Determinants of Residential Building Occupants' Behavior in Sustainable Living: A Questionnaire Survey in Hong Kong

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Abstract
Green building movement has been playing a major role in sustainable urbanism as well as current architectural development. In addition to its energy achievement, it could be influencing our living style according to some Environment and Behaviour (EB) studies. EB research showed that there are transactions between individuals and their physical setting that could change each other's performance. In its application on environmental problem, widespread human lifestyle change was suggested as the core factor of sustainability. To understand occupants' behaviour for improving the performance of green buildings, this paper studied four demographic variables (income, educational level, household size and area of apartment) and one variable about environmental belief for two pro-environmental behaviours (PEB) (control of shower time and waste sorting) in sustainable living. A questionnaire survey was carried out to analyse these PEB of over 400 staff from a property management company in Hong Kong. The result showed that though the display of PEB depends on environmental belief, income, area of flat and type of dwelling, the correlations are weak. This suggested that demographic factors and single environmental awareness have small impact in explaining PEB. As it is a preliminary study aimed at solving the problem of slow green building development in Hong Kong by enhancing behavioural change, further studies were planned for investigating other possible predictors of household PEB. For this research project, the author expected to identify variables which could activate PEB to engage in green building movement and learn the actual impact of these PEB on the performance of green buildings.

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Introduction

Green building movement has a key role in sustainable development (SD). Aligning with these global consenses, Hong Kong (HK), a well-developed and prosperous city in Southeast Asia, has committed to foster a quality and sustainable built environment since 1999 (Office of the Chief Executive, 2011). The HK green building certification (BEAM), which was launched in 1996, is the first of its kind in the Asian region. Besides, there are various policies and campaigns to promote green building development. But unfortunately, the performance of them is not satisfactory in term of quantity according to the joint study by Greenpeace East Asia and the University of Hong Kong (Lau, Gou, Mah, Tsang, & Cheung, 2011). The number of green building in HK falls behind that of Taiwan and Singapore. In addition to the quantity of green buildings, the success of green building development also depends on its quality. The quality of a green building is not determined only by its systems and materials, but more importantly, by human behaviour which influences its operation and maintenance. Research showed that widespread human lifestyle change is the core factor of sustainability (Howard, 2000; McKenzie−Mohr, 2000), so human behavioural research seems to be crucial for improving the unsatisfactory green building development in HK.

Promoting human behavioral change is an extremely challenging task. Stern (2000b) pointed out that there is a long causal chain of personal and contextual factors for pro-environmental behaviours (PEB). Thus, it is worth to study the correlation among the factors to figure out the most effective strategy to encourage households PEB for supporting the role of green building in SD. This paper is going to present the first study of a project that helps architects consider users' behaviour in green building design. First, the contribution of PEB towards the performance of green buildings will be explained. It is followed by the sustainable living campaigns in HK and factors for driving PEB. Then, the methodology and findings of the questionnaire survey will be presented for discussing possible factors of household PEB. This study is limited to demographic factors and water saving and recycling behaviour.

Pro-environmental behaviour & Green Building

The assessment for new green buildings in HK is mostly under BEAM (Building Environmental Assessment Method). It is a voluntary scheme consists of a set of comprehensive standard procedures for benchmarking and improving the performance of buildings. By adopting international consensus about defining green buildings, BEAM embraces the following aspects for the holistic assessment.

- Site: land use, site impacts & transport
- Material: reuse, recycling & waste management
- Energy: energy efficiency, conservation & management
- Water: water quality, conservation & recycling; and
- IEQ (Indoor Environment Quality): hygiene, health, comfort & amenity.

The fulfillment of credits mainly depends on the works of architect and building services engineer. Selection of material and systems, design of window and building layout, and provision of facilities can determine the grade of the new building. But the actual performance of the assessed building cannot be guaranteed since it is sensitive

to variability of occupant behavior (Wener & Carmalt, 2006), especially for buildings designed to utilize natural ventilation.

Natural ventilation can only be achieved by opening the windows. If the occupants always keep the windows shut, much energy will then be consumed by means of mechanical ventilation, such as fan and air-conditioner, for achieving thermal comfort. In addition, provisions of recycling bins, water flow regulators and windows for access of daylight might not able to reduce waste generation, water consumption and energy use for lighting unless occupants act environmentally responsibly. So it is significant to encourage sustainable living style to help secure the performance of green buildings by complementing with the green building equipment and systems.

Water Saving & Recycling Campaigns in Hong Kong

The PEB studied in this primary research are water saving and recycling behaviour as there is no mandatory measure for domestic waste and water reduction in HK yet. So far, the sustainability-related regulations for buildings are mainly for controlling energy consumption[1]. Environmental campaigns and programs are used for promoting water saving and source separation of domestic waste. For instance, lately, Water Supplies Department launched "Let's Save 10L Water" Campaign offering water saving tips for the household to encourage the public to actively utilize the precious water resources[2]. Non-Government Organizations (NGOs), such as Green Power, launched "5-minutes shower" to encourage the public to minimize the time for shower. Since 2005, the government has been offering funding for building management company and Incorporated Owners' Committee to reimburse the partial cost of setting up waste separation facilities to encourage domestic waste recycling. HK people have access to knowledge and information as well as financial incentives for domestic waste and water reduction by a wide range of means offered by the government and NGOs. However, statistics showed that the daily domestic water consumption in HK is more than that in many first world cities such as London and Singapore, and the daily domestic waste generation rate per capita is much more than that in other developed Asian cities (China Water Risk, 2012; Environment Bureau, 2013). It seems that, in general, HK people are wasteful despite the great effort by the government and NGOs.

Though the gap between environmental knowledge and the act of PEB has been studied by various theoretical frameworks with numerous factors, no definitive explanation has been found yet (Kollmuss & Agyeman, 2002). Since behavioural change is so complicated that it is almost impossible to be completely explained by a single model (Kollmuss & Agyeman, 2002), it is worth to understand the nature and possible effect of each factor before adopting the most desirable model to analyse an environmentally behavioural change for supporting green building development.

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[1] For example, Hong Kong Ordinance Chapter 598, Energy Efficiency (labelling of products) Ordinance; Hong Kong Ordinance Chapter 610, Building Energy Efficiency Ordinance; Hong Kong Ordinance Chapter 123M, Building (Energy Efficiency) Regulation

[2] "Let's Save 10L Water": http://www.waterconservation.hk/en/main.html

Pro-environmental Behavior (PEB)

Steg and Vlek (2009) introduced PEB as "behavior that harms the environment as little as possible, or even benefits the environment." Use of nontoxic products, practicing water conservation and waste recycling, eating less meat and driving less are some of the examples (Krause, 1993). As advised by Steg and Vlek (2009), factors influencing PEB can be categorized as (1) motivational; (2) contextual and (3) habitual.

Motivational factors are about intrinsic motives, such as, attitudes, values and belief as well as affect. McCarty and Shrum (1994) showed that values do affect the attitude of recycling of solid waste, but could not display the behaviour directly. According to the studies (e.g. (Hernandez, Tabernero, & Suarez, 2010; Stern, 2000a; Vining & Ebreo, 2002), values can be categorized into "self-centered", "socio-altruistic" and "ecocentric". It was argued that both altruistic and econcentric values have positive effect on PEB whereas egoistic value is mostly negatively related to it. However, Brown and Kasser (2005) revealed that care about personal well-being can be complementary with PEB. Environmental attitude was defined as "a psychological tendency expressed by evaluating the natural environment with some degree of favour or disfavour" (Milfont, Duckitt, & Wagner, 2010). Though it is one of the significant factors in Ajzen's Theory of Reason Action and Theory of Planned Behaviour (Ajzen, 1991), research showed that it usually has small impact on PEB (Kollmuss & Agyeman, 2002). Referring to the review of Vining and Ebreo (2002), affect/emotion is the self-conscious or self-evaluative motions, such as pride, shame, and guilt, that are central to conservation motivations. It can be a possible strong predictor of behaviour when the effects of attitude are weak.

Contextual factors include interpersonal influence, built environments, accessibility and availability of supporting facilities, monetary costs and benefits and legal and institutional factors, etc. (Stern, 2000a).

Aarts, Verplanken, and Knippenberg (1998) described habits as a learned, goal-directed act that automatically responds to specific circumstances. The stronger the habit, the less metal effort and conscious attention are required to induce the behaviour. Klöckner and Matthies (2004) and Knussen and Yule (2008) showed that the effect of habit for recycling behaviour and travel mode is dependent on the strength of habits and interventions available.

In addition to these factors, demographic factors showed influence to environmental attitude and PEB (Stern, Dietz, & Kalof, 1993). Women might be more aware than men of environmental issue due to emotion and the experience and effects of parenthood (Dietz, Stern, & Guagnano, 1998). Education, income, size of the living area and type of dwelling were found to be significant determinants of the use of recycling facilities (Berger, 1997). Research also showed that sociodemographic variables were related to impact-defined behaviours, such as energy and water use and waste production (Gatersleben, Steg, & Vlek, 2002; Poortinga, Steg, & Vlek, 2004). Hence, for a preliminary study, we studied the impact of demographic factors on two commonly promoted PEB in HK as well as that of an environmental belief as the motivational factor.

Methodology

Participants and Procedure
Participants were property management staff employed by a development company in Hong Kong. They, 100% Chinese, were recruited at their workplace for completing a Chines paper questionnaire in the summer of 2013. No benefits were offered to them for the participation. In total, 412 (208 male, 194 female, and 10 unreported) self-administration papers were returned. 376 papers were fully completed for this study.

Measures
This preliminary study is an intent-oriented measure of PEB as it only focused on what may predict the intention. The environmental impact of PEB will not be discussed.

Pro-environmental behavior (PEB). Based on the most common campaign about sustainable living, two household PEB were identified. Participants reported the frequency of waste separation before disposal and minimizing the shower time based on their past experiences on a 5-point scale ("never" to "always").

Demographic factors. In order to compare the effect of the demographic factors which have been studied by other authors, family monthly income, educational level, household size, gender, type of dwelling and area of apartment were studied.
Environmental belief. Participants reported if they agreed with the statement saying that "the capacity and natural resources on earth is limited" on a 5-point scale ("strongly disagree" to "strongly agree").

Result and Discussion

More than half of the respondents (57.1%) reported that they usually or always minimize the shower time if possible and nearly half of the respondent (46.2%) usually or always separate the domestic waste before disposal. By the result of Chi-square test, both minimizing the shower time and separating waste before disposal are independent with educational level, household size and gender. Only environmental belief about the limited capacity and natural resources is related to the two PEB. Income and area of flat are only related to the shower time while type of dwelling, varied from cheap rental public housing, public housing of subsidized sale-programme to private housing, is only related to the waste separation. Pearson's bivariate correlation was then used to examine the relationship among the factors (Table 1). The result showed that though the display of PEB depends on environmental belief, income, area of flat and type of dwelling, the correlations are weak. The strongest relation is the one between minimizing shower time and environmental belief, yet it is only 0.203. Hence, it can be concluded that the variables studied in this questionnaire survey are not likely to be the reliable predictor of minimizing shower time and separating waste before disposal.

The negative correlation between the shower time and monthly household income can explain that Hong Kong people with more money probably prefer longer shower for enjoyment even though they may be aware of the environmental problem. According to the survey by Green Power, Hong Kong people, on average, takes 14 minute for

each shower (Green Power, 2013). It seems that taking long shower has become a social norm in Hong Kong. Though the water charge is heavily subsidized by the government, the use of water is still related to the monetary factor. It is interesting that area of flat is also related to the shower time positively, so studies are required to examine such surprising result in the next phase of study. For waste separation, type of dwelling is positively related to it. This indicates that people living in private housing probably are more willing to participate in waste recycling. It is then worth to study the actual recycling process in different kinds of housing to find out the contextual factors of encouraging recycling behaviour.

Since the correlations are so weak, it is suspected that social desirability is as a suppressor variable that hide the actual correlation between the factors as suggested by Ganster, Hennessey & Luthans (1983). For improving this potential bias, further studies will conider the remedial advices by Podsakoff, MacKenzie, Lee & Podsakoff (2003), such as measureing the dependent and independent variables from different sources and introducing a time lag between the data collection of dependent and independent variables if there is only the same source.

Table 1
Bivariate correlations between PEB and demographic factors (N=376)

	IN	ED	FA	HS	GE	TD	EB	SH	SW
IN									
ED	.408**								
FA	.342**	.339**							
HS	.057	-.026	.242**						
GE	-.034	-.132*	-.047	-.084					
TD	.265**	.273**	.397**	-.127*	.048				
EB	.124*	.104*	.012	.099	-.005	-.012			
SH	-.048	.011	.123*	.005	.091	.083	.203**		
SW	.020	-.009	.175**	-.003	.094	.108*	.089	.203**	

**p<.01; *p<.05
Note: IN = monthly household income; ED = education level; FA = area of flat; HS = household size; GE = Gender; TD = type of dwelling; EB = environmental belief; PEBs are all scored from 1 “never” to 5 “always”), SH = reducing shower time as short as possible & SW = separating waste before disposal

Conclusion

In summary, the green building movement seems to have failed to make a significant contribution to SD in Hong Kong as expected. Though there are various sustainable living campaigns, the effect of them on behavioural change is little due to the complex chain of factors of PEB. Thus, it is worth to learn all factors inhibiting or promoting PEB for forming the best strategy to improve green building performance. In this preliminary study of a research project aiming to encourage households PEB for supporting the role of green building in SD, demographic factors and belief about limited capacity and natural resources on earth were studied with behaviours for water reduction and waste recycling. The result showed the weak correlation among them, but it led to several questions for the next phase of study. In the next step, the authors

would like to focus on intrinsic motives and contextual factors (e.g. provisions in green buildings) and then the actual impact of these PEB on the performance of green buildings will be examined.

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