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# The home as a system of practice and its implications for energy and water metabolism

Christine Eon <sup>\*</sup>, Jessica K. Breadsell, Gregory M. Morrison, Joshua Byrne

Curtin University Sustainability Policy Institute, Curtin University, Kent St, Bentley, Western Australia, 6021, Australia

## ABSTRACT

Policy and regulations for residential houses often consider the physical system alone and tend to focus on the energy performance of the building. This ignores the effect of occupants' everyday practices and their interaction with the building technologies. This research applies practice theory and the concept of system of practice to eight Australian homes with the objectives of providing a deeper understanding of the complexities of the home system as well as providing approaches to enable (rather than persuade) resource reduction. The homes were investigated through explanatory design mixed methods which combined results of one year of longitudinal quantitative data collection and home occupant interviews. The results revealed that practices are performed in a sequential temporal spectrum as part of a routine and are influenced by interlocked practices as well as interlocking routines from other home occupants. Practices also follow established daily patterns reflected by a frequency distribution curve where the standard deviation reflects the degree of habituality of the practice. Highly interlocked practices with a high degree of habituality are challenging to affect. However, automation could enable resource intensive activities to be dis-interlocked from an established routine and make change within the home system of practice easier and more flexible.

**Keywords:** Home system; Everyday practice; Energy; Water; Automation; Routines

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## 1. Introduction

The home can be considered a juxtaposition of the physical system including associated energy, water and resource metabolic flows (Harder et al., 2014) with the occupied social system of everyday practice (Guy and Shove, 2000) (Fig. 1). The concept of metabolism is used to describe the flow of materials and energy through an urban system, which similarly to living beings, consumes resources, transforms them internally and generates waste (Girardet, 2010).

The implementation of technologies which lead to more efficient buildings, including energy and water efficient appliances, renewable energy and sealed building envelopes, has

been a significant focus for research (Moore, 2012). In contrast, the home itself is not well understood and a theoretical and practical understanding of the complexities of occupant behavior and their interaction with the physical system of the building is an emerging area of investigation (Keyson et al., 2017). Attempts at reducing home resource use through changing attitudes and values and intelligent design features, may be confounded when users resist external control or refuse to change their behavior (Scott et al., 2012). Another approach has been to classify homes into simple typologies with targeted policy or resource criteria but these encounter similar issues of push back from the home residents (Ashton et al., 2016).

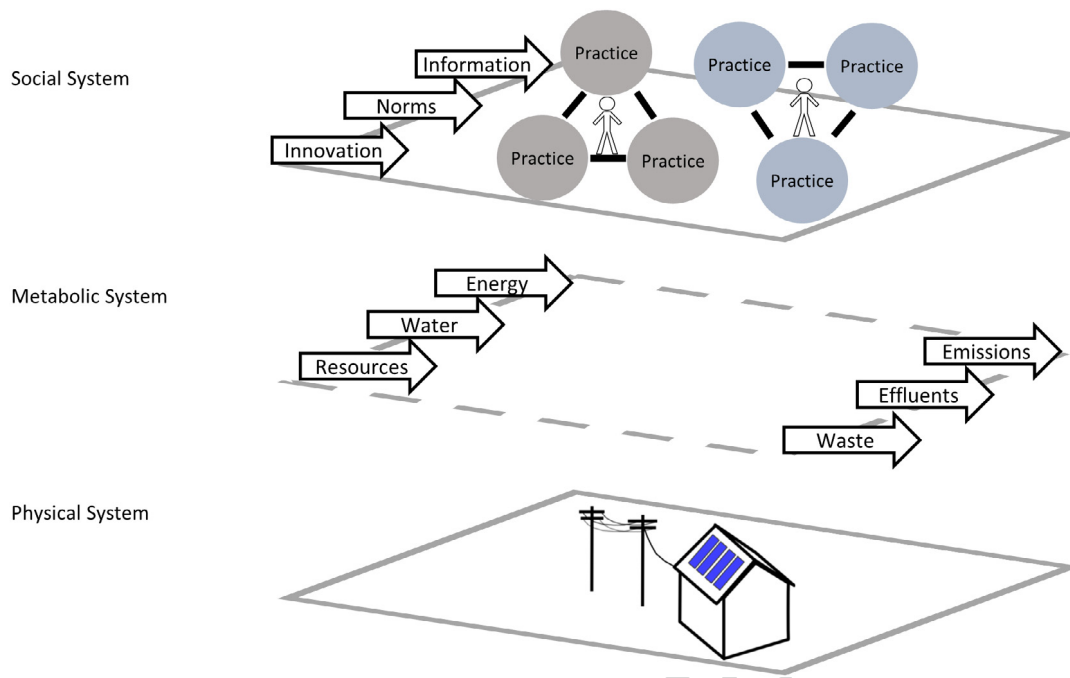
<sup>\*</sup> Corresponding author.

E-mail addresses: [christine.eon@curtin.edu.au](mailto:christine.eon@curtin.edu.au) (C. Eon), [jessica.k.breadsell@postgrad.curtin.edu.au](mailto:jessica.k.breadsell@postgrad.curtin.edu.au) (J.K. Breadsell), [greg.morrison@curtin.edu.au](mailto:greg.morrison@curtin.edu.au) (G.M. Morrison), [josh@joshbyrne.com.au](mailto:josh@joshbyrne.com.au) (J. Byrne).

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**Fig. 1 – The home system, which includes the physical building system, metabolic flows and occupant practices, which are connected in a system of practice (SOP).**

Proponents of practice theory argue that innovative user technology cannot be adopted without innovation in practice (Shove et al., 2012; Strengers and Maller, 2014). Smart meters, feedback displays and automation technologies are increasingly deployed to reduce energy and water consumption in residential homes (Faruqui et al., 2010; Fischer, 2008; Jain et al., 2012; Yew et al., 2012). However, these technologies do not necessarily fulfill their objectives if they fail to become embedded in the habits and routines that compose the practices of daily life (Brynjarsdóttir et al., 2012; Strengers, 2011). As a consequence, reducing energy, water and resource use in homes depends on the available infrastructure and technology, but also on occupant's everyday practices (Shove et al., 2007).

Practice theory (Shove et al., 2007), also termed social practice theory (Schatzki, 1996), identifies practice as the preferred unit of analysis rather than the individual (Reckwitz, 2002; Røpke, 2009, 2001; Schatzki, 2002; Schatzki et al., 2001; Shove et al., 2012, 2010, 2009, 2007; Warde, 2005). The advantage is that this approach provides a holistic view to understanding occupant behavior as it recognizes that elements of place and broader societal aspects affect the way practices are carried out in addition to individual values and attitudes (Hargreaves, 2011). Moreover, practice theory posits that individuals do not use resources for the sake of it, but rather as a means to achieve an objective. Therefore, comprehending the external context and occupant needs is crucial to understanding home resource use.

A practice is characterized as a routine behavior composed of several elements which are interconnected (Reckwitz, 2002). As practice theory is still emerging, there is a lack of a unifying model of assessment, however most models feature a number of elements (McMeekin and Southerton, 2012; Schatzki, 1996), the doings and sayings which collectively form the entity of a practice. These previous models can be collated into the three elements of practice defined here as meaning, skill and technology (Fig. 1). Meaning is the aspirations, emotions, ideas, perceptions, symbolic meanings

and values associated with the practice (Shove et al., 2012). Skill refers to the know-how, technique, and understandings for accomplishing a practice (Scott et al., 2012), although an important distinction of skill exists between implicit know-how and explicit rule-based or theoretical knowledge (Gram-Hanssen, 2010a). Technology is referred to as the devices used to perform a practice which are the infrastructure, materials and objects (Gram-Hanssen, 2010b). Practice theory should not be confused with the study of cultural practices that is currently being undertaken by cross-cultural psychologists (Kashima, 2014; Kashima et al., 2015; Kashima and Gelfand, 2012).

The implication of applying practice theory to the study of household resource use is that the sources of changed behavior lie in the development of practices (Warde, 2005). The quantitative monitoring of technologies utilized in a home reveals the performance of the products (Foulds et al., 2013), but not necessarily how the resource use fits into the broader systems of the home. Habits and routines co-evolve with practices (Shove, 2004) and the practices relating to the use of resources in the home are manifested in their daily performance (Chappells et al., 2011). Practices exist both in the historical collective reproduction of them as practice-as-entities and in their performance by individuals (Schatzki, 2002), the former being the storage of knowledge and learnings of the elements of the practice (meaning, skills and technology) within a practitioner's mind. Some household members have similar practice-as-entities in that everyone understands practices the same way and thus perform them similarly, resulting in resource use patterns, such as similar shower times. When practice-as-entities vary, we see intra-home and interpersonal variances in resource use and the performance of practices that are related to household habits and routines (Røpke, 2009). Section 3.1.1 outlines in more detail how a change in one part of the practice entity can influence the performance, and as such resource use, of the practice.

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