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Prioritising Storage Practices: A New Approach to Housing Design Thinking

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Abstract

Inhabitants of UK housing have more possessions than ever, whilst space for living in standardised houses is at a premium. The acquisition of material possessions, and how it affects both space and inhabitants' wellbeing, has not previously been considered in architectural practice or housing policy research fields. This paper addresses this gap, by exploring how practising architects design for the storage of material possessions in housing. For the first time, it places storage practices at the centre of housing design thinking, by engaging practising architects in a design intervention to explore original design solutions that support inhabitants' lives and lifestyles, and therefore their wellbeing. The study uses a new storage-focused conceptual design framework to seek design knowledge, to better understand how storage practices could be considered when designing. The findings have implications for design practice research, providing an account of how architects consider storage in housing design, drawing on novel design intervention methods.

Keywords: architectural design, design practice, housing design, material possessions, storage

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Introduction

The acquisition of material possessions, and their impact on inhabitants' well-being and the physical space of the house, especially that for storage, have been overlooked in fields of architectural practice and housing policy. In sociological, anthropological, and consumer fields, an extensive amount of research has been carried out on the acquisition of material possessions and its associated consumerism practices (Dittmar, 1991; Eastman et al., 1999; Hand et al., 2007; O'Cass & McEwen, 2004; Richins, 1994; Rojek, 2011). However, their impact on the physical space of the home has been largely overlooked. This study fills that knowledge gap, and contributes to current research into architectural practice in housing design, by exploring how practising architects design for the storage of material possessions. It focuses on the smallest range of housing units currently being built by UK developers, the standardised house types, to inform a more personalised and healthy approach to housing design that challenges current standardised housing design practices. These standardised house units tend to have rooms of the minimum possible size and are developed to be used 'universally' in the developer's schemes so that costs can be minimised. This house type is typically designed to accommodate a 'standard' range of furniture and kitchen/bathroom fittings, but not the myriad of material possessions that people need to accommodate.

Engaging with practising architects can drive innovative thinking and contribute to the architectural research practice body of knowledge, leading to the practical implementation of original design solutions (Eustance, 2018; Samuels, 2017). And whilst the focus of this study is on the UK, it is equally applicable to other countries where space is at a premium and the well-being of inhabitants is a priority.

The rising demand for housing in the UK, and its lack of affordability, have had an impact on the space provided for living (Morgan & Cruickshank, 2014; Williams, 2009). Current design practices are led by profit margins, development costs and housing demand, as well as the planning policies that govern the developments themselves (Mayor of London, 2010; West & Emmitt, 2004; Williams, 2009) and the design quality of houses, according to developers, is maintained by using house types with tested specifications where architects have a very controlled input (Jenkins & McLachlan, 2010). While architects' research advocates for flexible housing as part of the future housing provision (Designing for Well-being in Environments for Later Life [DWELL], n.d.; Schneider & Till, 2007), developers continue to build inflexible schemes where storage is hardly considered.

On the other hand, material possessions inundate the spaces within the home and affect the inhabitant's well-being, physical and mental health, security and comfort (Cwerner & Metcalfe, 2003; Roster et al., 2015; Shenk et al., 2004; Smith & Ekerdt, 2011). Hand et al. (2007) acknowledged that the sheer accumulation of material possessions could explain the current demand for more space. The inhabitants' lifestyles are supported by the material possessions accumulated during their lifetime, while the physical space of the house facilitates their life at a specific moment in time (Miles, 1998; Smith & Ekerdt, 2011). Modern houses fit smaller must-have rooms within the same footprint to support specific lifestyles (West & Emmitt, 2004) where the flexibility and functionality of the house are compromised. Storage design practices are given even lower priority, as more valued rooms, like the en-suite, take precedent, compromising space for living (Commission for Architecture and the Built Environment, 2005; 2009). Storage is considered within the context of this study to be the practice of ordering, sorting and disposing of material possessions in space and time. Storage is a fundamental but invisible dimension of the inhabitants' interpersonal relationships and lifestyles. It facilitates order, both physically and mentally, and affects well-being (Cwerner & Metcalfe, 2003; Smith & Ekerdt, 2011) and therefore the authors argue as part of this study that it needs to be at the forefront of housing design thinking.

As part of wider research concerned with how an understanding of material possessions can help inform spatial storage design, this study engages with practising architects to bring a new and much needed user-centred perspective on today's housing problem, namely the impact of inhabitants' material possessions on the physical space of the home. The study uses a new storage-focused conceptual design framework, developed by the authors from cross-field literature (Marco et al., 2020). Diagrams representing the framework were used as probes to stimulate dialogue and the design thinking of practising architects (Marco et al., 2020). By exploring new approaches to housing design thinking from a storage perspective, architects were able to propose designs that support the inhabitants' lives and lifestyles, and therefore their well-being.

Methods

This research uses a visually ethnographic six-stage design-probe method with practising architects (see Figure 1). The method combined qualitative research, in the form of in-depth semi-structured interviews supported by visual probes, with a design event involving participants. The use of probes (Gaver et al., 1999; Wallace et al., 2013) in participatory design in architecture practice

has been used before with residents (Luck, 2007), but to the authors' knowledge, not with the architects themselves. The use of visual probes creates a sensory experience (Rose, 2007; 2014) that provokes a reflective dialogue, interrogation, and examination from a very specific perspective. In this case, how an understanding of the impact of material possessions on the physical space in the home can help inform the design of storage practices. Wallace et al. (2013) articulate that the use of probes is not only a tool for design but also a tool to explore a specific aspect of design in a targeted but responsive way, which leads to deep reflection and stimuli for design, in this case with the architects themselves.

The design probes used in this study were in the form of four diagrams that articulate the characterisation and categorisation of material possessions, as well as the conceptual design framework developed by the authors from a cross-field literature (Marco et al., 2020) to be used when designing homes (see left-hand side of Figure 1). This framework identifies value, temporality, and visibility as core characteristics that drive the categorisation of material possessions into utilitarian and pleasurable possessions, or possessions that shape the inner and/or external self. While the utilitarian and pleasurable possessions are part of short-, medium-, or long-term cycles (frequency), material possessions related to internal or external identity are more sensitive to unidirectional flows of time, be they *life flows*, *emotional flows*, or *lifestyles flows*. Finally, depending on the sentimental, financial, or even aspirational value placed on the material possessions by the inhabitants, some of the possessions will be visible to themselves and others, and some will be hidden away from view. Strategies for the design of storage, at room- and house-level, are also articulated.

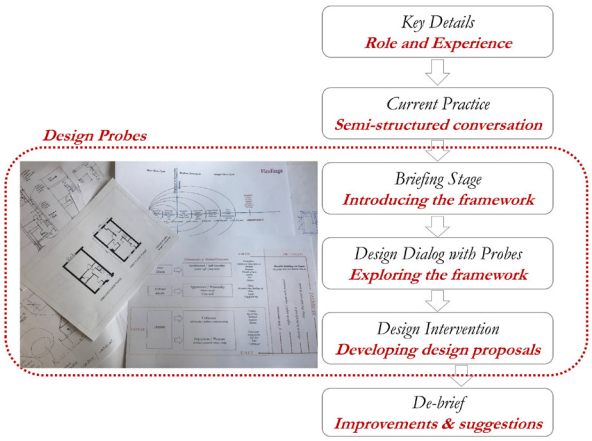

Figure 1
Ethnographic six-stage design-probe method (right) with visually constructed probes (left) (Image by authors)

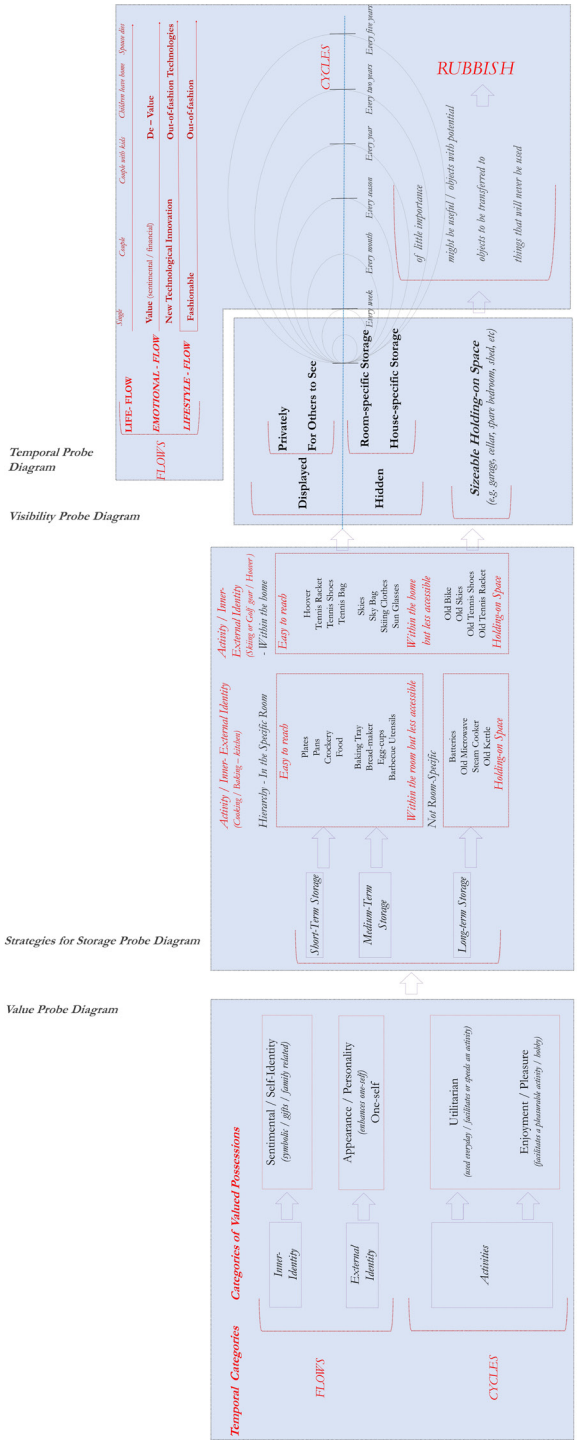

Figure 2
Overall conceptual framework diagram showing the four visual probes (Image by authors)

The framework was presented to the practising architects in the form of three separate visual probes (value diagram, temporal diagram, and visibility diagram) that also gave examples to the architects of the material possessions associated with each characteristic. A fourth diagram articulated the room- and house-level storage strategies, and linked them back to the three main characteristics. Figure 2 brings together an abstraction of the four diagrams used as visual probes, to show how the overall framework presents a new characterisation and categorisation of material possessions for design. For more detail on the framework, the reader is directed to Marco et al. (2020).

Table 1
Key details of participants including role and experience

	Size of company	No. of years working with house-builders/ developer schemes	Position held	Company location
Participant 1	11	11	Project Architect	Bristol
Participant 2	24	8	Associate Architect	Bristol
Participant 3	250	8	Senior Urban Designer	Bristol/London
Participant 4	5	5	Project Architect	Bristol
Participant 5	100	3	Project Architect	Bristol/London/ Plymouth
Participant 6	7	5	Director	Bristol
Participant 7	7	5	Director	Bristol
Participant 8	100	10	Director	Liverpool/Bristol
Participant 9	350	15	Divisional Director	Bristol/London/ Manchester
Participant 10	350	2	Associate Architect	Bristol/London/ Manchester
Participant 11	200	38	Senior Partner	London/Bath/ Manchester
Participant 12	60	5	Project Architect	Hereford
Participant 13	60	5	Project Architect	Hereford
Participant 14	50	25	Urban Design Director	Bath/Bristol
Participant 15	50	6	Associate Architect	Bath/Bristol
Participant 16	30	10	Director	Bath
Participant 17	30	5	Associate Architect	Bath

Initially, 25 professional architects were contacted to be potential participants in the study. However, they were interviewed sequentially and the decision was taken to stop the study after 17 interviews since responses had reached saturation and no further information was being collected (Creswell, 2007). In the first stage of the design probe method, the participants were asked to give *key details* to capture

information about their experience and role within the practice. The results (see Table 1) show that the participants include architects who work in small, medium, and large architectural practices, and who work with an array of major house-builders. The participants held a range of positions, from senior partner and director (41%) to project architect (41%) and associate architect (18%). The range of positions was considered important, as it ensures a diverse set of perspectives and approaches to housing design. The pool of participants was chosen solely for their experience of working with house-builders. Once the key information was gathered, the *current practice* stage asked participants five follow-up questions on how they currently approach the design of standardised house types and how, if at all, storage considerations feature in any way.

The authors then began the *briefing* stage, in which they introduced the participants to the carefully designed visual probes that summarise the storage-focused conceptual framework (Marco et al., 2020). The probes focused the architect's mind on the impact of material possessions in the physical space of the house and their associated storage practices.

The *design dialogue with probes* stage then explored the participant's initial thoughts on how the framework could facilitate architects' approach to designing for storage. This was followed by the *design intervention* stage where participants were asked to sketch a design proposal for a 3-bedroom house, chosen because it is one the most typical standardised house types currently being built in the UK (Hooper & Nicol, 2000). A layout from an anonymised typical 3-bedroom house was given for reference. This approach allowed the study to examine whether novel storage-design solutions and themes can emerge from the framework.

The final *debrief* stage asked the participants to make any further comments in relation to the study now that they had used the probes as inspiration. They were also asked to suggest any improvements to the probes, so the original framework could itself be refined as part of this research.

Each study lasted about an hour in total, with around 5 minutes for the key details, 20 minutes for current practice and briefing stages, 30 minutes for the design dialogue with probes and design intervention and 5 minutes for the debrief. Everything was audio-recorded, transcribed and then thematic coding carried out. The thematic coding also took into consideration the authors' reflective notes of all interviews, as well as the sketches of the design proposals

developed by the participants. The thematic coding firstly focused on participants' references to storage space, inhabitants and their experiences, flexibility, lifestyles, and valuable spaces. These broad categories form the basis of the analysis presented in this study.

Analysis of Current Practice

None of the participants considered storage to any great extent when designing, and the inhabitant's material possessions were hardly ever considered during the design process. In contrast, all of the participants consider the cycles of activities that take place in the home. Fifteen out of the 17 participants work with house builders that (re)use standardised house-packs, which have pre-specified layouts associated with costs, leaving little flexibility for change. All participants agreed that designing for storage would either increase the size of the house, or would reduce the number of bedrooms and bathrooms, and would therefore affect the house-pack specifications and overall cost. All participants agreed that the number of rooms is more valued than space for storage, irrespective of the size. Ten participants commented that there is a need for innovation on the current standardised house-packs, but not necessarily by making them less compact.

Analysis of Design Dialogue with Probes

Three main notions, that had a bearing on how effective the probes were for the architects, emerged from the thematic analysis of the design dialogue transcripts. Participants referred to their personal experience as inhabitants, they reflected on what had been lost in the physical space of the house, and they acknowledged the inhabitants as real people.

Personal experience

Whilst the participants received the probes well, the most powerful outcome was that the participants themselves stopped being the 'professional architect' and put themselves in the mindset of the inhabitants. Fifteen out of the 17 participants reacted personally to the framework, and one of the participants went so far as to express feelings of sadness, as the framework reminded him of our finite lives. The framework took the participants on a personal journey of reflection on the nature of their material possessions and where they are stored.

> I think, forgetting I'm a designer, this is me all over because it gets to a point where I have storage boxes which I keep under the bed and every now and then, generally, I'm putting sentimental things into them, I'll go through them and if I get

> something out and I think it maybe have been sentimental to me five years ago, but if it's not anymore, I'm ready to let go of it, so it's really interesting seeing that because I've never analysed what I do, but I do exactly that. (Participant 3)

Reflections on their own lives and lifestyles made them realise that if there is space it will be filled. Six of the participants, reflecting on their own homes, thought that house builders' approach to constrain the volume was the right one. All the participants asserted that proposing larger standardised house types was not the way forward, but house buyers need a better understanding of the space they are acquiring. Four of the participants advocated for different housing models, where there are choices that are more aligned with today's living activities, suggesting that some of the house builders 'packs' were outdated.

> I think maybe it comes to choice then. Personally, I think, usability, people would prefer an en-suite bathroom, from sheer naivety, until you move in and you realise you can't put your stuff everywhere. (Participant 5)

Reminder of what has been lost

Whilst bigger houses were not seen as the way forward, half of the participants felt that storage has been lost in today's standardised house types, especially long-term storage. Two of the participants argued that these residual, useful, but lost spaces will be very difficult to get back.

> I think people don't have, in new houses, that sort of space which is tucked out of the way that they don't often need to go into, but it's still useful to have. I'm thinking like the attic, so old houses always had a loft space, but the way they build them today with the truss rafters, it means you can't really use them and they're often specifically designed not to be used, so people don't have that kind of space for putting their kids' box of old toys or something that they don't want to get rid of. (Participant 10)

These tightly packed aspirational rooms have an effect on the flexibility of space and the loss of storage space. Even if, these rooms do not help store the inhabitant's material possessions, they are presented as desirable must-have rooms.

> They will put in a downstairs shower room, they will put in a boot room, they will put in a snug, so these are all extra

> rooms that they can put a name to that adds value, it's not that they're putting a name to extra storage, although a mud room and a utility room would be storage. (Participant 15)

Standardised house types are designed for marketability purposes, where these tightly packed extra rooms are more valued than space itself. Nevertheless, five of the participants questioned whether some of these rooms are actually necessary for today's living, or are simply aspirational.

> …is not too dissimilar from the house I lived in—it was nice as a couple because it's quite luxurious, we had three toilets and two showers, but that's a luxury. I think the space could have been better used for something else because as a couple, you don't need three toilets, there's only two of you, but going on to when these are designed and the marketability of them, that show home living, I think it's like an aspirational thing. (Participant 3)

Real inhabitants

The probes also provoked a discussion around the unknown inhabitant. While the participants might think that they know how someone is going to use the house, the reality will be something entirely different. Even if you are dealing with the 'anonymous' inhabitant, all the participants felt that providing a physical space with sufficient capacity, adaptability, and flexibility would enable the inhabitants to find ways to live in them. However, as seen in the previous section, flexibility is the major loss identified by the participants when considering standardised house types.

Five of the participants mourned the loss of widely used methods such as the Code of Sustainable Homes for assessing the sustainable design and construction of new homes, and tools like the Building for Life that assess the design quality of homes and neighbourhoods. The Code of Sustainable Homes was wound down in 2014 in response to the Housing Standards Review carried out by the UK Government and the Building for Life tool is less often used nowadays as the importance of the speed of delivery of housing has overtaken the desire to provide better places and spaces. These guidelines would have ensured that the quality of the houses was improved, embedded flexibility and better considered the inhabitant's lives.

> We miss the standards, so I miss Code for Sustainable Homes, and I miss having to do Building for Life assessments because they were rules that were just helpful. They would always try

> and get out of them, but they were really helpful in terms of raising the quality of the houses because I don't think they'll do it on their own. (Participant 15)

Five participants felt that house types should propose profiles of possible inhabitants that could live in a particular typology. Certain house builders' types would work for certain family units. For example, two of the participants felt that a three-bedroom house type would work well for a couple, but it might not work so well if it housed a five-person family unit.

> …a three-bed house—so I used to live in a three-bed house, a housebuilder house type—and it worked really well, for me and … as a couple. The people that bought it off of us had a newborn baby and a toddler. It's part of the reason we moved because I couldn't see how you would live in that space [with a child]. (Participant 3)

Analysis of Design Intervention

When presented with the challenge of using the conceptual storage design framework and the three-bedroom house reference probes in a design intervention, all participants started to resolve the entrance space for meeting and greeting people first, and then spent the majority of their time trying to resolve what they called the downstairs 'living spaces.' In addition, all of the participants considered the outside spaces at the front and back of the house, before even considering how many bedrooms. Only three participants considered options for different occupancies (2/3/4/5/6 inhabitants) or the idea of 'a day in the life of.' The rest of the participants designed the house based on the number of bedrooms, not inhabitants (or reduced the number of bedrooms in some cases). One of the participants went so far as to refuse to engage in the reconfiguration of the given typology, as the size was not acceptable for living and they do not work with house builders that build this type of house.

When the participants engaged in the creation of new design proposals that took into consideration the storage-focused design framework probes, three further themes emerged: the need for storage to be more valued, for inhabitants to distinguish between aspirational living versus practical living, and the importance of building flexibility within the space. These themes are expanded below.

Storage as a valuable space

The participants reported that storage is not valued when designing standardised house types. It is seen as the residual space that has

been left over. In contrast, this leftover space becomes a key design consideration when designing bespoke houses. Storage was seen as not adding value to how houses are marketed in the UK, and in order for it to be valued, it would need to be part of the house builders' financial model, which was seen as unrealistic. When developing their designs, participants were more interested in getting the 'critical dimensions for living,' before any consideration of storage. For example, one participant kept measuring his design proposal to ensure the double bedroom had the critical dimension of 2250 mm to ensure a double bed could be fitted tightly in the standardised space. All of them agreed that either you lose one of the bedrooms or the house size needs to increase, as space for storage could not be accommodated otherwise.

When exploring the typical three-bedroom house, 12 of the participants incorporated a *wall of storage* as a strategic design approach, so it becomes a defined and valued space. They considered the hierarchy of how to store material possessions depending on the short-, medium-, and long-term cycles, and thought about a strategy for storage at room-level and house-level. Eight of these participants even extended the wall of storage to the external spaces at the front and back of the house. The wall of storage became both a house and a room-specific type of storage (see Figure 3).

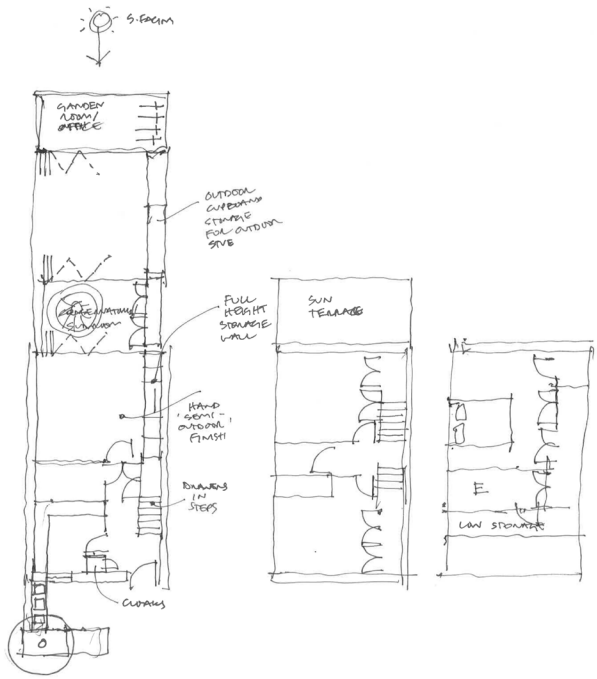

Figure 3
Wall of storage design strategy (Participant 10)

A *central house storage* space was considered alongside the wall of storage by five participants (see Figure 4). It was placed around either the staircase or the utility/bathroom areas. This option required a wider house footprint and considered double access storage.

> I'm thinking, it would be quite easy just to create a wall of storage behind the stairs, but that then starts becoming hidden storage, like on the ground floor, do you really need hidden storage on the ground floor, because the ground floor is normally your living spaces if you're thinking around the idea of displayed and hidden, and for you and for others, then your hidden needs to be mostly on the upper floors. (Participant 10)

> …but I suppose, as a design strategy, what they don't necessarily do is have storage walls—but they can be quite space hungry—but having a strategy, so that you can store things and for the storage to be concealed. (Participant 1)

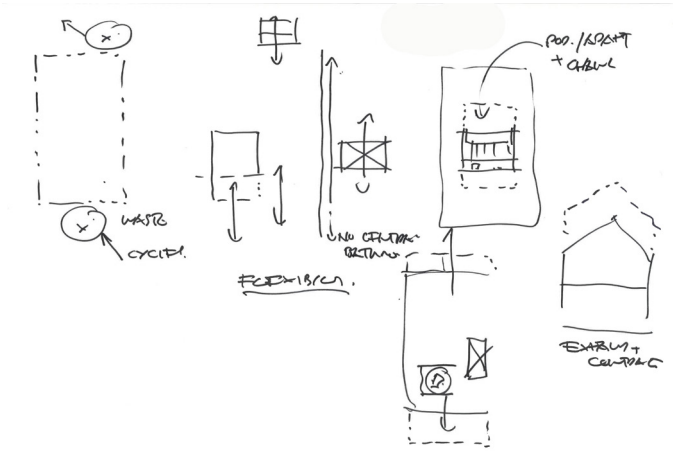

Figure 4
Central house storage design strategy (Participant 8)

Both the wall of storage and central storage design strategies became a defined space within the house, which could be specified and layered in a similar way to kitchens or bathrooms. Four of the participants explored how these walls of storage could be standardised in an IKEA way.

> I think inbuilt storage that is modular, standardised and I don't know if IKEA have the monopoly on how big a box is, but it seems ... I think it's that party wall condition because it's good for sound and … you could maybe split that into archive along the wall and then every day. (Participant 2)

Finally, five of the participants explored the *loft space* as a valuable room for long-term storage of material possessions (see Figures 5 and 6). The loft then becomes a space included as part of the house, that needs to be carefully designed, as an architect would do with a kitchen or a bathroom.

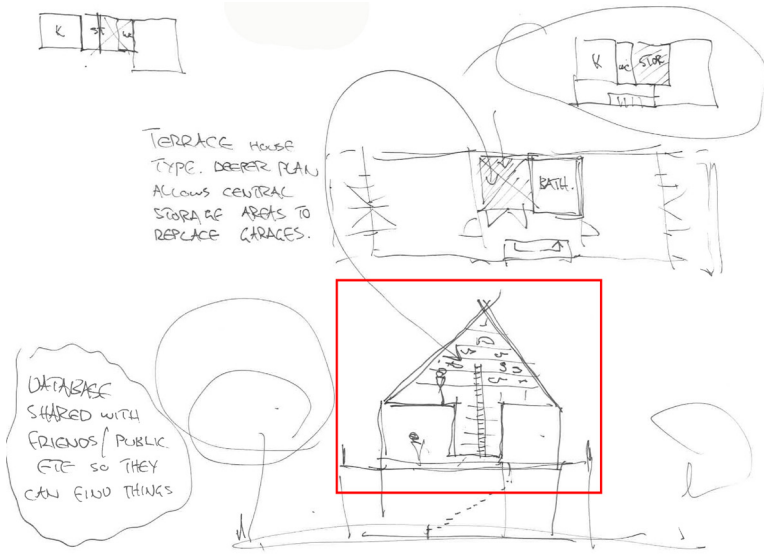

Figure 5
Loft space as a valuable space (Participant 9)

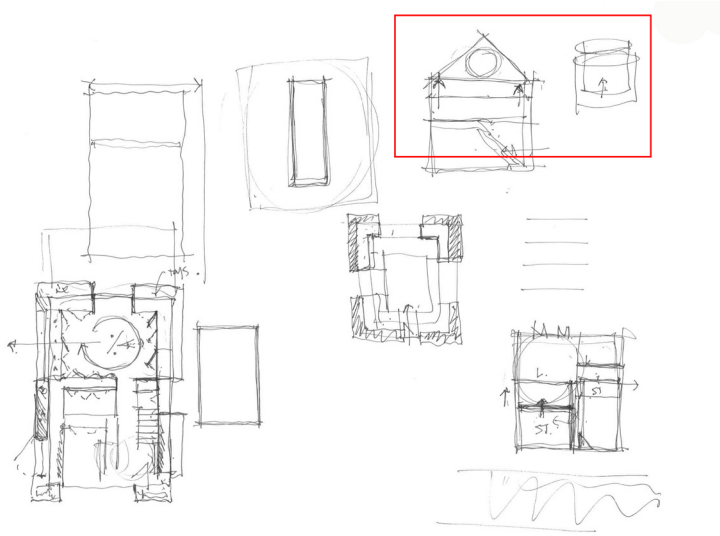

Figure 6
Loft space as a valuable space (Participant 5)

Aspirational versus practical living

House builders' houses are showcased to portray aspirational lifestyles that do not take into consideration the inhabitants' real lives and their possessions. Four of the participants advocated for 'practical' living instead of 'showroom' living. Storage needs to be considered from the perspective of efficient tendencies and design-out 'likes and wants.'

> It's not very glamorous, when you're buying a house, when the specification's listed out, it should be, I don't know how you make storage more glamorous to people to make them realise 'you' actually need this. (Participant 5)

Twelve of the participants proposed design strategies for living, where the relationships between rooms becomes very important and reflected modern (contemporary) living. Seven of the participants felt that the entrance space was key, to leave the outside life behind and to be able to meet and greet people. They paid special consideration to where to store coats, boots, etc.

> I suppose the thing that's missing on this and reflecting on this, where I've been focusing on using this house type is for something like this, it would be good to have ... like where do you dry your clothes? There's still not that practical ... there just isn't the space, whereas if you were to have that extra metre—perhaps it's more than that, actually. (Participant 3)

All participants were particularly interested in creating a *sense of space* related to their personal understanding of what today's modern living meant for them. Two participants also felt that what is understood as modern living puts pressure on space for living, especially with extra rooms being cramped, taking away any sense of space, space for living and space for storage. Three of the participants questioned the need for so many bathrooms considering the time spent in them, or the need to have the extra 'box room' to store their possessions.

> I think differently. I'm on a bit of a quest to know what are the numbers of en-suites in the modern world. Cramming in en-suites is a bit ridiculous. (Participant 10)

> What I haven't done is created storage space, I've created a sense of space more because that means that that is all one space. (Participant 11)

Flexibility

Creating a sense of space was linked with the desire to make the house flexible (see Figure 7), allowing inhabitants to explore different ways in which they could inhabit the space. It was seen as important to ensure that any design proposed could be adapted by the inhabitants. If a house can flex and adapt, it will have the necessary capacity to accommodate storage. Nine of the participants tried to reintroduce the flexibility that had been lost, back into their design proposals. Designing for 'anonymous' inhabitants (since the design is carried out without knowing who will be living in the house), would mean that they might be unable to satisfy their needs. Whereas, if flexibility was built-in, the inhabitants would find a way to make it work. So, proposing flexible and adaptable models within the same footprint that display different scenarios even with fewer rooms, was seen as important.

> So, I think my sense is that the important thing is there is space to be adaptable and flexible within the zone of the house and people will find ways to use them. (Participant 6)

> … has to be something more of a system, your house could get bigger, it could contract, depending on who takes it on board, so I think it's all about ... for me, it would link to the idea of flexible space and adaptable space within the same footprint. (Participant 8)

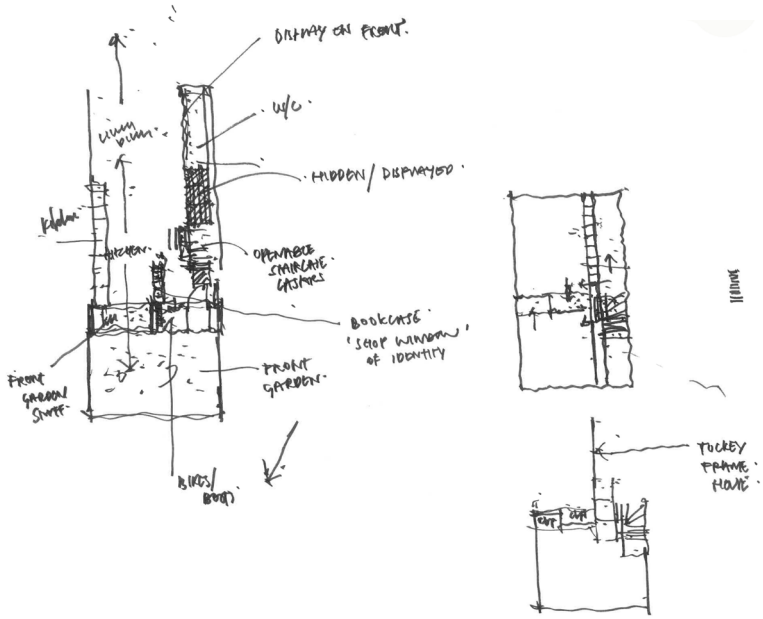

Figure 7
Designing for flexibility
(Participant 12)

Analysis of Debrief

All the participants found the conceptual storage design framework probes effective as a prompt to remind them that real people with real material possessions will be living in standardised house types. All but one of the 17 participants recognised that the framework unpicked an area of housing design that they had not considered in the level of detail that the framework presents.

> I find just the itemisation of it useful, in that it reminds you of all the different elements that there are to be considered …, it's quite a useful check list, to ensure that you are accommodating what you need to. There's things on here that are so small, you can forget about them really, but on the other hand, there are actually some of these things are quite significant and you don't want to hone spaces down so much or new homes down so much. (Participant 7)

However, Participant 6 found the detail too much. They articulated that designing the interior space of the house is less important than the space created outside the front door. This space, neither public or private, becomes more vital in shaping better places, which goes a long way towards defining the quality of people's lives and affects their well-being.

The participants were also asked to reflect on how the conceptual storage design framework probe could be improved. Participant 3 suggested that the house as a physical space is a unidirectional flow in itself, since it depends on the inhabitants and the specific moment in their lives. Therefore, they suggested that a *life-house flow* should be incorporated into the framework probe.

In addition, Participant 6 proposed the need to consider a *life-stuff flow* to reflect all the extra material possessions that the inhabitants or family unit will accumulate in their lifetime, even after completing cycles of ordering, sorting and disposing. Nowadays, architects are increasingly designing houses for an older age group, and therefore Participant 6 felt that it was important to consider those at the end of a life flow, as they have accumulated a large number of material possessions during their lives.

> They just wanted storage, they had a lifetime's worth of stuff, they'd got a house full of stuff, downsizing, getting rid of the house and trying to find space for their possessions is quite an important part of that and I think it's something that was not on offer. (Participant 6)

On reflection, the emotional flows within the proposed conceptual storage design framework probe already include the valued material possessions that have been collected during the inhabitants' lives, as they hold sentimental, emotional or financial value. However, the volume of these possessions needs to be more explicitly understood.

The participants agreed that the framework would be of use, even when designing for housebuilders. Eight participants thought that the framework would be even more useful with private clients, where houses are designed for the specific needs of the particular inhabitants. Two other participants thought the framework would be useful for participatory design, as a way to help inhabitants understand how they really live. They felt that this deeper understanding on the part of the inhabitants would lead to much more refined designs for storage.

> … because you could imagine using this system for participatory design, so if you were working with residents or co-houses or people like that, you imagine developing this as a tool to enable them to understand their waste and collections and help them to design their storage. I think it would be a really powerful tool for that, in many ways, more than it would be for developers. (Participant 8)

However, three participants identified time, resources and the nature of the client as key drivers to the design and delivery of standardised houses. Nowadays, the drive to deliver more houses and maintain profits is 'blinkering' the design quality of the houses that are currently being built. Twelve of the participants felt that innovation and change do not fit within a delivery agenda, and storage even less so, as it is not valued.

> So, you could see something like 'I wonder how much they would value this when the big boys are so blinkered and dominated by standardisation, delivery, delivery, delivery and profits?' But if we're not careful, what we're delivering won't be fit for purpose, it will always have to come from policy or a standard for it to be pushed forward. (Participant 14)

Discussion

Storage is not valued by house builders, architects, or even inhabitants when building, designing or buying a house. However, it is a vital and invisible dimension of the inhabitants' inter-personal relationships and lifestyles. It facilitates order, both physically and mentally, and affects their well-being (Cwerner & Metcalfe, 2003; Smith & Ekerdt,

2011). This study has argued that a consideration of storage and its associated practices is vital for housing design. By considering the appropriate characteristics of space and possessions, the inhabitants' lives and lifestyles will be better supported, which will have a positive effect on their well-being (Marco et al., 2020). For new models of housing to emerge, that consider inhabitants' material possessions, space for storage needs to be more valued than 'showroom living', and not seen simply as residual or leftover space. For this to happen, storage spaces need to be seen as inspirational and experiential (Rodrigues & Brandão, 2020) and, in the words of Participant 5, "made more glamourous."

In current housing design, space for storage has been eroded to accommodate the ever-increasing number of rooms. Rooms currently add value to a house, whilst space for living and storing does not. Currently, developers reduce the size of the houses, add more must-have rooms to ensure drivers like profit margins, developments costs and housing demand are addressed (Mayor of London, 2010; Williams, 2009), and dispute the need for more space and for regulated space standards (Madeddu et al., 2015). The UK has never had mandatory space standards for private housing, and since the removal of the Parker Morris standards in the 1980s, neither has it had them for public housing (Park, 2017). The National Described Space Standards introduced in 2015 (Department of Communities and Local Government, 2015) are optional, and local authorities can choose to adopt them if there is a local need and the viability of housing is not compromised. So, whilst the authors agree with most of the participants that standardised housing types need to continue to treat space as a premium to facilitate more house building, they feel strongly that this should be against a background of minimum space standards so that the houses are still fit for purpose and do not compromise the inhabitants' lifestyles or wellbeing.

When the study participants were asked to design for storage, their approach was to do so in a way that created a valued 'room' in the form of a wall of storage or a central house storage. Some participants also tried to bring back traditional residual spaces like the loft. This meant that the storage became a valued dedicated space in itself, one that could be costed-in by the developers. Whilst these must-have rooms sell well and continue to drive the developers' house portfolios, very little innovation in housing will be seen. Therefore, the authors argue that these static developers' portfolios need to be challenged, to bring about new and appropriate housing models, driven by flexibility and adaptability as well as inhabitant's profiles. This is reinforced in the literature, where it is noted that housebuilders do not often create

new designs, but make incremental modifications to their existing portfolio types, which lacks design innovation (Hopper & Nicol, 2000). The need to fundamentally challenge these developers' portfolios is also questioned by Imrie (2006), who argues for alternative developers' models for vulnerable groups such as disabled people, as the current models are 'perpetuated forms of spatial injustice.'

This challenge is unlikely to happen unless the market forces change also. Inhabitants need to understand the space they are buying and how it might work for their specific family unit's lifestyle at that specific point in their life. Furthermore, some participants desired a return to the historic mandatory design guides, which had minimum space requirements above current provision. This would provide space for greater flexibility in their designs, and would allow them to include storage provision.

The design proposals that emerged from the study reinforced previous studies, where flexibility was identified as critical (DWELL, n.d.; Schneider & Till, 2007), but brought new perspectives on the standardised house types. These design responses also built on the work of Bentley (1999) by placing the inhabitants, and their well-being at the heart of any design decision and propose a *layered approach to storage* as a crucial typological development. Participants advocated for flexibility and adaptability within the current compact sizes. They favoured largely maintaining current sizes, especially for standardised house types, as they need to be affordable. This is especially important, given that the UK is currently in the midst of a national housing crisis, in terms of the number of units available, their speed of delivery and their viability (Wilson & Barton, 2018). However, they challenged the need for so many must-have rooms that add value to the property, but not to the inhabitants if their space for living becomes compromised. Furthermore, by using the storage-focused conceptual design framework, the participants reflected on the inhabitants' material possessions related to the activities, the inner- or external-self of the eventual inhabitants, and created spaces that could be used appropriately by them. This is an approach they had never taken before and was a valuable and enlightening experience for some.

Conclusion

For the first time, this study has brought storage practices to the centre of standardised housing design, to stimulate new housing design approaches focused on storage for material possessions related to activities, inner- or external- self, either at room- or house-level. The strength of the study lies in bringing together two widely

acknowledged problems, the housing problem and the growing preoccupation with the acquisition of material possessions. The study also has brought a new unexplored dimension to design practice research and housing policy debates, that of going beyond providing space for living and taking into account the impact that material possessions have in the physical space of the home, supporting the resident's lives and lifestyles and therefore their well-being. It has engaged a small number of practising architects in an exploration of design, using a dynamic and reflective research method that challenges architects to approach a design problem from a new perspective, that of storage.

It demonstrated that practising architects found the storage-focused conceptual framework (Marco et al., 2020) an effective prompt to remind them that real people with real material possessions will be living in standardised houses. It produced new empirical knowledge of how storage can be included in housing design, avoiding cluttering spaces and therefore impacting positively on the quality of life and well-being of the inhabitants. The majority of participants who tested the effectiveness of the framework recognised that it unpicked an area of housing design that they had not considered in such a level of detail before.

The conclusions of the study challenge the current static developers' housing portfolios and identify a need for new and appropriate housing models for all. These new models can address the health implications associated with the accumulation of material possessions and insufficient space to store them, by proposing a layered approach to storage as a crucial typological development. These new models cannot ignore the viability and affordability of housing, especially when considering the smallest units, the standardised house types, but neither can they ignore the needs of those who will live there.

While the focus of the study has been on UK housing, its method could be applied more widely to any context where design practitioners are engaged in developing new and original knowledge towards the practical implementation of original design solutions. More research is required on how this storage-focused design framework and new architectural knowledge can be used to develop practical guidance for storage design that would be of use to architects, residents, housebuilders and policymakers. This is the focus of the authors' ongoing work.

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