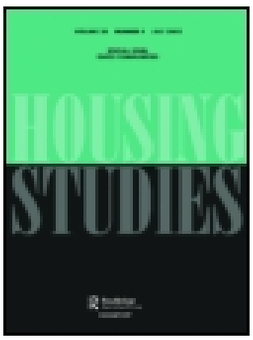

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A systems perspective for residential preferences and dwellings: housing functions and their role in Swiss residential mobility

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ABSTRACT

Worldwide, there is an urgent imperative to provide a housing supply that is environmentally sustainable as well as acceptable and desirable for its users. A holistic and integrative understanding of the relationship between households' residential preferences and dwellings is needed to achieve this goal. This paper addresses this gap by conceptualizing and operationalizing housing as a system whose human and material behaviours are determined by its *function*. Following a qualitative literature review to identify what housing functions are and investigate their effects on the housing system, we explore the applicability of such functions in Swiss tenants' residential mobility. Results show that multiple functions co-exist in the housing realm, each of which determines various human (i.e. residential preferences) and material (i.e. dwelling forms) behaviours that vary according to given societal and environmental structural elements (e.g. geography, culture). We also observe that housing functions potentially provide the missing link between the determinants of tenants' residential mobility.

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Housing system; housing function; residential preferences

Introduction

Sustainability is a core issue of current societal debates, which necessarily extend to housing studies and architecture. Although numerous countries are working to reduce energy consumption and CO_2 emissions in the residential sector, there is an urgent imperative to considerably increase 'appropriate' or 'adequate' housing supply to meet the needs of its current and future inhabitants (Acioly & Horwood, 2011; Lucon *et al.*, 2014). A built environment that is appropriate—or congruent with and supportive of the culture, values and needs of users (Franklin, 2001; Rapoport, 1977)—has long been considered a key determinant of households' quality of life (Acioly & Horwood, 2011).

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Notwithstanding their relevance, considerations of the private realm of the dwelling and its liveability have often been omitted from the sustainability debate (Franklin, 2001). This oversight is of particular importance inasmuch as what practitioners or researchers define as adequate may be not satisfactory from inhabitants' perspectives (Onibokun, 1974). Moreover, although this shortcoming was clearly identified in Europe and America in the 1960s and 1970s (e.g. Turner, 1976), the mismatch between housing stock and households' preferences has continued to increase over the last three decades (Lawrence, 2012, 2014). In most industrialized countries, this situation has been exacerbated by phenomena such as population ageing, labour market globalization and increasing mobility, which have not been translated into the provision of more diverse kinds of housing units (Lawrence, 2014).

In this context, only a minority of architects have demonstrated concerns about the growing gap between buildings and their users (Franklin, 2001). The apparent lack of interest in the ways in which people use space and the progressive 'dismissal of housing from the mainstream concern of architecture' have been compensated by contributions of disciplines not involved in the design and planning of space (Franklin, 2001, p. 86).

Interest in the relationship between people, place and space rose in the late 1960s in the US, where researchers in people–environment studies, also known as environment–behaviour studies, adopted a cross-cultural approach to explore interactions between people and their environments (Franklin, 2001, 2006; Lawrence, 2012). Such scholars acknowledged the urgency to better understand the 'sociophysical relations and processes' that structure the built environment (Studer & Vliet, 1987, p. 166).

Despite the abundant publications on the topic, the convergence of interests on and discourses about the relationships between the design, interpretation and experience of the physical forms of housing in an integrative and holistic conceptual framework has yet to be achieved (Franklin, 2006). As an appropriate research methodology for accomplishing this type of study has long been sought, a new perspective can be offered through the adoption of a *systems perspective*.

Systems science is a metascience that provides a 'somewhat unique mode of inquiry in revealing […] how all kinds of systems work' (Mobus & Kalton, 2015, p. 3). Often overlooked by housing researchers and practitioners, the application of systems science lenses can bring about a comprehensive view on how residential preferences and dwellings influence each other. In order to achieve this new understanding, systems terminology and concepts have to be introduced to housing studies, people–environment studies and architecture. More specifically, attention has to be brought to the *function* of the housing system for its role as a primary determinant of the system's behaviour (Meadows, 2008).

In this paper, we introduce an operational framework to grasp the complex interactions between residential preferences and dwellings. We adopt a systems perspective in order to focus on the role of the housing system's *function* in determining how the system behaves. To exemplify a potential application of the proposed framework, we explore the role of housing functions in influencing residential mobility in Switzerland. More specifically, this paper addresses the following research question:

> How does the concept of housing function contribute to the understanding of the relationship between residential preferences and dwellings?

To provide an answer to this question, we proceed as follows. We first introduce our theoretical framework, including our conceptualization of the housing system and the theoretical and geographical context of our exploratory study. Secondly, we describe the methods and materials used to conduct this research. Thirdly, we structure the findings in two parts. In the first part, we use our conceptualization of the housing system as a basis for the identification and classification of nine different housing functions. In the second part, we advance a set of hypotheses on the roles these functions play in households' decisions to move and select new dwellings based on an analysis of two exploratory group discussions with tenants in Lausanne and Zurich. Finally, we critically review the results and discuss their contribution to research and their implications for practice.

Theoretical framework

Housing, households and systems

The interdisciplinary field of systems research reached the built environment in the 1970s. Early conceptualisations of housing processes described them as subsystems of the larger environmental system that result from the interaction of people and products (i.e. systems elements) through the medium of roles and responsibilities (i.e. interrelationships; Turner, 1976). According to Rapoport (1990), these subsystems form the primary anchor for the household and provide primary *functions* (Coolen, 2006).

These systems-based conceptualizations have been criticized for overlooking a key structural component: the social organizations and institutions that influence the system (Franklin, 2006). Although housing was defined as a 'socio-spatial system' that merged the physical unit and the social unit, the latter was predominantly understood as being comprised only of the household (Peter Saunders *et al.*, 1988). Applying Giddens's structuration theory (1984), Binder (2007) introduced a framework for the analysis of human–environment systems that accounts for the interaction between human action, the natural and technical environments, and the social structure encompassing legislative, cultural and economic systems (i.e. 'rules' and 'resources').

Merging these findings, housing can be conceptualized as a subsystem of the coupled societal and environmental system (i.e. supersystems). The former comprises such aspects as the housing market, its culture, and construction techniques, whereas the latter includes, for instance, geographical location and local materials. At the heart of the micro-level are the material and human subsystems, which are in turn structured by elements such as dwelling features (e.g. size) and the residential biography or life course trajectory of a household (Mulder & Hooimeijer, 1999). These systems interact with each other at both the micro- and macro-levels and provide feedback across levels. For instance, a feedback relationship exists between society at large and individual needs, desires and motives (Gauvain & Altman, 1982). Households' preferences are also interlinked with the structural formal properties of housing through decision-making rules (e.g. the decision to move to a dwelling) and processes (e.g. design, construction and use of domestic spaces; Lawrence, 2012; Rapoport, 2000).

Table 1. Systems science terminology and definitions, and examples of their relevance to housing.

Terminology	Definition	Relevant to housing (examples)		SRC
System	'[…] interconnected set of elements that is coherently organized in a way that achieves something.'	Housing system		[1]
Structure	Elements and interrelationships	Macro-level (supersystem)	Societal, environmental (e.g. market, geography)	[2]
		Micro-level (subsystem)	Human, material (e.g. residential biography, dwelling size)	
		Inter-relationships	Across and within levels (e.g. society-human, human-material)	
Behaviour	Attributes that result from the structure variables	Human subsystem: residential preferences		[2]
		Material subsystem: dwelling forms		
Function, sub-functions	Teleology of the system	Supersystem: meaning		[2]
		Housing system: range of social and personal functions		
Boundary	'[…] permeable for inputs from and outputs to the environment. It defines the system's identity and autonomy.'	Encompasses dwelling, neighbourhood, relative location		[3]

Sources of definitions (SRC) 1. Meadows (2008, p. 11); 2. Gero & Kannengiesser (2004); 3. Bossel (1999, p. 20).

This 'material reality' is determined by the technologies and materials available in a given environment (Table 1, Figure 1).

To fully conceptualize the housing system, it is not sufficient to solely consider its subsystems, their elements, or interconnections; rather, its function must also be understood (Meadows, 2008). The function of an object is its teleology (i.e. *what is the object for*?): it determines how the system behaves or manifests itself (i.e. *what it does*) and the structure that allows the behaviour to happen (i.e. *what it is*; Figure 1; Gero & Kannengiesser, 2004, p. 374; Meadows, 2008).

As systems can be nested within other systems, there can be sub-functions within functions (Meadows, 2008). While 'meaning' has been identified as the most important function of the built environment (Rapoport, 1988), multiple (and sometimes conflictual) social and personal functions can be fulfilled by and give meaning to a dwelling (Lawrence, 1987b, 2012).

Despite extensive uses of the concept, a systems analysis to identify housing functions and understand how they relate to residential preferences and dwellings (i.e. systems behaviour) is absent in the literature and needs further investigation.

By enabling identification of the deep meanings that influence households' residential strategies, the field of residential mobility offers ideal ground for exemplifying the findings of such analysis (Lawrence, 2009b).

Residential mobility

Residential mobility has been studied by a broad range of scholars. Researchers have advanced varying conceptualizations of the relocation process, many of which share the assumption that the individual first decides to move and then chooses where to relocate (i.e. the two-stage choice approach; Brown & Moore, 1970; Clark & Onaka,

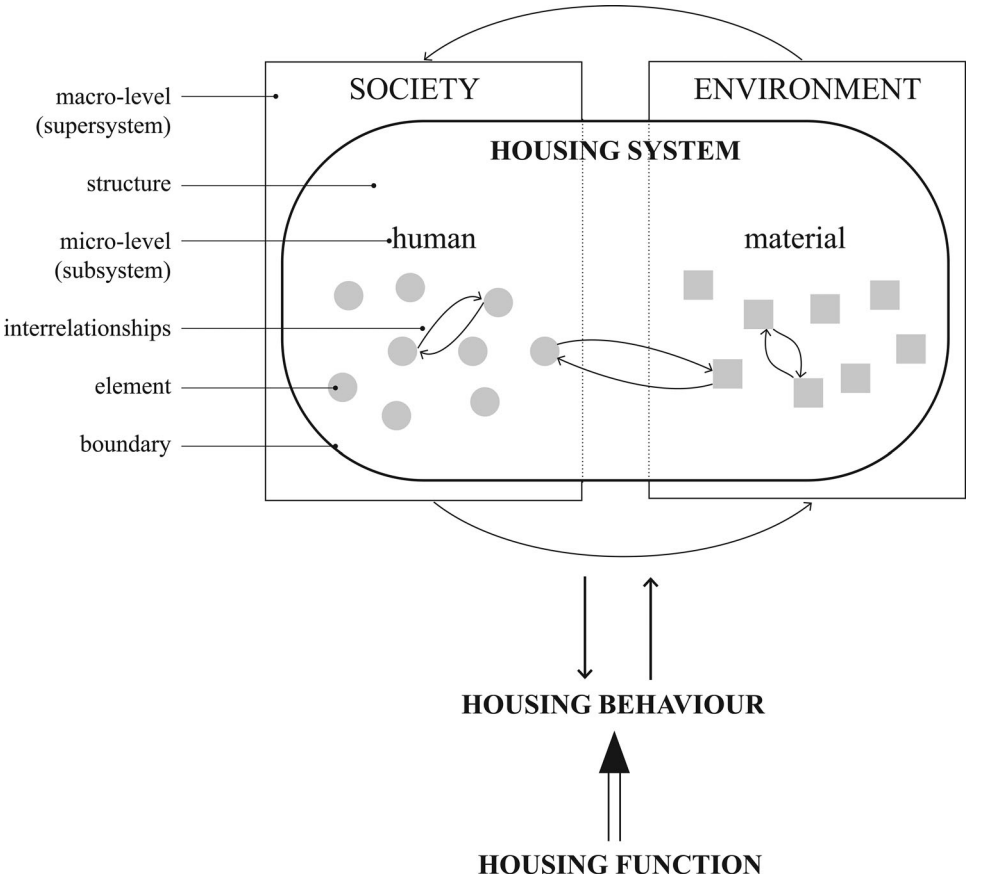

Figure 1. A framework for the housing system. The function of the system determines its behaviour, which is exhibited by and brings about the structure's configuration. This structure comprises at the macro-level the societal and environmental supersystems and at the micro-level the human and material subsystems. Super- and subsystems interact with each other between and across levels. Feedbacks between the micro- and macro-level are not represented.

1983; Mulder, 1996; Mulder & Hooimeijer, 1999; Rossi, 1980). Two terms are commonly used to define the factors that determine these decisions, namely *push* and *pull factors* (Hasu, 2018; Moon, 1995). Several studies have investigated the extent to which these factors are mediated by the concept of residential *satisfaction* (Lu, 1998). To illustrate the conceptualization of residential mobility adopted in this paper, below, we provide a concise overview of these three concepts and introduce the assumptions formulated on their relationships with housing functions.

Push factors are the determinants for a household to move. Also defined as 'triggers', they comprise a plurality of micro- and macro-level factors, which can arise from the environment as well as the educational, labour, family, or housing life-course trajectory of a given household (Brown & Moore, 1970; Clark & Onaka, 1983; Mulder, 1996; Mulder & Hooimeijer, 1999; Rossi, 1980).

Pull factors are the determinants for selecting a new dwelling. The characteristics of a dwelling, neighbourhood and relative location (i.e. the elements of the material

subsystem; Table 1) have long been prioritized as categories of pull factors. These features commonly define the building typologies used by practitioners (e.g. 'multi-family residential') or researchers (e.g. sustainability assessments; Berardi, 2012).

Residential *satisfaction* plays a role in both the decision to move and that to select a new dwelling. Findings from previous studies largely cite dissatisfaction with one's dwelling, neighbourhood or location as a motivation for moving (Brown & Moore, 1970; Clark, 2012; Clark & Lisowski, 2017; Mulder, 1996), whereas increasing household residential satisfaction has been widely proposed as the purpose of the move itself (and therefore of the selection; Lu, 1998; Mulder & Hooimeijer, 1999).

However, the relationships between *push factors, pull factors* and *satisfaction* are more complex than is often assumed (Lu, 1998). As observed by Brown & Moore (1970) and confirmed by later empirical research, push factors are not all equally influential and effective in triggering a household move and generally have 'unequal correlations' with how satisfied households are with their dwellings (Clark & Lisowski, 2017; Lu, 1998; Wong, 2002, p. 227). Furthermore, the categories into which dwelling characteristics are grouped are often found to differ from what households perceive as the determinants of their satisfaction (Wong, 2002, p. 231).

Introducing the concept of housing functions to the study of residential mobility may offer keys to disentangle the presented complexity. Previous studies have argued that during the selection process, occupants seek to make the best possible match between where they live and how they want to live (Thomas & Pattaroni, 2012). The former (i.e. 'where') is the current dwelling form, which corresponds to the behaviour of the material subsystem; the latter (i.e. 'how') are the residential preferences for the 'ideal' dwelling, corresponding to the behaviour of the human subsystem. As both are determined by the system's function (Figure 1), their match can be translated into the level of correspondence between a household's ideal housing function and that of its current dwelling. Based on this conceptualisation, a system of relationships between housing functions, push and pull factors, and residential satisfaction can be considered and explored.

Housing in Switzerland

Like most other European countries, Switzerland has experienced a significant increase in the mobility of its population in recent decades (Pattaroni *et al.*, 2009a). This shift is particularly apparent because Switzerland is a country of tenants, who have been demonstrated to be more mobile than owners (Clark, 2012; Dieleman, 2001; Rossi, 1980). In fact, Switzerland has the largest share of tenants among OECD countries (OECD, 2019). The country's housing market is dominated by rented dwellings belonging to private individuals and companies (i.e. insurance companies, pension funds, investment funds, etc; see Table 2). The large share of rental housing is remarkable considering that the Swiss rent control legislation has been limiting landlords' ability to raise rents and evict tenants at will for the last 80 years.

Over time, a decrease in the number of private landlords—who owned more than two thirds of the housing rental stock in 1990 (Lawrence, 1996)—and an increase in anonymous building owners (e.g. limited liability companies) have led to a greater prevalence of negotiations between stewards, caretakers and tenants at the expense of

Table 2. The Swiss housing market.

Occupancy status of dwellings, 2017	%
Tenant or sub-tenant	56.5
Cooperative member	2.9
Condominium/apartment owner	12.0
House owner	26
Other	2.6
Type of owners of rented dwellings, 2019	**%**
Private individuals	49.2
Public sector	3.8
Cooperative	8.4
Construction company or real estate agency	6.6
Other joint stock company/limited liability company/corporation	31.8
Other	0.1

Data source: Swiss Federal Statistical Office (FSO).

direct landlord-tenant relations (Lawrence, 1996). At the present stage, it is rare for housing stock builders to take explicit account of residents' aspirations and lifestyles (Lawrence, 2009, p. 201).

Although Swiss rules governing housing tenancy allow little-to-no residential participation in shaping their living environments (Rabinovich, 2009), there are multiple ways of being both tenant and owner. Among these is the housing cooperative system, which is dominated by 'large' or 'open' cooperatives that operate like property developers with a 'social purpose' (Rabinovich, 2009, p. 133). Cooperatives provide rents approximately 20% lower than those in the private rental market (Pattaroni & Marmy, 2016), which is of high importance considering the combination of high rents and a lower than 'natural' vacancy rate in many Swiss cities. In this regard, Lausanne (in the canton of Vaud) and Zurich (in the homonymous canton) evince the worst vacancy rates at 0.4% and 0.1%, respectively, and Zurich has the highest rental prices (Hugentobler, 2016).

In sum, large tenant proportions, increasing mobility rates, and the growing negligence of inhabitants' needs make the Swiss rental market a promising setting for an exploration of the determinants of residential mobility and the application of the operational framework proposed in this study.

Methods

Interdisciplinary literature review

Housing functions

To inform our identification of housing functions, we performed a qualitative literature review of the definitions and meanings of 'house' and 'home'.

Our analysis focused on the interdisciplinary literature of people–environment studies (including architectural psychology, environmental psychology, human ecology and environment–behaviour studies) and the disciplines contributing to this body of research, namely architecture, sociology, anthropology, psychology, environmental studies, geography, spatial planning, economics, demography, and housing, urban and cultural studies.

Table 3. Criteria for the inclusion and exclusion of publications.

Criterion for inclusion	Explanation
Disciplinary and topical focus	People–environment studies and constituent disciplines focusing on (i) housing, (ii) its system, (iii) its behaviour, and (iv) its function(s)
Definition of *function* in literature	A function of an object must provide an answer to the question 'what is the object for?' (Gero & Kannengiesser, 2004). We therefore used 'what is housing for?' as the guiding question. In parallel, we explored the behaviour of the housing system, looking for possible answers to the question 'what does housing do?'
Predominant languages	English, French
Time span	1955–2020
Geographical regions	A wide geographical area was covered. A search on the system's behaviour was conducted in relation to specific environmental and social structures.

Adapted from Fritz & Binder (2018).

To select the most useful publications to define what housing functions are, we followed a three-step procedure. The first step was a meta review aimed at exploring the heterogeneity of meanings attributed to housing and commonly-employed terminologies across disciplines. Searches were conducted in Google Scholar and Web of Science using combinations of keywords covering (i) the object under study (e.g. home, dwelling, house, residential), (ii) its system's structure and interconnections (e.g. system, culture, decision-making), (iii) its behaviour (e.g. residential preferences), and (iv) its functions (e.g. meaning, use, function; see Table 1). In the second step, we followed a snowball sampling approach (Noy, 2008), which entailed the examination of the reference lists of the first set of publications, a manual search of journals, and research of individual authors. The third step was a deep exploration of the functions identified in the two previous steps.

Table 3 illustrates the criteria applied for the inclusion and exclusion of publications. As systems science and people–environment studies gathered momentum in the 1950s and 1960s, the earliest publication dates to 1955. The distribution of the sample in time is homogeneous, with 2000 being the average publication year.

By applying the principle of saturation (Onwuegbuzie *et al.*, 2012), 39 publications were eventually selected to define housing functions: 28 journal publications, seven books and four book chapters. This variety of article types was needed to avoid overlooking the publishing traditions in each field. Diversity was also present in terms of thematic foci and geographical regions, although Europe and North America predominated among the latter. Secondary sources (i.e. literature reviews) were also selected, which enlarged the boundaries of our literature search.

The analytical procedure entailed examining and categorizing the literature by applying a synthetic approach for qualitative studies (Fritz & Binder, 2018; Noblit *et al.*, 1988). More specifically, while collecting the material, we first organized information according to author name, his/her discipline, thesis or argument, and assumption(s) (Repko & Szostak, 2016). We then extracted definitions of housing functions, which were considered in light of the question 'what is housing for?' (Gero & Kannengiesser, 2004). Lastly, we inductively derived nine definitions of housing functions following an iterative process (analysis, cluster, discussion of the findings; Fritz & Binder, 2018). The obtained definitions were organized in a table.

Housing function-behaviour-structure

Gero's (1990) function-behaviour-structure (FBS) framework was used to investigate the role of the nine housing functions in determining possible human and material behaviours of the housing system (i.e. residential preferences and dwellings) for given societal and environmental structural elements. Developed in the design field, the FBS framework describes 'different aspects of a design object' through its function, behaviour and structure (Gero & Kannengiesser, 2004, p. 374).

Qualitative exploratory group discussion

To explore the utility of the selected housing functions for the study of Swiss households' residential mobility, we organized two small group discussions with the tenants of three large housing owners: the insurance company and institutional property owner Swiss Mobiliar (Schweizer Mobiliar Asset Management AG), along with two of the country's largest housing cooperatives—ABZ (Allgemeine Baugenossenschaft Zürich) and SCHL (Société Coopérative d'Habitation Lausanne). Collectively, these owners manage approximatively 10,000 dwellings: 3,500 across the country (Mobiliar), 5,000 in the canton of Zurich (ABZ) and 2,100 in the canton of Vaud (ABZ). The two group discussions took place in Lausanne and Zurich.

Sampling and instrumentation

To organize the discussions, we first defined the sample universe, which included all tenants who were not determined to be vulnerable adults or children. Subsidized tenants were also excluded from the sample as, considering that the public rental housing represents a very small share of the Swiss housing market (see Table 2), a targeted search would have been needed to get in contact with them. Not aiming for representativeness, we adopted a convenience sampling strategy and sourced the samples accordingly (Patton, 1980; Robinson, 2014).[1] We obtained a total of ten participants in Lausanne and eight in Zurich (Table 4).

Compared to Lausanne, Zurich offered a different dataset characterized by tenants of higher age, coming predominantly from housing cooperative systems, and living in a distinct language region (French versus German-speaking part of Switzerland).

We structured the content of the discussions around the following five themes:

1. Push factors – exploration of reasons for leaving the former dwelling, including the level of satisfaction prior to the trigger (open-ended questions);
2. Housing functions – ranking of the nine housing functions; match between current and ideal function at the time of the move (yes/no); change in housing function between former and current dwelling (yes/no);
3. Dwelling characteristics – comparison between the characteristics of the household's former and current dwelling (open-ended questions);
4. Pull factors – exploration of reasons for choosing the current dwelling (open-ended questions); and
5. Lessons learnt during the discussion – change in opinion, feedback gathering.

Concerning point 2, tenants were asked to rank the housing functions from 1 (most important) to 9 (least important) depending on the extent to which their

Table 4. Characteristics of the sample.

	Lausanne		Zurich	
	SCHL	Mobiliar	ABZ	Mobiliar
Total	5	5	6	2
Males	2	3	3	1
Females	3	2	3	1
Age range[a]	25 – 65+	26 – 46	40 – 65+	34 – 65+
Tenant since (year)[a]	*missing*	2016 – 2018	*missing*	2016 – 2018
Nationality[b]		IT, CH, PL, PO, UK		CH

[a]Only data for Mobiliar tenants were accessible; the age range for the cooperatives is an approximation.
[b]Abbreviations refer to official ISO Country Codes.

current dwelling fit the description provided by the researchers. If one or more functions were equivalent, they could be accorded the same rank. If one or more did not apply to their dwelling, it/they could be discarded.

Analysis

The analysis was carried out in two steps. We explored first whether the housing functions derived from the literature were 'credible'. Based on tenants' rankings, we performed word counting and organized the functions in a table. The table columns indicated the amount of times the functions were ranked as the first, second and third most important (#1-2-3) or as the seventh, eighth, ninth, and 'not mentioned' (#7-8-9-0). We then organized the functions according to descending values of #1-2-3 and ascending values of #7-8-9-0.

Secondly, we investigated potential interrelationships between functions, push and pull factors, and residential satisfaction. The collected data were extracted, condensed and summarized. We constructed codes using English keywords from data gathered in the first group discussion, which provided the basis for qualitative tables designed for the analysis of both group discussions. The analysis and interpretation of the first discussion was then enriched with the results from the second. We used data display to draw descriptive conclusions (Miles & Huberman, 1994). More specifically, we systematically presented the data for the purpose of comparison and pattern recognition with the help of two matrices: a checklist matrix and a thematic conceptual matrix. The checklist matrix, which 'includes several components of a single, coherent variable' (Miles & Huberman, 1994, p. 105), was used to illustrate the diversity of determinants of participants' decisions to move and choose new dwellings. Based on patterns observed in the checklist matrix, we clustered the data first according to categories of tenants' residential satisfaction with the former dwelling and second according to trigger types. The resulting thematic conceptual matrix was key to drawing and displaying hypotheses on the relationship between housing functions, push and pull factors, and tenants' levels of satisfaction with the dwelling.

Findings

Housing functions in the housing system

Nine housing functions

The nine housing functions identified from the literature review integrate recurring and evolving definitions of 'what housing is for' (Gero & Kannengiesser, 2004).

As Støa & Aune (2012) elucidated, understandings of what an 'appropriate' home is have evolved throughout history. With the rise of the Modern Movement, the multi-generational sense of belonging that home conveyed in premodern agrarian society (*permanence*) was abandoned in favour of a new ideal home where the modern person 'should' live (i.e. a change in *status symbol*). From place-rooted localities to transitory stages (*impermanence*; Rérat, 2012), dwellings have become 'disposable products' or *commodities* 'that can be moved from once [they have] lost [their] attraction' (Støa & Aune, 2012, p. 115).

Based on this overview, one could argue that the definition of home is a social construction that has varied across history. However, different meanings of home can co-exist (Sixsmith, 1986). For instance, desires for place attachment and belonging (*permanence; property*), privacy, separation, and protection (*shelter; security*) can be identified over time in the empirical categories of meaning elaborated by Sixsmith (1986), in the list resulting from the literature review of Després (1991), in the examination of the 'concept of home' by Moore (2000) and among the dominant and recurring ideas about home identified by Mallett (2004). Furthermore, regardless of culture, housing remains a means of communication and identity and a marker of ways of thinking (*self-expression*). We can in fact identify Cooper's (1974) definition of housing as 'the symbol of the self' in several investigations of the 'home for its occupants' (e.g. Després, 1991; Mallett, 2004). Scholars also frequently define home as an 'arena for activities' or a place for practices, e.g. the *production and consumption* of food, kinship, language, or religion (e.g. Lawrence, 1987b; Rakoff, 1977; Sixsmith, 1986; Støa & Aune, 2012).

It can be observed that rather than justifying an evolution across history, the study of what home is has opened a door to different ways of defining it; the meaning of housing can be understood as something that adapts, that moves with its inhabitants and is constantly remade by them (Wise, 2000). Therefore, although housing's predominant function in society might have changed over time, all of the functions that we identify today are sub-functions of the housing system.

The functions derived from the literature review are displayed in Table 5. The synthetic definition assigned to each name (i.e. shelter) is of critical importance to avoid misinterpretation.

Functions, behaviours and structures

It has been shown that multiple housing functions coexist in the housing realm. According to the theoretical framework illustrated in Figure 1, each function determines a distinct system's behaviour, which is exhibited by and brings about a set of elements and interconnections (i.e. structure; Table 1).

Table 6 illustrates the system of each function through the application of Gero's FBS framework (2004). The nine housing systems are arranged according to housing functions (column 1), and examples of *possible* behaviours of the material (3) and human (4) subsystems. The second column illustrates elements of the social and environmental macro-level structures influencing such behaviours. We illustrate some key results below.

Table 5. Definitions of the nine housing functions.

Function	Definition	SRC
Shelter	A refuge, a fortress where one can return to get rest before going back out 'into the world'; the 'homely home'.	[1-4,6,8,11-16, 19,22-23]
Security, Privacy	A private place mainly for the family's needs. Recreation preferably happens outside.	[1-6,8-9,11,13-15, 17,19,20,22-23]
Permanence	A place where a person feels they belong or are rooted in.	[5-6,8,15,20-23]
Production, Consumption	A place that enables one to perform activities (like eating, laundering, companionship).	[6,10,12,16,19]
Impermanence	A place free from tradition or memory, which reflects one's life stage.	[13,15,19,22-23]
Commodity	A temporary place or a starting point. May be attractive for its price or location.	[6,12-13,22,24]
Status symbol	A credential for esteem, a place for exhibiting.	[1,3,5-7,10,13-14, 17-18,22-23]
Self-representation	A place for self-expression or satisfaction of aspirations.	[12,4-7,14-17, 19,22-23]
Property	A place that belongs to the occupant, s/he is entitled to do what s/he wants.	[3,6,9,12,20]

Selection of key sources illustrating the concept (SRC): 1. Belcher & Vazquez-Calcerrada (1972); 2. Blunt & Dowling (2006); 3. Coolen (2006); 4. Cooper (1975); 5. Cooper (1974); 6. Després (1991); 7. Gauvain & Altman (1982); 8. Gieseking et al. (2014); 9. Kleinhans & Elsinga (2010); 10. Koppe (1955); 11. Kuoppa et al. (2019); 12. Lawrence (1994); 13. Lawrence & Barbey (2014); 14. Lawrence (2012); 15. Mallett (2004); 16. Rakoff (1977); 17. Rapoport (1988); 18. Rapoport (2000); 19. Sixsmith (1986); 20. Stara et al. (2017); 21. Studer & Vliet (1987); 22. Støa & Aune (2012); 23. van Ham (2012); 24. Wong (2002).

A system only exists 'if its structure and functions are adapted to [the] environment' (Bossel, 1999, p. 24). In line with this definition, results show that dwelling forms and residential preferences vary with structural macro-level elements such as a given culture or locality (Belcher & Vazquez-Calcerrada, 1972; Coolen, 2006; Lawrence, 1987b).

For instance, the geographical location and cultural context can influence the material behaviour of a dwelling that fulfils the function of *shelter*. Whilst shelter is needed from inclement weather in certain regions of the world, '[t]here are some homes in tropical sections of the world [whose] shelter function is little more than giving shade when the sun shines in as much as they neither keep out rain nor serve as a barrier to winds' (Belcher & Vazquez-Calcerrada, 1972, p. 751). In the framework of Western domesticity, this function can manifest itself in the desire for the most 'homely home': the detached suburban house (Blunt & Dowling, 2006; Støa & Aune, 2012), which Cooper (1974, p. 133) described as 'a house form in which the self and family unit can be seen as separate, unique, private, and protected'.

Whether or not to adhere to the 'universal need' for this dwelling form also depends on the importance of housing as a symbol of the self, i.e. a place of *self-representation*. To a certain extent, the urban sprawl of many American cities is rooted in the power of the culture of the self-made man 'clearing the land and building a cabin for himself and his family' (Cooper, 1974, p. 133). This image plays a role in generating resistance to measures such as the provision of housing by the state (subsidized housing) or certain housing typologies such as high-rise apartments or mobile hippie houses-on-wheels (Cooper, 1974).

Table 6. Nine housing systems derived from the qualitative literature review.

				SRC
What is the system for?	*What affects its behaviour?*	*What does the system bring about? (material)*	*What does the system bring about? (human)*	*Who said this?*
Shelter	Location Culture	Basic house providing shelter Detached suburban house	Dream of the homely home	[1-4,9,15]
Security, Privacy	Location Culture	Undifferentiated homes Differentiation public/private Specific room functions	Desire for privacy Recreation outside of home	[1,3,9,12,15]
Permanence	Culture	Universal archetype of house Long-lasting structures	Rigid customs, codes and regulations Attachment, identity	[9,11,14-16]
Production, Consumption	Culture Technologies	Domestic equipment substituting shared facilities	New customs, codes, regulations	[1,9]
Impermanence	Culture	Multiplication of ideal solutions for different groups and life phases	Reduced significance of place-rooted localities	[9,11,13,15]
Commodity	Market Policies Values	Prioritization of convenience (price, location) over quality	Short-term social networks	[4,15,17]
Status symbol	Socioeconomic structure Values	Facilities indoor (library, exercise rooms) Modern forms, styles, materials	Indoor social life Increasing demand on comfort and on privacy Exhibiting	[1,3,6,9,12,8]
Self-representation	Culture Life phase	Customization of housing typologies, decoration Detached suburban house	Association between the 'self' and the dwelling Difficulty of accepting different housing typologies	[1,3,6,9,15]
Property	Culture Location	Differentiation in housing contracts and tenure	Empowerment Less/more entitlements and obligations	[5,7,10,15]

Descriptions are structured according to (from left to right) housing functions (1), macro-level system elements (2), and the micro-level material (3) and human (4) behaviours they affect. Feedbacks between levels are not included in the table.
Sources (SRC): 1. Belcher & Vazquez-Calcerrada (1972); 2. Blunt & Dowling (2006) 3. Cooper (1974); 4. Després (1991); 5. Forrest (1983); 6. Gauvain & Altman (1982); 7. Kleinhans & Elsinga (2010); 8. Koppe (1955); 9. Lawrence (1987b); 10. Lawrence (2001); 11. Pattaroni et al. (2009b); 12. Rapoport (2000); 13. Rérat (2012); 14. Stara et al. (2017); 15. Støa & Aune (2012); 16. Studer & Vliet (1987); 17. Wong (2002).

The desire for self-representation can engender conflicts in the definition of what the 'self' is and the multiple goals that a household can associate with the phases of their life course (Lawrence, 1987b). When these goals become the driving reason to choose a dwelling, the function *impermanence* prevails, bringing about a multiplication of 'ideal solutions' and a reduction in the significance of 'place-rooted localities' (Støa & Aune, 2012, p. 113).

As the dwelling acquires an increasing number of functions, households with 'a penchant for social climbing' add a vast number of features to their homes to reflect their *status*—libraries, exercise rooms, workshops, etc. (Belcher & Vazquez-Calcerrada, 1972, p. 752). This can result in a social life that primarily takes place

indoors, where guests take part in the residents' exhibition of their status (Koppe, 1955). What this status is and how it is reflected varies with the values and socioeconomic structure of the society.

Results from the literature also illustrate how together with macro/societal forces such as financing instruments, zoning regulations and housing policies (Després, 1991), the liberalization of housing markets and the concomitant shift in values have engendered the rise of housing as a *commodity*. In both the rental and property markets, dwellings are reduced to convenient rather than quality products (e.g. close to the current job, the cheapest possible alternative), or they may become income-generating assets (e.g. rented, sub-rented, turned into an Airbnb, used for speculative purposes; van Ham, 2012). Prioritizing housing economic and exchange value (Lawrence, 1987a), this function is shown to affect the development of social ties, which in turn impact the viability and stability of human communities (Støa & Aune, 2012).

Like the *commodity,* the *property* does not necessarily connote a private property regime; rather, this function refers to the rights conferred on both tenants and homeowners (common and private; Forrest, 1983). However, the social effects of these rights (empowerment, obligations, care or maintenance) remain under discussion (Forrest, 1983; Kleinhans & Elsinga, 2010; Støa & Aune, 2012).

Housing functions in Swiss tenants' residential mobility

Having identified nine housing functions, we display herein the results of our exploration of their utility for the study of Swiss households' residential mobility. More specifically, we outline four hypotheses and the data they were derived from. The hypotheses focus on the system of relationships between housing functions, residential satisfaction, and the determinants of the decisions to move and select a dwelling.

Hypothesis 1. The nine housing functions derived from the literature are credible.

During the group discussions in Lausanne and Zurich, tenants ranked each of the nine housing functions at least once among the three most important functions of their current dwellings. In Lausanne, top rankings were most frequently assigned to *property*, *shelter*, *security* and *self-representation*. The least important function, or the least mentioned, was housing as a *permanent* place. As illustrated in the theoretical framework, the Swiss population is increasingly mobile (Pattaroni *et al.*, 2009a). Furthermore, one-third of the workforce in Switzerland's labour market is comprised by international work migrants (Swiss Federal Statistical Office, 2018), many of whom do not plan to permanently settle in the country (Mulder, 2006).

In Zurich, *security* and *shelter* were again predominant; however, in contrast to Lausanne, *permanence* also featured among the three most important functions. It must be considered that the majority of the participants in the Zurich-based discussion were tenants of a housing cooperative (see Table 4). During the group discussion, this type of tenancy was inferred as engendering a stronger feeling of 'belonging' to a community.

In both group discussions, tenants indicated that the functions fulfilled by the chosen dwelling (i.e. 'current') corresponded to the ones desired at the time of the move (i.e. 'ideal').

Hypothesis 2. A relationship exists between tenants' level of satisfaction (LoS) with their housing consumption prior to the trigger and the trigger that prompts them to move. Triggers can be categorized into three types.

The analysis of the reasons for leaving the former dwelling shows that, when the LoS prior to the trigger was medium-to-low, tenants had predominantly moved for *opportunities*—or favourable circumstances to improve the quality of the dwelling. Examples of this trigger type are being informed of a new dwelling on the market or the opening of a noisy bar downstairs. When the LoS prior to the trigger was high, the only push factors resulting in a move were 'imposed' triggers: *radical change* and *problem-solving*. The former could correspond to a change occurring in the tenant's life course (e.g. household formation, retirement), whereas the latter could be any problem affecting the quality of life in the dwelling (e.g. expiry of the rental contract, a change in job location). Imposed triggers were found to apply to tenants with any LoS.

Hypothesis 3. Depending on the trigger, the housing function and, consequently, the elements of the housing's material structure (i.e. the dwelling's characteristics) are more—or less—prone to change. If the function remains unchanged, then the quality or type of some characteristics will be adjusted in line with the LoS and the trigger; if the function changes, the characteristics will adapt to the new function.

During the group discussions tenants did not indicate any change between the functions of the former and current dwelling, except when a radical change had triggered their move. Despite the function remaining unchanged, dwelling characteristics had sometimes been adapted: for instance, when an opportunity had engendered the means to improve the quality of a significant feature (e.g. size or a balcony) and thereby achieve a higher level of satisfaction; or following the need to solve a problematic characteristic (e.g. the distance to work).[2] On the other hand, a radical change was found to bring about a shift in function and a strong readjustment of the characteristics. Interestingly, the tenants who had moved due to this trigger type often ranked 'self-representation' as the most relevant function of their current dwellings, which reflects the tenant's desire for identification with their environment. For example, when shifting from an active life to retirement, the function desired for one's dwelling could transform from a more mundane purpose such as shelter where to find rest after work to a more symbolic or hedonic role such as a place of self-representation or a pleasant place to spend one's remaining years and free time.

Hypothesis 4. The housing function(s) of the dwelling at the time of the move determines the tenant's propensity to move.

We illustrate this hypothesis with two examples taken from the share of tenants for whom the functions fulfilled by their current dwellings corresponded to their former ones. First, the functions 'shelter' and 'security, privacy' were often mentioned among tenants having moved due to a low LoS or a problem to solve, which indicates that such households only left their former dwellings when certain conditions were not met. Second, the predominant functions mentioned by tenants having moved with a medium LoS were 'commodity' or 'impermanence', which by definition suggest a greater propensity to move following an opportunity—e.g. a better job in the case of 'commodity'.

Table 7. Thematic conceptual matrix of the past move of Swiss tenants.

Trigger type	Opportunity	Radical Change	Problem-solving
LoS prior to the trigger	Low; medium	Low; medium; high	Low; medium; high
Function change	No	Yes	No
Characteristics change	Improvement in quality of characteristics	Change in characteristics	Improvement in problematic characteristic(s)
Functions at the time of the move	Commodity; impermanence	–	Shelter; security, privacy

Data are gleaned from two group discussions with tenants in Zurich and Lausanne. LoS: Level of satisfaction, '-': data unavailable.

Concerning the share of tenants who moved due to a radical change, it must be considered that, since the functions of their former dwellings had changed compared to the current ones (see hypothesis 3), data on the latter could not be used to assess their propensity to move.

To summarize, the exploratory study in Switzerland shows that relationships between the elements that play a role in tenants' residential mobility can be identified when introducing the notion of housing function (Table 7). More specifically, preliminary results of the analysis of the past move suggest that the tenants' level of satisfaction with their dwelling and the function(s) they fulfil prior to the move can indicate their propensity to move following a trigger (i.e. push factors). This link becomes more apparent when introducing three types of triggers (i.e. opportunity, problem-solving and radical change). We also observe that, in their turn, the triggers can affect the function(s) for the new dwelling and/or its characteristics. For instance, this can happen following a change in tenants' or households' characteristics (e.g. retirement).

Discussion

This paper conceptualized and operationalized housing as a system with the goal of contributing to shaping an integrative and holistic knowledge of the interactions between residential preferences and dwellings, and thus, on a larger scale, to the critical and timely research on adequate housing.

In the following subsections, we first discuss the theoretical contribution of this paper; second, we illustrate the implications of the results for practice; and finally, we acknowledge the study's limitations and suggest potential pathways for future research.

Theoretical contribution

In this study, we adopted a systems perspective, which implied acknowledging the role of the system's *function* as key determinant of the system's behaviour. Contrary to the mechanistic approach of 'form ever follows function' debated in the architectural field since the late 19th century (Sullivan, 1896, p. 408), our research focused on the sociocultural interpretation of the notion.

With this focus, the findings of the qualitative literature review showed that the housing system can fulfil multiple housing functions (Table 5). What housing means for individuals, societies or groups and its link to the artefact has been widely

investigated, and several categorizations can be found in the literature produced in the fields of environmental psychology and people–environment studies, especially in the context of Western contemporary society (e.g. Cooper, 1975; Després, 1991; Moore, 2000; Sixsmith, 1986). However, the inductive categorization of the functions proposed in this paper differs from the approach used in similar studies inasmuch as it derives from the application of systems science lenses and thus uses explicit criteria for functions' selection—i.e. 'what is housing for?' This approach resulted in a set of functions sometimes described as separate in other studies; for instance, the meaning conferred by friends and family (e.g. 'friend and entertainment'; Sixsmith, 1986) was not defined as a function but rather as a component of other functions (e.g. security, status symbol).

Subsequently, these functions were used to understand the behaviours of the human and material subsystems, meaning households' residential preferences and dwelling forms, for given social and environmental structural elements. The way in which these two subsystems influence each other is a subject of debate among scholars, with the predominant perspective being that residential settings are contextually defined and used and no deterministic relation exist between, e.g. the geographical and physical components of spaces and their uses (Lawrence, 2014). Our conceptual framework both agrees with and challenges these findings by displaying how these 'settings' are directly and indirectly interrelated. On the one hand, we agree that the context—understood as domestic culture at the macro- and micro-level—directly influences the systems behaviour and its elements (e.g. use of space, physical housing components; Table 6). On the other hand, we observe that both human and material behaviours are orchestrated, and thus indirectly linked, by the housing functions.

The existence of such a link is also proposed in a study by Lawrence (2009), which introduces the federative concept of *attractiveness*. The notion simultaneously accounts for the characteristics of the building stock (building, dwelling, neighbourhood, etc.) and a variety of stakeholders' evaluations of the features' strengths and weaknesses. Strong attractiveness engenders a high level of satisfaction among households and thereby results in a relatively low rate of residential relocations (Lawrence, 2009). Our work conceptualized attractiveness by means of different lenses. Rather than focusing on the households' appreciation of dwelling features, we introduced an operational framework for the translation of the housing's material structure into the human structure and vice-versa, including their systems-hierarchical effects.

However, the purpose of our research did not differ from that of Lawrence's (2009) work, and a set of hypotheses was laid down to illustrate the role housing functions play in residential mobility. Although the literature is replete with studies on the determinants of households' decisions to move and select new dwellings, the introduction of the notion of housing functions suggested a possible path to overcome lingering gaps in the field. Introducing this concept enabled us to question the commonly-used categorizations of pull factors (e.g. dwelling, neighbourhood, relative location); as the system's functions determine its behaviour and thereby shape the structural elements enabling it (Figure 1), the elements of the material subsystem—i.e. dwelling features (Table 1)—and their categorization were found to vary with the overarching housing function. Furthermore, it addressed the limited knowledge on

the interactions between triggers and levels of satisfaction (see Wong, 2002) by displaying how satisfaction with *and* the functions of the current dwelling influence the propensity to move following a trigger type (Table 7).

It can be concluded that by clearly introducing the systems terminology and exploring the potential utility of the concept of housing function in residential mobility, this paper offers a new perspective on the heterogeneous and divergent research on households and dwellings conducted until now.

Practical applicability

The growing gap between housing supply and demand and the insufficient effort put by the architectural practice into filling it inevitably affect the desirability of dwellings and thus the market (Franklin, 2001; Kuoppa *et al.*, 2019; Lawrence, 2014). Further, it potentially hinders the success of strategies targeting environmentally sustainable and appropriate or adequate housing supply (i.e. if cultural or social conventions diverge from rather than align with new performant housing solutions).

It is in this context that the United Nations Human Settlements Programme (UN-HABITAT) advocates for housing policies that are 'responsive to demands and real needs' (Acioly & Horwood, 2011, p. 1). Following this recommendation is not straightforward; housing's incubation time and long-life service, as well as the multiplicity of involved actors, all contribute to hindering the maintenance of congruence between users' goal(s) and the supporting built environment (Studer & Vliet, 1987). Limited understanding of the housing system has resulted in the proliferation of short-term solutions to what are perceived as a series of 'events' (e.g. increasing vacancies, changing preferences; Meadows, 2008). Moreover, the myopic focus of practitioners, housing owners and policy-makers on the characteristics of dwellings (e.g. in the framework of zero-energy or low-emissions buildings) has resulted in their negligence of the human structure of the system and its relationships with the wider societal and environmental structures. Below, four examples illustrate how applications of the systems knowledge acquired in this research could benefit the wide spectrum of professional figures in the housing sector. Such applications go beyond the environmental and economic considerations of the housing footprint to explicitly integrate the third fundamental pillar of sustainable development—i.e. the social one (Purvis *et al.*, 2019; World Commission on Environment and Development (WCED), 1987).

1. *Transdisciplinarity.* Use the function of housing as a transdisciplinary inclusive concept to unravel the complexity of scholarly discourse and language and thereby enable engagement in the debate by all the stakeholders who participate in producing residential space (i.e. dwelling, neighbourhood and location qualities) and who are often excluded from it (Franklin, 2001).
2. *Housing typologies.* The categories of housing characteristics or 'typologies' widely adopted in the building sector and by a multitude of actors only consider the material structure of the system. In order to account for the system as a *whole*,

reorganize such categories according to the housing functions that they fulfil and the social and environmental context under study.

3. *Sustainability*. For each housing function, identify the environmental and socio-cultural sustainability issues and opportunities that it generates (see the material and human behaviours associated with each function, Table 6). Conversely, apply this knowledge to investigate how changes in the macro-level structure (e.g. technical innovations) can impact the behaviour of the housing system (e.g. impact of automated stores on households' routines).
4. *Design and architecture*. Rethink residential space to accommodate change in (i) housing functions by providing a multitude of housing functions at the dwelling, building and neighbourhood scales and (ii) context by offering the possibility for dwellers to adapt the manifestation of these functions over time (Kuoppa *et al.*, 2019). Consider that in the proposed system, the design can provide feedback to the larger society and environment, thereby generating new meanings and functions.

Limitations and future research needs

It must be acknowledged that the identification of the functions and of possible behaviours of each housing subsystem derives from the reviewed literature and therefore reflects a cultural and geographical bias as well as that of the researchers. It is also of interest to highlight the consequences of innovations in communication technologies as well as the unpredictable shifts brought about by phenomena such as pandemics or climate change, which will or may subvert our relationship with housing and thus impact the identified functions (Fritz *et al.*, 2021; Lawrence, 2014; Mallett, 2004). Therefore, rather than considering the findings as fixed, we emphasise the operational framework used to identify the system's functions and behaviours.

Regarding the framework's exemplification, the limits of the literature on residential mobility reviewed for the scope of this research should be taken into consideration. The paper provided a concise overview of studies on households' decisions to move and where to move, the complexity of which requires a more thorough illustration. Additionally, it must be acknowledged that due to the small sample size and exploratory nature, the group discussions cannot be used to draw conclusions but rather only to advance hypotheses framed by contextual boundaries. In fact, as our exploration was carried out with tenants in Switzerland, the results are limited to the Swiss rental housing market and its specificities and subject to the bias of the small sample (e.g. time of move, type of owner). We also point to the fact that the formulation of such hypotheses rested on the conceptual assumption that, in the relocation process, tenants seek for the best match between their ideal and current dwelling functions. Before proceeding with further analyses, this assumption should be carefully tested, e.g. by investigating the influence of this match on households' decisions to move and select new dwellings. Lastly, it is worth mentioning that this exploratory study was based on the past move of tenants (i.e. the so-called 'revealed preferences'; Clark & Dieleman, 1996) and did not take into account the role played by households' resources and restrictions (i.e. structural micro-level elements of the housing system) and opportunities and constraints (i.e. the macro-level ones) in the relocation

process (Mulder & Hooimeijer, 1999). For instance, the very low Swiss vacancy and new building construction rates (1.66% and less than 1%, respectively; Swiss Federal Statistical Office, 2019) can affect tenants' propensity to move following a trigger or the degree of change in the characteristics of the new dwelling.

As the group discussions are part of a wider research strategy, additional research is foreseen. First, to test our hypotheses, a targeted exploration of the literature on residential mobility will be conducted, which will account for the limits of the introduced concepts (i.e. 'push' and 'pull' factors, 'level of satisfaction'; Lawrence, 1987a). Second, to overcome the limits of a small sample size, a survey has recently been conducted with a larger sample of 1,000 tenants of the three housing owners introduced in this paper. The survey results will be key to clarifying the applicability of the operational framework to the residential mobility of tenants in Switzerland.

Additionally, we encourage scholars to apply the proposed operational framework in context-specific analyses. These could enrich the qualitative data collected in Table 6 and shed light on the diversity of each function's potential behaviours (i.e. residential preferences and dwelling forms) and their specificity to the context. Only if the collection of such behaviours reaches a significant threshold will it be possible to foresee the functions' architectural application and thereby contribute to the design of appropriate, adequate and sustainable housing (i.e. appropriate scale, affordable price, sufficient diversity of size, price and typology, suitable locations; Acioly & Horwood, 2011).

Conclusion

This paper presented an operational framework for understanding the relationship between residential preferences and dwellings. By integrating the systems terminology and concepts into the existing literature of people–environment studies, housing studies, and architecture, we introduced the notion of *function* as the key determinant of the system's behaviour. We used qualitative literature review to identify the functions of the housing system (i.e. what housing is for, e.g. shelter) and how these determine its possible human and material behaviours (i.e. residential preferences and dwellings forms) for given societal and environmental structural elements (e.g. geographical location, culture). We then conducted two small exploratory group discussions with Swiss tenants to exemplify the use of the operational framework in the context of residential mobility. The results demonstrate the potential of the housing functions concept to fill knowledge gaps concerning the determinants of households' residential relocations.

In light of the urgent imperative to provide a housing supply that is environmentally sustainable as well as culturally acceptable and desirable for its users, we propose housing functions as a transdisciplinary inclusive concept, the use of which would benefit (i) the dialogue between and inclusion of different stakeholders in the residential sector; (ii) the redefinition of holistic housing typologies; (iii) the identification of housing sustainability issues and opportunities; and (iv) the design of residential spaces capable of accommodating change at both the micro- (e.g. household's educational or occupational career) and macro-levels (e.g. innovative technologies, pandemics).

Notes

1. An agreement on the data to collect was established with the three housing owners, their technical administrations, and the Human Research Ethics Committee (HREC) of the École Polytechnique Fédérale de Lausanne (EPFL).
2. Since the selection of a dwelling often results from compromises between the desires of different household components (Rérat *et al.*, 2014), small improvements were also recorded in characteristics other than problematic ones.

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References

Acioly, C. & Horwood, C. (2011) *A practical guide for conducting: Housing profiles. Supporting evidence-based housing policy and reform. UN-Habitat* (C. Horwood & R. Rollnik, Eds) (Nairobi: UNON). Available at https://unhabitat.org/a-practical-guide-for-conducting-housing-profiles (accessed 22 July 2020).

Belcher, J. C. & Vazquez-Calcerrada, P. B. (1972) A cross-cultural approach to the social functions of housing, *Journal of Marriage and the Family*, 34, pp. 750–761.

Berardi, U. (2012) Sustainability assessment in the construction sector: Rating systems and rated buildings, *Sustainable Development*, 20, pp. 411–424.

Binder, C. R. (2007) From material flow analysis to material flow management. Part II: The role of structural agent analysis, *Journal of Cleaner Production*, 15, pp. 1605–1617.

Blunt, A. & Dowling, R. (2006) *Home* (New York: Routledge).

Bossel, H. (1999) *Indicators for Sustainable Development: Theory, Method, Applications* (Canada: International Institute for Sustainable Development (IISD)).

Brown, L. A. & Moore, E. G. (1970) The intra-urban migration process: A perspective, *Geografiska Annaler: Series B, Human Geography*, 52, pp. 1–13.

Clark, W. A. V. (2012) Residential mobility and the housing market, in: D. F. Clapham, W. A. V. Clark, & K. Gibb (Eds) *The SAGE Handbook of Housing Studies*, pp. 66–83 (London: Sage).

Clark, W. A. V. & Dieleman, F. M. (1996) *Households and housing: Choice and outcomes in the housing market* (Rutgers: Center for Urban Policy Research).

Clark, W. A. V. & Lisowski, W. (2017) Decisions to move and decisions to stay: Life course events and mobility outcomes, *Housing Studies*, 32, pp. 547–565.

Clark, W. A. V. & Onaka, J. L. (1983) Life cycle and housing adjustment as explanations of residential mobility, *Urban Studies*, 20, pp. 47–57.

Coolen, H. (2006) The meaning of dwellings: An ecological perspective, *Housing, Theory and Society*, 23, pp. 185–201.

Cooper, C. (1975) *Easter Hill Village: Some Social Implications of Design* (New York: The Free Press).

Cooper, C. (1974) The house as symbol of the self , in: J. Land (Ed) *Designing for Human Behavior*,pp. 130–146 (Stroudsburg: Dowden, Hutchinson & Ross).

Després, C. (1991) The meaning of home: Literature review and directions for future research and theoretical development, *Journal of Architectural and Planning Research*, 8, pp. 96–115.

Dieleman, F. M. (2001) Modelling residential mobility; a review of recent trends in research, *Journal of Housing and the Built Environment*, 16, pp. 249–265.

Forrest, R. (1983) The meaning of homeownership, *Environment and Planning D: Society and Space*, 1, pp. 205–216.

Franklin, B. J. (2001) Discourses of design: Perspectives on the meaning of housing quality and "good" housing design, *Housing, Theory and Society*, 18, pp. 79–92.

Franklin, B. J. (2006) *Housing Transformations: Shaping the Space of the Twenty-First Century Living*, Vol. 1 (London: Routledge).

Fritz, L. & Binder, C. R. (2018) Participation as relational space: A critical approach to analysing participation in sustainability research, *Sustainability*, 10, pp. 2853.

Fritz, L., Vilsmaier, U., Clément, G., Daffe, L., Pagani, A., Pang, M., … Binder, C. R. (2021) Explore, engage, empower: A transformative mixed methods study tackling the COVID-19 lockdown. Submitted for review.

Gauvain, M. & Altman, I. (1982) A cross-cultural analysis of homes, *Architecture & Comportement*, 2, pp. 27–46.

Gero, J. S. & Kannengiesser, U. (2004) The situated function-behaviour-structure framework, *Design Studies*, 25, pp. 373–391.

Giddens, A. (1984) *The Constitution of Society: Outline of the Theory of Structuration* (Cambridge: Polity Press).

Gieseking, J. J., Mangold, W., Katz, C., Low, S., & Saegert, S. (Eds) (2014) *The People, Place and Space Reader*, 1st ed (London: Routledge).
Hasu, E. (2018) Housing decision-making process explained by third agers, Finland: 'We didn't want this, but we chose it', *Housing Studies*, 33, pp. 837–818.
Hugentobler, M. (2016) Switzerland, in: M. Pareja-Eastaway & N. Winston (Eds) *Sustainable Communities and Urban Housing: A Comparative European Perspective*, pp. 203–224 (London: Routledge).
Kleinhans, R. & Elsinga, M. (2010) "Buy your home and feel in control" does home ownership achieve the empowerment of former tenants of social housing?, *International Journal of Housing Policy*, 10, pp. 41–61.
Koppe, W. A. (1955) The psychological meanings of housing and furnishings, *Marriage and Family Living*, 17, pp. 129–132.
Kuoppa, J., Nieminen, N., Ruoppila, S. & Laine, M. (2019) Elements of desirability: Exploring meaningful dwelling features from resident's perspective, *Housing Studies*, 35, pp. 1–23.
Lawrence, R. J. (1987a) *Housing, Dwellings and Homes: Design Theory, Research and Practice* (Chichester: John Wiley & Sons).
Lawrence, R. J. (1987b) What makes a house a home?, *Environment and Behavior*, 19, pp. 154–168.
Lawrence, R. J. (1994) Rented housing design reconsidered in context, in: B. Danermark & I. Elander (Eds) *Social Rented Housing in Europe: Policy, Tenure and Design*, pp. 139–157 (Delft: Delft University Press).
Lawrence, R. J. (1996) Switzerland, in: P. Balchin (Ed) *Housing Policy in Europe*, pp. 36–50 (London: Routledge).
Lawrence, R. J. (2001) Human Ecology, in: M. Tolba (Ed) *Our Fragile World: Challenges and Opportunities for Sustainable Development: Vol 1* (Oxford: EOLSS Publishers), pp. 675–693.
Lawrence, R. J. (2009) L'attractivité du logement: Notion fédératrice pour saisir la complexité du marché immobilier, in: L. Pattaroni, V. Kaufmann, & A. Rabinovich (Eds) *Habitat en Devenir: Enjeux Territoriaux, Politiques et Sociaux du Logement en Suisse*, pp. 225–244 (Lausanne, Switzerland: PPUR).
Lawrence, R. J. (2012) People–environment studies, in: D. F. Clapham, W. A. V Clark, & K. Gibb (Eds) *The SAGE Handbook of Housing Studies*, pp. 230–244 (London: Sage).
Lawrence, R. J. (2014) Integrating domestic culture with housing design and housing policies, in: R. J. Lawrence & G. Barbey (Eds) *Repenser l'Habitat: Donner un Sens au Logement (Rethinking Habitats: Making Sense of Housing)* (Gollion: Infolio Editions).
Lawrence, R. J. & Barbey, G. (Eds) (2014) *Repenser l'Habitat: Donner un Sens au Logement (Rethinking Habitats: Making Sense of Housing)* (Gollion: Infolio Editions).
Lu, M. (1998) Analyzing migration decisionmaking: Relationships between residential satisfaction, mobility intentions, and moving behavior, *Environment and Planning A: Economy and Space*, 30, pp. 1473–1495.
Lucon, O., Ürge-Vorsatz, D., Zain Ahmed, A., Akbari, H., Bertoldi, P., Cabeza, L. F., … Vilariño, M. V. (2014) Buildings. in: O. Edenhofer, R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, … J. C. Minx (Eds) *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, pp. 671–738 (Cambridge, UK: Cambridge University Press).
Mallett, S. (2004) Understanding home: A critical review of the literature, *The Sociological Review*, 52, pp. 62–89.
Meadows, D. H. (2008) *Thinking in Systems: A Primer* (D. Wright, Ed) (London: Chelsea Green Publishing).
Miles, M. & Huberman, M. (Eds) (1994) *Within-case displays: Exploring and describing Qualitative Data Analysis*, pp. 90–142 (London: Sage).
Mobus, G. E. & Kalton, M. C. (2015) Principles of systems science, in: G. E. Mobus & M. C. Kalton (Eds) *Principles of Systems Science*, pp. 3–41 (New York: Springer).

Moon, B. (1995) Paradigms in migration research: Exploring 'moorings' as a schema, *Progress in Human Geography*, 19, pp. 504–524.
Moore, J. (2000) Placing home in context, *Journal of Environmental Psychology*, 20, pp. 207–217.
Mulder, C. H. (1996) Housing choice: Assumptions and approaches, *Netherlands Journal of Housing and the Built Environment*, 11, pp. 209–232.
Mulder, C. H. (2006) Population and housing: A two-sided relationship, *Demographic Research*, 15, pp. 401–412.
Mulder, C. H. & Hooimeijer, P. (1999) Residential relocations in the life course, in: L. J. G. Van Wissen, P. A. Dykstra (Eds) *Population Issues: An Interdisciplinary Focus*, pp. 159–186 (Dordrecht: Springer).
Noblit, G. W., Hare, R. D. & Hare, R. W. (1988) *Meta-Ethnography: Synthesizing Qualitative Studies*, Vol 11 (Newbury Park, CA: Sage).
Noy, C. (2008) Sampling knowledge: The hermeneutics of snowball sampling in qualitative research, *International Journal of Social Research Methodology*, 11, pp. 327–344.
OECD. (2019) Housing tenures. Available at http://oe.cd/ahd (accessed 29 September 2020).
Onibokun, A. G. (1974) Evaluating consumers' satisfaction with housing: An application of a systems approach, *Journal of the American Planning Association*, 40, pp. 189–200.
Onwuegbuzie, A. J., Leech, N. L. & Collins, K. M. T. (2012) Qualitative analysis techniques for the review of the literature, *Qualitative Report*, 17, pp. 1–28.
Pattaroni, L., Kaufmann, V. & Rabinovich, A. (2009a) L'habitat en questions, in: L. Pattaroni, V. Kaufmann, & A. Rabinovich (Eds) *Habitat en Devenir: Enjeux territoriaux, politiques et sociaux du logement en Suisse*, pp. 1–22 (Lausanne, Switzerland: PPUR).
Pattaroni, L. & Marmy, V. (2016) *Les Coopératives de Logements dans le Canton de Vaud, Une étude réalisée par le Service des communes et du logement du canton de Vaud et le Laboratoire de Sociologie Urbaine de l'EPFL* (Lausanne: DIS, SCL).
Pattaroni, L., Thomas, M.-P., Kaufmann, V. & Ortelli, L. (2009b) *Habitat Urbain Durable pour les Familles* (Lausanne: Cahier du Laboratoire de Sociologie Urbaine, Lasur, EPFL Programme national de recherche PNR54).
Patton, M. Q. (1980) Designing qualitative studies, in *Qualitative Evaluation and Research Methods*, pp. 145–198 (London: Sage).
Peter Saunders, P. S., Peter, P. & Williams, W. (1988) The constitution of the home: Towards a research agenda, *Housing Studies*, 3, pp. 81–93.
Purvis, B., Mao, Y. & Robinson, D. (2019) Three pillars of sustainability: In search of conceptual origins, *Sustainability Science*, 14, pp. 681–695.
Rabinovich, A. (2009) Participation et expertise: Entre "diversité et ordre commun" dans le logement coopératif, in: L. Pattaroni, V. Kaufmann, & A. Rabinovich (Eds) *Habitat en Devenir: Enjeux territoriaux, politiques et sociaux du logement en Suisse*, pp. 139–147 (Lausanne, Switzerland: PPUR).
Rakoff, R. M. (1977) Ideology in everyday life: The meaning of the house, *Politics & Society*, 7, pp. 85–104.
Rapoport, A. (1977) *Human Aspects of Urban Form* (Oxford: Pergamon).
Rapoport, A. (1988) Levels of meaning in the built environment, in: F. Poyatos (Ed) *Cross-Cultural Perspectives in Nonverbal Communication*, pp. 317–336 (Toronto: Hogrefe).
Rapoport, A. (1990) Systems of activities and systems of settings, in: S. Kent (Ed) *Domestic Architecture and the Use of Space: An Interdisciplinary Cross-Cultural Study*, pp. 9–20 (Cambridge: Cambridge University Press).
Rapoport, A. (2000) Theory, culture and housing, *Housing, Theory and Society*, 17, pp. 145–165.
Repko, A. F. & Szostak, R. (2016) Conducting the literature search, in: *Interdisciplinary Research: Process and Theory*, 3rd ed., pp. 182–206 (Thousand Oaks, CA: Sage Publications).
Rérat, P. (2012) Gentrifiers and their choice of housing: Characteristics of the households living in new developments in Swiss cities, *Environment and Planning A: Economy and Space*, 44, pp. 221–236.

Rérat, P., Gurtner, M. & Baehler, D. (2014) Les choix résidentiels des couples: Motivations, arbitrages et logiques de genre parmi les classes moyennes supérieures urbaines, *Bulletin de La Société Géographique de Liège*, 63, pp. 51–65.
Robinson, O. C. (2014) Sampling in interview-based qualitative research: A theoretical and practical guide, *Qualitative Research in Psychology*, 11, pp. 25–41.
Rossi, P. H. (1980) *Why Families Move [1955]* (Beverly Hills: Sage Publications).
Sixsmith, J. (1986) The meaning of home: An exploratory study of environmental experience, *Journal of Environmental Psychology*, 6, pp. 281–298.
Stara, V., Felici, E., Rosa, M., Di Olivetti, P. & Rossi, L. (2017) Multifaceted factors that influence the housing decision-making process: A pilot study with older adults, *Journal of Gerontology & Geriatric Research*, 06.
Støa, E. & Aune, M. (2012) Sustainable housing cultures, in: S. J. Smith (Ed), *International Encyclopedia of Housing and Home: Vol 7*, pp. 111–116 (Oxford: Elsevier).
Studer, R. G. & Vliet, W. V. (1987) Sociophysical congruence as a problem of supply and demand, *Architecture & Comportement*, 3, pp. 159–173.
Sullivan, L. H. (1896) The tall office building artistically considered, *Lippincott's Magazine*, 57, pp. 403–409.
Swiss Federal Statistical Office. (2018) Employment Statistics (ES). Available at https://www.bfs.admin.ch/bfs/en/home/statistics/work-income.html (accessed 5 February 2019).
Swiss Federal Statistical Office. (2019). Construction and housing. Neuchâtel, Switzerland. Available at https://www.bfs.admin.ch/bfs/en/home/statistics/construction-housing.html (accessed 13 July 2020).
Thomas, M.-P. & Pattaroni, L. (2012) Choix résidentiels et différenciation des modes de vie des familles de classes moyennes en Suisse, *Espaces et Sociétés*, 148–149, pp. 111–127.
Turner, J. F. C. (1976) *Housing by People: Towards Autonomy in Building Environments* (New York: Pantheon Books).
van Ham, M. (2012) Housing behaviour, in: D. F. Clapham, W. A. V. Clark, & K. Gibb (Eds.) *The SAGE Handbook of Housing Studies*, pp. 47–65 (London: Sage).
Wise, J. M. (2000) Home: Territory and identity, *Cultural Studies*, 14, pp. 295–310.
Wong, G. K. M. (2002) A conceptual model of the household's housing decision–making process: The economic perspective, *Review of Urban and Regional Development Studies*, 14, pp. 217–234.
World Commission on Environment and Development (WCED). (1987) *Our Common Future* (Oxford: Oxford University Press).