DESIGNING FOR NEURODIVERSITY: REIMAGINING THE HOME FOR A COVID NORMAL LIFE

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As cities went into lockdown in response to COVID-19, for many, the role of the home in everyday life expanded. Activities that would normally occur at another venue, including work, study, recreation, and health appointments, were reconfigured to be done in the home. Among the legacies from this experience is a clearer understanding of the spatial and phenomenological quality of the spaces in which we live. Housing design already assigns private and public areas within dwellings, such as bedrooms and living rooms, but these are often rigidly defined and largely inflexible for alternative uses. Research on designing housing suitable for people with cognitive disabilities, including autism spectrum disorder (ASD), (such as a 'sensory design' approach, where it is necessary to move beyond public vs private, and recognise other dicotisms, light/ dark, warm/cool, loud/quiet, hard/soft, work/rest, and so on, and the transition between modes), may provide lessons for more general COVID-normal housing design. This study analyses three case studies of residential accommodation for people with ASD as opportunities for developing more responsive housing that can adapt to the demand for a greater range of activities to be fulfilled in the home.

Keywords: housing, COVID-19, sensory design, disability

INTRODUCTION

Whatever form COVID-normal takes, the COVID-19 experience has, for many, forced a re-evaluation of the home environment, as more is demanded of our homes. In response, there are valuable lessons to be taken from the experience of neurodiverse people's engagement with the built environment. The three design principles advocated for in this paper—sensory zoning, spatial sequencing, and escape spaces—offer a way to view a dwelling as a sensory moderating machine that acts in a way to calm and prepare residents for changes in sensory intensity, and the likelihood of physical and social interactions that require mental and physical effort. Like all good design, a well-organised dwelling should make things easier and require less mental effort to complete day-to-day tasks, now expanded to include work, study, health, and social interactions previously undertaken mostly outside the home. Spatial constraints in apartments, often coupled with limited access to external walls (and light and air), make designing with neurodiverse principles more challenging, but also rewarding and impactful. Transitions, sequences, and escape zones need not be large in spatial terms, but they should be considered.

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As lockdowns were implemented globally to contain the spread of COVID-19, activities that would normally occur at other venues—work, study, recreation, and health appointments—were reconfigured to be done in the home. Established patterns of living were interrupted, including extended periods indoors, cohabitation with other people for extended times, or alternatively, isolation from social networks. The places where we live were designed with specific residential functions in mind—the kitchens, dining/living rooms, bedrooms—and so were challenged by the necessity to accommodate workspaces, study spaces, pets, and exercise spaces. The apartments that we produce are a product of a particular procurement system—a commodity in Australia and the UK, developer-led and driven—with a focus on cost, investment return, and compliance with the minimum regulatory requirements. Quality of space is therefore seen as something marketable rather than a genuine experience of space.

Building codes and energy rating systems mandate minimum performance levels for ventilation, sound, light quality, as well as spatial requirements controlling circulation spaces and entrances and exits, but these are determined by measurable (and absolute) physical characteristics like air movement, dB, lux, and meters squared (Allman 2021). In contrast, best practice guidelines for designing for people with a disability, in particular for people who identify as being neurodiverse such as those diagnosed with Autism Spectrum Disorder (ASD), focus more strongly on individual experience of space (Ahrentzen and Steele 2009).

In the literature on designing for people with ASD, there are two competing schools of thought. Recognising the particular tendency for people with ASD to experience sensory overload, and spatial disorientation, on the one hand, sensory design theory, advocates ‘altering the sensory environment using specific design interventions’ (Mostafa 2015) whereas the neurotypical environment school promotes the idea of people with ASD needing to ‘adapt to the day-to-day reality of the world’ (Henry 2011).

This paper moderates that discussion by asking how the implementation of sensory design theory in apartment design can improve outcomes for everyone, neurotypical and neurodiverse alike, rather than accept the ‘day-to-day reality’ of current apartment design. By analysing designs for neurodiverse clients using a small sample of case studies to demonstrate some applications of the principal design drivers, the intention is to turn the focus back to contemporary design for a primarily neurotypical housing market, particularly for apartments, so as to highlight the areas where design intervention can provide the most benefit in terms of privacy, security, and safety, but also dignity, wellbeing, and mental and psychological calmness. In this way, lessons from the lockdown might stimulate a greater dialogue between neurodiverse and neurotypical design.

REVIEW OF THE LITERATURE

Designing in the built environment for people with a disability has come to focus on the idea of the ‘person-environment fit’, a concept first introduced by Alexander (1970). Iwarsson and Stahl (2003) have discussed the relationship between person-environment fit and three terms common to the literature around disability-design (and often used interchangeably)—accessibility, useability, and Universal Design. In their terms accessibility is an “environment in which an individual with any impairment can function independently” (2003:58). As such, accessibility is a relative concept that includes a personal component and an environmental component in determining the person-environment fit. Useability is where “the built environment has to allow any

individual, in spite of impairments, to be able to perform daily activities within it" (2003:59). Hence useability is subjective in nature, a measure of effectiveness, efficiency, and satisfaction. The determination of the person-environment fit requires a personal component, an environmental component, and an activity component. Universal Design is "based on the principle that there is only one population, comprised of individuals representing diverse characteristics and abilities" (2003:61). Therefore, Universal Design, or design for all that can be used by everyone, is a process more than a result. While Universal Design (sometimes also called inclusive design) has been recognized to have many positives for people with a disability, it has been critiqued, most notably by Imrie (2012), as being underpinned by a belief in technology and technological solutions. This references the medical-model of disability long discredited, a propagation of market-based discourse, and a defence of universalism with a particular ambiguousness towards particularism and the individual nature of a person's abilities (2012:880). In contrast to Universal Design, design that focuses on the needs of people diagnosed as having autism spectrum disorder (ASD) places emphasis on individuality and the ability to perform in particular environments, and so have more in common with the notion of useability, in Iwarsson and Stahl's terms.

Design guides that deal specifically with the needs of people with ASD and their interaction with the built environment are relatively recent. While initial research focused on schools and children (Baumers and Heylighen 2010; Mostafa 2014; Vogel 2008; Whitehurst 2006), this has broadened to include consideration of the home. Driven in part by the centrality of the home in the constitution of 'a life', and the increasing focus of governments and autism support service organisations on the deinstitutionalization of housing for people with ASD, and a resolve to encourage people to live in the community (Bonyhady 2014). This exposed the near total lack of available, appropriate, and affordable housing for people with ASD in the private housing market.

Housing design research, notably by Ahrentzen and Steele (2009) with 'Advancing Full Spectrum Housing: Designing for Adults with Autism Spectrum Disorders', identified key areas of design that included: safety and security, maximizing familiarity, stability and clarity, minimizing sensory overload, opportunities for controlling social interactions and privacy, providing choice and independence, fostering health and wellness, enhancing dignity, assuring durability, achieving affordability, and ensuring accessibility and support in the surrounding neighbourhood. Work by Nagib and Williams (2017), 'Towards an Autism-friendly Home Environment' examined home modification strategies employed by families with children with ASD in Canada and the USA. A similar study was carried out in Australia by Owen and McCann (2018). Several design guides have since been built on the principles highlighted by Ahrentzen and Steele, with adaptations to reflect National or State-based circumstances (see Brand *et al.,* (2010) for the UK, and Araluen (2020) for Australia).

Starting with the above-mentioned best-practice design guidelines for people with ASD, the methodology developed in this paper to assess apartment design has three focus areas adapted from Mostafa (2015); the alignment of appropriate sensory levels for different parts of a dwelling, the organising of space for predictability which includes spatial proximity but also the transition between spaces, and (most radically) the provision of space to mitigate sensory overload—that is, an escape space. This is consistent with a useability approach to dwelling design that, in addition to the

technical response to noise, light, temperature and so on, recognizes a degree of subjectivity and the importance of an individual's ability to perform necessary tasks. In Mostafa's words "...that to design the built environment for autism, one must calm it down, break it down into manageable experiences in discrete spaces, organise those spaces in a sensory and temporally logical flow and accommodate for sensory overload escape" (2015:58).

METHODOLOGY

This research was conducted as a desktop study that analysed existing case study housing developments. This was necessitated by the lack of recent purpose-built housing development for people with ASD in Melbourne, Australia, where the researchers were located with (continuing) bans on Melbourne residents travelling internationally. Search guidelines included that the developments be 10 years old or less (as Ahrentzen and Steele's research into design guidelines was published in 2009).

Further, the developments had to be specifically designed for and occupied by people diagnosed with ASD. Several candidate developments were identified across the United States, the UK, France, Denmark, and Singapore. Only developments where architectural plans and sections were available, along with photographs were accepted, as physical site visits were not possible, but the architectural experience of the researchers allowed partial assessments to be made. Some elements of Mostafa's ASPECTSS were not able to be determined by this method, for example around acoustics. Therefore, a simplified assessment and rating system was developed that enabled an existing, or proposed, dwelling to be assessed across three criteria:

- Sensory zoning—is the level of sensory experience in a space appropriate for the use of that space?
- Spatial sequencing and transitions between spaces—is the dwelling's layout logical and are there transition zones between spaces of different sensory intensity?
- Escape spaces—does the dwelling provide a space of retreat and seclusion that is not in a bedroom?

In recognition of the space constraints on this paper, three case studies were chosen that in the researcher's perspective, represented different typologies, scales, urban settings, and approaches. It should be noted that methodologies for assessing building quality are many and varied, ranging from purely qualitative and subjective to attempts at more rigorous and quantitative formats. Design assessment tools are often described as 'performance-based' or 'prescriptive', or a combination of the two. The intent here is to promote a dialogue between the designer and the dwelling, taking our clues from the neurodiverse experiences of the built environment, and so the outcome is an assessment of the likely performance of a dwelling, with all the subjectiveness that implies. Ideally, this initial phase will be followed-up with interviews of the dwelling's residents to gauge their experiences and cross-check the predictions of performance.

Case Studies

This study implements comparative analysis using three case studies of medium-density residential projects designed for people with ASD. The selection criteria

implemented sought equivalence of typology/scale, and the intentional use of ASD guidelines in the design of the residential project.

First Place, Phoenix, Arizona, USA

First Place is a new 55-unit apartment complex in central Phoenix. Opened in July 2018, the 55-unit apartment complex was designed by RSP Architects. The building is an intentional community designed to cater to adults with autism with a focus on independence and community integration (Curley 2018). First Place uses "The Six Feelings Framework" as part of their design strategy (Saltzman 2018).

Fig 1: Typical one bedroom unit First Place (Image: firstplaceaz.org)

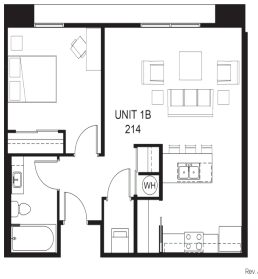
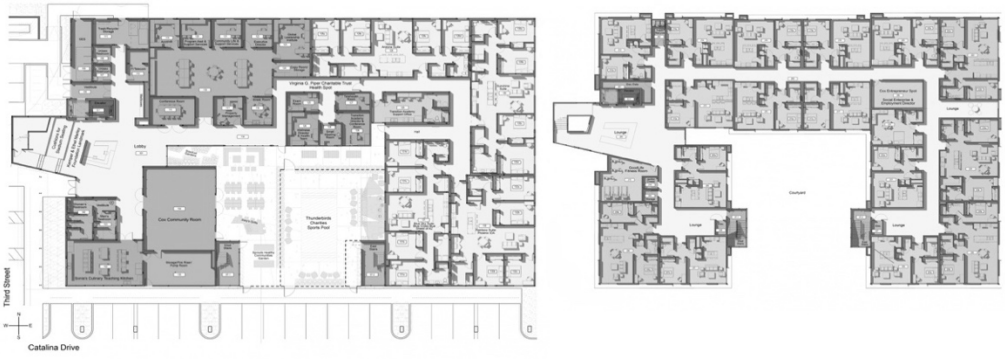


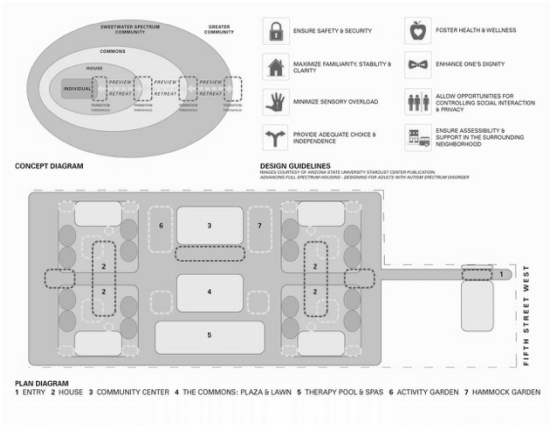
Fig 2: First Place Ground [Left] and First Floor [Right] (Image: Firstplaceaz.Org)



Sweetwater Spectrum Residential Community, Sonoma, California, USA

Sweetwater Spectrum Residential Community is a new development providing supportive housing for adults with autism that opened in January 2013. The project was designed by Leddy Maytum Stacy Architects using Ahrentzen and Steele's work as the design guide (Tortorello 2013).

Fig 3: (Left) Sweetwater Spectrum Residential Community: Design concept guidelines. (Right) Plan of typical residential unit Sweetwater Spectrum Residential Community



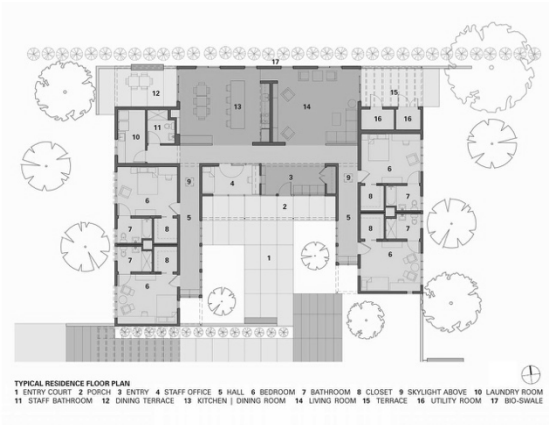


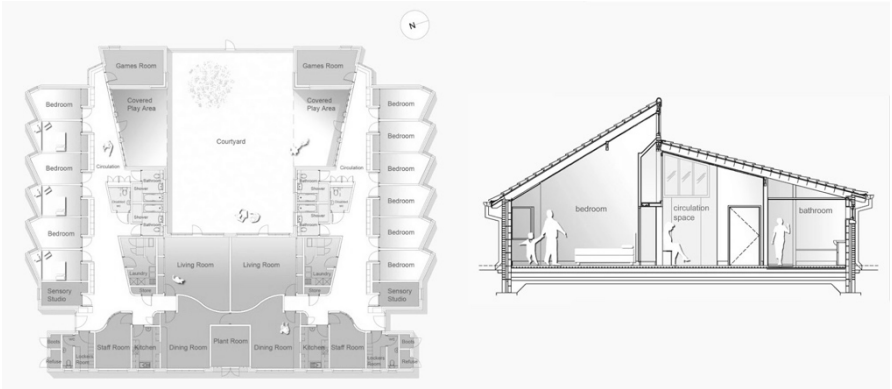
Fig 4: Sweetwater Spectrum Residential Community (left) view into kitchen [13], (centre) view into living room [14], (right) reading space at end of corridor [5].

Rowan and Oak House Clent, England, UK

The Rowan and Oak House is a residential building designed by GA Architects. Completed in 2012, it is part of the larger estate of Sunfield Children's Home and School. The school supports children with complex learning needs including ASD. GA architects use the following themes in their design: Layout, Personal space, acoustics, heating, health and safety, sustainability, supervision, colour, and patterns (GA Architects 2021).

Fig 6: Rowan and Oak House [Left] Detail of bedroom with window seat. Different bedrooms have different colours. [Centre] View along corridor. [Right] Detail of high-level window. Windows in different locations use different colours to assist with wayfinding. (Images: Autism-architects.com)

Fig 8: [Left] Plan of Rowan and Oak House. [Right] Section through Rowan and Oak House (Images: Archdaily.com)



RESULTS

Sensory Zoning

Whereas the aim of sensory design theory is to reduce sensory experience throughout a dwelling, the approach here is to determine an appropriate level of sensations commensurate with the likely tasks or activities that are undertaken in that space. Table 1 describes key spaces within a dwelling, including kitchens, bedrooms, front

entrance, etc., and the likely tasks undertaken in those spaces. It then provides an assessment of optimal (or acceptable), sensory conditions based on a series of sensory dichotomies such as light/dark, warm/cool, hard/soft, and so on. In this way, individual spaces within the dwelling can be assessed for their sensory appropriateness. The more information a designer/assessor has, such as floor and wall materials, window heights, or building orientation, the more accurate an assessment can be made.

Table 1: Room description relative to activity and optimal sensory conditions

Location	Tasks	Optimal Sensory Conditions
Front door	The transition point between outside and inside	The transition from high stimulus to low stimulus, public, quiet, light, warm
Corridor	Transition zone	Public to private, the transition from different stimulus points in the dwelling, quiet, dark, hard
Living	Entertainment, relaxation	Public, Loud, Potential for different levels of stimulus, public, loud, light, warm, soft
Dining	Eating	Public, loud, light, warm, work
Bedroom	Resting/sleep	Private, Quiet, dark, soft, cool, rest
Bathroom	Ablution	Private, Quiet, light, hard
Balcony	Relaxation	Public, Sound determined by location, light, rest,
Kitchen	Food preparation, Food storage	Public, loud, light, warm, hard, work
Escape space	Retreat/respite from environmental overstimulation	Private, Quiet, Low stimulus, soft

Separation of intensity

The residences at Sweetwater and Sunfield Children's School clearly separate areas of high sensory intensity including the kitchen and living areas from lower intensity zones such as bedrooms and bathrooms. In both cases the high intensity zones are brought together and centralised, while two wings of bedrooms are situated to the sides to enclose a centralised courtyard space. Corridors act as a link and transition zone between the different sensory zones, and in the case of Sweetwater the entry area and staff office act as a buffer. Sweetwater uses the ceiling profile to further differentiate the zones. The one-bedroom apartment highlighted from the First Place case study is much smaller therefore a literal separation is harder to achieve. However, the transition zone between the front door, bedroom, bathroom, and laundry acts to differentiate the higher intensity (kitchen and living) zone from the lower intensity one. Note that exiting the bedroom or the bathroom, the resident goes through this zone before entering the living-kitchen space. This provides both privacy and a chance to prepare for the change in sensory experience. Movement between the bedroom and the bathroom (both low intensity zones) does not need to go through the high intensity zone of the apartment.

Diffusion of light

Both Sweetwater and Sunfield use articulation of ceilings and window placement to diffuse direct sunlight into occupied space. Interestingly, in Sweetwater the diffused light is concentrated in the high sensory intensity areas of the dwelling, whereas at Sunfield it is directed into the bedrooms—a low intensity zone. All three case studies utilise a courtyard typology and so natural light and ventilation are available to most zones of the dwellings. Figs 3 and 8.

Spatial Sequencing and Transitions

After analysing individual spaces, the next set of questions for the designer concern the sequence of spaces throughout the dwelling—what adjacencies of use are appropriate and which are not, how are the different sensory zones moderated across the dwelling and critically, what transition zones (if any) are there between spaces of different sensory intensity? When assessing spatial sequencing, concerns such as privacy, safety, surveillance (or site-lines), and acoustics will be central. Predictability and perceptibility are also important, especially when considering transitions between spaces.

The Sunfield example demonstrates two spatial sequences mediated by transition spaces. The first—from the privacy of an individual bedroom to the public open courtyard (a journey from left to right on the plan). Starting from inside the bedroom, the first transition space is immediately adjacent to the bedroom door (note that the built-in robes in the bedroom, and seating in the corridor, create a small entrance space near the door). Then entering the corridor with its double-height space, then proceeding to the covered play area (with lower ceiling) and then out into the open courtyard. Each step represents an increase in public display and likely social interaction, with a corresponding increase in sensory intensity. The second sequence is along the corridor (from top to bottom of the plan). This also marks a journey from the privacy of the bedroom to the high intensity zones of the living and kitchen areas. Here, the private bedroom is mediated by the shared bathroom facilities and shared laundry, before approaching (at an angle) the kitchen, dining and living zones. Note that there is a small transition zone immediately before the choice of which door (kitchen, dining or living) and associated sensory levels the resident chooses.

At Sweetwater, the concept diagram (Fig 3) makes explicit the spatial sequence from individual privacy to the larger community through five transitions. With the apartment at First Place, the sequencing is condensed, as noted, but follows a similar logic in going from bedroom/bathroom to kitchen/living through a transition space. In the Sweetwater and Sunfield examples, the staff offices have been positioned to allow observation of the transition between low intensity to high intensity zones within the dwellings.

Escape Space

Assessing sensory conditions and spatial sequences are effective strategies for the design of most built environment spaces intended for use by multiple user groups. The inclusion of an escape space for all dwelling designs is something more specific to a user group likely to experience sensory overload and discomfort. However, increasingly stressful lifestyles and the encroachment of work and other activities into both homes and non-traditional work hours in the evenings and weekends, suggests that the design of a sensory escape space in every dwelling may be worthwhile. It may be that this space is linked to concentration and work or be a place to escape work and other life stresses. Ideally, an escape space would be personalised by the occupant or user, and so the assessment need only indicate whether suitable and sufficient space is provided within the floorplan. Of three case studies, only Sunfield provides a dedicated sensory room (the Sensory Studio) as a common space aligned with each bedroom wing. However, in the Sweetwater model, each bedroom contains a large walk-in robe (Room 8 in Fig 3) that links to the bedroom and potentially the outdoor courtyard space as it includes an external wall to the corridor. The central node/transition space identified in the one-bedroom apartment in First Place also can potentially access space from the laundry and storage cupboard that may be modified

to include a small, secluded escape space (Fig 1). However, a sensory escape space need not be a completely enclosed space, careful design around thresholds and boundaries can also generate spaces to calm and relax. Fig 8 showing the small triangular seat near the window in a bedroom from the Sunfield case study is a good example.

CONCLUSION

The COVID-19 experience has shown that the role of the home in everyday life is an expanding one. In responding to this expectation, accessible design is not enough, and that while Universal Design has its virtues it is insufficiently adaptable to personal particularities. A useability design approach that captures the creativity and uniqueness needed to design successfully for ASD requirements offers a pathway to a COVID-normal approach to housing that recognises sensory intensity, transitions and escape alongside more conventional technical considerations such as light and warmth and air.

This research began to explore how a neurodiverse perspective on the adequacy of home environments might influence how we design the homes of the future, adaptable and appropriate to the changing way we use our homes. A critical next step in moving forward needs to include the perspectives and input of people on the ASD spectrum in the design conversation.

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