ARCHITECTURE AND AUTISM.
SENSORY PERCEPTION AND INDEPENDENT LIVING
The International Workshop ‘Architecture and Autism. Sensory Perception and Independent Living’ was proposed as a multidisciplinary discussion on the relationship between architecture and autism. The underlying hypothesis is that this is not only a necessary relationship to improve the living conditions of autistic people and their families, but also potentially useful to expand the possibilities and views of architecture rather than limiting them. Designing for alternative models of mind and non-prevalent sensory perceptions can lead architecture to rethink ways of prefiguring future realities by moving from known patterns and experiences.

The Workshop was divided into two sessions. The first session, ‘Design Processes: the Issue of Inclusion’, aimed to raise some interdisciplinary reflections on the topic of inclusion as a non-obvious but problematic issue. The second session, ‘Design Practices: Integrating Sensory Perception with Independent Living’, proposed and compared some design practices and experiences.
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International workshop
Trieste, 20th April 2021

in the frame of
Interreg V-A Italy-Austria 2014-2020
https://senshome.projects.unibz.it/

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9:45 Marco Caniato (Free University of Bozen-Bolzano)
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10:00 Ann Heylighen (KU Leuven)
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11:00-11:15 – COFFEE BREAK

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11:45 Philip Scharf (Carinthia University of Applied Sciences)
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12:15 – DISCUSSION AND OPEN QUESTIONS
send questions to senshome@units.it

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SESSION 2 – DESIGN PRACTICES: INTEGRATING SENSORY PERCEPTION WITH INDEPENDENT LIVING

14:30  Francesca Giofrè (Sapienza University of Rome)
AUTISM SPECTRUM DISORDERS: BUILDINGS REQUIREMENTS ON EVIDENCED BASED RESEARCH AND ITALIAN CASE STUDIES

15:00  Javier Sánchez Merina (University of Alicante)
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15:30  Phuong Lan Nguyen (KU Leuven)
DETAIL MATTERS: EXPLORING SENSORY PREFERENCES IN HOUSING DESIGN FOR AUTISTIC PEOPLE

16:00  Anna Dordolin, Paola Limoncin (University of Trieste)
SENSHOME STRATEGIC APPROACH FOR A HOUSE "AS NORMAL AS POSSIBLE, AS SPECIAL AS NECESSARY"

16:30 – DISCUSSION AND OPEN QUESTIONS
send questions to senshome@units.it

17:00 – CONCLUSION AND GREETINGS
abstract
This paper reports on the opening intervention of the Workshop: the title, objectives and structure are explained. The study day was proposed as a multidisciplinary comparison of the relationship between architecture and autism. The starting assumption was that this is not merely a relationship necessary to improve the living conditions of autistic people and their families, but also potentially useful to broaden the possibilities and viewpoints of architecture rather than limiting them. Some theoretical references are presented to support this hypothesis, which could guide the new technical possibilities which engineering and technology can make practicable to enrich the sensitive responsiveness of architecture.

keywords
SENSHome; Autism; Plurality; Architecture; Otherness.

As the title of the workshop states, the theme proposed by the study day was not the one most frequently dealt with in manuals and guidelines of “architecture for autism” – suffice to mention the famous system of design criteria ASPECTSS* Architecture for Autism, by Magda Moustafa, and international reference to autism-tailored design – but to the relationship between architecture and autism. The aim of the title is to focus reflection on the desirability of establishing a relationship between architecture and autism, something which is not only necessary but could also broaden the possibilities and viewpoints of architecture rather than limiting them. Some theoretical references are presented to support this hypothesis, which could guide the new technical possibilities which engineering and technology can make practicable to enrich the sensitive responsiveness of architecture.

Planning living usually involves referring to habits, in Italian the two words, ‘abitare’ – to live –
and ‘abitudine’ – habit – have, in fact, the same root. Investigating a complex relationship with neurodiversity can convince architecture to question itself, as it did in the most fruitful moments of its history, about its own responsibility towards the other. This also means openness to “the otherness of the future”, as Jacques Derrida wrote; the otherness of forms and ways of living that we are not yet familiar with: “[…] the opening to the other and, thus, to the future, to the otherness that cannot be anticipated” (Derrida, 1992, p. 23), by abandoning habits and certainties.

Another philosopher, Hannah Arendt, used the metaphor of a table – a furniture item, among other things, redesigned within the SENSHome project – which can be read, as was done recently (OASE, 2020), as an appeal to architecture to a responsibility towards otherness, understood in this case as a plurality of many kinds, all different from one another. To describe the physical world we all share, Arendt wrote: “To live in the world means essentially that a world of things is between those who have it in common, as a table is located between those who sit around it. […] The world, like every in-between, relates and separates men at the same time, it connects a plurality of people while simultaneously it enables plurality” (Arendt, 1958, p. 52).

This image was considered illuminating to investigate the sense of thinking about, designing and building works of architecture as part of that common world which connects and separates them. A useful metaphor to define the political, social and cultural roles of architecture. For Arendt, the table suggested an idea of the plurality of inhabitants in the world and the reality of the public realm that relies on the simultaneous presence of innumerable perspectives and aspects. One could call it diversity. “Being seen and being heard by others derive their significance from the fact that everybody sees and hears from a different position.” […] “Only where things can be seen by many in a variety of aspects without changing their identity, so that those who are gathered around them know the see sameness in utter diversity, can worldly reality truly and reliably appear.” (Arendt, 1958, p. 57) Differences of position and variety of perspectives are what guarantee the reality of a common world.

Since the 1960s, architecture historian Kenneth Frampton has referred to ‘The Human Condition’ of Arendt to define the ability of architecture to represent a collective value (Frampton, 1969), to the extent that it guarantees a plurality of perspectives without nullifying diversity.

The world of autism, in which the issue of interaction and relationship is addressed day after day, is a potentially extraordinary opportunity to measure and exercise architecture’s capacity to connect with the other, preserving diversity and avoiding compliance with the habits of the neurotypicals, as Milton requested.

In ‘A Genealogy of Modern Architecture: Comparative Critical Analysis of Built Form’, from 2015, Frampton returned, once again, to a reading of Arendt’s text. Here the historian bases his critical analysis of architecture on the distinction between public and private, which the philosopher defines in spatial and architectural terms: the private person needs to be protected from the public world and is surrounded by “four walls”. These walls – and of course the thresholds, doors and openings which together safeguard the private sector – constitute a spatial device which mediates between the public and private sectors. It is this intermediate space which brings to life the physical experience of the transition to the public scene or vice versa of withdrawing into the private one, offering “stabilizing protection.” Thanks to this mediation/protection, the public sphere can become a social space between different pluralities.

For many autistic people, as we shall see in some of the contributions gathered here, the spaces of threshold, transition, and therefore mediation, are essential to prepare for an unfamiliar environment and situation.

During the Covid-19 pandemic, the mediation role of architecture may have become more
evident to everyone. Evidence of this – arguably rather exaggerated – is that during lockdown, the International Committee for Documentation and Conservation of Buildings, Sites and Neighbourhoods of the Modern Movement, known as DoCoMoMo, posted this statement on social media: “So far, the best vaccine to prevent contamination has been made by architects: the house.” (1) Prevention of the spread of the virus imposed on everyone a series of procedures related to the passage between interior private spaces and exterior or public spaces: the removal and putting on of masks, leaving used shoes and clothes at the entrance to the house outside, disinfecting the hands on entering a public or communal space. These sequences of actions re-proposed the intense experience of the threshold limit: crossing a limit through time slowed by a succession of gestures.

The spread of the virus also made us discover everyone to be fragile, exposed, potentially sickly, forcing us to slow the race to always be high-performance. This experience can arguably help us to better understand the position of people who, regardless of the spread of a virus, every day experience an awareness of the limits on performance, sociality as a need not to be taken for granted and how to conquer it, hypersensitivity to the requirements of safety and comfort, and consequently, the need for spaces and times expanded in the passage between private and public, interior and exterior, intimate and collective. This shared experience can, to some extent, help to build that empathy which, according to Milton, can fill the lack of mutual understanding of perceptions between autistic and non-autistic people, a lack which allows one group of people to consider themselves normal, while considering the other group abnormal, on the basis of a social deficit (Milton, 2012).

A kind of architecture as a part of a world in which differences are related without losing one’s own identity, can move from a threshold idea which, from a space in which exterior and interior co-imply by putting something together, also becomes a place in which neurodiversity and neurotypicity, like different perspectives of those at the same table, co-imply pooling the collective experience of the tenuous limits of being “healthy”.

The study day was divided into two sessions. The first, entitled ‘Design Processes: the Issue of Inclusion’, sought to solicit some interdisciplinary reflections on the theme of inclusion as a non-obvious and problematic issue but as a concept to be handled with caution if one wishes to avoid the risk of falling into the schemes of standardization and if one intends, instead, to open up to a true encounter with otherness, to that reciprocal exchange between neurodiversity and neurotypicity which Damian Milton requested.

The second session, entitled ‘Design Practices: Integrating Sensory Perception with Independent Living’, proposed and compared practices which are also profoundly different from Participatory Design, as well as some project experiences which share with the SENSHome project the objective of favouring and supporting the autonomous living of autistic people by working on specific skills rather than on alleged deficits.

The challenge of the SENSHome project is to allow degrees of customization, a tuning sensitive to the user’s needs, in vigilant safety, but without making the securitarian logic become dominant, inhospitable to the autistic person and his/her family alike.

Here comes into play what environmental psychologist Robert Sommer has called “hard architecture,” buildings and furnishings that aim to stand up to the user in order to preserve his/her safety, but which, in this way, cannot be modified by the user, are never marked by his/her imprint: “Hard architecture is designed to be strong and resistant to human imprint. To the inhabitants it seems impervious, impersonal and inorganic” (Sommer, 1974, p. 2)

To face the challenge of “soft architecture”, as Sommer calls it, as safe as possible but not impersonal, the multidisciplinary contribution can be decisive.
This is what was sought at the conference, convening the humanistic disciplines – which ask architecture questions and solicitations, such as those seen before, inspired by philosophers – engineering and technology, which enable new ways to enrich the sensitive responsiveness of architecture.

I would like to close with a final question, which may appear a formal or ritual clarification, but instead has a relevance that does not differ from the themes of the study day. During the Workshop, which was attended by PhD students of the Inter-University Research Doctorate between the University of Trieste and the University of Udine in Environmental Civil Engineering and Architecture, and involved Italian and European scholars and architects, some comments were received regarding the terms used by the speakers. The question of the terms chosen to define people “with autism”, “in the autistic spectrum” or “autistic”, is complex and interesting since it reflects the plurality of perspectives and the impossible-to-simplify elaboration of awareness by the people involved in autism, with various roles. In the various papers we find the lexical expressions that each author has decided to adopt and the definition Autism Spectrum Disorder, abbreviated as ASD – used by two international psychiatric classification systems: the Diagnostic and Statistical Manual of Mental Disorders, DSM, and the International Classification of Diseases, ICD – however, we should like to point out here that some people who were streaming wrote that they would prefer to use the formula “Autism Spectrum Conditions”, to avoid the perceived negativity associated with the word “disorder”. Personally, I share this view, and I trust that the many opinions gathered here will contribute to a better understanding of Autism Spectrum Conditions and how architecture can enrich itself in embracing them.

notes

references


(image 1) ‘Próximamente’, Uruguay pavilion exhibition at the Biennale Architettura, Venice 2021, ‘How Will We Live Together?’. ‘Throughout history, tables have worked as storytelling devices, becoming a powerful communicational emblem in which the public and the private, the domestic and the territorial can live together’.

(image 2) ‘Border Ecologies and the Gaza Strip’, Foundation for Achieving Seamless Territory (FAST) exhibition (Central pavilion) at the Biennale Architettura, Venice 2021, ‘How Will We Live Together?’. The installation tells ten stories that highlight daily life in a small farm in Kutzaz using a table as a place where many different aspects come into play in the dialogue on the border.
**abstract**
Autistic Spectrum Disorder – ASD – is a developmental disorder estimated to affect 1 out of 160 children. It involves repetitive behaviour, a lack of communication skills, a complex sensory perception, and individual peculiarities. ASD begins in childhood and tends to persist into adolescence and adulthood. For some ASD individuals, it is possible to live independently, but housing services for special needs conventionally deal with issues of physical access and rarely with their complex and sensory needs. This paper aims to produce an overview of what has been characterized on the overall sensory perception of ASD individuals. Furthermore, the European SENSHome Project is presented.

**keywords**
Indoor Comfort; Acoustics; Thermal; Visual; Autism.

Autism Spectrum Disorder – ASD – is the definition of pervasive neurodevelopmental disorders characterized by impaired social and communication skills along with repetitive and restrictive behaviour. The clinical presentation is highly heterogeneous, including individuals with severe impairment and Intellectual Disability – ID – as well as individuals with above-average Intelligence Quotient – IQ – and high levels of academic and occupational functioning. ASD affects 1–1.5% of individuals and is highly heritable and both common and rare variants contribute to its aetiology.

Over-reactivity to sensory stimuli and tendency to engage sensory stimulation and/or motor activities are common clinical issues for ASD people. According to some researchers, these disturbances in sensory modulation are caused by brainstem abnormalities. Studies of autonomic and vestibular responses have provided support for such abnormalities. Communication is strikingly impaired so that the function of the hearing system has been discussed. Indeed, the disorder diagnosis by many clinicians includes behavioural descriptive of abnormal sensory sensitivities.

In a multi-sensory world, we are constantly undergone to information reaching us through our different senses. The brain has to process this mix of sensory information into one coherent multi-sensory perception. What happens if the brain is impaired in integrating this mix of sensory input? This is one of the main issues related to ASD. In addition to traditional impairments in communication, social behavior and repetitive movements, abnormalities in sensory processing are often reported.

Several researches focused on the biological and neurologic study to understand the perception of ASD people, but only few studies focused on the comfort perception and sensitivity. In this paper, an overview of the research and studies on the acoustic perception and sensi-
tivity of people with Autism Spectrum Disorder is depicted, providing a comparison between those approached with a qualitative procedure and the ones with a quantitative analysis. To raise awareness and to create and adapt a house to the sensory demand and needs of ASD people an Interregional Project has been funded by the European Union. The SENSHome project aims to design a user-centred indoor environment for people with ASD to involve them, their needs, and their sensory perception in all the phases of the project. The sensibility of the users plays a key role in all the customization of the design phase. The main aim of the project is to permit to combine independency and security.

Materials and methods.
In order to characterize the sensitivity to environmental factors, anonymous questionnaires were prepared. People with a high severity of autism, especially individuals who cannot live a normal life, could not be able to properly answer the questions concerning their own well-being. Indeed, they often have difficulties in interacting with other individuals and they rarely answer direct questions, such as “How are you feeling?”. Neglecting this aspect may, for instance, provoke a crisis. Therefore, it was necessary to ask the questions focusing on individuals’ sensitivity to specific environmental stimuli.

In this view, it was essential to include a “third-party approach” – proxy –, developing the questionnaires focusing on diverse respondents:
1. caregivers working in care units;
2. parents of autistic individuals.

A complete description of the process can be found in Caniato et al. (2022a) and Caniato et al. (2022b). After initial instructions and explanations, questionnaires’ respondents were asked to indicate whether they were caregivers or parents. In each questionnaire filling, the respondent was required to report the main information about the ASD individual he/she was referring to: data such as gender – male, female or other –, age, level of ASD and comorbidities – obsessive-compulsive disorder, depressive disorder, anxiety disorder or other psychiatric or neurocognitive disorders – needed to be reported. The indication of the level of autism was asked according to The Diagnostic and statistical manual of mental disorders of the American Psychiatric Association, which identifies three main levels:
1. Level A, requiring support;
2. Level B, requiring substantial support;
3. Level C, requiring very substantial support.

In addition, questions regarding the date of questionnaire completion and the environment where the described individual was – family house, apartment, assisted facility, etc. – were included in the introduction of the questionnaire.

The four comfort domains were analysed according to the percentage of respondents giving a specific answer. A preliminary analysis was made on all the four samples – control, local, online and overall – by means of descriptive statistics, identifying the common and different trends in the percentages of answerers indicating a specific sensitivity. When analysing the online survey, the local survey and the control samples, parents’ and caregivers’ answers were considered separately. The Mann-Whitney test was used to evaluate if the differences found were statistically significant.

Descriptive statistics and Mann-Whitney tests were additionally used with the ‘overall sample’ to identify association of sensitivities to the four main comfort domains using:
1. Gender – females or males;
2. Presence of co-morbidities;
3. Level of autism – level A or higher levels;
4. Age.
The following age groups were selected: 1. “7-9” ; 2. “10-17”; 3. “18-29”; 4. “30-39”; 5. “40-49”; 6. “≥ 50”. These age groups were chosen in order to differentiate among age decades, as well as between childhood and adolescence and adolescence and adulthood.

In all cases, the Mann-Whitney test was selected due to the independence and the unknown distribution of the samples. Moreover, as the analyses were explorative, a 10% level was used in addition to the conventional 5% level of significance.

Results and discussion.

A total of 71 and 67 questionnaires were collected during the “online” and the “local survey”, respectively. Particularly in the latter, caregivers were the highest number of respondents – 32 parents and 39 caregivers in the “online survey”, 26 parents and 41 caregivers in the “local survey”.

The gender and the age of the respondents of the two surveys were analyzed. Both in the “online” and in the “local survey”, the majority of subjects are males – 63% and 76% respectively. Moreover, subjects are younger in the “local survey”, with 100% and 97% of the subjects under 30 for females and males respectively. Results show that the majority of the answers regard individuals with Levels B and C.

Intellectual disability was the co-morbidity detected most often, both in “online” – 58% of the questionnaires – and “local” – 33% of the questionnaires – surveys. More co-morbidities were detected in the “online survey”, consistently with the stronger forms of autism of the subjects involved.

The results of the statistical tests used to investigate the association of answers with the type of respondent and the type of survey are analyzed.

These findings can be highlighted:

1. The percentages of “average” and “extreme” sensitivity to the acoustic environment are quite high in both cases – 35% “average” and 20% “extreme” by parents, 30% “average” and 20% “extreme” by caregivers. In the extended-care unit the number of subjects who rated “absent” sensitivity to this field is higher – 25% by caregivers vs. 0% by parents. Even though some sound absorbing panels are present in order to reduce reverberation in the rooms, they still do not prevent acoustics from being the most stressful comfort domain for individuals on the spectrum.

2. In terms of the visual indoor environment and indoor air quality, the results show a major sensitivity to visual environment in the everyday life environment – households –, in the range of “minor” sensitivity – 60% by parents vs. 10% by caregivers. These differences are due to the design of the extended care unit, specifically designed to be utilized by ASD people, such as the presence of mechanical ventilation, proper illumination, lamps and light colors, or proper daylight exploitation. This is in contrast with normal conditions in domestic environments.

3. The statistical analysis shows that, with the exception of visual environment, the differences between answers in the everyday life and care environments are not significant. These differences are mainly in lower and similar levels of sensitivity. Since there are few major differences, the two groups do not seem to show different levels of reliability.

Conclusions.

A methodology to study global indoor environmental comfort related to impaired people was applied in this research, focusing on ASD individuals. Questionnaires were designed so that they could be completed by parents and caregivers. One “online survey”, involving different international stakeholders from different assistance associations and one “local survey”, involv-
ing a specific extended care unit were developed. The study is expressed more in details in Caniato et al. (2022a) and Caniato et al. (2022b).

In all the cases considered, acoustic was the most stressful comfort domain, constituting a strong nuisance both in the extended care units and in households, in all the surveys considered. The other environmental issues, namely thermo-hygrometric, visual and IAQ were in general much less disturbing, with similar trends in all cases, with percentages of respondents decreasing as the sensitivity scale increases. The sensitivity to acoustics seemed to depend on the level of autism, being higher when the autism level was higher.

references

The aim of this research is to understand significant aspects offered to architects who deal with designing living environments for adults on the spectrum. The study was conducted through a preliminary collection and further analysis and comparison of guidelines and design recommendations from all over the world. Inside the wide area of designing for autism, little has been written – and above all verified – for adults on the spectrum in the community and for adults’ residential spaces (Steele & Ahrentzen, 2015). More attention has been given to children’s environments, even when the studies concerned living spaces (Mostafa, 2010). For architectural design, it is important to address this topic – of the home – in a specific way, since the home environment responds to completely different life goals and has different kinds of spatial features in comparison to schools, therapy rooms, public spaces. Furthermore, the home environment has a prominent place in the life of autistic people (Kinnaer et al., 2016, p.194). It is the “sanctuary” where they can control everything as much as possible and keep everything as they want, without external intrusions. The home is the place where they can learn to be autonomous and improve their self-confidence in a comfortable and safe place (Steele & Ahrentzen, 2015).

When looking for guidelines in autism design, there are no well-defined and generally approved design instructions, and it is even harder for the designer to transform such recommendations into concrete spatial interventions. There is a general agreement on which goals and aspects must be taken into account, but there are varied opinions on how this could be achieved (Dival, 2017). Few experiments have verified the impact of these considerations on the real life of inhabitants of designed environments, also because of the difficulty of interacting with people on the spectrum using such classic survey tools as questionnaires and interviews (Steele & Ahrentzen, 2015).
Recent studies have investigated through biographies of people on the spectrum (Kinnaer et al., 2016) and through observation of autistic people in their living environment (Nguyen et al., 2020) how concepts advanced by design guidelines appear in autistic people’s experience. The results of these researches have demonstrated that guidelines for autism-friendly architecture are not enough to design environments that fit people on the spectrum. A more nuanced approach and a balance between different design aspects must be found for each single inhabitant (Kinnaer et al., 2014).

If we try to translate the definition of a guideline from the medical field to that of architectural design, we might say that it is a recommendation developed in a systematic way to assist designers (and the people for whom they design) in making decisions about appropriate designs under specific conditions. (2) The goal in each case is the quality. But what happens in the case of designing for autism is that it might not be very useful to apply a systematic way to search for a quality design. Designers must define new kinds of guidelines and use these recommendations in a critical way, searching for a quality design empirically, by trial and error, since little can be standardized, but everything must be tailor-made for the particular person (Gaudion et al., 2015).

Literature and guidelines.
The collection of sources was made from publications from all over the world, mainly written in English, significant for having been cited in other texts, or for their innovative and experimental approach, and also published in the last decade.

In total, thirteen guidelines were identified and examined. (image 1)

Three of them are structured design guides:
– Steele and Ahrentzen (2015), ‘At Home with Autism: Designing Housing for the Spectrum’ – this outlines a set of design goals and guidelines and provides a wide and complete overview of the topic;
– Braddock and Rowell (2011), ‘Making Homes That Work ‘ – this takes a more practical approach, providing a template for identifying specific modifications in the home to address individual needs.

Other publications are significant for their innovative approaches:
– Arnardóttir and Sánchez Merina (2015), ‘La Casa Pictograma’ – a manual to design a home based on frontal vision and visual language;
– Michael Singer Studio (2014), ‘A New Model for Shared Housing’ – in which the author proposes a relationship between autistic people’s needs and sustainable building design;
– Specialist Area Autism (2016), ‘Residential Services’ – this is a presentation of four different types of residential facilities for autistic adults.

Not strictly related to housing, but significant for the use of a scientific approach to identify and verify design guidelines, is the study by Magda Mostafa (2015) ‘Autism ASPECTSS™ Design Index’ – this is the first set of evidence-based design guidelines in the world to address built environments for autistic individuals.

Institutional documents which summarize design criteria and give useful – and more importantly – practical – elements to design for the spectrum, are:
– Signal Architects (2010), ‘Model programme for residential facilities for the elderly with autism’.
Another contribution to the topic, not strictly related to home design, is the American research entitled ‘Designing for Autism Spectrum Disorders’ by Gaines, Bourne, Pearson and Kleibrink (2016).

Finally, there are informal recommendations given by architects who specialize in designing for autism (Beaver, 2006) (Humphreys, 2015) (Medical Architects, n.d.). These sources are not easily comparable since they present significant differences in their structure and are aimed at different contexts. In some cases, they give very technical and specific indications – colours, finishes, lighting, acoustics... –, in other cases they provide the designer with more generic indications on the objectives of the design.

All selected sources were analysed and summarized, grouping the various recommendations into the design aspects addressed by the authors/designers. Then the contents were compared through a matrix table. The significant design aspects which emerged and were used for the grouping of recommendations are briefly presented in the following paragraphs. The summary produced should be taken as a tool for reasoned analysis and research, since it necessarily leads to a simplification of the entire contribution of the guidelines.

“General layout”. Related to spatial sequencing and circulation, the flexibility of the house in terms of its size and location, the connection between outdoor and indoor spaces. A good layout is one which provides a visual connection between the rooms, facilitating wayfinding, supporting safe wandering and daily routines.

Specific environments, known as escape spaces, were proposed in order to compensate for a lack or overload of sensory stimuli. These are places to retreat from overly demanding situations, to regain control and security, for containment. For many people, this function is carried out by a personal space, such as a small corner of the house, or an old armchair. The themes of escape and protection are strictly related to proxemics, the amount of personal space around the body in which social and physical interactions take place.

While the built environment is often considered in the design for autism in relation to sensory perception, some guidelines invite a change of perspective and a use of the total potential of the built environment as a non-verbal communication tool to enhance the clarity of the space (Arnardóttir & Sanchez Merina, 2015). It is the environment itself, with its features, which must give a “sense of security, which must indicate the way to go from one room to another and also offer those occasions of escape safely” (Steele & Ahrentzen, 2015), in a purposeful wandering. Clarity is also related to coherence between the characteristics of the space and the activity carried out inside it.

Merged under the title “threshold space” are all those aspects related to the transition from one room to another. The theme of the threshold deals with predictability, with sensory balancing, with time and space for adaptation. Transition is an underestimated aspect which affects a lot of people on the spectrum, and which architecture could do a lot with. A threshold space can help users recalibrate their senses as they move from one level of stimulus to the next. It can be realized with a variety of forms and characteristics, from a distinct node to a full sensory room.

“Sensory experience” is the most studied aspect of autism, but also one of the most complex, probably because it is not possible to generalize sensory experiences, which are very subjective. People in the spectrum may be hypo-sensitive, hyper-sensitive, with a combination of these features for each of the five senses. They have their own taste and preferences, as all people do. For this reason, some guidelines suggest building multi-sensory environments so that residents can choose which space best suits them, with threshold spaces between these to enhance sensory balance.

The aspect on which it seems possible to generalize most is the theme of “safety and technical...
equipment”. Safety is for both the people themselves and their caregivers, and it is also one of the greatest challenges related to independent living and privacy. Innovative and supportive technologies are frequently used to tackle these aspects. While some authors highlight the risk of creating an unrealistic environment in which people cannot develop their own skills, the most effective technology is one which helps residents to face the challenges that independent living entails in a gradual, controlled and safe way (Gaines et al., 2016).

This offers residents the opportunity to be more in control of decision making, so that the home environment becomes a place to learn how to manage other environments (Steele & Ahrentzen, 2015).

All the references analysed confirm the necessity to take the aspect of “acoustic comfort” into account to design comfortable environments, because low-quality acoustic conditions in an environment significantly affect the psycho-physical wellbeing of a person on the spectrum. For most people, choosing a suitable neighbourhood is a first important step when searching for a place to live (Kinnaer et al., 2014, p.179). The importance of the house’s location, the connection to public transport and local services, the possibility of having a private outdoor space are all aspects which have an important impact on the quality of life of an adult on the spectrum in an independent living context.

Issues of house design that deal with the outdoor space of the house and the neighbourhood should be considered tools which support a person’s autonomy and safety. Collateral but no less important themes are “sustainability”, “dignity”, and “economic aspects”. The architect Michael Singer (2014) has proposed a correlation between design for autism and design for environmental sustainability. The use of ecological materials, low carbon systems and low pollution are considered factors which could have a positive impact on the quality of life, especially for autism.

A building is also an expression of the “dignity” of the person who inhabits it. When thinking of a disabled person, we tend to visualize a medicalized building. In this sense, designing for people on the spectrum should have the same dignity as designing for other clients; the right to quality and a beautiful design is for everyone.

Finally, the issue of housing for adults and young adults needs to be addressed within a larger perspective. A good design must offer a variety of housing options for a broad spectrum of autistic adults (Steele & Ahrentzen, 2015). The literature analysed confirms that there is a great lack of alternatives for the residences of autistic adults, also due to “economic issues”. Instead, precisely because the autism spectrum is very broad, an equally broad range of affordable housing options should be offered, while new ways to assist young adults in choosing where to live should be developed.

Conclusions.

The comparison of the guidelines revealed that the most widespread indications are given to designers, despite the themes being the same. Otherwise, what emerges clearly is that the needs of people with autism cannot easily be listed and generalized, but must be collected within a broad framework of needs. (image 3)

The autism spectrum is usually described like the light spectrum, where each user is at a specific point of this spectrum. However, autism is not one condition/one colour. Autism is a collection of intertwined neurological conditions more similar to a rainbow of traits (Lynch, 2019). An alternative image to the spectrum which better reflects the uniqueness of any individual is that of the piano keyboard, as proposed by the anthropologist Belek (2019). He suggests that “each key represents an autism trait, and the keyboard represents autism; and so, the collection of autism traits embodied by any individual autistic person could be likened to a single chord played on the piano” (p. 239).
Architects need to find the right “chord” for each user. (image 4) This challenge requires a case-by-case and creative approach, since finding solutions can be a case of trial and error. In this perspective, the guidelines that are most meaningful for the design process seem to be the ones which set out goals, rather than only providing technical indications. Ones which do not generalize but, through transversal considerations, urge the project to take a contextual and personalized direction with the final user in mind. A way to use the guidelines to achieve a quality design is not to use them to just find right answers, but to better understand what the questions for the project are, and which consideration the design process should start from.

notes
(1) The research has been conducted by the author within the project ‘SENSHome Sensitive Home: Sensors for Special Environments. The house as normal as possible and as special as necessary’, financed by the 2014 - 2020 INTERREG V-A Italy-Austria European programme.

(2) Defined by the Institute of Medicine in 1992 as “systematically developed statements to assist practitioner and patient decisions about appropriate health care choices for specific clinical circumstances”.

references


Braddock, G., Rowell, J. (2012). ‘Making Homes that Work: Planning, Design and Construction of Per-
son-Centered Environments for Families Living with Autism Spectrum Disorder’. Inclusion Press.


Guidelines 2006-2020. Map of sources consulted from all over the world. The list provides the code used to organize the database, the title, the authors, the country where the guidelines have been developed and the year.

Comparative framework used in the research to organize and compare contents from all the sources consulted. In each line are recommendations for each design aspect. In each column are recommendations from each guideline. The lines which are whiter, are the aspects addressed least.

Design keyboard. Concept of guidelines conceived for the uniqueness of any individual. The needs of people with autism must be collected within a broad framework of needs and design guidelines must offer a variety of “chord” for each design aspects.

Concept of the right “design chord” that architects should find for each user, as the collection of autism traits embodied by an autistic person could be compared to a single chord played on the piano.
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A variety of chord for each design aspect, conceived for the uniqueness of any individual.

1. Metaphor of the autism spectrum as the visible light spectrum.

2. Uniqueness of any individual on the spectrum.

3. Design keyboard to understand what the questions for the project are.

4. Design “chord” for the single user: the designer must find the right combination of design aspects and make a different pressure on each key.
Designing for autism, Asperger syndrome and other dis/abilities, especially cognitive ones, is hardly ever developed in interior design studies but rather entrusted to building regulations, accessibility manuals, supportive technology, or linked to the prescriptive application of guidelines. However, this approach to the design of living environments cannot suffice, since it does not take into account the multiple facets of autism in many aspects of life. In this paper, some examples will be described of design experiences of architects all over the world who have been able to mediate between the generalizations needed to build guidelines and the study of specific preferences.

**abstract**

Interior design studios are still too little concerned with designing for autism, instead, these issues are left to building regulations, accessibility manuals, supportive technology, or linked to the prescriptive application of guidelines. However, this approach to the design of living environments cannot suffice, since it does not take into account the multiple facets of autism in many aspects of life. An approach which considers social, cultural and aesthetic aspects, and not only regulatory ones, can contribute to making designed environments more “sensitive” to identities that are considered disadvantaged because of being more fragile, vulnerable, and low-performing. Autistic people have a different sensory experience (Bogdashina, 2003), and this can cause situations of sensory overload. Moreover, they are not always able to select from among a lot of information received at the same time. Due to their particularities, autistic people interact with the environment in an atypical way.

Recent studies have highlighted that most of the work in the literature on architectural design for autism is focused on how to “adapt” the physical and functional limitations of autistic people to the environment, considering these differences simply as a deficit. In this way, a regulatory “people-repair” programme is often unintentionally pursued (Frauenberger, Spiel and Makhaeva, 2019, pp. 666–678). This attitude heavily limits the design possibilities and leaves out the ethical question of the inclusion of “neurodiverses” in society which has recently emerged in autism studies (Belek, 2019).

If we wanted to think instead about how the environment might conform to people on the autism spectrum, recognizing or enhancing their skills rather than their deficits, we can envision broader and more sensitive design opportunities. Thinking in terms of neurodiversity, considering the deficits but also the potential strengths of autistic people, such as visual and spatial
skills, can influence the conception of architectural projects. (image 1)
The author is a research fellow at the University of Trieste, in the project ‘SENSHome: Sensors for Special Environments. The home as normal as possible and as special as necessary’, funded by the European programme Interreg V-A Italy-Austria 2014-2020. The aim of this project is to study and develop new design – interior architecture and special furnishings – and technologies for smart homes to be applied to homes “as normal as possible” which can be inhabited autonomously by more sensitive people, in particular people in autism spectrum conditions. In order to define the criteria for the SENSHome project, useful information was collected on how to design environments for autistic people, in particular young adults in the spectrum. This target was identified to verify the possibility of an independent life with the aim of supporting autonomy when reaching adulthood or in the case of a lack of family support. The methodology adopted for the SENSHome research project was to devote an initial part of the research to a study and redesign of selected architectural projects to allow a comparative design analysis of them. This was conducted in parallel with a comparative analysis of the recommendations and guidelines for autism-friendly architecture. Some architectural aspects were seen to be significant since they have appeared several times as important features in the design process and identified as key principle in guidelines. It is important to say, however, that these aspects must be combined with the specific need of the person to whom the project is addressed. (image 2)
In the last decade, scientific literature has emerged which questions the use of guidelines which tend to a simplification, by focusing on the identification of constants and common elements and not on differences and individualities (Kinnaer et al., 2016) (Heylighen et al., 2019). The design process itself involves an understanding of different needs of the end user, which are determined by his/her experience, character, and culture, etc. This becomes even more tricky when the architect, as in this case, has to face an even greater number of needs arising from the fact that there is not a single type of autism, but a spectrum, and that people often do not know how to express their needs. Although it is difficult to meet all the needs of the end user since they are extremely variable, some distinctive elements emerge which are considered important to emphasize.

Current status of design for autistic people.
Several built and unbuilt projects were selected, developed in various countries – UK, Italy, Spain, Denmark, America, etc. – between 2005 and 2020. The main intention was to analyse various design experiences in order to compare approaches and solutions, and identify which aspects emerged from the project practices. In the next paragraph, some aspects of these projects will be described, which the author considers relevant given that they represent the architect’s ability to combine architectural quality, attention to detail, and above all a sensitivity towards the people for whom the project is intended, in compliance with the recommendations of autism-friendly guidelines.

Flexibility and customization of environments and furnishings.
The possibility of adapting the built space to the needs of the final user is an important issue, and was developed in the Danish project called Seniors House by Wienberg Architects. (1) Located in Hinnerup, this was the first residence for elderly autistic people in Europe (Bellini, 2020). This example is pioneering for the flexibility of its housing modules since it was designed to provide the greatest comfort and wellbeing for autistic residents, while also taking into account the changes in its inhabitants’ life over the years – the property houses adults up to retirement age. Flexibility is important not only in the home, where residents have very different spaces in terms
of layout and rooms, but also in the communal areas, which must be able to accommodate widely divergent functions. This Danish project is interesting because the flexibility has also been applied to the furniture: to avoid distribution solutions and permanent furnishings, a system of partitions and modular cabinets on wheels has been incorporated into the apartments, allowing residents to modulate space and light.

The Adult Autism Inpatient Unit in Mitford by Medical Architecture, (2) is an autism inpatient service for adults who are on the autism spectrum, who have extremely complex needs and display challenging behaviour. In this project, the spaces are designed so that the apparent volume of the rooms is visually reduced by a rail which runs along their entire perimeter and determines the height of the doors and closets. This provides home proportions to the rooms and at the same time allows the closets and doors to close so as not to become the object of patient attention. TVs and closets can be hidden from view by locking doors in a defined position to remove the stimulation.

The threshold, the transition spaces, and the inclusion of outdoor spaces.
To reduce the sensory overload of autistic people, areas that have different functions can be visually and spatially separated. The threshold is the place where the passage between these different environments takes place, it must be gradual, and it must be designed with devices that accompany this gradualness.

In the projects we analysed, special importance has been given to transition spaces (image 3) which connect/relate different environments of the built space, between inside and outside and between public and private.

There are spaces designed to help the person to have a “preview” of the situation he/she is about to face. For example, in the Danish AT Home project, designed by Pluskontoret Arkitekter, (3) the transition space is between indoors and outdoors, where a small waiting place is created at the entrance, from which the person can see the world outside, but stay safe in his/her environment, and be able to decide whether to go out or not. Similarly, in the Adult Autism Inpatient Unit by Medical Architecture, a long seat allows guests to look out through a large glass window, so that the outdoor space is visually integrated into adjacent rooms.

When a person has to move from one environment to another, he/she can decide whether to access it thanks to the ability to see in advance what is going on in the space where he/she has to go, for example by looking through a window. An alternative to the use of glass is proposed by Wienberg Architects in the Senior House. They design an entrance with the possibility of opening the top door to look through and a lower door to go out, after seeing what is happening beyond the threshold.

The colours and materials used have also been chosen to create an indistinct effect between the inside and the outside, creating an easy transition between the spaces.

Another important issue in projects for people in the autism spectrum condition is the possibility of having an outdoor space. It has been demonstrated that well-designed gardens can enhance focus and attention and reduce anxiety among those with autism (Steele & Ahrentzen, 2015). Gardens can have areas for activities, for privacy and for socializing (Gaudion & McGin-ley, 2012).

Seniors House by Wienberg Architects is conceived with three buildings which feature a path to access the residences in an area with a lot of vegetation. Trees and bushes have been planted to create a natural filter between indoors and the greenery outside, so that residents can sit behind the numerous windows, enjoying the daylight and feeling part of the community, while shielded by vegetation. The treatment of the exterior façades is also green, which is a recurring colour in this project, both inside and outside, bringing a sense of security and tranquillity.
Frequent is the presence of courtyards which represent a good solution for security purposes, in direct contact with the accommodation, easily accessible, private and controllable. A solution of patios and fences is found in the project of Grijalba Arquitectos in the “Residencia y Centro De Día Para Autistas – Unidades mínimas entre patios y recintos”. (4) These open spaces filter between different areas and reduce stimuli.

Other research developments.
The research on living for autism has also been developed by the author in her own teaching experience. The theme of the course in Architectural Design at the University of Trieste concerned the design of environments for fragile, vulnerable or disadvantaged people. (5) Some of the students’ projects became degree theses, of which the author was assistant supervisor. One of these theses was about designing a small residential centre for the hospitality and life of families with an autistic member. (6) The aim was to create a spatial and life bond with a non-profit association in that area, which supports autistic people and their families. The individual housing units have been designed taking into account the different degrees of autonomy of the autistic people for whom they are intended. From a zero degree of independence, in which the person in the autistic condition lives in the care facility and the house is designed only for his/her family in a nearby location, up to a degree of maximum autonomy which can allow an independent life. This gradualness meant that the independent unit was gradually positioned further away from the main nucleus, to represent an ever-growing feeling of autonomy. The independent housing units and the house for the family were conceived as two clearly separate nuclei and conceived externally as a volume made of unclad reinforced concrete. The roof has been tapered upwards, placing a skylight at the top to allow the entry of diffused natural light inside the house. Externally, the entrance area includes a rounded wall which represents an element leading towards the interior of the house. (image 4)

Conclusion.
It is important to note the impossibility of creating a generic design output due to the heterogeneous nature of autism, but the attempt to contain and reduce the sensorial and environmental discomfort of the people in autism spectrum conditions and to ensure a sense of security in living are the first goal which all of the projects analysed have set. The attention of the architect to the design choice of spaces and materials comes not only from building regulations and accessibility manuals, but also from listening to and involving the final beneficiary and other experts in this field. Architectural solutions cannot be separated from social and cultural issues, just as solutions relating to comfort cannot be separated from the data relating to the autistic condition as defined by the biomedical disciplines. The involvement of the end user in the design phase can be a decisive strategy for the realization of an environment that considers as much as possible his/her wellbeing and specific needs. To do this, the architect must be able to foster reciprocity in creating an inclusive process, without the autistic person losing his/her uniqueness, but by exploiting the potential of diversity.
notes
(1) Seniors House in Hinnerup (DK), Wienberg Architects (architectural design), Frier Architecture og Møller og Grenborg A/S (furniture, interior), 2014.

(2) Adult Autism Inpatient Unit in Milford (UK), Medical Architecture, 2016.

(3) AT Home is a project undertaken by Specialområde Autisme (Central Denmark Region's Specialist Area Autism), these are flexible mobile homes for people with autism. The first prototype was built on the outskirts of the city of Tørring, Denmark, 2015-2016 (put into use).

(4) Residencia y Centro De Día Para Autistas in Valladolid (ES), Grijalba Arquitectos, 1997-2006 (two phases).


references


(image 1) Conception of architectural projects. Starting point of most projects: how to adapt to limitations? / Changing point of view: how to conform to skills?

(image 2) Design process. Realization or adaptation of a residential environment for people on the autism spectrum. How can we optimize the project?

(image 3) Threshold spaces as places and times for gradual adaptation to the environment.

(image 4) Master’s Degree Thesis “Progetto Autismo: abitare gradi di autonomia”, Simone Culot, 2018/2019 in Master’s degree course in Architecture at the University of Trieste, supervisor prof. Giuseppina Scavuzzo, assistant supervisor PhD Paola Limoncin.
abstract
Acoustics represent one of the most important comfort parameters for autistic people, their relatives and caregivers. Many design criteria of residential spaces related to autistic user describes the peculiarities of acoustic theme as their primary target. But an approach based specific acoustic parameters of international standards is still missing. For the SENSHome project, we had to figure out what the ideal interior acoustic conditions were for a space – a house – that could be autistic-friendly and, at the same time, accommodate smart support systems. The reverberation of a living space can be controlled by the insertion of sound absorbing elements of various types, but in the case of autistic users, literature suggests that it is necessary to follow the fundamental concept of “user centered design approach”.

keywords
Acoustic; Hearing Impaired; Noise Insulation; Reverberation; UCD.

When neurotypical people experience to much noise, due to annoying neighbours as an example, or sudden events from outside the house, they get nervous, or up-set, because their physical and psychological well-being is altered. But the typical reaction after anger is to take action to solve or to decrease the causes of the discomfort in some way. People without cognitive impairment can process these typical situations through pre-acquired mental schemes (Scott, 2003). The process of selecting the arrangement to correctly manage a situation is the basis of normal understanding. Thank to this schematic memory, it is possible to recognize the world as “familiar”. Anything that does not correspond to already acquired experiential data is recognized as “extraneous”; this is a very quick process. If most situation details fit well into a pattern, attention is immediately driven by unknown ones. Conversely, if most of the details are not familiar at all, a new pattern is processed.

Each pattern can also be considered as a large network of memories with potential associative connections. When events follow our expectations, some previously acquired memories reach the peripheral consciousness and arouse the sensation of being already happened. Thus, it is possible to react. This cognitive process is the responsible of everyday ordinary living. People affected by Autistic Spectrum Disorders are characterized by severe and generalized impairment in some areas of cognitive development, including hyper or hypo-reactivity to sensory stimuli or unusual interest in particular details of the environment – DSM V-2003. For high functioning individuals – HFA –, without intellectual disability, marked difficulties in the process of social inference may be verified and, in particular, this dysfunction may occur when they have to choose which information have to be taken into account (Panerai et al., 2014).

For an autistic person with hypersensitive hearing, it can be very difficult to cope with noisy situations of everyday life. Most people on the spectrum have difficulty processing intense,
multiple sensory experiences at once. Sensory overload often becomes their sensory experience in everyday life.

In a recent study conducted in Canada involving 168 families with child with autism – 3-16 years old – the 87% of the respondents reported that their children were sensitive to noise (Nagib et al., 2018). These results are confirmed also by the first analysis of the SENSHome Project research, with an investigation on Italian and Austrian Families involved in this research: acoustics was found to be the most important comfort parameters, for autistic people and their relatives and caregivers (Caniato et al., 2022).

Specific studies carried out on school environments with autistic children have shown that the application of interventions aimed at reducing noise coming from outside the classroom – from corridors, or neighbouring classrooms –, has allowed them to reduce behavioural temperament’ – self-stimulatory behaviour – such as obsessive behaviour, specific for each child, including head-banging, biting their hands and rocking (Kanakri et al., 2017).

Within the SENSHome project, we analysed literature, institutional programs, manuals and documents that summarize design criteria, space requirements, guidelines related to autism-friendly design within the last ten years, focused on residential spaces – individual and collective ones. Many authors and designers describes the peculiarities of acoustic theme in their projects.

For professor Mostafa acoustic is the first aspect that has to be considered in the priority scale of design process (Mostafa, 2014); also for GA Architects – an architecture practice in UK specialized in the design of environments for autistic children and adults and other learning difficulties – in their autism friendly design approach, a sense of calm is essential because noise will result in anxiety. The recent book “At home with autism” (Steele & Ahrentzen, 2015) is the most recent systematic work in this field. They talk about how auditory aspect must be taken into account in several aspects of home design. Also the Michael Singer Studio has been working in the field of “Autism Design” for several years on both housing for adults with autism as well as classroom design for children with autism, repeatedly focusing on aspects of auditory sensitivity (Singer, 2014). Architect Simon Humphreys, informed by personal experience of his autistic brother, also agrees that the most essential auditory experience created by architecture is tranquility. Humphreys suggests an interesting acoustic design way: he talks about the correct application of number to create acoustically balanced spaces, in particular using the Fibonacci proportion. He intended to apply the Fibonacci proportion – a numerical series – to the plan and section design of a building because he thinks it could provide an intuitive balance to the space and the acoustics to the space. But at present there is not scientific evidences that it may works. George Braddock and John Rowell suggest that lighting and acoustic treatments have to support caregiving not aggravating the individual. One of the sound insulation aspects they highlighted is certainly the fact that sometimes the autistic person, due to unusual hours of night-time movement for example, can become the cause of disturbance to roommates or neighbours – they like extended water play, repetitive motion, running, throwing things, bouncing, picking, sing loudly and so on. They may become active at odd times of day or night. The goal is to reduce the negative consequences of these activities on the neighbours – as much as possible – thanks to acoustic insulation treatments (Braddock et al., 2011). The Model Programme compiled by architects Andersen and Kristensen gives high priority to acoustics: they point out how internal acoustic treatment can help having a low reverberation period, supporting calm and homeliness. Allowance must also be made for limiting disruptive noise from ventilation, kitchens or engineering rooms. The Checklist for Autism-Friendly Environments by Stephen Simpson, among the basic and minimum requirements to create a more autistic friendly environment is auditory perception. The checklist consists of
several questions that will have a response yes or no. After each question there is a section called solutions/discussion. From a building acoustics point of view, the questions for the designers are, for example: “have you considered the general noise level in the environment?”, Is there noise from flooring and can this be deadened if needed?”, “Have you any specific quiet and louder areas that people can choose from?”. I think it can represents a good starting point for a designer when dealing with interior acoustics and sound insulation in spaces for autistic people (Simpson, 2015).

All the analysed references confirm the necessity to take acoustic aspect into account. But an approach specifically based to those acoustic parameters that the international standards refer to – minimum insulation requirements of internal or external walls, reverberation time, “clarity” or “definition” – is still missing.

Today we can refer to calculation methods and predictive formulas to study and to support design, in order to provide what we have to expect in terms of acoustic insulation and internal sound field of a specific room.

International Building laws or regulations define the minimum acoustic performance requirements for each type of partition in terms of dedicated indexes, but these requirements may not include values higher enough to protect both normal and special users.

In same case, national regulations impose that airborne noise insulation between adjacent rooms – e.g. partition walls between apartments – offers barely a level of privacy (Rasmussen, 2006).

The requirement for façade sound insulation is often not related to the real noise conditions of the outdoor environment. This could represent a problem in case of design an accommodation for autistic user, for whom loud noises from the street can be distracting, but above all frightening.

Reverberation contributes to confusion about the source of sounds. People on the spectrum often have a lot more trouble identifying them and consequently are more confused than others. Such confusion adds to the nuisance; one can even say that the difference between sound and noise is marked by such confusion. In order to qualify the acoustic of internal environment, the parameters reverberation time, clarity and definition are certainly representative.

Reverberation time is the time required for the sound to decay in a closed space. Clarity – C50 – is an objective measure of the clarity of speech: late reflections are unfavourable for understanding speech because it causes speech sounds to merge, making speech unclear; if the delay does not exceed a certain time limit – 50 ms –, the reflections will contribute positively to the clarity. The percentage ratio between early sound reflections and overall sound energy of the impulse response is defined in terms of Definition – D50.

There is a specific range of optimal reverberation time values depending on the purpose for which an environment is intended. It is more difficult to determine an optimal reverberation time value for specific subjects. The acoustic subjective studies available today are those that some countries have conducted, independently, with regard to school environments and people with hearing impairments.

In researching the topic of acoustics and autism, we found some references on the acoustic comfort of school environments, written by professionals, audiologists and university researchers alike. An example is represented by the UK Building Bulletin 102, that contains the maximum mid-frequency reverberation time requirements for newly-built environments and refurbishments also for spaces intended for users with special hearing or communication needs. But in the case of living spaces – flats, offices – we did not find specific indications in terms of spatial acoustic requirements for autistic people.
For the SENSHome project, we had to figure out what the ideal interior acoustic conditions were for a space – a house – that could be autistic-friendly and, at the same time, accommodate smart support systems. Microphone sensors are part of the smart system for hazardous event recognition that is one of the SENSHome project targets. The use of smart sensor systems represents a valuable support to internal design in order to achieve independent living for impaired people. Accordingly, these devices can monitor or prevent hazardous situations, ensuring security and privacy. Acoustic sensor systems, for instance, could be used in order to realize a passive monitoring system. The correct functioning of such devices needs optimal indoor acoustic criteria. Nevertheless, these criteria should also comply with dedicated acoustic requests that autistic individuals with hearing impairment or hypersensitivity to sound could need.

In the case of autistic individuals, the low stimulus option is usually most appropriate. That's why we correlated reverberation time values obtained from some works deal-with hearing and learning impaired people’s with optimal values for the functioning of microphone sensors. Our research point out that obtaining reverberation values range from 0.4 to 0.7 seconds should represent optimal comfort conditions, both for autistic guests inside a room and for the functioning of microphone sensors (Bettarello et al., 2021).

The reverberation of a living space can be controlled by the insertion of sound absorbing elements of various types, but in the case of autistic users, literature suggests that it is necessary to follow the fundamental concept of “user centered design approach”. Autistic individuals could dislike discontinuity related to vertical walls, thus micro-perforated sound absorbing panels may alter wall appearance. Accordingly, it is of paramount importance not to introduce disturbing elements such surface interruptions.

Furnishing with sound absorbing elements on dedicated areas can be considered. Some furniture elements like beds, cushions, armchairs and sofas are all intrinsically sound absorbing. This property will depend on their geometries and thicknesses.

The possible inclusion of all these elements in the indoor environment should therefore be studied in advance, in order to optimize the indoor acoustic characteristics of the room according to the likes and dislikes of individuals on the autistic spectrum.
American Psychiatric Association (5th ed.). (revision 2022, March 18). Diagnostic and Statistical Manual of Mental Disorders. https://doi.org/10.1176/appi.books.9780890425678


Design, values and a paradox about inclusion.

Inclusive design not only faces the problem of providing a clear conceptual and theoretical foundation to address ethical issues in design practice, but also seems to generate a distinctive paradox. In exploring how to deal with this paradox, we ended up developing a framework for investigating and promoting justice in design practice that contributes conceptual and theoretical tools to adopt a systematic approach to foundational and applied issues of design ethics.

Research has increasingly focused on how ethics and values both affect and should be addressed by design practice. The issue has been raised by “value-sensitive design” and “design for values” approaches that target a broad set of disparate issues, from “human dignity”, over “welfare”, “human rights”, and “privacy”, to “environmental sustainability” and “democracy” among others (Friedman, 2004) (Mandel-Huits, 2011) (Vermaas et al., 2015) (Kroes & van der Poel, 2015). What marks off such approaches is considering human and moral values prospectively as a potential target of design practice rather than retrospectively, as evaluative standard for assessing artefacts after they are produced. These approaches, however, are still not developed enough to cover the variety of issues they confront in a systematic way, as they generally lack a clear articulation of the goals, methods, and concepts that is required for a sensible application of ethical theory to design practice (Cenci & Cawthorne, 2020) (Jacobs & Huldtgren, 2018). Conversely, inclusive design approaches focus on a clear, apparently uncontroversial goal, and attention is growing for their theoretical development (Imrie, 2012), yet they seem to yield paradoxical results. (1)

What we labeled the paradox of inclusive design arises from the apparent inconsistency between the premises and the conclusion of the argument that typically defines the purpose.
of inclusive design. The premises involve recognizing (a) that human physical and mental capabilities vary so widely across individuals and across their life-course that it is inaccurate to associate a certain range of ability with “normalcy” and (b) that disabilities arise from the interaction with social and material environments that are virtually open to structural intervention rather than from whatever degree of physical or cognitive impairment (Clarkson & Coleman, 2015). The conclusion is that design practice should have the purpose to “ensure that […] products and services address the needs of the widest possible audience, irrespective of age or ability” (Design Council, 2009). The paradox arises from the fact that endorsing the premises makes the purpose of inclusive designing impossible and likely restricts the “widest possible audience” to the point of irrelevance. The more differences are taken into account, the less designed artifacts are likely to be usable by anyone and trade-offs can be expected to arise because responding to differentially specific needs will involve costs as to responding to other needs. Conversely the more artifacts design targets usability for all, the less it is likely to be specialized on pain of turning out so complex that overall usability decreases dramatically (Bianchin & Heylighen, 2017). When considering the autism spectrum, for instance, accommodating the needs of hyporeactive people may severely restrict the usability for hyperreactive people, and vice versa.

The paradox converted. Interestingly, the distinction between impairment and disability mirrors a distinction routinely made in the literature concerning gender and race, that is the distinction between the biological traits that marks off certain people – like being dark skinned or having female genitals – and the social category into which people carrying such traits are classified, defined broadly in terms of social roles or positions: Black, Asian, woman, man, and so on (Haslanger, 2012). The point is that biological traits impose no necessary condition on social categorization. Now, value-laden terms like “impairment” might blur the issue. Yet the distinction between impairment and disability is apt to convey the difference between (a) a physical or mental condition that is intrinsic to individuals and (b) a restriction in the ability to perform specific physical and cognitive tasks that is socially determined, because it crucially depends on the resources individuals have access to, on the demands they are subject to, and on the prevalent cultural norms that fix what counts as able-bodied. Moreover, it can be argued that sorting out the disabilities as a political issue because it concerns the opportunities people are taken to be entitled to, which makes disability a question of distributive justice (Begon, 2021). Accordingly, the paradox of inclusive design can be converted into a question of distributive justice. On the one hand, understanding the paradox as the manifestation of an underlying question of distributive justice seems appropriate as long as disability involves a deprivation of opportunities people are entitled to. On the other hand, the paradox arises as a matter of fact under conditions that routinely define the circumstances under which questions of distributive justice arise: we live in a world of limited resources and widespread value pluralism. Under such conditions human differences can be expected to place conflicting demands on design practice rather than lead to harmonic design solutions. By specifying these conditions, the rather vague question of how to address the needs of the widest possible audience is converted into the specific question of how design can address conflicting demands under a moderate scarcity of resources. And this is a question that can be sensibly handled as a question concerning how usability can be fairly distributed across users who differ in their abilities and in the value placed on them.

That the paradox can be converted into a question of justice is therefore good news. Contrary to paradoxes, questions are tractable and we can draw on existing theories of justice to work out the tools for inclusive design practice. More specifically, converting the paradox
into a question of justice answers the worries that have been raised about the alleged utopian character of inclusive design, because it constrains the aims of inclusive design to realistic mundane conditions – moderate scarcity of resources and value pluralism. If a conception of inclusive design can be worked out that matches these conditions, inclusive design will escape the charge of utopianism that is often raised by critics and used as a reason not to teach or practice it (Steinfeld & Tauker, 2002) (De Cauwer, Clement, Buelens, and Heylighen, 2009). In what follows we outline basic tools such approach provides to confront the ethical and political demands placed on design practice.

A framework for justice in inclusive design practice.

The first tool draws on current theories of justice in order to address the moral demand placed on inclusive design. Given that designing artefacts that are equally usable by anyone clashes with the very idea of being responsive to differences, a sensible move is to shift the demand for inclusivity from the output to the process of design and to look for principles that can be used as guidelines for a just design practice. Such principles need be chosen in a way that does not grant an arbitrary privilege to any contingent conception of ableness on pain of giving in to ableism of one sort or another. The underlying rationale is that justice requires a decision procedure to be set that constrains what counts as a good reason in deliberating those principles in order for them to be impartial and fair (Barry, 1995) (Freeman, 2007).

In political theory, Rawls (1999) introduced this procedural constraint under the label “original position”. In the context of design practice, the point of endorsing such a procedure is preventing biased conceptions of ableness to filter into the principles and to be responsive to each user. Following Rawls, we hence suggest that the agents deliberating about the principles should wear a veil of ignorance that blinds the information they possess about their own abilities, social position, and conception of the good while preserving their general knowledge of human psychology, society, and human affairs. In a nutshell, this forces the deliberating subjects to ignore the user condition in which they might turn out to be, that is how they will be affected by design, and therefore to reason as if they could be any randomly chosen potential addressee (Bianchin & Heylighen, 2018). Think of the original position as a deliberating device that constrains people to take the stance of those who are affected by institutional arrangements. Ignoring the position one will occupy within a specific arrangement will prompt one to maximize the expected utility for the worst offs out of prudential reasons to keep safe in the worst case scenario. Rawls’ theory of justice predicts that people deliberating under such constraints will choose two principles according to which the basic social institutions are to be designed (Rawls, 1999, p. 266):

– principle 1: each is to enjoy the maximal compatible system of liberties;
– principle 2: inequalities must be arranged so that they are both (a) to the greatest benefit of least advantaged and (b) attached to offices and positions open to equality of opportunity.

If we turn to design practice, similar principles can be expected to be chosen as long as people ignore which disabilities they will be possibly affected by as a consequence of their physical or mental condition, their social position, and their values. Taking usability as what design distributes, we end up with:

1. artifacts should be designed to overcome limitations to enjoying the maximal compatible system of liberties;
2. inequalities concerning usability must be arranged so that they a) maximize usability for the worst off and b) promote a fair equality of opportunity.

Notice that maximizing usability for the worst off is different from designing for all or addressing the widest possible audience: it entails identifying who will be most affected by a specific design and taking them as the proper target of inclusive design even if this can decrease the
usability of most users or average usability. Moreover, it explicitly admits that differences in usability across users can be fair, when they are justified by the fact that they increase usability for the worst offs. On this view, the target of design justice is a fair social distribution of usability across users rather than maximal usability for all or for the widest audience, where the principles provide general guidelines whose implementation admits multiple realizations that are expected to be sensitive to contextual factors (Bianchin & Heylighen, 2018).

Empathy and Deliberation.
The second tool we advance is empathy. While counterfactual, the original position is psychologically realistic, as it merely asks that “persons can […] simulate the deliberation in this hypothetical situation” (Rawls, 1999, p. 119), that is “from the standpoint of one person selected at random” (Rawls, 1999, p. 120). This is in line with the capacity for cognitive empathy generally credited to humans (Goldman, 2007). Cognitive empathy allows people to put themselves in the mental shoes of others and simulate their reasoning, that is to read their minds in order to collect information about them, predict their behavior and coordinate (Goldman, 1989) (Tomasello, 1999) (Bianchin, 2015a). The implications for moral reasoning have been stressed since Smith’s theory of moral sentiments (Smith, 2002) (Goldman, 1993) (Gordon, 1995). In the present context, simulating deliberation allows figuring out the principles one would choose in the mental shoes of the worst offs and concluding that the two principles are justified as the rational choice of whoever whose reasoning is constrained by the veil of ignorance to be impartial and fair.

Things change when it comes to applying the principles to actual design problems, which requires lifting the veil of ignorance to let context sensitive information about specific users and situations to flow into design processes. Empathy again has been reclaimed to design in this connection to access users’ needs as well as the background beliefs and values that structure their experience (Kouprie & Visser, 2009) (van der Bijl-Brouwer & Dorst, 2017). Since artefacts are “objects embedded in use plans” (Houkes & Vermaas, 2010, p. 137), it is sensible to expect designers to recruit cognitive empathy to anticipate users’ experience. Research on empathy in philosophy and cognitive science, however, suggests that it is subject to significant limitations, which depend on bodily differences as well as on omitting relevant inputs and projecting one’s own personal and cultural biases onto other minds (Heylighen & Dong, 2019) (Goldman, 2006). Finally, empathy is notoriously proportional to spatial, temporal and cultural distance.

We suggest that the cognitive limitations of empathy can be overcome by making users participate in the design process through public deliberation, which we conceive as the third tool of inclusive design, as it elicits the connection between design justice and participatory design (Heylighen & Bianchin, 2013). Public deliberation is routinely taken to possess both an epistemic and a moral dimension, as it channels information and arguments that are otherwise hardly accessible, while inducing participants to take a reflective and pro-social attitude in collective decision making (Dryzek & List, 2003). In the context of design practice, this converts in collecting context-sensitive information and argument from those who are affected by design about the demands to be addressed, to submit proposed solutions to public scrutiny, and to commit design practitioners to be responsive to reasons that arise from the relevant audience. Provided that participants can voice their reasons, that no standpoint is arbitrarily privileged, and that public reasoning is constrained by argument (Habermas, 1995, p. 89) (Bianchin, 2015b), the deliberation process can be expected to preserve in concreto the impartiality and fairness depicted in abstracto by the original position, while tuning principles to the contextual features of actual design processes.
Wrapping up.
In this paper, we outlined a framework for justice in design practice that escape the paradox inclusive design seems to be trapped in and introduces three tools to meet the demands it raises: Raws's idea of the original position, cognitive empathy, and public deliberation. We suggest that applying these tools to the design process makes sense of inclusive design as an effective design stance and allows meeting the demands it raises.

notes
(1) In this paper we use “inclusive design approaches” or “inclusive design” (with lowercase) as an umbrella term to refer to design approaches like Universal Design, “Design for All”, or Inclusive Design (with capital letters). While differences exist in where these approaches originate and how they have evolved, in the context of this paper, we focus on their shared purpose.

references


Autism Spectrum and the need for Human Centered Design.

Autism spectrum diagnoses increased over the last decades, as reviews comparing prevalence rates from different studies conducted in the previous decades show. Research assumes that about 0.6% of the world population is affected by ASD (Elsabbagh et al., 2012) (Fombonne, 2009). Due to different effects of the spectrum, personal support is required that is provided by formal and/or informal caregivers in various activities of daily living and other situations like school, work or home life. People affected often have a different perception of the environment and thus different resources, needs, and requirements (Kamp-Becker & Bölte, 2014) regarding a supportive, smart home and interior design environment as it is designed in the SENSHome project. To design solutions tailored to the later users that are useful and usable and thus are accepted, the respective users must be included in the development process from the very beginning.

The Human Centered Design – HCD – approach places human needs, capacities and behavior first and then designs to accommodate those needs and capabilities. Using this research approach, designing inappropriate or bad usability technology can be avoided, instead enabling user-friendly and adequate technology (Norman, 2013). HCD is an iterative process that includes all relevant stakeholders in the development process from the beginning. (image 1) Following the content of (ISO 9241-210:2019, 2019), HCD is an approach to interactive systems development that aims to make systems usable and useful by:

– focusing on the users, their needs and requirements;
– applying human factors/ergonomics, and usability knowledge and techniques.

This approach:
– enhances effectiveness and efficiency;

abstract

People on the autism spectrum face challenges in different areas of life that can be supported by a smart home and interior design solution developed in the SENSHome project. A guideline is provided through the Human Centered Design approach, that includes methods and tools to assist the design process from the very beginning. Through workshops, the users and the context of use were considered in order to derive requirements for a comprehensive solution. Personas, which represent too a corresponding depiction of activities of daily living, risk factors, and mitigating measure served as a basis for the later development of the requirements and functionalities of the SENSHome environment.

keywords

Autism; Human Centered Design; Participatory Research; Smart Home; Interior Design.
– improves human well-being;
– user satisfaction;
– accessibility and sustainability;
– counteracts possible adverse effects of use on human health, safety and performance.

Using this participatory research approach is especially important for the target group of people on the autism spectrum, as requirements of a smart home and interior design solution might differ from neurotypical users in certain areas like the user interface or furniture functionalities.

Methods of HCD – in a pandemic.
The main framework of all user interactions conducted in SENSHome were workshops. These user interactions lasted around 1-2 hours, in which small working group or single persons intensively dealt with a specific topic, issue or question. To achieve concrete and sustainable outputs, it was crucial to define clear goals and an appropriate activity design and avoid unnecessary and pointless workload for the involved participants at the same time. All participants involved in the workshops were adequately informed about their participation and agreed to take part by signing an informed consent.

A challenging factor in this first phase of the project was the COVID-19 pandemic, as first lockdowns lead to a change in conventional participatory processes like workshops, interviews or focus groups. To overcome these challenges, digital tools were used to support the conduct of the user interactions.

In order to reduce social interactions and to ban the spread of the corona virus, we were forced to switch to remote work in the early months of 2020. This situation brought not only opportunities but also barriers equally. Online user interactions come with the advantage of not having to travel to a destination for participating at an event. We were able to set up time and resource efficient calls with the stakeholders which was a great opportunity. At the same time, it turned out to be very challenging to bring more stakeholders on one table, which resulted in more one to one discussion rather than group meetings.

To overcome the given barriers and challenges, one of the most used tools was MURAL, (1) which is a digital workspace for visual collaboration. It is a set of cloud-based shared, virtual whiteboards where teams can visually explore complex challenges, facilitate design thinking methods, and organize agile processes across any device. The work is performed within a mural where all kinds of content can be mapped. It is like a giant canvas that can be individually customized.

Before starting with user interactions, a stakeholder map helps to identify who are important user groups and participants to consider. The results of initial phases of the HCD process can be derived to personas and user days, which are two commonly used methods that were also used in SENSHome.

1. Stakeholder map. A common first step in the HCD process is to identify relevant stakeholders that can contribute to the respective topic. To understand and specify the context of use of SENSHome and to specify the user requirements, different groups of stakeholders were taken into consideration according to the quintuple helix model. This includes civil society users with the primary user group of people with ASD, business, research and education, public administration and the environment (Carayannis et al., 2012). (image 2)

2. Personas. Especially when working with HCD approach, the future user moves to the center of the development process. When people with various backgrounds and perspectives work together on a project, they may have different ideas and interpretations of the future users. This is where personas come into play. The “personas” method is suitable for developing a common, homogeneous image of the user. The user becomes tangible for everyone involved in
the project. The aim is to gain insight into a probable user profile. The method does not claim to depict reality completely, but represents a model of the user, which is based on the motives and goals of real users (Cooper, 2004) (Arnold et al., 2005).

Personas are an effective way of supporting the human centered design process and a powerful supplement to work user definitions. A persona is not an actual user but a hypothetical archetype. Personas are a well-known and successful technique for making users real (Hartson & Pyla, 2012). Benefits of using this method are (‘Personas: Why Is It Important to Understand Your Users?’, n.d.):

– project wide understanding of who the “primary” users are;
– understanding of users’ needs and behavior;
– preventing project workers and contributors from talking about themselves, their friends or their family as the users;
– empathy with the user;
– clearer and better decision making focused on user needs/goals.

3. User Days. User days are derived from user stories (Cohn, 2004) and scenarios which are common methods in software engineering to meet the user’s needs. Typically, scenarios describe everyday situations and routines. They are plausible stories about a Persona who will use a future technical solution in a particular situation. The scenarios contain a character – persona –, a challenge in everyday life that must be mastered, a specification of the need and an idealized conclusion. User stories describe the Persona’s needs, which are presented in the respective scenario, to achieve a certain goal. They represent a software requirement formulated in everyday language, deliberately kept short. As a collective output of User involvement activities and the literature research, we created user days to present the integration of the future SENSHome system embedded in the ecosystem of the daily living of primary and secondary end-users.

Results and outcomes of the initial user interactions.

From January 2020 to April 2021, 25 workshops were held with different user groups: people on the autism spectrum; formal and informal caregivers; managing directors of care facilities; representatives of associations in the field of autism. The primary outcomes of the initial phase of the project were the description of the potential target group by means of three personas. These personas depict different types of users on the autism spectrum with different resources and needs in order to cover a broader spectrum of possible user types. Accompanying to the personas, user days were set up that show different scenarios during the day when a smart home solution like SENSHome can help. Furthermore, requirements of and functionalities for a smart home solution were gathered in the workshops and mock-ups of the central user interface designed within the workshops – these results are not presented in this work.

1. Persona Dominic. As one example of the three personas, the persona Dominic shows what type of information was gathered and brought together descriptively. (image 3) Next to an overview on the left side, that shows general characteristics of the persona, a detailed description of the autism spectrum, care needs, social life, education, occupation, hobbies and interests and other symptoms is provided. The needs and assistance part of the persona show first insights how SENSHome could support people in the autism spectrum.

2. One day in the life of Dominic. Extending the personas, we created user days to point out in which critical events can occur that might lead to dangerous situations and how SENSHome can foster autonomy and self-reliance of people with ASD and increase the comfort for residents in different housing situations.

The daily routine depicts how a common day of the persona Dominic could look like. (image 4) The curve shows the risk level for critical or dangerous events. It rises when stress-factors oc-
cur and falls when mitigating interventions are set. The functionalities of the SENSHome system are shown in the last row of the image and is split up into Case, Recognition and Measure. The Case describes the situation, in which the SENSHome system comes into effect. The Recognition is the sensory part of the system where certain parameters are measured. When the system’s functionality is an interior design element, no Recognition is stated. The Measure is the reaction of the system on the detected parameter or, in case of interior design, the proposed architectural solution. The declared functionalities show an excerpt of possible functionalities of the SENSHome system. The SENSHome user days are a useful method of our HCD portfolio to make a typical day of our end users more tangible.

What’s next in SENSHome.
Based on these initial results of the first project phase, the requirements for the sensor system and the furniture elements were derived and developed in iterative workshops. The requirements were transformed into functionalities the SENSHome system would later comprise. Next to autism-specific functionalities like a crowd warning, where the system informs about – too – many people in certain areas, e.g. the entrance or the recognition of loud noises, general security and wellbeing functions were integrated into the solution. These are, for example, a fire or fall detection or the measurement of the temperature with automatic adjustment – if possible from an actuator side. The interior design elements include autism-friendly furniture like a shelter seat or a table with dividers to provide privacy when needed.

The SENSHome environment will be tested in two different labs in Italy and Austria and evaluated by people on the autism spectrum and caregivers. The results will give insights into the acceptance of a smart home solution for people on the autism spectrum.

notes
(1) https://mural.co/

references


(image 2) Stakeholder Map (Carayannis et al., 2012).

(image 3) Persona Dominic.

(image 4) User day for Persona Dominic.
DOMINIC

Age 35
Residence Assisted Living
Region Carinthia

Severity of autism
- low
- moderate
- high

Care needs
- low
- moderate
- high

Communication skills
- low
- moderate
- high

Autism spectrum and care needs

Dominic was diagnosed with autism spectrum disorder at the age of five. Prior to that, noticeable problems. His speech problems in his hands and a delayed language development were observed. Dominic needs assistance in almost all activities of daily living (ADL). For security reasons, a caregiver must be present 24 hours a day. Simple activities he can perform autonomously (e.g., prepared meals, dressing, using the toilet). Daily routines are very important for Dominic.

Social life and communication

Dominic has one person from the assisted living facility who shares interests with other than that, he only has social contacts with the caregivers from the assisted living facility and with his family. He is content when he can communicate. His communication skills are very limited. He only communicates on a factual level. He can barely express his needs and has issues with interpersonal contact and the interpretation of nonverbal signals.

Education and occupation

Dominic attended a special education school until sixth grade. He is neither able to write nor to read. Currently, he is engaged in a supported employment close to the assisted living facility where he lives. He is working in a grocery store. He enjoys hand-crafting wood and is also very skilled in that particular field. An apprenticeship as a carpenter was not possible due to his autism spectrum disorder.

Interests

He is highly interested in nature, especially in forests, where he likes to go for walks and collect stones. He also likes to do puzzles, which he can do alone. In the supported employment, he is well-organized in public transport and enjoys his many travels. He would like to use public transport alone, as it is not possible for him because of his autism spectrum disorder.

Conorabilities and other symptoms

Dominic suffers from deficits in self-help activities typical for autism spectrum disorder (ASD). He also has problems with self-regulation. Aggressive behavior against others occurs regularly that is mainly triggered by interrupted daily routines, when his needs are not satisfied or when he feels overwhelmed. It is very important for Dominic to have the same daily routine every day.

Needs

Dominic suffers from deficits in self-help activities typical for autism spectrum disorder (ASD). He also has problems with self-regulation. Aggressive behavior against others occurs regularly that is mainly triggered by interrupted daily routines, when his needs are not satisfied or when he feels overwhelmed. It is very important for Dominic to have the same daily routine every day.

Assistance

Before aggressive behavior occurs, there are preliminary signs that indicate this behavior. As an example, stereotyped movements of arms or swinging back and forth with the upper body can be detected. If these signs are recognized, caregivers can be informed.
In Italy, the Autism Spectrum Disorder – ASD – occurs in one of every 77 children aged 7-9 years old (Italian Ministry of Health, 2021). There is a lack of precise data on the young and adult population because the medical competencies in the childhood period are greater than in other life phases (Vivanti, 2010). An autistic person has a high life expectancy with different levels of autonomy; hence, the need for a set of treatments and services dedicated to people without family support – so-called “After Us”. Despite the strategic role played by parent associations like the National Association of parents of people with Autism and the National Autism Observatory, founded by the Italian National Institute of Health, a housing solution for ASD adults is not a much-debated topic in both of its main aspects in Italy; on one hand, public medical care and social assistance, and on the other hand, the specific architectural solutions. In fact, there is a lack of residential solutions designed to meet the needs of these users, and there are different facilities that host people with various disabilities (Giofrè, 2010). There are various types of autism and for that reason, the suitable term is “Autism Spectrum Condition”.

The paper discusses the typologies of facilities for young and adults with Autism Spectrum Disorder within Italian context, the methodology applied by Sapienza University team in this field of research, and in conclusion, it shows a “best practice” to aid the transition of autistic young adults into the labour market. The paper underlines the importance of the research in this specific field, with the aim to identify the building requirements based on the users’ needs.

**abstract**

The paper discusses the typologies of facilities for young and adults with Autism Spectrum Disorder within Italian context, the methodology applied by Sapienza University team in this field of research, and in conclusion, it shows a “best practice” to aid the transition of autistic young adults into the labour market. The paper underlines the importance of the research in this specific field, with the aim to identify the building requirements based on the users’ needs.

**keywords**

Autism Spectrum Disorder; Young; Adults; Facilities; Building Requirements.

In Italy, the Autism Spectrum Disorder – ASD – occurs in one of every 77 children aged 7-9 years old (Italian Ministry of Health, 2021). There is a lack of precise data on the young and adult population because the medical competencies in the childhood period are greater than in other life phases (Vivanti, 2010). An autistic person has a high life expectancy with different levels of autonomy; hence, the need for a set of treatments and services dedicated to people without family support – so-called “After Us”. Despite the strategic role played by parent associations like the National Association of parents of people with Autism and the National Autism Observatory, founded by the Italian National Institute of Health, a housing solution for ASD adults is not a much-debated topic in both of its main aspects in Italy; on one hand, public medical care and social assistance, and on the other hand, the specific architectural solutions. In fact, there is a lack of residential solutions designed to meet the needs of these users, and there are different facilities that host people with various disabilities (Giofrè, 2010). There are various types of autism and for that reason, the suitable term is “Autism Spectrum Condition”.

The paper starts with the question: “How can we design a space that reduces discomfort and helps young and adults with autism to cope with their needs?”. The paper discusses within the Italian context the facilities dedicated to an autistic person, and the methodology applied in some research developed starting from the first Italian book that explores the relationship between an autistic person and architecture, through an interdisciplinary approach (Giofrè, 2010). In conclusion, one Italian case study is described and assumed as best practice for the opportunity of social inclusion offered to autistic adults.

Residential typologies for adults with Autism Spectrum Disorders: the Italian framework Structures that can host a person with ASD are described in two Law Decrees – L.D.:
23/11/2016 issued by the Italian Ministry of Labour and Social Policies and the L.D. n. 308/2001 issued by the Minister of Social solidarity. (1) (2) Both of Law Decrees’ subject is identified “people with different disabilities”. The L.D. 23/11/2016 is aimed at supporting people severely disabled in general and the same group of disabled that cannot have the support of their parents for different reasons – e.g. both parents are dead or they are not able to provide aptly a support –, and the L.D. n. 308/2001 is aimed at a different type of users, which is possible to include persons with ASD. The L.Ds provide indications for the localization of each residential typology solution, based on their characteristics and users.

The dwellings, apartment groups, or co-housing solutions that reproduce housing and relational conditions of the family home, and provide, where possible, the use of their objects and furniture; they should be close to family homes and open to the surrounding community, near leisure areas, and employment opportunities, shops and health services – 15 minutes walking. Houses with private gardens are recommended, also houses in rural areas within social agriculture projects such as farm communities. These community structures and protected residential structures should be in inhabited areas, easily accessible by public transport, allowing users to participate in social life, and facilitating visits.

The research proceeded to identify the Functional Areas – FA – and the related Environmental Units – EU – that constitute these facilities, according to a homogenous group of activities that take place, applying a consolidated methodology, already used to investigate other architectural facilities such as hospitals, services for the elderly, etc. (3) This functional breakdown aims to obtain a map of each part of the building, to subsequently categorise the requirements that each of them should have to match the users’ needs.

The main functional areas of the dwellings, apartment groups, or co-housing solutions and their environmental unit are:

- collective/recreational area: units for aggregative, recreational-cultural, free time activities, and dining unit;
- residential area: sleeping rooms with maximum 10 beds – 2 modules x 5 beds –, some single rooms, and bed for emergencies and/or relief.

These facilities have to reproduce the sense of home, and provide the use of domestic objects and furniture.

The main functional areas of community structure and their environmental unit are:

- collective/recreational area: units for aggregative and recreational-cultural activities, dining unit;
- residential area: sleeping rooms with double or single rooms with 7-10 beds – for emergency too –, the rooms’ dimension must be adequate for daily activities, one toilet for every four non-self-sufficient guests;
- caregivers’ area: space for health services according to the specific needs of the hosted users.

These facilities have to promote the guest’s autonomy, and usability.

The protected Residential Structure is articulated in:

- collective/recreational areas: units for aggregative and recreational-cultural activities, dining unit;
- residential area: sleeping rooms with double or single rooms, maximum 20 beds, with dedicated furniture bells close to each bed. One toilet for the disabled for each double room and one toilet for the disabled every two single rooms, and the toilets must be connected with the sleeping room;
- caregivers area: 1 room for educator and 1 ambulatory with toilet;
– therapeutic, educational, and occupational area: occupational laboratories and gym space. The facility’s complexity changes according to the conditions of autonomy and state of health. One of the environmental units not listed above, apart from the therapeutic area, is the multi-sensory room – Snoezelen room –, a space designed to experience a sensory environment. It aims to reduce hyperactivity and distraction, improve focus, increase mental alertness, reduce depression, encourage socialization and promote creativity. (4)

Methodology of research: performance requirement approach. The researchers developed by the Sapienza' university team, after the identification of FA applied different methods:
– scientific evidence;
– expert’ interviews;
– case studies/observation on site;
– post occupancy evaluation studies.
The main goals were to identify the users’ needs and provide design guidelines for entities responsible for renovating or building new facilities for autistic persons. Scholars identified specific needs for autistic persons that have to be translated into architectural solutions for each functional area identified. These general needs are:
– assure proxemics;
– avoid situations of impoverishment or sensory hyper stimulation and environmental stress;
– neutralize the stimuli of disorientation ;
– stimulate perceptual skills;
– ensuring multi-sensory systems able of helping the use of space autonomously;
– ensure safety conditions for users and operators;
– promote both privacy and socialization;
– allow, where possible, the freedom of choice;
– recreate familiar atmospheres as much as possible.

Turning the general needs into basic design indications, it is possible to identify different spatial and organizational requirements that must be considered:
– clarity in space geometry and organisation;
– preference for curvilinear design;
– basic spatial organisation, few stimuli, sequence-based organisation;
– intimate space used also for therapy – i.e. sensory rooms;
– signposts for spatial boundaries;
– materials and finishes with neutral and mat colours;
– steady furniture, also specially coloured to signal specific activities;
– need to signal the depth of space;
– micro-climate factors control;
– lighting control;
– noise control;
– safety;
– customization of bedroom;
– accessibility.

A further step of the research is the PhD research by Porro (2018). This research focused on facilities for autistic adults, it built a chart organized according to four classes of needs – aspect/shape, usability, wellbeing, and safety – and for each class, it defined the requirements, and the connected design indications – total 80 –, in relation with the FA. Two Italian case studies were investigated; the House Sebastiano and Home special home (Porro, 2018; Porro & Giofrè, 2019).
Italian case study: Luna Blu

This part of the paper briefly discusses an Italian case study, called Luna Blu located near the La Spezia Migliarina station in Liguria, built in 2018 by the private foundation AUT AUT, which was established in 2017 with the aim “aid the transition of autistic young adults into labour market, with a focus on the tourism sector, to foster an inclusive model that – starting out from work situations – can offer concrete and innovative answers to needs linked to pervasive developmental disorders”. (5) (6)

Luna Blu is managed by Fondazione il Domani dell’Autismo – “I ragazzi della Luna”. It is a new three-story building built over an area of 2,300 sqm, including 700 sqm of parking; the covered surface is 795 sqm and the green surface 1,500 sqm. It offers several services to support autistic persons and their families. There is the holiday house – 290 sqm – which has ten double ensuite bedrooms, and one that can accommodate people with disabilities. The restaurant – 180 sqm – is open to Luna Blu guests and to external customers. In the laboratories – 55 sqm – autistic people are trained by educators and they learn how to make baked goods. In Luna Blu there is an “apartment for autonomy” with six bedrooms – five single and one double rooms – a kitchen, a dining room, a common area, and a laundry room. (image 1) (image 2)

Autistic persons can have an independent life in these apartments for up to one year. During this period of stay, they participate in occupational activities in the laboratory and other services necessary for running the facility, such as the hotel reception and the accommodation management. Luna Blu also includes five rooms to foster the path foreseen by the Italian Law n. 112/2016 “After Us”, hosting people with autism who had to face family separations, assisted by staff and in close collaboration with the local health authority. (7) (8) The room and housing spaces reserved for ASD persons and their families occupied 405 sqm. The design project takes into consideration the needs of autistic people. In fact, the geometrical shape of the building is simple and clear, within a residential area, colours are neutral, and each room door is marked by an easily identifiable colour.

Conclusion.
The role of the architectural and technological research in this topic is crucial, with the support of an interdisciplinary vision. Identifying the needs of users and designing an environment that can cope with these needs is an operation that requires competence and receptiveness. Facilities and spaces where autistic people live have to be designed to be respectful and inclusive, especially given the role they play in supporting the residual abilities and adequately stimulating them. Therefore, it is essential to involve stakeholders, such as families, associations, operators, and educators, from the early planning stages of the intervention. The architectural and technological project has to respond to the requirement of flexibility, thus allowing from time to time an adequate solution to the complexity and variety of needs and expectations of people with ASD (Porro & Giofrè, 2019).
notes


(3) A functional area is an area of the building that carries out homogenous activities/service, and it is divided into different environmental units.

(4) For references on Multi-Sensory room see the article: Katy L. Unwin, Georgina Powell, Catherine R.G. Jones (2021). The use of Multi-Sensory Environments with autistic children: Exploring the effect of having control of sensory changes. Available at: https://journals.sagepub.com/doi/pdf/10.1177/13623613211050176


(7) Law 22/06/2016 n. 112 “Disposizioni in materia di assistenza in favore delle persone con disabilità grave prive del sostegno familiare”. (GU n. 146, 24-06-2016).

(8) For more details about Luna Blu see the video https://www.youtube.com/watch?v=g0T9d-GSrUA and https://www.cittadellaspezia.com/2019/05/03/luna-blu-ristorante-e-camere-per-l’inclusione-atrasverso-l’autonomia-285225/

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A commission for a dwelling for a family with a child with severe autism gave us the opportunity to make an Agreement of Investigation between the University of Alicante and ASTRADE – Association for Individuals with Autism in Murcia Region.

An opportunity that turned into a creation of an architecture that went beyond building a mere house with the functional requirements to accommodate Autism Spectrum Disorder – ASD.

Co-directed with Halldóra Arnardóttir, art historian, we had the ambition to create therapeutic architecture. That is to say, the house itself would serve the child to develop and mature. To reach that goal the Pictogram House is a guide designed as to strengthen the frontal view of the objects and to be read from the left to right. Moreover, the order of the rooms is foreseeable and announces the next one at every step. Even more, each room is associated to one determined activity:

– firstly, routines provide a person with ASD a strategy to understand and foresee the order of events that surround him/her, as a consequence, agitation generally diminishes and encourages the development of skills;
– secondly, if the parents do not foresee routines, it is common that a person with ASD will develop his/her own, which might be less adoptive or acceptable;
– thirdly, if the Manual for the Pictogram House draws out a clear and straight route, depending on the circumstances – such as the characteristics of the person with Autism, the place where to build the house or the family’s economy –, the final architecture is designed with an incorporated flexibility.

The program of house needs to be very structured, in such a way that the child knows exactly that every space relates to a specific action, and the relationship with the next space/action...
that is ahead. Let’s take a closer look at the individual elements of each room:

– one enters in the hall through a front door that is clearly demarcated from the outside of the house; a traditional hanger for coats is the first thing you notice; the hanger, directly taken from the image of the pictogram, seeks attention, so to speak, and waits for coats to be hung – if the pictograms are produced from an abstraction of the reality, the architecture of the Pictogram House is produced the construction of the pictogram themselves; next to the right is a comfortable chair with slippers next to it; on the walls are photographs of the family;

– from the entrance hall there is direct access to the toilet with washbasin; the organization is a clear sequence of actions; when the door is opened, the washbasin is visible, and the order of the units is a tap, soap, and a towel; opposite the washbasin is the toilet, so one sees it in a frontal way before leaving the toilet;

– laundry facilities are also connected to the entrance; this arrangement is intended for the child to enter the apartment clean after playing outside with water and soil;

– storage room for food takes over, everything sorted by size, weight or even different meals; accessibility is limited here, but in collaboration with parents;

– then one enters the kitchen; a big working bench with rounded corners is in the middle, explicitly so that the family can all take part in the cooking as a social interaction; from here you can walk directly to the orchard; different vegetables are grown there to be used in cooking; when the child goes to the garden, he immediately monitors the passage of time since the plants are seasonal;

– to facilitate the connection between cooking and eating for the child, the dining table is placed directly following the workbench; but at the edge of the desk are cutlery and plates for the family so the child can lay the table; the goal for the family is to enjoy eating together and having conversations, undisturbed;

– the living room follows the dining room, where the child’s diary is kept with the day’s organization, as well as the folder that contains available picture cards of things and actions if the child needs further help to express himself; the living room is another family gathering place to watch TV, talk and enjoy the view from the outside garden;

– it is desirable that the child has special facilities to play and do his homework; it happens in a separated room from other areas, according to the TEACCH teaching method, which assumes a very organized environment where there are very defined the individual work and group work zones; also, there are places to play, physical movement in front of a mirror, for thinking and coordinating emotions;

– the bathroom for the child is spacious and organized so it is easy to access even for a wheelchair; the order of the toilet equipment is the same as in the toilet by the hall;

– next to the bathroom is the child’s bedroom and it is only for sleeping and resting; there are two windows in that room, one facing East and the other West, so that the child can follow the sun’s cycle; the wardrobe is large because the clothes are hung up with a frontal vision of them, like in a window-shop of a store; this arrangement offers the parents the possibility to negotiate with the child during weekends the clothes of the seven days of the week, avoiding everyday conflicts;

– although all the rooms of the house are on the ground floor, the parents’ sleeping area is located on the first floor; it is a unit consisting of a bedroom with a dressing room and a small lounge with views to the horizon.

One can see the direct application of the Manual for the Pictogram House in the layout of the house finally built: "La Casa LM+L". The drawings of each room coincide, including their furniture and the rest of the elements, as well as the order in the layout of the house. Although the parents were against having their bedroom on the first floor, since they wanted
to be by the child, finally they were easily convinced “by medical prescription”. It was in fact thanks to José Manuel Herrero Navarro, Psychologist and Pedagogue, and today’s Director of ‘Equipo Específico de Autismo’ – Murcia Region – who explained to us that a great number of parents with an ASD child get divorced. They are so concentrated in the care of the child that they forget to take care of themselves. That was the reason for incorporating a suit in the project, a space for the parents to be used at the end of the day, once the child is asleep. Then they have time and space for themselves. Upstairs, with long views over the Murcia orchards, they will find their necessary privacy.

Once we defined each room and its specific activity, a work that was done in collaboration with different international experts, we had clear that the house would be a very well-organized succession of spaces/activities where the child would feel an order. It would be a house like a long train, where every wagon is a different room, a linear house that could measure up to 50 mts long.

At this moment we recalled the first time going to Ikea. Personally, I remember trying to visit the shop when it opened in Murcia. It was impossible, since it seems that everybody wanted to see it, to experience what it was considered the arrival of modernity. It was not until a month later when I managed to visit the shop. It was amazing how well structured its spaces were:
- Living rooms / Living room storage / Workspaces / Kitchens / Dining / Bedrooms / Bedroom storage / Children / Tableware / Cookshop / Bed textiles / Bathroom / Textiles / Rags / Home organization / Lighting / Wall decoration & mirrors / Home decoration.

After doing the long route I didn’t return to Ikea until I needed to buy something for the bathroom. This second time I went there, the highly organized space I had enjoyed so much became an infinite nightmare and impossible to escape from. But, during the worst moment of the experience, automatically I discovered shortcuts, which allowed me to jump into another room avoiding the long path.

In 2011 we organized the Master trip to London, where we had multiple meetings interviewing experts on urban sustainability. From that experience we started collaborating with Space Syntax, directed by Alan Penn, professor of Urban Planning at the Bartlett School of Architecture – UCL. Their research was enlightening the way to realize the importance of intelligibility of space, as the correlation between local and global notion of the house.

Space Syntax forecasts the impacts of planning, transport, economic and design decisions on people and property for all scales of development. This is a process based on geometry, the number of connexions of the axial network and evidence based on human behaviour for cities, urban places and buildings. Between two points, A and B, humans tend to move not in the shorter way but along that street that offers more possibilities of changing our mind. Therefore, it is possible to relate different colours to the streets of a city to different amount of connections, being red for the more connected and blue for the dead end.

Penn’s analysis of IKEA shows how there exists a provoked unintelligibility of the space to remove the autonomy of the client. First, they measured the real movements of clients and afterwards they produced a Space Syntax graph. Both drawings look different. That relates to the perception we have of the space: we can feel lost although we cannot get lost. And that is crucial for losing our autonomy and makes us consume more.

This collaboration was fundamental for us when proposing a plan for the house that establishes correlation between its parts and the notion of the home. It was important for the house to promote the autonomy of the child, having him always sure where he was and to be able to predict the next space. As it happens in the shopping malls, there is a strong association between location and action, but we include the notion to knowing where on is, anticipating the next action/space: all the spaces turn around the courtyard, which acts as the hub that organizes
the home, as well as being the space where the child can develop those activities that are not allowed in a “conventional house”: playing with water, swimming in the mud, throwing gravel to the air, or even rubbing his genitals with the soft ground… actions of freedom for our child that relates to his body.

Casa LM+L learns from the Ikea’s short cuts, allowing the child to reach his bedroom from different ways. The designed routes are available to the decision of the parents, in that way the house will encourage the child to be flexible, a necessary quality to get integrated in society. Today, for example, the child does not stand any variation on the way from his home to his school, something that provokes tense moments when they need to deviate the route due to urban works.

Within the structure of the house, therefore, scenes are created to reinforce the social habits and even the ability to choose the ways to go from one place to another in the least amount of time. The use of shortcuts between rooms are thus to be acknowledged, although negotiated, by the family by doing activities in a slightly differently way, playing games or the food that is being prepared etc. With these gestures, the house makes an attempt to increase the capacity of the person with ASD to handle his/her needs in an autonomous way.

Once we had the basic project of the house developed, it was a magic the moment we showed it to our experts: still one remembers, for example, when the Psychologist Jose Manuel Herrero told us that the final result of the research was a better house that his own. He would feel more secured there and at the same time more stimulated. It was the moment when architecture learned from a neurological disorder, ASD in this case, understanding it as a different reality, just different to ours, knowing that we can learn so much from it. This is an architecture that embraces intelligibility, time, collaboration, integration, prediction and autonomy.

The experts who have assessed this work are:
– Salvador Martínez Saura, Co-Director ASTRADE;
– José Manuel Herrero Navarro, Psychologist y Pedagogue, Director ‘Equipo Específico de Autismo’, Región de Murcia;
– Carlos Casas Fernández, Paediatric Neurologist;
– Michelle López, Director Program of Accessibility, Children’s Museum of the Arts, New York;
– Barry M. Prizant, Director, Childhood Communication Services, Brown University, Rhode Island;
– Carrie McGee, Assistant Director Community and Access Programs, Museum of Modern Art, New York;
– Lourdes Viñuelas, Speech therapist - Teacher;
– Sigrún Birgisdóttir, Managing director of the ASD Association, Iceland.

They have all shown an interest in following the research closely, results and evaluations that will be obtained from individuals with ASD, their families and social impact:
– teach skills in its natural context; community skills, skills to know their emotional state and communicate it, skills to prepare food in the kitchen, to understand the passing of time and the ability to select the clothes when dressing;
– measuring tool for the evolution of ASD.

The recently built house, Casa LM+L, just won the Award for Accessibility in Architecture of Murcia Region. It is a very significant prize since up to now the notion of accessibility just dealt with percentages of rams, width of doors and corridors, or radius for a wheelchair to turn around. It is a big jump of attitude, from physical measurements into psychological ones, that reinforces our conviction: undoubtedly architecture can become part of the therapy for autism.
references


(image 1) Casa LM+L, entrance view to the garden.

(image 2) Casa LM+L, entering the house.

(image 3) Casa LM+L, preparing lunch.

(image 4) Casa LM+L, courtyard and child's bedroom.
Different studies report that many autistic adults live either with their families or in some form of supervised residential setting (Billstedt et al., 2011) (Howlin et al., 2014) (Steele & Ahrentzen, 2015). Compared to persons with other types of impairment, autistic adults are more likely to live with their parents and less likely to live independently after leaving high school (Anderson et al., 2014). The observation that most autistic adults, regardless of their IQ level, are behind their peers regarding independent living raises questions about what living independently means to them and the role of their housing environment therein. Focusing on the latter, this paper aims to provide insights into the role of the built environment in the independent living of autistic people. This paper summarizes insights gained in the context of a PhD research project about ‘Home Tailoring: The Built Environment in Experiences of Independent Living on the Spectrum’ (Nguyen, 2022).

Compared to prevailing research on design for autistic people (e.g., Ahrentzen & Steele, 2009) (e.g., Mostafa, 2010) (e.g., Steele & Ahrentzen, 2015), this research takes a different approach. First, while other scholars consider the built environment as the phenomenon of their study and search for its impact on autistic people (e.g., Mostafa, 2010), our approach focuses on autistic people and brings their lived experiences to the fore. Second, whereas other scholars attempt to reinforce positive effects on autistic behavior in the built environment (Khare, 2010) (Mostafa, 2008, 2015), this research attempts to shed light on autistic people’s interaction with/ response to their living space/the built environment without any attempt to change their reaction/response. By foregrounding spatial aspects in autistic adults’ experiences of living independently, the research seeks to shed light on what aspects of the built environment potentially support or hamper them.
The phenomenon of the study is autistic adults in their living context. We conducted empirical studies about the lived experience of autistic adults in their living spaces and the role of the built environment therein. Efforts were put into recruiting participants who live in different residential settings – group homes, an inclusive housing project, and regular apartments – in different regions of Belgium. The research is built around three empirical studies. Since existing design guidelines related to autism pay much attention to sensory aspects, our first empirical study explored the relationship between sensory preferences in designing a group home for 20 people on the autism spectrum and the sensory experiences of actual end-users. The two other studies focused on the lived experience of four autistic men, Steve and Leo live in an inclusive housing project but in two different settings. (1) (2) Thomas lives in a group home of 22 people with diverse needs, and Mathieu rented regular apartments. Empirical data was collected through a triangulation method: in-depth – walk-along – interviews, visual methods – participant-made drawings, photos –, and participant observation. Besides the first-person perspectives, we included insights from parents, support staff, architects, and housing developers/coordinators. To guard the quality of the analysis, we discussed preliminary findings with two expert panels composed of autistic adults, family members, parents, architects, housing developers, support staff, and academics/researchers. The panel discussions confirmed and reinforced the preliminary findings and allowed refining them.

The findings suggest two things. First, the role of the built environment plays at different scales in autistic residents’ lives: from location to spatial organization and interior finishing and detailing. Second, the built environment’s design can facilitate or hamper independent living in various ways, not only through sensory qualities but also through what it affords and what it means. In what follows we explain these findings in more detail.

In terms of location, it is essential that autistic residents live in proximity to public facilities, different types of stores, services, and social contacts for different reasons. For example, Leo drew that he lived nearby different types of stores, public facilities. Mathieu chose his first-ever apartment because of its location. It was on an animated street, next to an entrance of a university and a bar. He hoped that he could have more social contacts living there. Steve lived next to a supermarket, and as he explained, “doing a small amount of shopping is easier than buying many things at the same time.” Also, he needs to live near public transport. He said, “I think living in the city where you’re close to everything. I don’t have a car. I have to do everything with public transport. It’s more living alone nearby my parents”.

The findings show that the spatial organization of the building can afford – or not – social interaction for residents living independently. Living in the same inclusive residential project but in different buildings, Steve and Leo had different experiences related to social interaction. Steve appreciated the “good neighbors”, and he met them regularly in the building. He said: “a good neighbor also motivates each other. It’s not about therapy; it’s about the first step to help me to feel better. It’s motivating”. Leo’s experience was different from Steve’s. Leo felt somewhat isolated, he did not see many people, and he communicated with the “good neighbors” by sending messages. He said, “we’re actually pretty isolated from each other […] I don’t see much people”. We found that types of housing, the apartment’s position within the building, its relation to the apartment of the good neighbors, and the number of neighbors per floor affect the social interaction experiences of the autistic residents (Nguyen et al., 2020a).

The first study investigated the relationship between architects’ design intentions and residents’ experiences regarding interior finishing and detailing. The findings give insights into residents’ experiences in visual stimuli in private units, temperature, noise, and the size of the shared rooms, which were different from architects’ design intentions (Nguyen et al., 2020).
They tried to minimize visual stimuli in multiple ways regarding visual design. For example, the architects introduced a curved corridor to avoid hard edges and minimize unexpected confrontations between residents. They minimized window details by installing a window fitting to be flush with the wall and used floor heating to avoid seeing radiators in the room. However, in residents’ experiences, many little things and objects were observed inside the private units. Finding suggests that minimizing visual stimuli could benefit public and shared spaces, yet was not always required in private rooms because it depends on individual needs.

The architects paid particular attention to sensory issues concerning the room temperature. Using floor heating was for multiple reasons: to reduce visual stimuli, avoid potential noise from water running in the radiators, and for safety reasons. However, it was difficult for residents as they could not control the room temperature. Support staff said: “it’s hard to explain to the technician to arrange the temperature, because they say ‘No, it’s 21 degrees, it’s fine like that’. But no, we have cold, and we have to use trousers. Because the feeling is not like that.”

The finding showed that the architects made all-out efforts for acoustic design. Some examples were: situating the building centrally on the site to create a buffer area which reduces noise from the surroundings; ventilation shafts running separately to a basement to avoid sound traveling between residential units, double walls between residential units, sand-lime bricks absorbing sounds, and using underfloor heating avoided sounds from running water inside radiators. Nevertheless, the biggest concern from the users’ perspective was noise inside the building. Because of the robust material, the noise occurred as echo sounds along the corridor in the middle of the building. A small detail like a lock created a loud sound each time a door was locked or unlocked, and residents tended to check the lock multiple times. A resident said, “they are very nervous, very angry, noise cannot escape.” In terms of sensory quality, despite all-out effort from architects, something as small as a lock could become a big issue in terms of acoustic comfort.

In addition to sensory qualities, findings suggest that the built environment’s design can hamper independent living through what it affords. For example, Mathieu’s first-ever apartment hindered him from using it. He claimed that the interior detailing of his apartment was displeasing and hampered him. Examples include a border of a narrow sink, a shower cabin that was difficult to clean, the limited depth of a desk, and a window without views outside. He asked for references on his social media site, “my apartment continues to displease me; what to do when you realize that you don’t like to live independently?”. Then after eight months, Mathieu moved to a studio. The new studio affords him to use it. He showed that the interior detailing was more convenient for him to live independently. Examples are the border of the sink is larger, the shower cabin is easier to clean, a desk with a good depth, and a window with views of outside.

In addition to sensory qualities and affordances, findings suggest that the built environment’s design can facilitate independent living through what it means. For example, it was important for Steve to choose furniture and decorate the apartment in his way. Steve painted each room in different colors. He said: “it’s my personal style, a mixture of shiny colors […] Some people say it’s ugly. But I like the flashy […] It’s funny, it’s optimistic of flashy color. The vision of my flashy – laughing – like me”. Leo loves Marvel. He said, “It’s like the power of me […] I started to live here and designed all the stuff”. He chose a one-bedroom apartment, and he had spaces in his living room for exhibiting and expressing his passion for Cosplay and Marvel. Interestingly, Thomas expressed that he lives in two homes. He described his parents’ house as his “favorite home”, where he comes back once per two weeks. He explained that the “comfortable home” is his group home, where he has fun with friends and lives with his housemates. The findings show that the meaning of space was significant in facilitating independent living. The built environment can play a role in expressing and building up self-identity and self-esteem.
through interactions between residents and spaces. These interactions could occur at diverse levels, depending on residents’ choice and control over their places.

In conclusion, the research broadened the understanding of the role of the built environment in relation to autism. We learned that this role plays at different scales in autistic people’s independent living: from location, over the spatial organization, to interior detailing. The built environment’s design can thus facilitate or hamper independent living in various ways, not only through sensory qualities but also through what it affords and what it means. As the built environment combines existing manufactured products that architects do not design and may not have control of, the research highlights the importance of taking into account neurodivergent end-users in design theories and practice not only in architecture but also in other design domains.

notes
(1) Residents’ names are pseudonymized.

(2) In an inclusive housing project, autistic residents rent their apartments through social housing agencies and receive personalized support from a coaching center. There are no shared living spaces and no professional caregivers in the building. Instead, “good neighbors” who live in the same housing project are the contact persons if residents need urgent support. The “good neighbors” are also residents who have a contract with the coaching center that supports residents, and in return pay a lower rent.

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Examples of minimizing visual stimulation in design strategy were installing a window fitting to be flush with the wall to diminish window details and using floor heating to avoid seeing radiators in the shared living room. ©The architect.

Visual stimuli were visibly essential for some residents in observed private units.
FEDERICA BETTARELLO. Research Fellow at the Department of Engineering and Architecture at the University of Trieste (Italy), she has a PhD in engineering sciences (acoustics) and her research topics are the building and architectural acoustics. She actually focusing on “Analysis of spatial acoustic requirements of environments designed for people with cognitive impairments” for the research project SENSHome, funded by the European Union.

MATTEO BIANCHIN. Associate professor at the University of Rome Tor Vergata. His research focuses mainly on the Philosophy of Mind, the Philosophy of the Social Sciences, and on Social and Political Philosophy. He is author of three books and of a number of papers published in ‘Philosophy of the Social Sciences, Design Studies, Design Issues, Philosophy and Social Criticism, Husserl Studies’ among others.

MARCO CANIATO. He works at the Faculty of Science and Technology at the Free University of Bozen, where he also teaches. He is author of more than 90 papers, most of them presented in English in Conferences, journals and books. His main research is focused on thermal and acoustic properties of construction and building materials as well as building elements. Another focus of his studies is related to the indoor comfort perception, evaluation and implementation of individuals featuring special needs.

VIVIANA D’AURIA. Associate Professor in International Urbanism at the Department of Architecture, KU Leuven. Her research focuses on the interplay between social inclusion/exclusion and spatial conditions in a variety of contexts. Exploring ‘practised’ and ‘lived-in’ architecture is an integral part of her work within a more general interest in the trans-cultural construction of cities and their contested spaces.

ANNA DORDOLIN. Architect, she is a research fellow at the Department of Engineering and Architecture of the University of Trieste, in the SENSHome project, funded by the European Union. Since 2012, she has collaborated in architectural design and interior architecture courses at the University of Trieste and also in architectural restoration courses. In her professional activity as an architect and in her research she deals with living spaces for the elderly, people with dementia, and those on the autism spectrum.

SASCHA FINK. He graduated in human movement science, sport and health at the University of Graz. Since 2020 he has been working on his PhD with a focus on mobility challenges in everyday life of vulnerable groups. He has been working in the Research Unit “Active Assisted Living” at CUAS since 2021. The overall focus of his research activities is flanked by technology – signal analysis and data science –, participatory approaches and the digitalization of Human Movement Data for rehabilitation.

FRANCESCA GIOFRÈ. PhD and Associate Professor in Architectural Technology at the Department of Architecture and Design, Faculty of Architecture, Sapienza University of Rome. Innovative design for healthy environment is one of her research areas, the research activities build on the analysis of the needs of ‘fragile’ and institutionalized persons to find suitable architectural and technological solutions. She wrote on that area several book and scientific products, as
results of researchers.

ANN HEYLIGHEN. As a Professor of Design Studies at KU Leuven, she co-chairs the Research\Design, a research team at the interface of design research and social sciences/humanities. She studies design practices in architecture and related design domains, and explores how the experience of people of various abilities, ages and perspectives may expand prevailing ways of understanding and designing space.

DANIELA KRAINER. Medical engineer and occupational therapist, she is a researcher and lecturer in the field of Active & Assisted Living (AAL) at Carinthia University of Applied Sciences since 2013. She is head of the research unit AAL and deputy head in the department “Health and Assistive Technologies” of the Institute for Applied Research on Ageing. Her main focus lies on participatory research, including concept, design and evaluation as well as management and planning of user studies.

SANDRA LISA LATTACHER. She is a researcher at the Carinthia University of Applied Sciences – Research Group AAL and Institute for Applied Research on Ageing in the department Health and Assistive Technologies. Besides the major research topics Data Science and Human Centered Design, her interests lie in the development, visualization and dissemination of research results via digital media.

PAOLA LIMONCIN. Architect, PhD in Architectural Design, she is a research fellow at the Department of Engineering and Architecture of the University of Trieste, in the SENSHome project, funded by the European Union. She collaborates in architectural design and interior architecture courses at the University of Trieste. Her research and professional activities focus on architectural and interior design where the theme of the spatial experience and perceptual aspects of people with different abilities play an important role.

PHUONG LAN NGUYEN. Architect and Lecturer in architecture at Faculty of Architecture and Planning, National University of Civil Engineering (Vietnam). She is a PhD candidate in the Research\Design group at the Department of Architecture, KU Leuven (Belgium). Her PhD is about “Home Tailoring: The built environment in experiences of independent living on the spectrum”.

JAVIER SÁNCHEZ MERINA. He is a Associate Professor of Architecture at Alicante University. His classes, writings and built works show a commitment to establish relationships between teaching, research and profession, under the ability of architecture to question the limits of other disciplines: Winner of the Region of Murcia Award for Architecture, Nomination Award Mies van der Rohe, Referent for Therapeutic Architecture of the American National Alzheimer Plan and co-author of the series of articles “STORIES OF HOUSES”.

GIUSEPPINA SCAVUZZO. Architect, PhD in Architectural Composition at the IUAV University of Venice, research fellow at the Fondation Le Corbusier in Paris, she is currently Associate Professor in Architectural and Urban Design at the Department of Engineering and Architecture, University of Trieste, where she is Director of the MSc in Architecture and Vice-coordinator of the PhD board. She is the scientific manager for the University of Trieste of the SENSHome project, funded by the European Union.

PHILIP SCHARF. Junior Researcher at the Carinthia University of Applied Sciences, he finished
his bachelor’s degree in Medical Engineering and his master’s degree in Health Care IT. From 2019 to 2021 he worked for the research group Active and Assisted Living, where he was involved in multiple national and international research projects in the area of healthy ageing and assistive technologies. In these projects, he focused on participatory research and software development.

LUKAS WOHOFSKY. Researcher at the Carinthia University of Applied Sciences in Austria. He works at the intersection of health, people and technology with a background in health and engineering. His research is based on participatory processes (Human Centered Design) and focuses on Smart Home, Smart Health and teleX solutions for all kinds of people. In addition, ethics in technology and research is part of his area of expertise. One of the research projects he is working on is SENSHome, funded by the European Union.