

Private tenant's choices between aesthetics, energy efficiency and comfort

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Abstract

The Dutch rental market in the private sector is a rather small market in comparison. About 10% of the housing stock is privately rented. Mainly the people at the end or the beginning of their home career are renting their dwellings in this sector. The rental prices are widely dispersed, with rents about twice as high in the capital compared to the former mining areas in the south. Using 3D-virtual designs of facades, we investigated their preferences for characteristics associated with sustainability (bio facades, bio shading), comfort (glazing), and architectural design characteristics (Shape, Materials) and rents. The questionnaire was filled out by 116 respondents all intending to relocate. Except for shape, all other characteristics were influencing respondents' choices. The results seem to suggest that rather than choosing for energy efficiency, choices for bio facades and bio shading afforded respondents environmental attitudes.

Introduction

It is widely acknowledged that current climate is changing and that such is primarily driven by the emission of greenhouse gases from energy use (Intergov. Panel Climate Change 2007). In Europe, the building sector is the biggest energy user, accounting for 35.8% of the total energy consumption. Improving energy efficiency in buildings can lead to a substantial reduction of CO₂ emission from the building sector (Knaack, Bilow, Konstantinou, & Lieverse, 2012). To this end, sustainable transformation of the existing housing stock is to be preferred to demolition and renewed construction, because the environmental impact of life cycle extension of existing buildings is lower than of demolition and new construction (Itard, Klunder, & Visscher, 2006). Across Europe, much of building decay is found in the building envelope in early post-war housing. Measures like roof and facade insulation can cut energy consumption of buildings by half (Esteves, 2007) and enhance the poor look and feel of these housing (Andeweg & Koopman, 2007; Riccardo, Van Oel, & De Jong, 2012). In the Netherlands, about one third of the housing is owned by housing associations. Large scale improvements in energy efficiency of existing housing stock have been mainly obtained in collaboration with housing associations. In the Netherlands however, about 60% of the housing stock is owned by occupant-owners and this is will increase to around 70% over the next years. Therefore, although more difficult to address, the private owners should be targeted as well to meet up with the set aims of reduction in greenhouse gasses emissions.

Pro-environmental goals

Physical and technical energy saving measures imply behaviour changes, not only because occupant-owners need to accept and understand them, but they need to buy and to properly maintain and use related equipment as well (Steg & Vlek, 2008). However, human behaviour is a poorly understood factor in striving for energy efficiency of housing. Applying energy efficiency measures concerns onetime choices to adopt an efficient technology and this is to be distinguished from curtailment behaviour that reduces consumption for instance by turning off a light. Efficiency behaviour is thought to have greater energy-saving potential as it does not require sustained actions. One installed, the energy savings are there and thought to prevail in the long run. At the same time, efficiency behaviours are more prone to losses caused by the rebound effect. That is, people tend to increase their energy consumption as a psychological compensation for making a climate-virtuous choice (Gifford, 2014). This shows it is important to consider psychologically important aspects of energy behaviours, e.g. perceived costs and benefits, goals, values, beliefs. Steg et al. (2014) use goal framing theory to explain how hedonic, gain and normative goals or motivations steer attention and influence the information people infer. In turn, this influences what knowledge is cognitively most accessible, and how alternatives are perceived and eventually guide people's behaviours. Pro-environmental actions they argue, involve a conflict of normative goals with hedonic and gain goals and encouraging pro-environmental behaviours is to reduce or remove the conflict between these goals. Since people high in environmental concern seem to focus on environmental consequences, whereas others being low in environmental concern seem to underscore personal outcomes when making choices (Hawcroft & Milfont, 2010), this implies that people weight implications for their most important goals (Steg et al., 2014). When it comes to decisions in complex situations, e.g. when considering relocation or housing renewal, people will prioritise one goal over other goals, as they have to manage multiple goals e.g. rents, costs for energy, attractiveness, comfort, well-being. According to Steg et al. (2014) pro-environmental behaviour may not only fulfil normative goals because it is the right thing to do, but also make people feel good about themselves, because they

adhere to their biospheric values. They propose that strong biospheric values imply that normative goals are chronically activated.

Affordances

Decisions about housing involve efficiency behaviour, whether people consider relocation or whether they are either as tenant or as private owner involved in decisions about in energy efficiency measures. For residents, energy efficiency of a dwelling impacts monthly costs for energy and heating. In addition, energy efficiency measures may determine look and feel as for instance façade insulation may imply renewal of the façade. Frequently, energy efficiency measures affect comfort by reducing draught, enlarging floor areas because a glasshouse is added to a south façade, etc. Indeed, adding liveable floor area was shown to be an important facilitator in obtaining residential commitment for participation in a large scale renewal project among occupant-owners (De Haas, van Oel, & Hasselaar, 2008). This case study into facilitators and impediments of residential decision making about energy efficiency measures also found health concerns to be an argument to opt for energy efficiency measures. Indeed, measures like a greenery roof, or bio-shading that might be have been proposed in housing renewal projects because of their energy efficiency by engineers, could have been interpreted by residents who are not that familiar with energy efficiency calculations because of their interdependence with the natural environment (Davis, Green, & Reed, 2009). This raises the question whether, in the eyes of residents, efficiency behaviour is actually about what the energy efficiency measures afford. Heft and Kyttä (2006) interprets affordances, or perception and meaning, in relation to the intentionality of action. People directly see both use and cultural meaning in their environment, because people are so socialized. Clapham [12] used Heft's concept of intentional action in providing a theoretical framework to understand the relationship of the affordances housing offers to people and their needs. Since people act to meet their needs, these needs will control the perception of affordances. Clapham [2, 12] argues that needs can be evaluated in terms of wellbeing. This theoretical framework allows to understand the joint influences of energy behaviour and the change in affordances impacting a person's own quality of life, which is important to address as well (Gifford, 2014).

To address people's valuation of affordances of multiple sustainable housing renewal measures and to investigate whether their adherence to biospheric values influenced their valuations, an alternative research method was applied in this study. The general method of evaluating people's preferences for energy efficiency measures was thought to overlook the complexity of decision making in real life. In these situations, decision making is not a matter of checking a list of possible technical measures. With few exceptions (Banfi, Farsi, Filippini, & Jakob, 2008; Poortinga, Steg, Vlek, & Wiersma, 2003) most studies do not address the complexity of decision making by asking people to evaluate how multiple energy efficiency measures show off when applied in a dwelling. We therefore investigated how energy efficiency measures were valued by tenants considering relocation using a questionnaire with visualizations of housing situations in which multiple energy efficiency measures were applied (Riccardo et al., 2012), and evaluated the influence of adherence to biospheric values influenced the affordances of these sustainable housing situations.

In the sections that follow, we first discuss the embodied meaning of home. We then discuss the measurement of valuations and formulate our hypothesis. Thereafter, we report and discuss the

design and results of the choice experiments with visualizations and their relationship with general indices and adherence to biospheric values.

Embodied meaning of home

Applying energy efficiency measures to a dwelling will lower energy losses from the building envelop, but it will also influence the look and feel one's home and as put forward by Steg et al. (2014) this may add to feelings of wellbeing and happiness because of adherence to biospheric values. However, these measures might also affect the emotional attachment to home. Important energy efficiency measures involve the roof and façade, for instance attaching a prefab insulated façade to the existing façade. If the old façade looks obsolete, one might feel proud of the new attractive façade and this may influence emotional attachment to the dwelling. The development of emotional attachment has been studied within the theoretical framework of place attachment (Scannell & Gifford, 2010).

Following the Person-Process-Place (PPP) framework of Scannell and Gifford (2010), place attachment involves affective, cognitive and behavioural connections to a place or space and the meanings therefore ascribed to it and draw from it. Place identity is related to place attachment, since place is a fundamental component of personal identity (Hernández, Carmen Hidalgo, Salazar-Laplace, & Hess, 2007; Proshansky, Fabian, & Kaminoff, 1983). Through interactions with places, people describe themselves as belonging to a specific place. Place attachment and place identity are not identical, as place attachment developed before place identity (Hernández et al., 2007). The behavioural dimension of place attachment is founded in the desire to remain close to a place (Scannell & Gifford, 2010). However, the behavioural dimension is also thought to include behaviour, such as engaging in neighbouring and other social activities (Lewicka, 2005, 2013; Scannell & Gifford, 2010). For many years, interests in social dimensions of place attachment have been stronger than interests in its physical dimensions (Lewicka, 2011; Van Assche et al., 2013). According to Stedman (2003) individuals feel attached to places through symbolic links, thus for the meaning they assign to physical features themselves, rather than feeling attached to actual physical place characteristics. Such an interpretation is at odds with Gibson's theory of affordances (Gibson, 1979/1986/2013) that meaning exists in the environment and is not constructed in the mind alone. The concept of affordance concerns the relationship of the person to the environment. Essentially, this is a dynamic relationship which is based on perception and involves sensorimotor pathways (van Dijk, Withagen, & Bongers, 2015; Zipoli Caiani, 2014). Thus the concept of affordances offers a way of assessing this relationship in a holistic way that emphasises both the utilitarian and the meaning elements of the relationship (van Dijk et al., 2015). Experimental research has shown that respondents generally act faster and more fluently when they act in line with perceived object affordances than when acting against perceived affordances (Ellis & Tucker, 2000; Regenber, Häfner, & Semin, 2012; Symes, Ellis, & Tucker, 2007). Tucker and Ellis (2004) showed that affordances might convey sensorimotor information as a result of memorizing a place.

Empirical studies assessing affordance perception are generally conducted with participants using an object he has to categorize. With one exception that we are aware of, no other research has looked at the processes that people use to detect meaning and memory recognition within the housing context. An attempt was made by Coolen (2006). He first identified the uses afforded by different dwelling characteristics. He then ascertained the meanings these attributes have for individuals. The problem with this attempt is that the unit of measurement is the individual dwelling attribute, but several dwelling attributes might be assigned the same meaning and are therefore substitutable (Clapham, 2011). The problem is that any house has many affordances and these vary between

individuals. Clapham (2011) and Heft and Kyttä (2006) suggest that this problem can be solved if the unit of measurement is the uses afforded to the individual by an individual's house. Or alternatively, the problem may also be solved by understanding the way in which the information supports the individual's identification or personal norms.

The main question then is how might this be applied in such a diverse setting. With this in mind we propose to use 3D virtual reality designs of a dwelling to assess the values that are afforded by these 3D virtual reality designs as a research method. These virtual reality designs would do as well as the object, the dwelling itself. This method would work, because affordances play a role in cognitive processes such as visual memory and perceptual awareness of what a person can or cannot do, does not necessarily rely upon actual motor actions (Quak, Pecher, & Zeelenberg, 2014). Thus, by providing a 3D virtual reality design of a living room, a person will be able to evaluate whether such affords people's identification or personal norms.

The concept of affordances emphasises both the utilitarian and the meaning elements of the relationship (van Dijk et al., 2015) of a person to his environment. Tenants will thus link affordances, or perception and meaning, in the physical design of housing to their perceptions of wellbeing. Hartig and Staats (2006) showed that people's need for psychological restoration framed their preference for natural environments and disapproved urban settings. This highlights a difference in reasoning with those aiming for sustainable transformation of housing by targeting pro-environmental behaviour. If preferences for certain energy efficient measures are to be understood as pro-environmental behaviours, then it is hypothesized that tenants (and owners) will evaluate the energy efficiency of these measures and choose accordingly, if they express strong adherence to biosphere values as such implies that normative goals are chronically activated (Steg et al., 2014). In contrast, if tenants link affordances, or perception and meaning in the physical design of housing to their perceptions of wellbeing and evaluate whether or not these measures afford their need for psychological restoration, then we hypothesized that they ignore the energy performance of the dwelling, even if they express a strong adherence to biosphere values.

Measuring valuations

In this section, we introduce the general methodology used for quantifying affordances for sustainable housing situations. In both marketing research (Kuhfeld, 2010) and engineering design research (Orsborn, Cagan, & Boatwright, 2009), utility functions have been successfully employed to ask people to value characteristics of a designed space. A utility function is a tool used by economists to describe a person's utility, that is, the valuation or a measure of satisfaction gained by using a certain good or service. A benefit of a utility function is that it can represent a complex space in which many 'design factors' or 'attributes' each account for a dimension. A utility function offers a means to describe the relationship of all these attributes to a person's utility (Orsborn, et al., 2009). In evaluating a set of multiple attributes, a person will maximize his or her personal utility function, and therefore utility functions can be used to determine an optimal set of trade-offs between several energy efficiency measures (Kuhfeld, 2010; Orsborn, et al., 2009).

In measuring the utility for a product, one can distinguish between the revealed and the stated preference method (Adamowicz, Louviere, & Williams, 1994). The former is based on observation of the actual choices made by households and individuals, and it assumes that people reveal their

preferences by their actions. However, an evaluation of existing settings would not easily relate persons' valuation to utility functions, because revealed preferences research only captures peoples' opinion on economic goods, like rent levels, cost for energy and heating, etc. (Hanley, Wright, & Adamowicz, 1998). As we were interested in assessing affordances yielded by multiple energy efficiency measures by asking people to choose from a set of pictorial representations, we asked them for their stated preferences. We used images to avoid the problem of presenting semantic scales to people about attributes that are usually visualized to show what these are like. Semantic scales are commonly used to assess architectural qualities, but this is complicated as these characteristics are processed and memorized as configurationally information [4, 5]. Therefore, buildings are better described as visuals than in words [6].

Some stated preference methods require people to rank or rate alternatives according to their preferences. There are a number of disadvantages associated with the use of these methods as a means to obtain preference data (Hensher, Rose, & Greene, 2005). The first problem is the arbitrarily choice of the scale: why choose a 10-point rating scale and not a 100-point scale, or vice versa? Even on an 11-point scale, it makes a difference whether the anchors are assigned the numbers [0,10] or [-5,5] (Fischhoff, 2005). Another issue is that everyone is assumed to use the scale in a similar cognitive way. However, it might well be that one person rates an alternative with a 6, whereas one actually values it the same but applies a 5. Third, the most common way to analyse these data is by means of regression analysis with the rating or ranking as dependent variable. Although ratings may best be assumed to be interval scaled, they are most likely ordinal scale variables. Rankings are by definition measured on an ordinal scale. Although commonly applied, using such data as the dependent variable in regression analysis violates the requirement that the dependent variable be continuous (Hensher, et al., 2005). Furthermore, ranking or rating alternatives according to one's preferences does not necessarily imply that this preference translates into a choice. Choosing between alternatives overcomes this problem, and it addresses the criticism that there may be cognitive/perceptual differences between two respondents. If two persons value a housing situation in the same way, this will be clear from their choice, whereas their rankings or ratings might be different (Hensher, et al., 2005).

A common way to assess valuations is therefore the two-alternative or referendum question. This so-called contingent valuation choice method is to be distinguished from the discrete choice experiments. A discrete choice experiment is a sequence of multinomial choice questions (Adamowicz, Boxall, Williams, & Louviere, 1998). Discrete choice experiments are characterized by two elements. First, a person is asked to make a discrete choice between two or more discrete alternatives in a *choice set*; second, the alternatives in a choice set are constructed by means of an *experimental design* that varies one or more attributes within and/or between persons in such a way that information related to preference parameters of an indirect utility function can be inferred (Carson & Louviere, 2011; Kuhfeld, 2010). There is some evidence that discrete choice experiments are better in estimation and provide a better understanding of the choices made by persons than the contingent valuation method using a referendum approach (Mogas, Riera, & Bennett, 2006).

The current study

Methods

Participants

Participants were 116 tenants of private housing in the Netherlands who considered relocation. Another 19 started the online questionnaire but quit after few questions. In the Netherlands about 10% of the housing stock is rented from private landlords, and this share is much smaller than that of social tenants (30%). Many of the private tenants will be high educated starters who earn too much for social renting. Since we failed to gain access through private landlords, convenience sampling of private tenants occurred using social media and an alumni network of the department of Real Estate and Housing of TU Delft.

Table 1 summarizes descriptive characteristics. Respondents were asked for their highest completed educational level according to Dutch standards. The grading in educational answering categories was designed so that respondents could easily find the appropriate answer, but this yielded low cell counts in some cells. Therefore, primary education, lower/intermediate secondary education and higher secondary education were recoded into low level of education; junior/intermediate vocational education and senior vocational education were recoded into medium level of education; the remainder were recoded into high level of education. Respondents' biospheric values were evaluated using the revised New Ecological Paradigm Scale (NEP) (Dunlap, Van Liere, Mertig, & Jones, 2000). The NEP scale consists of 15 items designed to measure beliefs about nature and humans' relationship with it (e.g., "Humans are severely abusing the environment"; "Plants and animals have as much right as humans to exist"). For each item, participants responded on a 5-point Likert scale ranging from strongly disagree to strongly agree. Since we translated the scale into Dutch, and removed a double negation not to confuse respondents what to answer, we first calculate for all the subscale the internal consistencies and made sure all that no negative covariances were present by reverse recoding items if necessary. Two items, i.e. item 3 (fragility of nature's balance) and item 4 (rejection of exceptionalism) were left out, because of negative covariances with other items and a item-rest correlation close to 0. Cronbach alpha was 0.78. We averaged responses to items to create a composite index for the NEP, with higher scores representing a greater ecological worldview. We used the median value of the NEP composite score to divide respondents into 2 groups of low and high environmental concerns, respectively. The average composite score is 2.38; more respondents with lower education showed significantly more frequent low ecological concerns than those with medium and higher education ($\chi^2=9.29$, $df=2$, $p=0.01$). No significant difference in biospheric values were found amongst age groups (those of 45 years and older were combined with 35-44 years; $\chi^2=4.21$, $df=2$, $p=0.12$) and between men and women ($\chi^2=0.14$, $df=1$, $p=0.71$).

Table 1 Descriptives

	% (n=116)	Mean	95%CI
Gender			
♀	43.1 %		
♂	56.9 %		
Age			
18-24 yrs	32.8 %		
25-34 yrs	50.0 %		
35-44 yrs	12.1 %		
45- yrs	6.28 %		
Education			
Low	17.2 %		
Medium	43.1 %		
High	39.7 %		
New Ecological Paradigm Scale (NEP)		2.38	2.26 – 2.49

Materials

We used the questionnaire with discrete choice experiments which is elsewhere described in full detail by Riccardo et al. (2012). Briefly, discrete choice experiments were included in an online questionnaire. 3D-virtual reality designs of a housing block with different sustainable renewal measures and pricing were showed to respondents in 12 questions in which respondents were asked to choose the housing situation they liked most. Using an optimization procedure (i.e. an efficient fractional factorial model (Kuhfeld, 2010)) we systematically varied amongst the following design factors each having 3 different levels:

1. **Form:** the housing could be a slightly curvilinear housing block as in the lower half of Figure 1, or a rectangular volume with additional volumes on top (not shown) or a more complex form consisting of inclined volumes on the vertical surface and a fragmented top floor (upper half in Figure 1). The most energy efficient form would be the first as this form has high compactness and therefore lowest heat losses;
2. **Materialization:** this were either light-coloured materials (see lower half Figure 1); medium coloured materials (not shown) or a combination of medium and dark coloured materials (see upper half Figure 1). Façades in countries with long heating seasons, like the Netherlands, would be most energy efficient if materials with medium or medium and dark coloured materials are applied;
3. **Bio façades:** these were made using moss tiles and here the 3 levels differed in the degree of what surface of the façade was covered. This could be either no moss tiles (lower half Figure 1), half the surface was covered with moss tiles (not shown); or the full surface was covered with moss tiles (upper half Figure 1);
4. **Windows:** medium sized horizontal windows (lower half Figure 1); smaller volumes of vertical windows (not shown); and the last level are floor to ceiling windows (upper half Figure 1). Obviously, the floor to ceiling windows are having the highest energy losses;
5. **Sun shadings:** the types of sun shadings are venetian blinds (not shown), movable aluminium screens (upper half Figure 1) and bioshading from dense trees in front of windows (lower half Figure 1). The venetian blinds provide the best shading.

6. **Affordability:** here there are three rent levels: basic rent level; basic rent level + 5% and basic rent level + 10%. Since baseline rent levels differ across the Netherlands, the local average private rent level was used as a baseline and respondents were asked for the local area they were looking for privately rented housing and rents were shown accordingly to their area of interest.



Figure 1 Example of 3D-Virtual Reality Design: : Combinations from set 31. Top picture: Form level III, Materialization level III, Green walls level III, Windows III, Sun shadings level II, and Affordability level II. Bottom picture: Form level I, Materialization level I, Green walls level I, Windows level I, Sun shadings level III, and Affordability level I.

Procedure

Since we were targeting different sustainable renewal measures, and respondent might be generally unable to infer how these measures impacts energy efficiency of the housing we calculated the energy efficiency of the housing (Riccardo et al., 2012). This was visualized using a bar with red showing high energy use and low energy use in green. The questionnaire was made online available. Per local area 3 versions of the questionnaire were made and respondents were randomized into 1 of these 3 versions. Basic rent levels were equalled to the average local levels for private renting to avoid that inappropriate rents were shown. Respondents could indicate that they were looking for rented housing in 23 areas fully covering The Netherlands. Afterwards, the 3 versions were combined across local areas which is possible because the rent levels were modelled as basic rent, basic rent with 5% and 10%, respectively.

Each questionnaire started with questions asking for demographic information. This was followed by 12 visual choice experiments and thereafter, the 15 questions of the New Ecological Paradigm Scale (Dunlap et al., 2000) as translated into Dutch were asked.



Figure 2 Example of the way the 3D-Virtual Reality designs were used in the questionnaire.

Results were analysed in SAS 9.3; SPSS 21.0 was used in additional analyses. Multinomial logit models were used to model the relationships between a polytomous response variable and a set of regressor variables. Multinomial logit models are a broad class of models. Generalized logit and conditional logit models were used to model customer choices. The generalized logit model was used to analyse the choices as a function of the characteristics of the individual making the choice. The conditional logit model was used to analyse the choice among the two alternatives as a function of the characteristics of the alternatives. In SAS, the PHREG procedure was used after preliminary data processing to fit a conditional logit model. The PHREG procedure fits the Cox proportional hazard model to survival data and the partial likelihood of Breslow has the same form as the likelihood in a conditional logit model. This model was used to analyse the influence of the attributes. A mixed model was used to study how choice depends on both sustainable renewal measures and individual characteristics like adherence to biospheric values (Kuhfeld, 2010). A threshold of $p < 0.05$ was generally used in significance testing of the main effects. Interactions were considered significant at a significance level of $p < 0.01$.

Results

As explained, we employed utility functions to relate sustainable housing measures and pricing to tenant preferences. The choice patterns of all tenants were analyzed using the conditional multinomial logit model. This model assumes that tenants make choices from the alternatives that maximize their perceived utility. In Table 2, for all five sustainable renewal measures and the pricing factor that were systematically varied in the images, the importance of the selected factor in choosing the housing situations that best afforded their wishes is shown as the estimated utility of all six factors. The higher the estimated absolute utility, the more weight the characteristic has in

deciding about affordances. For example, rent shows the highest estimate for the utility (1.09; Hazard Ratio = 3.0), meaning it is the most important factor in choosing the most preferred housing situation. The reference level of rent is basic rent levels + 10%, and as one would expect tenants prefer the lowest rent level over any of the higher rent levels. The hazard ratio (HR) is 1.0 if both alternatives are equally preferred. The HR shows that the impact an attribute has on the choice profile likelihood. It is three times more likely that the image – representing a profile of sustainable renewal measures – will be chosen if the rent level is the lowest possible than if rents were 10% higher. Table 3 shows that tenants preferences were significantly influenced by the Materialization; Bio facades (the more moss tiles the better); Windows (ceiling floor glazing was preferred to vertical oriented windows with less glazing surface); and Shading (bio shading was clearly appreciated over aluminum screens).

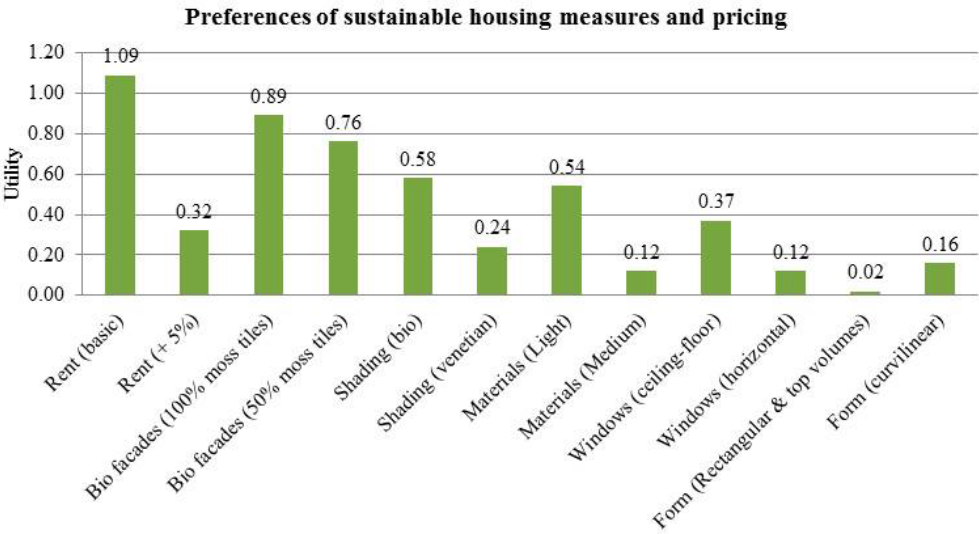


Figure 3 Preferences of sustainable housing measures with rent levels of private tenants

The utility estimates are relative estimates, and if the 95% confidence intervals of the HR do not include the utility estimate of one of the other features, this can be used to cluster the factors according to their influence on tenants’ choices. Figure 3 shows the attributes ordered from most influential to not influential according to the largest utility estimate per factor. It is not surprising rents were important to respondents decision making. Interestingly, bio façades were highly appreciated. A façade fully covered with moss tiles was as important as a low price (see Table 2). Also a façade partly covered with moss tiles and bio shading were rather high valued. In general, tenants valued whole façade glazing and the use of light colored materials which are both considered the least energy efficient measures. They preferred bio shading to Venetian shutters which would have been the more energy efficient alternative. However, their choice of fully covered bio façade is consistent with pro-environmental choice behavior.

Influence of biospheric values on preferences for sustainable housing measures and pricing

To investigate the influence of adherence to biospheric values on preferences for sustainable housing measures and pricing, the influences of these factors was compared between those showing weak and strong adherence to biospheric values. Adherence to biospheric values only influenced

valuations for bio shading (HR=1.77, 95% CI 1.15-2.7; $\chi^2=6.7$, df=1, $p < 0.001$). Those with weak adherence to biospheric values valued bio shading much higher than aluminium sun screens relative to those who expressed strong adherence to biospheric values. There was no interaction of adherence to biospheric values and the valuation of Venetian blinds, which were the most energy efficient types of sun shading. However, bio shading is more energy efficient than are aluminium screens.

Table 2 Tenants' preferences (utility estimates) for sustainable housing measures and rent levels

characteristic	Reference							
	characteristic	DF	Utility	SE	χ^2	p	HR	95%CI HR
1. Rent (basic)	Basic + 10%	1	1.09	0.11	100.0	<0.01	2.98	2.40 – 3.87
2. Rent (basic + 5%)	Basic + 10%	1	0.32	0.10	10.3	<0.01	1.38	1.13 – 1.68
3. Bio Façade (100% moss tiles)	No moss tiles	1	0.89	0.11	69.4	<0.01	2.44	1.98 – 3.01
4. Bio Façade (50% moss tiles)	No moss tiles	1	0.76	0.11	51.6	<0.01	2.13	1.74 – 2.63
5. Shading (bio shading)	Aluminium screens	1	0.58	0.10	31.8	<0.01	1.79	1.46 – 2.19
6. Shading (Venetian blinds)	Aluminium screens	1	0.23	0.10	5.4	0.02	1.27	1.04 – 1.54
7. Materials (light)	Mix medium and dark	1	0.54	0.10	26.8	<0.01	1.71	1.40 – 2.10
8. Materials (medium)	Mix medium and dark	1	0.12	0.11	1.2	0.28	1.12	0.91 – 1.39
9. Windows (Ceiling-floor)	Vertical glazing	1	0.37	0.11	12.3	<0.01	1.46	1.18 – 1.79
10. Windows (Horizontal)	Vertical glazing	1	0.12	0.10	1.4	0.24	1.13	0.92 – 1.38
11. Form (Curvilinear)	Complex	1	0.16	0.11	2.1	0.14	1.17	0.95 – 1.45
12. Form (Rectangular & top volumes)	Complex	1	0.02	0.10	0.1	0.81	1.02	0.84 – 1.25

Discussion

In this study we investigated how energy efficiency measures were valued by tenants considering relocation using a questionnaire with visualizations of housing situations in which multiple energy efficiency measures were applied (Riccardo et al., 2012), and evaluated whether the influence of adherence to biosphere values influenced the affordances of these sustainable housing situations. The concept of affordances emphasises both the utilitarian and the meaning elements of the relationship (van Dijk et al., 2015) of a person to his environment. Tenants will thus link affordances, or perception and meaning, in the physical design of housing to their perceptions of wellbeing. Hartig and Staats (2006) showed that people's need for psychological restoration framed their preference for natural environments and disapproved urban settings. This highlights a difference in reasoning with those aiming for sustainable transformation of housing by targeting pro-environmental behaviour. If preferences for certain energy efficient measures are to be understood as pro-environmental behaviours, then it is hypothesized that tenants with strong adherence to biosphere values will evaluate the energy efficiency of these measures and choose accordingly, as strong adherence implies that normative goals supporting pro-environmental behaviour are chronically

activated (Steg et al., 2014). In contrast, if tenants link affordances, or perception and meaning in the physical design of housing to their perceptions of wellbeing and evaluate whether or not these measures afford their need for psychological restoration, then we hypothesized that they ignore the energy performance of the dwelling, even if they express a strong adherence to biosphere values and that the valuation stems from whether or not the sustainable housing measures resulted in a housing situation that supports their well-being. Our results are in favour of the latter, as the outcomes seem to suggest that pricing (basic rent level) and bio façades instead of factors profoundly affecting the energy efficiency e.g. form and materialization were equally important to tenants. In addition to bio façades, bio shading was also highly influencing tenants' choices, and this was even stronger in tenants with rather weak adherence to biosphere values. These outcomes are consistent with the findings in our pilot study (Riccardo et al., 2012) in a sample of first year students in architecture and seem to corroborate the findings of Hartig and Staats (2006) that the restorative effects of greenery afford wellbeing. Tenants' choice for ceiling to floor windows might be also understood as affording well-being. The valuations for windows reflect glazing surface: the largest surface is with the ceiling to floor windows; the smallest is with the vertical windows. If tenants had chosen according to the energy performance they had chosen the latter. Now preferences reflect surface and therefore daylight access. Daylight access is also known to influence wellbeing (Beute & Kort, 2014; Partonen & Lönnqvist, 2000; Smolders, de Kort, & van den Berg, 2013).

We made sure that the energy performance of the building was clear to people (see Figure 2) by means of a red/green bar. However, we did not include well-known measures that campaigns of pro-environmental behaviour address such as PV panels. We are currently undertaking a study that involve PV panels as well. Notwithstanding our results seem to suggest that the strong emphasis on consumers' willingness to pay for energy efficiency measures in housing industry (Banfi et al., 2008; Kwak, Yoo, & Kwak, 2010) corroborate the findings of Poortinga et al. (2003) that people tend to ignore the amount of energy savings. Housing accounts for a large share of the energy consumption and to meet up with the set aims of reduction in greenhouse gasses emissions, it might be better to use the need for housing renewal to better afford people's wellbeing, meanwhile enhancing the energy performances of buildings.

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