car pickup zone in front of the building and soft undercover seating at the waiting area.

Home environment:
Once home, she creates an environment with soft textures, warm, soft lighting and the ability to regulate the environmental temperature.

Key takeaways from this case study include:
- Commuting: Alternates between short periods of walking and sitting
- In the office: Being around people can be helpful for accountability
- Getting home: Emphasises the importance of easy exits and comfortable waiting areas
- Home environment: Creates an environment with soft textures, warm lighting, and temperature control

Photograph: Rainer Taepper

Photograph: Nina Leen, TIME Magazine

Photograph: Daily Life Magazine

Example 2: An individual with multiple autoimmune diseases

The "day in the life" example looks at a person who works in creative industries and lives in Melbourne. They live with a layering of autoimmune diseases and maintain a full-time desk-based job despite having debilitating pain almost all day. They report that upon waking up, her muscles are seized and stiff, and pain reverberates through their body. The interviewee also reported that they try to minimise the use of analgesics throughout the day, instead opting for non-pharmacological pain management solutions wherever possible.

During the work day:
At work, moving is difficult, but sitting feels worse, and they try to alternate between an agitated crouching position and slow laps around her office.

By mid-morning they consider abandoning social convention and laying down on the office floor to release the pressure from their back and legs.

Lunchtime:

At lunchtime they walk to a park nearby and lay down in the shade; the dappled movement of the light on their closed eyelids provides some gentle distraction, they say. They also enjoy listening to the chatter and natural sounds of the park.

Key takeaways from this case study include:

- At work: The ability to change positions regularly is beneficial
- Seeks physical environments with varying social conventions, such as a park, where laying down is socially appropriate
- Findings relief in natural surroundings, citing beneficial visual, temperature and auditory conditions

4.4 IDEAL CONDITIONS FOR PAIN MITIGATION

Based on the interview findings and research into virtual environments used for pain management, several ideal conditions for pain mitigation in public spaces were identified:

• Natural visual environments (green or blue landscapes)
• Gentle movement in the environment (e.g., wind through grass, moving water)
• Calming soundscapes (often preferencing natural sounds such as water or wind)
• Minimal changes or evolution in the environment (whether virtual or physical)
• Multi-sensory experiences (where possible)
• Comfortable seating options
• Temperature control
• Easy access to amenities
• Clear wayfinding
• Soft or adjustable lighting
• Comfortable textures (largely preferencing soft materials)
• Opportunities for both social interaction and privacy

The main reading room of the National Library of Australia in Canberra by Bunning and Madden, shot from the eastern end (1968). Image: Max Dupain Source: Architecture AU

5.0 DISCUSSION

5.1 ANALYSIS OF INTERVIEW FINDINGS IN CONTEXT OF EXISTING LITERATURE

The findings from the interviews align with and expand upon existing research on environmental effects on pain management. The preferences expressed by the interviewees for natural environments, comfortable seating, temperature control, and gentle visual stimulation echo the principles of Environmental Enrichment (EE) discussed in the literature review.

For instance, the preference for galleries, libraries, and museums as public refuges aligns with the EE concept of providing a combination of inanimate environmental stimuli. For example, these spaces offer a balance of visual interest, controlled environments, and opportunities for both social interaction and solitude, which are key elements of EE (Patel, Bates, and Patel, 2023).

5.2 COMPARISONS BETWEEN PHYSICAL AND VIRTUAL ENVIRONMENTS

The findings reveal interesting parallels between the preferred conditions in physical environments and those used in virtual reality (VR) environments for pain management:

Natural Environments:
Both Soft Spaces interviewees and VR studies emphasise the importance of natural, particularly green or blue, landscapes (Bordeleau et al. 2022).

Gentle Movement:
The preference for dappled light or moving water in physical environments mirrors the use of gentle environmental movement in VR settings.

Controlled Stimulation:
The desire for "just enough distraction" in physical spaces aligns with the careful balance of stimulation provided in VR environments designed for pain management.

For example, one respondent noted that they enjoyed "crowd-watching" through a window to outside, finding a small amount of distraction to be calming

rather than overwhelming. This preference could be compared to the use of slow environmental or narrative evolution in VR environments, such as in the ECO VR experience where a user moves underwater through a digitised version of the Great Barrier Reef.

Multi-sensory Experience:
While VR is limited to visual and auditory stimuli, findings highlight the importance of considering all senses in physical environment design, including temperature, texture, and even smell.

5.3 IMPLICATIONS FOR DESIGN OF PUBLIC SPACES

The alignment between the interview findings and existing research on both physical and virtual environments for pain management suggests several key considerations for the design of public spaces:

Inclusive design beyond physical accessibility:
While traditional accessible design (such as requirements within the National Construction Code) focuses on physical mobility, these findings suggest a need for a broader approach in addition to those regulations, that considers sensory experiences and emotional comfort.

Flexibility and choice:
Given the varied needs of individuals, the ideal public space would offer a range of environmental conditions and seating options. Practically, this could mean variety in terms of ventilation, temperature or seating opportunities.

Connection to nature:
Ideally, an aspect towards a natural vista would be provided. While this is not always possible, the incorporation of natural elements within the space, the use of devices such as internal courtyards or

longer distance views towards urban spaces could also be beneficial.

Sensory consideration:

Designers are prompted to consider the full sensory experience of a space, including lighting, acoustics, temperature, and textures.

Clear wayfinding:

Easy navigation and access to amenities emerged as crucial factors, with clear signage and intuitive layouts prioritised in public space design, such as the ability for a user to immediately understand the distance and directions to amenities or an exit.

Refuge spaces:

Refuges are calm, controlled environments, or pockets of space, within larger public spaces. Refuges can be created through spatial planning, employing prospect-refuge theory to create environments that offer safety, while also offering users the ability to survey their surroundings. Practical examples could include seating with one's back to a wall, use of elevational changes to allow a user greater prospect over the space, or furnishing interventions such as "phone pods"; chairs which are walled on three sides.

These considerations are addressed in the following chapter, which outlines initial recommendations or design considerations, grouped under the nine themes identified from the interview responses.

6.0 RECOMMENDATIONS

6.1 THEMES FROM INTERVIEW DATA

The recommendations are organized into nine categories, derived from the themes identified in the interview response data:

Physical accessibility
- Design issues such as the location of elevators, stair design, and key distances
- Create a mix of open and more intimate spaces
- Design flexible spaces that can be adapted to different needs

Lighting
- Brightness, colour, consistency, and location of lighting
- Provide adjustable lighting options
- Incorporate natural light where possible
- Avoid harsh, flickering, or overly bright lights

Visual stimuli
- Provision of a calm uncluttered visual environment, without rapidly changing or moving visual stimuli such as advertising, transport, or crowds

Amenities
- Number of and location of toilets or parents' rooms, as well as provision of seating
- Offer a variety of seating options (soft, firm, with and without armrests)
- Include options for reclining or lying down where appropriate
- Ensure easy access to restrooms
- Provide water fountains and rest areas

Air
- Humidity levels, temperature, ventilation, smells
- Offer temperature-controlled environments
- Provide areas with different temperature zones

Aspect and Nature
- Inclusion of views toward green or blue spaces, as well as the lighting conditions created by that proximity
- Incorporate views of nature or green spaces

- Include indoor plants or water features

Materials and Textures
- Use a mix of soft and supportive materials
- Avoid extremely hard or cold surfaces in areas designed for extended stay

Noise and acoustics
- Modest ambient noise levels and types of sound
- Design for sound absorption to reduce noise levels
- Create quiet zones within larger spaces

Wayfinding
- Provide clear, intuitive signage
- Design easily navigable layouts
- The provision of easy egress, clearly located amenities, and rest spaces

6.2 BUILT EXAMPLES

To illustrate how these recommendations can be implemented, examples are provided of existing buildings or spaces that successfully incorporate some of these elements:

For example:

Quiet hour at Coles Supermarkets meets the following criteria:

N1 (A gentle soundscape without beeping), and

L6 (Soft, dim, warm lighting).

6.3 IMPLEMENTATION MATRIX

A matrix is included which plots the recommendation categories (as outlined in the previous chapter) against other emergent design themes, or commonalities such as "easy movement," "just enough distraction," and "a homelike environment." Quotes, comments and preferences extracted from the interviews are plotted on this matrix, with each given an alpha-numeric code.

These codes correspond to built examples which achieve that criteria. For example, The National Gallery in Canberra, an example given by one of the respondents, meets several of the coded criteria (L1, V2, A13, A15, AM2). Lines are drawn between these coded phrases to identify relationships that exist across categories, and to communicate the connectedness of the criteria.
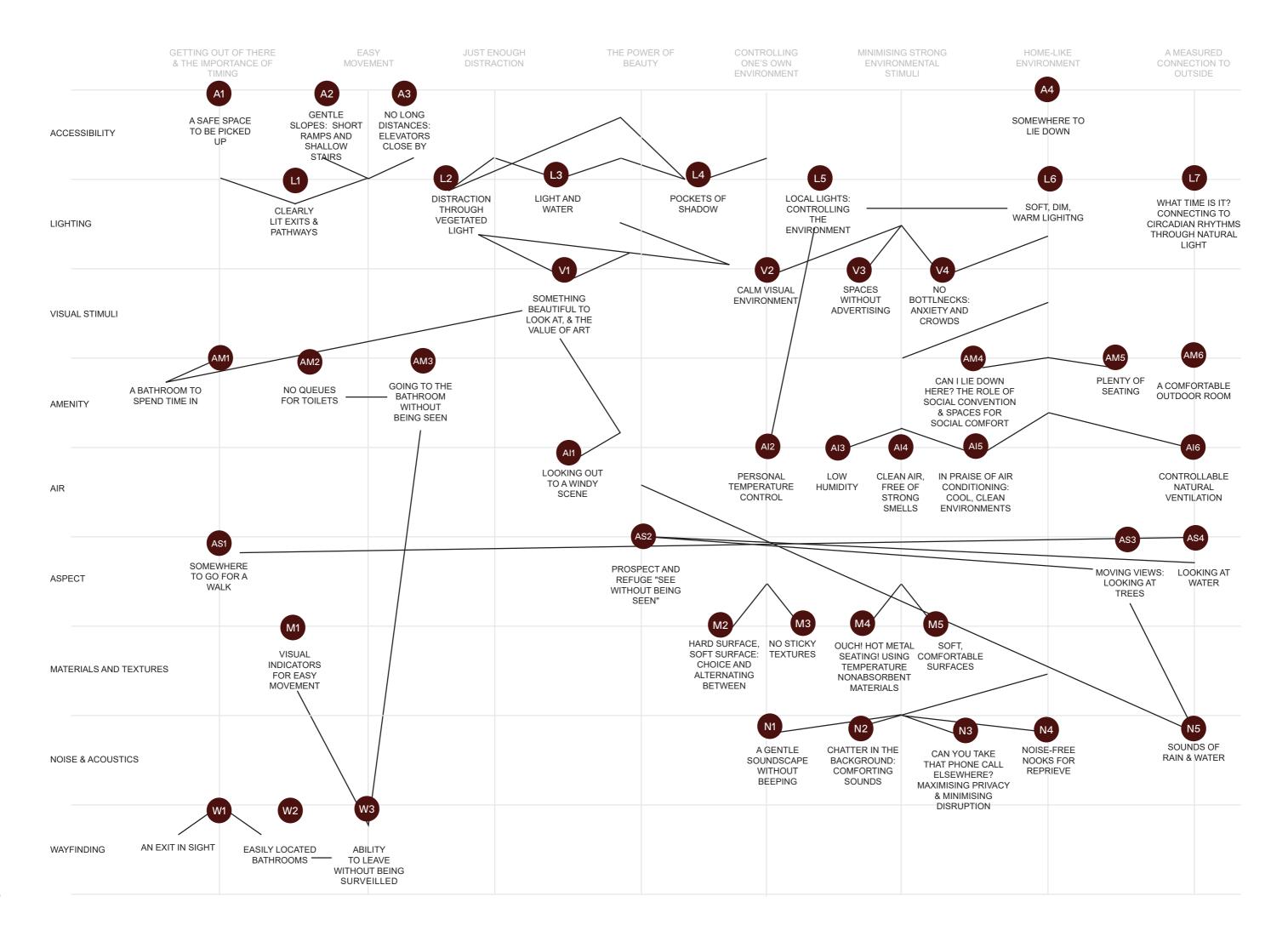
This matrix can serve as a tool for readers to refer to, to understand the specific interview response that the criteria or example is addressing, or to prompt consideration of a particular user's need.

The matrix is a tool to visualise verbal and written interview response data. It is also a means to understand the commonalities between responses, and the interconnectedness of the interviewees recommendations. By implementing these considerations, public spaces have the potential to become more inclusive and comfortable for individuals living with chronic pain, while also enhancing the experience for all users.

6.4 PRELIMINARY RECOMMENDATIONS

For each category, initial design recommendations are offered.

These examples demonstrate that it's possible to create public spaces that are both functional and sensitive to the needs of individuals with chronic pain, as well as the impact that can be achieved by incorporating, whether physically or operationally, as few as one recommendation.

ACCESSIBILITY

- **A1** — A SAFE SPACE TO BE PICKED UP
- **A2** — GENTLE SLOPES: SHORT RAMPS AND SHALLOW STAIRS
- **A3** — NO LONG DISTANCES: ELEVATORS CLOSE BY
- **A4** — SOMEWHERE TO LIE DOWN

LIGHTING

- **L1** — CLEARLY LIT EXITS & PATHWAYS
- **L2** — DISTRACTION THROUGH VEGETATED LIGHT
- **L3** — LIGHT AND WATER
- **L4** — POCKETS OF SHADOW
- **L5** — LOCAL LIGHTS: CONTROLLING THE ENVIRONMENT
- **L6** — SOFT, DIM, WARM LIGHITNG
- **L7** — WHAT TIME IS IT? CONNECTING TO CIRCADIAN RHYTHMS THROUGH NATURAL LIGHT

VISUAL STIMULI

- **V1** — SOMETHING BEAUTIFUL TO LOOK AT, & THE VALUE OF ART
- **V2** — CALM VISUAL ENVIRONMENT
- **V3** — SPACES WITHOUT ADVERTISING
- **V4** — NO BOTTLNECKS: ANXIETY AND CROWDS

AMENITY

- **AM1** — A BATHROOM TO SPEND TIME IN
- **AM2** — NO QUEUES FOR TOILETS
- **AM3** — GOING TO THE BATHROOM WITHOUT BEING SEEN
- **AM4** — CAN I LIE DOWN HERE? THE ROLE OF SOCIAL CONVENTION & SPACES FOR SOCIAL COMFORT
- **AM5** — PLENTY OF SEATING
- **AM6** — A COMFORTABLE OUTDOOR ROOM

AIR

- **AI1** — LOOKING OUT TO A WINDY SCENE
- **AI2** — PERSONAL TEMPERATURE CONTROL
- **AI3** — LOW HUMIDITY
- **AI4** — CLEAN AIR, FREE OF STRONG SMELLS
- **AI5** — IN PRAISE OF AIR CONDITIONING: COOL, CLEAN ENVIRONMENTS
- **AI6** — CONTROLLABLE NATURAL VENTILATION

ASPECT

- **AS1** — SOMEWHERE TO GO FOR A WALK
- **AS2** — PROSPECT AND REFUGE "SEE WITHOUT BEING SEEN"
- **AS3** — MOVING VIEWS: LOOKING AT TREES
- **AS4** — LOOKING AT WATER

MATERIALS AND TEXTURES

- **M1** — VISUAL INDICATORS FOR EASY MOVEMENT
- **M2** — HARD SURFACE, SOFT SURFACE: CHOICE AND ALTERNATING BETWEEN
- **M3** — NO STICKY TEXTURES
- **M4** — OUCH! HOT METAL SEATING! USING TEMPERATURE NONABSORBENT MATERIALS
- **M5** — SOFT, COMFORTABLE SURFACES

NOISE & ACOUSTICS

- **N1** — A GENTLE SOUNDSCAPE WITHOUT BEEPING
- **N2** — CHATTER IN THE BACKGROUND: COMFORTING SOUNDS
- **N3** — CAN YOU TAKE THAT PHONE CALL ELSEWHERE? MAXIMISING PRIVACY & MINIMISING DISRUPTION
- **N4** — NOISE-FREE NOOKS FOR REPRIEVE
- **N5** — SOUNDS OF RAIN & WATER

WAYFINDING

- **W1** — AN EXIT IN SIGHT
- **W2** — EASILY LOCATED BATHROOMS
- **W3** — ABILITY TO LEAVE WITHOUT BEING SURVEILLED

Photograph: Author's own,
National Gallery, Canberra

6.4.1 PHYSICAL ACCESSIBILITY

When designing the layout and accessibility features of the building, several key considerations emerged from the feedback:

- Distances between various amenities and exits benefit from being minimised, ensuring exits are highly visible with clear wayfinding back to them
- Additionally, co-locating exits with car pickup areas enhances convenience.
- Ideally, toilets, parents' rooms, and facilities for persons with disabilities (PWD) would be prominently placed, and easily visible from the building entry and main gathering spaces to facilitate accessibility.

Design considerations may include:

- Elevators situated near the building entry, especially for those who may prefer to avoid stairs (respondents noted that they will avoid using a lift if it is a significant distance further than the stair).
- Staircases with gentle slopes and handrails on both sides of the stair wherever possible. Very short treads should be avoided wherever possible.
- Regular provision of seating within short distances to prevent users from walking long distances without access to a seat (ideally, a user would not need to walk more than 40-50m to find a seat).
- Designing spaces or furniture elements that allow users to lie down or change positions comfortably is highly desirable, as is providing options for sitting in various ways
- Locating amenities within the building such that they aren't visible from common or gathering spaces
- Provide undercover space for car pickup, with seating
- Provide shaded outdoor or semi-outdoor space, ideally with bathrooms located nearby

6.4.2 LIGHTING

With regards to artificial lighting within the space, consideration should be paid to both primary thoroughfares and main areas as well as refuge areas. Respondents noted different requirements for thoroughfares and main areas, as opposed to refuge areas. A primary thoroughfare was identified by respondents as a pathway via which they may need to quickly exit the building, whereas a refuge area is a place where a person may rest for a longer period of time.

In primary thoroughfares and main areas, respondents requested that lighting should be bright enough to facilitate easy wayfinding, with a preference for neutral or warm light tones. A consistent spread of lighting, avoiding "hot" spots and ensuring even distribution of washed light to prevent glare and discomfort is preferable. Flickering lighting, including moving advertising, can be aggravating and some respondents noted that it could trigger a pain response (this response was particularly important to the respondent with a brain injury).

In refuge areas, softer, warmer lighting was noted as preferred, with controllable options being ideal to cater to varying preferences. Additionally, soft lighting integrated with vegetation or water features can contribute to a calming and distracting environment.

Design considerations may include:
- Respondents expressed a strong preference for dappled light through vegetation, or reflected from water for its pleasant distracting effect
- Lighting should facilitate easy wayfinding, especially to bathrooms and exits
- Designers may consider the use of anti-glare lighting solutions
- Designers may consider the use of lighting solutions that avoid "hot spots" of lighting, instead opting for a more even distribution
- Where possible, provide areas of low, soft, warm lighting
- Where possible, designers may consider providing users the opportunity to control or adjust the lighting environment themselves

6.0 RECOMMENDATIONS
Photo top

Photographer: Brendon Thorne/ Bloomberg

One example where noise and lighting considerations are integrated operationally, is pictured below, at Coles Supermarket. A "quiet hour" is offered, where store lighting is reduced, the radio volume is lowered, noises from register and scanner volumes and reduced to the lowest level, and no PA announcements will be made except in the case of emergencies.

6.4.3 VISUAL STIMULI

Visual stimuli is a broad category encompassing a holistic visual environment. Respondents seek a calm uncluttered visual environment, without rapidly changing or moving visual stimuli such as advertising, transport, or crowds.

While respondents differ on preference, most prefer a small amount of calm, natural visual stimuli such as water of views to vegetation. Harsh, bright visual stimuli and quickly changing visual environments, such as digital billboards can be aggravating. Preferences were also expressed against large areas of very bright saturated colors, as well as layering of materials that create visual illusions such as the moire effect.

Design considerations may include:

- The provision of some ambient visual distraction, natural is most preferable, but artwork and views to the outside also provide desirable distractions
- Where avoidable, minimise fast-moving video or advertising.
- Where possible, designers may consider the use of analogue rather than digital signage, to avoid flickering lighting or constantly changing imagery (such as on directory signage).
- Where space permits, minimise the potential for bottlenecks and large crowds, particularly where noise would reverberate.
- Designers may consider avoiding large areas of very bright colour or highly contrasting patterns.
- Designers may consider also avoiding overlaid patterns that can create visual illusions such as the moire effect.

1. Physical accessibility
2. Lighting
3. Visual stimuli
4. Amenity
5. Air
6. Aspect and nature
7. Materials and textures
8. Noise and acoustics
9. Wayfinding

A calm visual environment, with some distraction and visual interest is found in the ground level gallery at the National Gallery in Canberra.

6.4.4 AMENITY

Respondents requested that additional toilet facilities should be provided wherever possible, with respondents expressing a strong preference for private, quiet toilet amenities which are easily accessible from circulation spaces.

The precise location of amenities, as well as their visibility from main gathering spaces is crucial in order to create amenities that can be accessed for long periods of time, in relative anonymity.

Participants noted the preference for several banks of toilet facilities located throughout the building, as opposed to one larger centralised bank of amenities, as travel distances throughout the building to amenities is decreased. This was particularly important for users such as the four respondents with Inflammatory bowel diseases, who expressed that long distances to toilets is anxiety inducing for people who experience urgency in using the restroom.

Design considerations may include:
- Seating areas that aren't surveilled are highly desirable.
- A general environment of low surveillance (while often dictated by building typology, operation and location) is desirable.
- Designers may consider the provision of more than the minimum number of toilets wherever possible.
- Designers may consider the provision of full height partitions to toilet cubicles, rather than partial height partitions for additional privacy and comfort.
- Designers may consider decentralising amenities blocks throughout the building where spatial efficiencies permit, such that distances between amenities is reduced throughout the building.
- Locating amenities such that they are not surveilled by waiting areas. Note: however the importance of clear wayfinding to amenities.
- Provide plentiful seating, ideally in different styles.

6.0 RECOMMENDATIONS
Photo top

Photographer: Ben Guthrie

The Leura public amenities block, extended and refurbished by Welsh and Major, provides amenity to the nearby Leura mall in the Blue Mountains. Previously, more than 50 people could be found queuing for bathrooms, and the addition of new facilities has increased the accessibility of the shopping precinct through this provision.

6.0 RECOMMENDATIONS
Photo top

*Photographer: Brendon Thorne/
Bloomberg*

The Translational Research Institute in Brisbane is programmatically centred around an outdoor room. The naturally ventilated, often cool semi-outdoor space is well utilised, and offers a mediated relationship to the outdoors.

6.4.5 AIR

Temperature regulation is important for many respondents with an approximate target of 21-23 degrees identified as the optimal balance, catering to the predominant preference for cooler temperatures among respondents. It should be noted however, that responses were varied when it came to being in air conditioned or naturally ventilated spaces. Some respondents also preferred to be able to control their own temperature and adjust their environment as required.

Opinions among respondents are divided regarding preferences for natural ventilation. Low humidity levels are desirable, and strong smells of any kind, whether "pleasant" or not, should be avoided, respondents say.

Design considerations may include:
- Consider the provision of areas of natural ventilation, or where the occupant can control the ventilation themselves.
- Consider the provision of spaces of varying temperature, allowing occupants to regulate temperature themselves, by sitting in direct sunlight, or beside a window, for example.
- The use of passive and mechanical ventilation systems are adequate to remove smells.
- Where areas from which smells can emanate are included, such as a kitchen in an office environment, separating these areas such that smells are not carried into other areas.
- Providing passive or mechanical conditioning to ensure that temperature is within a comfortable range, and that humidity levels are kept low.
- If possible, allow occupants to adjust temperature themselves at a local level.
- Consider when using carpet or other soft materials potential for soft materials to absorb scents.

1.   Physical accessibility
2.   Lighting
3.   Visual stimuli
4.   Amenity
5.   **Air**
6.   Aspect and nature
7.   Materials and textures
8.   Noise and acoustics
9.   Wayfinding

The offices of BVN Architecture in Brisbane contain operable windows; a rare inclusion given the stringency of NCC requirements. Users are free to open and close the windows, which are in a mechanically separate zone from the workstations and office proper.

6.4.5 ASPECT AND NATURE

Inclusive spaces benefit from views toward green or blue spaces and the lighting conditions created by that proximity. This can include dappled light through vegetation or pleasant views outwards.

Current, as well as historical research supports the idea that views of nature shorten recovery times, and have benefits to mental health and anxiety, both of which are affected by and in turn, affect, pain responses.

Design considerations may include:

- Provide views to green or blue landscapes, whether man-made or, if location permits, toward a natural view.
- Utilising internal courtyards and other interior landscape devices to facilitate views to greenery
- Employment of prospect-refuge theory, where a user can see without being seen is ideal. Such as, provision of small, recessed seating nooks offering some prospect outwards. Examples of prospect offered may include:
  - a distant vista
  - an elevated view
  - beautiful natural outlook; mountains, oceans, sky expanse
- Offering some opportunities for refuge without surveillance, such as:
  - a nook or recess in an interior space
  - a bench seat with a wall behind
  - Recesses within a facade such as a portico

Photo top

Photographer: Mitsumasa Fujitsuka

AS1 AS2

1. Physical accessibility
2. **Lighting**
3. Visual stimuli
4. Amenity
5. Air
6. **Aspect and nature**
7. Materials and textures
8. Noise and acoustics
9. Wayfinding

The Comico Art Museum by Kengo Kuma seperates the building form into pavillions, allowing for blue-green landscaped spaces in between and around each area. In this way, almost every space in this public building has a view toward, as well as a distinct, transient natural light quality of moving water and vegetation.
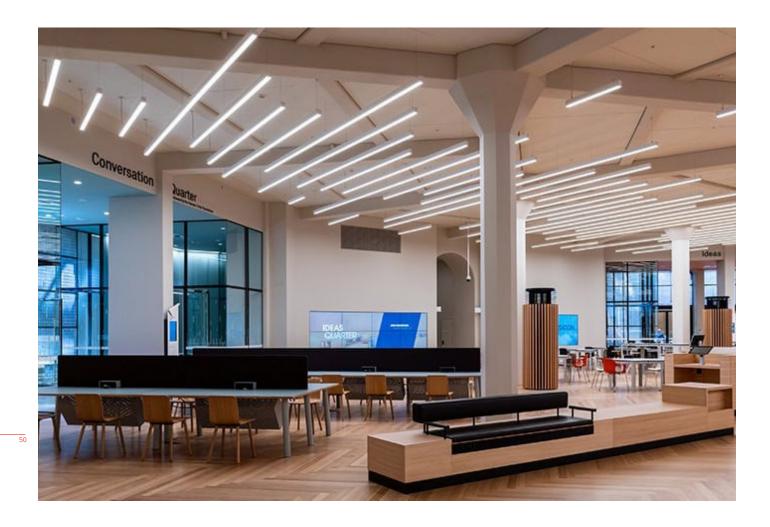

Photographer: Mitsumasa Fujitsuka

Photo credit: Architectus and Conrad Gargett Website

M2   M4   M5

1.   Physical accessibility
2.   **Lighting**
3.   Visual stimuli
4.   Amenity
5.   Air
6.   Aspect and nature
7.   **Materials and textures**
8.   **Noise and acoustics**
9.   Wayfinding

The revitalisation of the State Library of Victoria by Architectus and Conrad Gargett sees the separation of the library into distinct zones, each with different uses, noise and activity levels, and seating opportunities. The bench in the foregound has a combination of soft and hard textures.
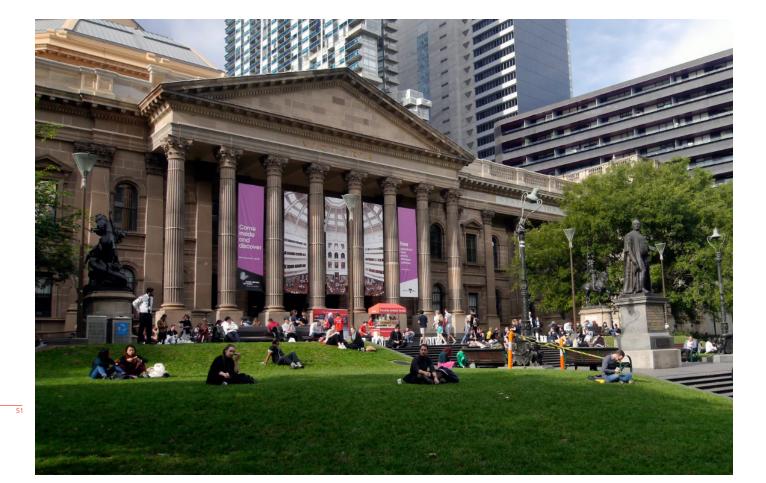
State Library of Victoria, image from Medium

At the State Library of Victoria forecourt, elevation permits the prospect over the pedestrians of Swanston Street, granting refuge for the occupant to sit on the grass.

6.4.6 MATERIALS AND TEXTURES

Preferences for seating materials were largely consistent: almost all respondents preferred soft seating, but others find cool, hard temperature absorbent surfaces soothing. With this in mind, provision of both soft seating surfaces and hard ones may be optimal.

Some respondents specifically noted a preference for nonabrasive upholstery, or where soft upholstery isn't possible, timber. One respondent who has autism preferred that all soft textured materials be removable from the room. The same respondent also noted that textures that make "squeaky" noises (such as rubber or vinyl floor finishes) were generally unpleasant, although this did not trigger or necessarily aggravate a pain experience for them.

Other respondents noted that soft textures underfoot such as reconstituted rubber playground materials or deep carpets offer some pain relief and make walking or standing more comfortable.

Design considerations may include:

- Consider balancing hard surfaces with soft ones to allow occupant choice when it comes to seating and floor finishes
- Consider additional provision of soft, deep seating
- Avoid where possible the use of highly temperature-absorbent materials in situations where a person can touch or sit on that surface
- Use sparingly floor finishes that make "squeaking" noises such as vinyl or linoleum
- Consider the use of generous underlays to floor finishes to soften impact for users, especially in situations where people may be standing for long periods.
- Consider also the use of carpet in areas where someone might be standing for a long period.

Source: BVN

1. Physical accessibility
2. Lighting
3. Visual stimuli
4. Amenity
5. Air
6. Aspect and nature
7. Materials and textures
8. Noise and acoustics
9. Wayfinding

Hard and soft materials applied to floors, wall surfaces and seating areas create differentiated zones, acoustic conditions and textural experiences at the TC Beirne Library by BVN Architecture.

6.4.7 NOISE AND ACOUSTICS

Low, ambient noise is ideal, with many users expressing a strong preference for natural soundscapes such as water sounds, fire sounds, rain or wind. Harsh traffic noises and noises that demand attention, changing rapidly such as advertising videos, were noted to be highly aggravating by most respondents.

One respondent noted that "beeping" sounds are highly aggravating, which may be a consideration for designers when selecting electronics, appliances or equipment.

Spaces that facilitate a low level of auditory distraction for users, such as gentle background chatter, rather than complete silence, may be an appropriate response to the relatively even distribution of auditory preferences identified by interviewees.

Design considerations may include:
- Consider the provision of "quiet" areas, which are removed from the general thoroughfare and which utilise sound absorbent materials
- Consider the provision of separable "loud" areas, such as places for occupants to take phone or video calls
- Consider how the space could facilitate a pleasant level of white background noise by sizing rooms, selecting materials and locating spaces
- Avoid specifying appliances or fixtures that "beep" regularly
- Look for opportunities for natural soundscapes to be heard indoors, or to amplify pleasant sounds

6.0 RECOMMENDATIONS
Photo

Patricia Blessing, University of Michigan

The Sultan Bayezid II Complex Health Museum, constructed by the Ottoman Empire in the 15th Century, uses a fountain at the central courtyard, with the sounds of water as a healing tool in medical treatment ("Water and Sound in Islamic Architecture" 2020).

6.4.8 WAYFINDING

Inclusive spaces benefit from the provision of easy egress, clearly located amenities, and accessible rest spaces. Toilets, parents' rooms, and facilities for persons with disabilities (PWD) should be prominently placed, easily visible from the building entry and main gathering spaces to facilitate accessibility. Accessible rest spaces should be clearly visible, such that users can intuit how far they will need to walk before reaching a seat or rest area.
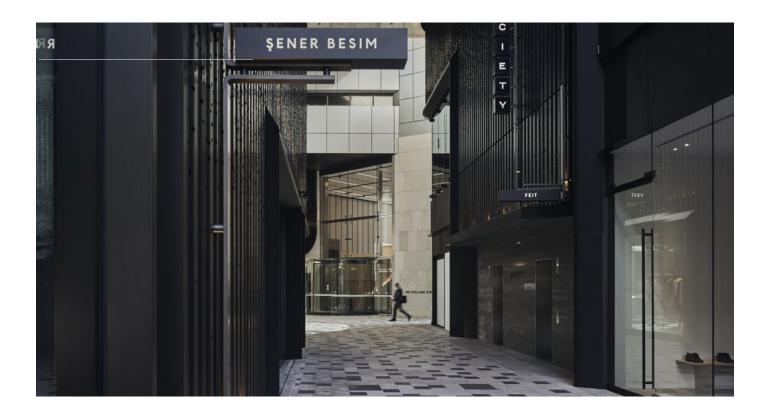
The easy and intuitive understanding of exit locations and bathrooms is beneficial, as respondents note the relationship between pain, urgency and anxiety, and the potential affect that spatial confusion can have on this experience.

Design considerations may include:

- The use of large, clear signage for amenities, and locate them in a place visible from the intuitive, main circulation space, such that a person entering the building for the first time could find them quickly
- Providing amenities in a place accessible to the public; a provision of a semi-pubic bathroom is a desirable act of generosity to the public realm
- Locate rest spaces or seating along a circulation path (or clearly visible from a circulation path)

Photo

Upper: 80 Collins Street Melbourne
Lower: Gasworks plaza, Brisbane

While shopping centres may not come to mind as exemplary examples of physiological inclusion, these examples integrate a combination of intuitive and welcoming wayfinding with clear spatial organisation to provide easy, fast and relatively anonymous access to bathrooms and street exits.
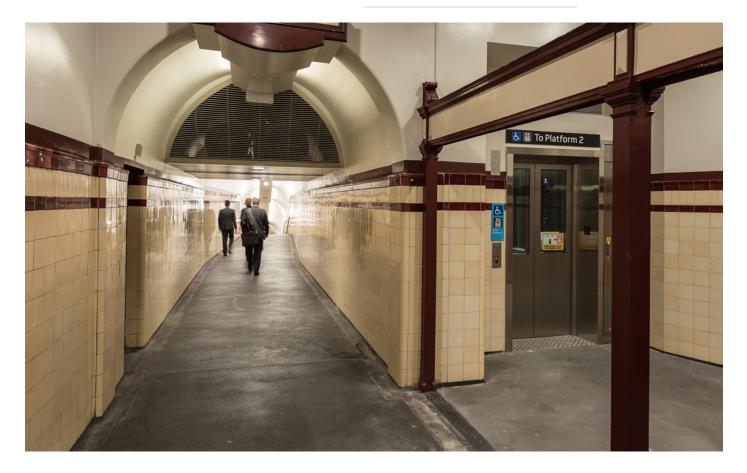
While train stations contain some of the qualities identified as aggravating (such as noise, crowds, long distances to walk), the provision of amenity and efficient wayfinding, as often necessitated by the typology, is highly successful in providing plentiful ,easily identified and relatively anonymous use of the facilities.

7.0 CONCLUSION

7.1 SUMMARY OF KEY FINDINGS

The considerations may act as a resource for practitioners to consider when designing spaces to ensure they are doing so in a manner sympathetic to the millions of Australians living with chronic pain.

Designing for pain goes beyond rote standardisation, with accessibility as an open-ended project where architectural problem-solving changes with medicine and user experience, to ultimately offer better spaces not just for people who live with pain, but for all Australians.

With the population of people living with chronic pain increasing yearly, there is a pressing need for our built environment to address this significant portion of the population. Findings confirm that the physical environment can play a crucial role in pain modulation, and on the potentially circular experience between pain and other related symptoms such as anxiety.

This research has explored the intersection of chronic pain and environmental design, revealing initial insights into how public spaces can be designed to better accommodate individuals living with pain:

Preferred Spaces:
Galleries, libraries, museums, and parks were frequently cited as ideal public refuges, offering a balance of stimulation, comfort, and accessibility. Users prefer spaces which not only meet their criteria in terms of physical and environmental design, but also that offer a low level of percieved supervision, and that have less strict cultural regulations around behaviour, such as the percieved permitted length of time that a person can dwell or the ability to lie down.

Key Environmental Factors:
Temperature control, comfortable seating, natural elements, gentle visual stimulation, and easy access to amenities emerged as critical factors in creating pain-friendly environments.

Multi-sensory Consideration:
The research highlights the importance of considering all senses in environmental design, expanding beyond the visual and auditory focus of virtual reality pain management techniques.

7.2 IMPLICATIONS FOR FUTURE DESIGN AND RESEARCH

The findings of this study have several implications:

HOLISTIC APPROACH TO INCLUSIVE DESIGN

There is a need to expand our understanding of inclusive design beyond physical accessibility to encompass sensory and emotional comfort. This means in addition to the provisions required by the Australian Standards which make provision for people with visual impairment or who use wheelchairs, considering the cumulative emotional and physical affects of public environments.

INTERDISCIPLINARY COLLABORATION

The parallels between preferred physical environments and virtual reality pain management techniques suggest potential benefits from increased collaboration between architects, designers, and healthcare professionals.

PERSONALISATION AND FLEXIBILITY

Given the diverse needs of individuals with chronic pain, future designs may consider the provision of adaptability or user control over environmental factors to allow greater individual autonomy over the space where suitable.

URBAN PLANNING CONSIDERATIONS

The importance of access to natural elements and quiet spaces in urban environments highlights the need for thoughtful integration of these features in city planning.

ECONOMIC AND SOCIAL BENEFITS

Creating more pain-friendly public spaces could potentially increase participation in public life for individuals with chronic pain, leading to broader social and economic benefits. Productivity losses associated with chronic pain were estimated by Deloitte in their report titled "The Cost of Pain in Australia" to be $48.3 billion, or on average $21,830 for every Australian (15-64 years old) living with chronic pain (Deloitte 2018, 38).

7.3 FUTURE RESEARCH DIRECTIONS

While this study provides initial insights, it also opens up several avenues for future research:

QUANTITATIVE STUDIES

Large-scale quantitative studies could help validate and refine the design recommendations proposed in this report.

LONG-TERM IMPACT ASSESSMENT

Research into the long-term effects of pain-sensitive environmental design on chronic pain management and quality of life could provide valuable data for policymakers and designers.

TECHNOLOGY INTEGRATION

Exploration of how smart building technologies could be leveraged to create more responsive, personalised environments for pain management.

CROSS-CULTURAL STUDIES

Investigation into how cultural factors might influence environmental preferences for pain management could inform more culturally sensitive design approaches.

The research underscores the role that thoughtful environmental design can play in supporting individuals living with chronic pain.

In considering the recommendations outlined in this report, designers are prompted to consider the impact of interventions, both small and large, and the potential opportunity to create more inclusive, comfortable public spaces that benefit not only those with chronic pain but all members of society. As we move forward, continued research and interdisciplinary collaboration will be crucial in refining the approach to pain-sensitive design and creating inclusive built environments.

7.4 GLOSSARY OF TERMS

AD: Accessible Design
Accessible design refers to fulfilling a set of measurable requirements (technical notes and specifications) as prescribed in legislative requirements.

Chronic pain:
Pain that persists for longer than three months.

EE: Environmental Enrichment
Environmental enrichment refers to stimulating the brain through physical and social surroundings.
(Bozkurt et al. 2023)

UD: Universal Design
Universal design is the design of buildings, products or environments to make them accessible to most people, regardless of age, disability, background or any other factors.
(Victorian Health Building Authority, 2024)

VR: Virtual Reality
Virtual reality (VR), the use of computer modeling and simulation that enables a person to interact with an artificial three-dimensional (3-D) visual or other sensory environment.
(Lowood, 2024)

7.5 REFERENCE LIST

Australian Institute of Health and Welfare (AIHW). "Chronic Pain in Australia: Summary." 2020. Accessed February 10, 2024. https://www.aihw.gov. au/reports/chronic-disease/chronic-pain-in-australia/summary.

Australian Institute of Health and Welfare (AIHW). "Chronic Pain in Australia: Summary." 2020. Accessed July 11, 2024. https://www.aihw.gov.au/ reports/chronic-disease/chronic-pain-in-australia/summary.

Bordeleau, M., A. Stamenkovic, P. A. Tardif, and J. Thomas. "The Use of Virtual Reality in Back Pain Rehabilitation: A Systematic Review and Meta-analysis." Journal of Pain 23 (2022): 175–95. https://doi.org/10.1016/j.jpain.2021.08.001.

Bozkurt, Salome, Natasha A. Lannin, Richelle Mychasiuk, and Bridgette D. Semple. "Environmental Modifications to Rehabilitate Social Behavior Deficits after Acquired Brain Injury: What Is the Evidence?" Neuroscience & Biobehavioral Reviews 152 (2023): 105278. https://doi.org/10.1016/j.neubiorev.2023.105278.

Chiland, Elijah. "How Architecture Changes for the Disabled." New York Times, July 20, 2020. https://www.nytimes.com/2020/07/20/arts/disabilities-architecture-design.html.

Deloitte: Access Economics. "The Cost of Pain in Australia." Painaustralia, March 2019. https://www.painaustralia.org.au/static/uploads/files/the-cost-of-pain-in-australia-final-report-12mar-wfxbrfyboams.pdf

Fernandez, Ephrem, and Dennis C. Turk. "The Utility of Cognitive Coping Strategies for Altering Pain Perception: A Meta-analysis." Pain 38, no. 2 (1989): 123–135.

Godman, Heidi. 2022. "Virtual Reality for Chronic Pain Relief." Harvard Health Publishing, April 1, 2022. https://www.health.harvard.edu/pain/virtual-reality-for-chronic-pain-relief.

Goldin, Rebecca. "Sensationalizing Cochlear Implants: Exploring the 'Miracle Cure' for Deafness." Perspectives in Science, 2019. Accessed July 11, 2024. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6913847/#:~:text-t=an%20inspirational%20video%3F-,Sensationalizing%20Cochlear%20Implants,%E2%80%9Cmiracle%20cure%E2%80%9D%20for%20deafness.&t-ext=When%20the%20implant%20is%20first,sudden%20flood%20of%20sensory%20inputs.

Jones, T., Moore, T., & Choo, J. (2016). The Impact of Virtual Reality on Chronic Pain. PLoS One, 11(12), e0167523.

Keates, Simeon, and P. John Clarkson. Designing Inclusive Futures. 2018. Accessed February 10, 2024. https://www.researchgate.net/publica-tion/321598760_Designing_Inclusive_Futures.

Li, Angela, Zorash Montaño, Vincent J. Chen, and Jeffrey I. Gold. "Virtual Reality and Pain Management: Current Trends and Future Directions." Pain Management 1, no. 2 (March 2011): 147-157. https://doi.org/10.2217/pmt.10.15.

Lowood, Henry E. "Virtual Reality." In Encyclopedia Britannica, August 8, 2024. https://www.britannica.com/technology/virtual-reality.

Mace, Ronald L. "Universal Design Principles and Models." 1985. Accessed July 11, 2024. https://www.researchgate.net/publication/328250073_Uni-versal_Design_Principles_and_Models.

Mahrer, Nicole E., and Jeffrey I. Gold. "The Use of Virtual Reality for Pain Control: A Review." Current Science Inc 13 (2009): 100–109. https://doi.org/10.1007/s11916-009-0019-8.

New South Wales Ministry of Health. "Chronic Pain - Medical Practitioners." Accessed May 3, 2024. https://www.health.nsw.gov.au/pharmaceutical/doctors/Pages/chronic-pain-medical-practitioners.aspx.

Ossipov, Michael H., Gregory O. Dussor, and Frank Porreca. "Central Modulation of Pain." Journal of Clinical Investigation 120, no. 11 (2010): 3779–3787. Published online November 1, 2010. https://doi.org/10.1172/JCI43766.

Pain Australia. "National Strategic Action Plan for Pain Management." 2018. Accessed July 11, 2024. https://www.painaustralia.org.au/static/uploads/files/mrnpw220718final-wfstwuzlelpc.pdf.

Pain Australia. "Role of Medication." 2021. Accessed July 11, 2024. https://www.painaustralia.org.au/find-support/getting-the-right-care-1/ role-of-medication-2021.

Painaustralia. "Submission to the Review of the Australian Government's Financial Assistance Grants Programme." Treasury.gov.au. Last modified May 2021. Accessed May 1, 2024. https://treasury.gov.au/sites/default/files/2021-05/171663_painaustralia_0.pdf.

"Pain in Its Environmental Context: Implications for Designing Environments to Enhance Pain Control." Pain 134, no. 3 (2008): 241–244. Published online January 4, 2008. https://doi.org/10.1016/j.pain.2007.12.002.

Phelan, I., P.J. Furness, M. Matsangidou, et al. "Designing Effective Virtual Reality Environments for Pain Management in Burn-Injured Patients." Virtual Reality 27 (2023): 201–215. https://doi.org/10.1007/s10055-021- 00552-z.

Richtel, Matt. "The Sunday Read: Virtual Reality and Chronic Pain." New York Times, May 22, 2022. Accessed July 11, 2024. https://www.nytimes.com/2022/05/22/podcasts/the-daily/the-sunday-read-virtual-reality-and-

chronic-pain.html.

Teh, J. J., D. J. Pascoe, S. Hafeji, et al. "Efficacy of Virtual Reality for Pain Relief in Medical Procedures: A Systematic Review and Meta-analysis." BMC Medicine 22 (2024): 64. https://doi.org/10.1186/s12916-024-03266-6.

Toscano, Chrystiane V.A., et al. "Neuroinflammation in Autism Spectrum Disorders: Exercise as a 'Pharmacological' Tool." In Neuroscience & Biobehavioral Reviews, 2021. Accessed July 23, 2024. https://www.sciencedirect.com/topics/psychology/environmental-enrichment.

UNSW. "Virtual Dog, New Tricks: Virtual Reality Game a Creative Tool to Help Manage Acute Pain." Accessed July 13, 2024. https://www.unsw.edu. au/arts-design-architecture/our-research/research-impact/case-studies/ virtual-dog-new-tricks-virtual-reality-game-a-creative-tool-to-help-manage-acute-pain.

Victorian Health Building Authority. "Universal Design." Last modified January 20, 2024. https://www.vhba.vic.gov.au/resources/universal-design.

Viderman, D., K. Tapinova, M. Dossov, S. Seitenov, and Y. G. Abdildin. "Virtual Reality for Pain Management: An Umbrella Review." Frontiers in Medicine 10 (2023). https://doi.org/10.3389/fmed.2023.1203670.

"Virtual Reality for Chronic Pain Relief." Harvard Health Publishing. Accessed May 1, 2024. https://www.health.harvard.edu/pain/virtual-reality-for-chronic-pain-relief.

Wiederhold, Brenda K., Kenneth Gao, Camelia Sulea, and Mark D. Wiederhold. "Virtual Reality as a Distraction Technique in Chronic Pain Patients." Cyberpsychology, Behavior, and Social Networking 17, no. 6 (2014): 346-352. https://doi.org/10.1089/cyber.2014.0207.

"Water and Sound in Islamic Architecture." Khamseen: Islamic Art History Online. Accessed July 13, 2024. https://sites.lsa.umich.edu/khamseen/topics/2020/water-and-sound-in-islamic-architecture/.

YouTube. "Daniel Clauw: Virtual Reality May Help Ease Chronic Pain."
Filmed May 2, 2022. YouTube video, 2:34. https://www.youtube.com/
watch?v=B0EhNajqkdU.