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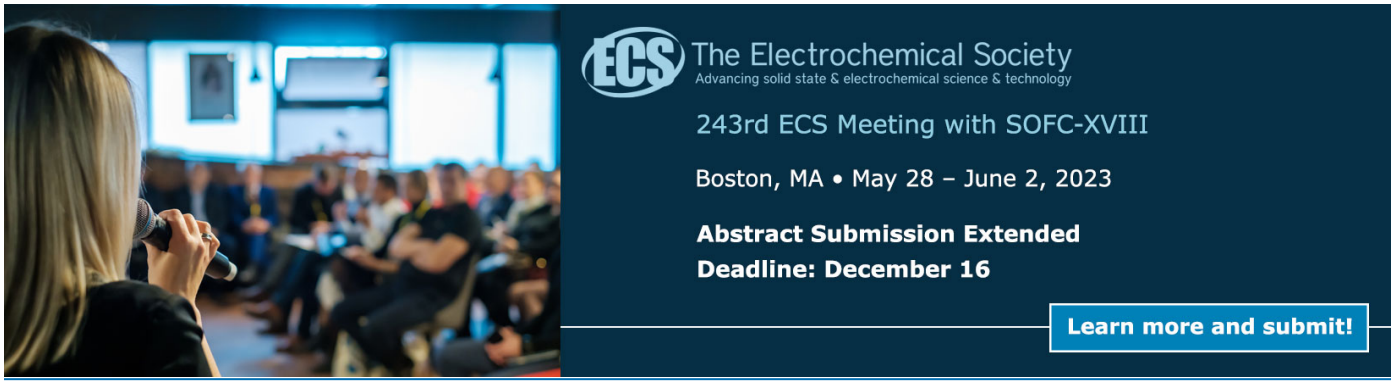

Environmental attitudes and recycling behaviour of architects in New Zealand

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Abstract. The use of reclaimed and recycled building materials is considered a pro-environmental behaviour and studying the factors that influence this is a first step towards establishing such behaviour. It is therefore essential to understand how pro-environmental behaviours develop. This article investigates the relationships between the influential factors on behaviours that help reduce waste in the construction industry, focussing on New Zealand architects. The study utilizes an online questionnaire based on the Theory of Planned Behaviour (TPB), which is made up of attitude, subjective norm, intention, and perceived behavioural control. The study reveals that the attitudes, intentions and perceived behavioural control of architects are strong predictors of pro-environmental behaviour while the subjective norm is a weak predictor. Knowledge of architects about regulations and certificates related to recycled materials will influence the pro-environmental practices. One of the obstacles in this way is the attitude of people and architects can play an important role in changing it. These findings show that architects need to be informed about related regulations and educated about different ways of integrating these materials.

1. Introduction

Treating waste as a valuable resource is an opportunity that producers and other stakeholders in the construction industry, such as architects and builders, can consider. Nearly 50% of waste streams in New Zealand come from construction demolition sites, a figure not dissimilar to the global proportions of construction waste. Earlier studies indicate that 80% of the waste from construction processes go to clean-fills in New Zealand [1].

The Resource Efficiency in Building and Related Industries (REBRI) association have developed guidelines for reducing waste, giving consideration to business and practical issues [2]. The design stage is often the best place to plan for waste minimization and resource efficiency in the different phases of the construction process. The REBRI report notes that designers, architects, and engineers can have a significant influence on the effectiveness of this plan. Nevertheless, there are always constraints on achieving waste minimization targets, and in New Zealand these include the fact that waste reduction targets are non-mandatory, that the cost of planning for waste minimisation is high, and that timber resources are plentiful, making it easier to build with new rather than to recycle [3]. Despite this,

reducing waste through the use of recycled materials is a strategy that can have little impact on time or cost [4].

Two earlier studies have found that around 33% of waste in the construction process occurs because of shortcomings in the design stage. These shortcomings include design complexity, use of a diverse range of materials, the fact there are various people making decisions, design iterations, reworking, client requirements, lack of experience, lack of information and ability to predict what may happen, and long project durations [5, 6]. Other studies have shown that the role of designers is critical for waste reduction. This conclusion came from studying the responsibilities and barriers to effective design for waste reduction, but few studies have focused on investigating the attitudes of participants in the design process [5, 7, 8], and few researchers have tried to study the different factors quantitatively [9]. Apart from the lack of interest from designers in waste minimization strategies, clients also lack interest, which is another big barrier [5, 10]. In summary, there is a lack of support in the literature for ways to predict the behaviour of and find the motivation for recycling and using reclaimed and recycled building materials (RRBMs) [11].

1.1. Objectives and research question

This article reports on part of a larger study of the attitudes toward reuse and recycling of building materials of the five key stakeholder groups in the New Zealand building industry. The focus here is on the architectural profession with the aim of identifying the key factors affecting architects' behaviour and RRMBs. This investigation is centred on the Theory of Planned Behaviour (TPB), which is made up of people's attitudes, intentions, perceived behavioural control and subjective norms.

There is a lack of literature on the attitudes and mindsets when it comes to the use of RRBMs of stakeholders in the construction sector. The wider study aimed to discover the driving force behind a potential increase in the use of RRBMs. The focus in this article is what architects, as a potentially important stakeholder group, felt about the use of RRBMs. Above all, a lack of research into attitudes and behaviour around waste management in the New Zealand construction industry was a catalyst for studying the perceptions of architects and factors that may influence their use of RRBMs. Another novelty of this study is using the constructs of the Theory of Planned Behaviour (TPB) in the form of two components for each factor, in order to examine both general reuse and recycling and the use of RRBMs separately, and through trying to remove the weak predictors from the model. The intention is to create a specific model for the behaviour of architects towards reuse and recycling and the use of RRBMs in New Zealand. Given the international nature of architectural education and practice through the influence of the Royal Institute of British Architects (RIBA), and the fact architects trained in one country work in another, means the results and findings will have value beyond New Zealand.

2. Literature Review

2.1. Theory of planned behaviour (TPB)

Since the 1980s, predicting environmental behaviour has been an evolving area of research in environmental psychology, with the emergence of several theories since that time. According to Klöckner (2013), the Theory of Planned Behaviour is one of the most commonly used models in this domain when it comes to green product purchase and recycling behaviour. The TPB variables are more useful in the prediction of environmental behaviour compared to the Norm Activation Theory and the Value Belief Norm Theory. Also there is much experimental and practical evidence behind the TPB **[11]**. The main determinants of this model are shown in **Figure *1***, which has been adapted for this study. The concept of this model is that a behaviour depends jointly on motivation and ability. Motivation is the intention and ability can be a number of different factors, like context of the opportunity, facilitating factors, and resources that shape control of the behaviour.

According to the TPB, the relevant factors here are attitude, subjective norm (expectations of other stakeholders like builders, regulators, and consumers), and perceived behavioural control (perceived capability). In the TPB, motivation or intention is essential, and has a direct relationship with the

previous factors **[12]**. Based on the findings of other studies supporting the TPB, these three factors have an influence on behaviour via intention, but the perceived behavioural control factor also has some direct influence **[9]**. The TPB has been applied to other relevant fields such as household waste reduction and recycling **[13-16]**, and food waste **[17]**. These studies supported the ability of the TPB to predict behaviour and some extended the TPB by adding the new construct "guilty feeling" (Soorani and Ahmadvand, 2019). Mak et al. (2019) found that perceived benefits and costs, social values, and behaviour control beliefs can be predictors of intention and among perceived behavioural controls, regulatory compliance is the most important factor for experts **[18]**.

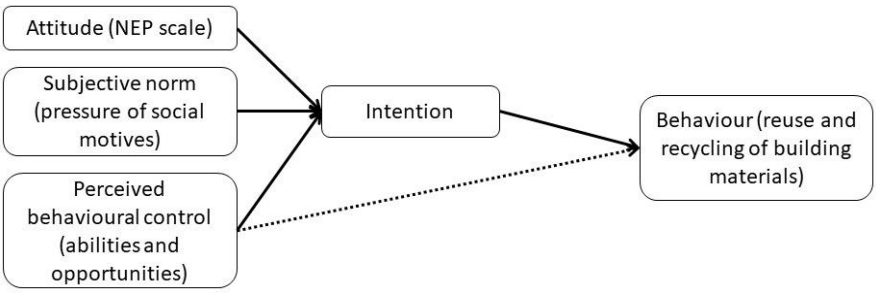

Figure 1. Theory of Planned Behavior, adapted from (Ajzen 1991)

Li came to the conclusion that attitudes and perceived behavioural control could have a significant influence on implementing waste reduction strategies at the design stage. Li measured perceived behavioural control by asking about perceived difficulties and controllability of the situation. However, the subjective norm was not found to have been influential. Li considered the approval of clients and line managers ("significant relevant people") for measuring the subjective norm. Among these factors, perceived behavioural control was the most influential factor for designers based on their self-reported and not actual behaviour [9]. However, there are studies with contradictory results such as that by Davies et al (2002) who demonstrated that intention is not indicative of behaviour [19].

Most of the studies in this field support Ajzen's Theory of Planned Behaviour on the basis that understanding attitudes can better help explain behaviour [20]. Ajzen believed that many studies which failed to show correspondence between attitude and behaviour are because attitudes and behaviours were not specified correctly [21], or the target population even for the same behaviour responded differently [22-24]. Therefore, it seems that combining factors from a wide range of behaviours or different dimensions of attitudes may mask the real relationship that exists between attitude and behaviour [25]. Also, a review study indicated a relationship between environmental attitude and recycling activities but, not with people's values [26, 27]. **Table *1*** sets out the items measured in each of the TPB dimensions.

Table 1.Measured items for examining the TPB

TPB constructs	Items
NEP	1.The balance of nature is very delicate and easily upset by human activities 2.The earth is like a spaceship with only limited room and resources 3.Plants and animals do not exist primarily to be used by humans 4.Modifying the environment for human use seldom causes serious problems 5.There are no limits to growth for nations 6.Mankind is created to rule over the rest of nature
Perceived behavioural control 1	1.Price plays an important role in buying RRBMs. 2.RRBMs are usually available in your nearby suppliers' stores. 3.Required information for deciding on RRBMs are easily accessible. 4.You can easily find specifications of RRBMs.

	5. People normally find any RRBMs that they want from suppliers near their living areas. 8.Producers and suppliers of RRBMs communicate enough with people.
Perceived behavioural control 2	1.There are enough regulations related to RRBMs. 2.You have knowledge about regulations related to the use of RRBMs in the building construction process. 3.There are enough building certificates related to RRBMs. 4.There are enough building material certificates related to RRBMs.
Perceived behavioural control 3	1.Price plays an important role in buying RRBMs.
Subjective norm	1.People are more concerned about reuse or recycling of materials these days.
Intention 1	1.Building or purchase of sustainable buildings 2.Building or purchase of buildings with lower carbon footprint 3.Purchase of buildings made with materials responsibly produced
Intention 2	1.Purchase of environment-friendly building materials 2.Purchase of reclaimed building materials 3.Purchase of recycled building materials
Behaviour 1	1.Recycling paper, plastic, glass bottles, cardboard, aluminium cans, or other products 2.Repairing items as much as possible 3.Reusing different products 4.Reduction in waste generation 5.Selection of products based on carbon footprint 6.Buying energy-efficient products 7.Purchase of environment-friendly products 8.Buying recycled products
Behaviour 2	9.Purchase or build energy-efficient buildings 10.Purchase or building sustainable buildings 11.Purchase or building buildings with lower carbon footprint 12.Purchase of environmentally-friendly building materials 13.Purchase of building materials locally produced 14.Purchase of building materials with lower carbon footprint 15.Purchase of reclaimed building materials 16.Purchase of recycled building materials

2.2. Environmental Attitudes

Understanding the perceptions of people regarding environmental issues is vital when it comes to solving environmental problems and consequently improving ecological sustainability. Hence, through history researchers have tried to establish sound instruments with which to study and measure environmental attitudes. Hundreds of different ways of doing this exist. Besides, in more affluent countries like New Zealand, environmental actions are more influenced by morality, so can be predicted

by attitudes [28]. Through a meta-analysis of previous studies, we understand that factors such as legislation, available opportunities and residence type can influence environmental behaviour. The New Environmental/Ecological Paradigm (NEP) scale with its documented validity and reliability stands out among other instruments and is one of the richest measurement tools for predicting behaviour from attitudes [25]. Studies have shown a significant relationship between NEP scale results and self-reported or observed environmental behaviours [29, 30]. The NEP was initially created as a 12-item and a 15-item scale but a 6-item scale has been used by researchers as it takes less space in surveys, and this use has provided evidence to prove the criterion, content, and construct validity [31], **Table *1***.

3. Methodology

As noted in the objectives, the investigation set out to find the relationship between the newly modified constructs of TPB for architects in New Zealand. An on-line method was used to collect responses. The survey enabled statistical analysis and helped ensure that the results could be scaled, depending on the number of responses [11]. To cover all the influential components to be measured and shape a comprehensive questionnaire, a number of variables were adapted from other relevant studies of household waste reduction and recycling, and designers' attitudes towards design-oriented strategies. The sample in this study is composed of architects in New Zealand. The search for participants started with the public register held by New Zealand Registered Architects Board (NZRAB) and then with the list of practices on the New Zealand Institute of Architects (NZIA) website. All architects found in these ways were contacted by email that invited them to do the survey and forward the invitation fellow architects in a snowball sampling technique. This means the response rate cannot be calculated. This technique was used to increase the sample size, since previous studies of New Zealand architects have had a low participation rate [32].

Generally, a five-point Likert scale was used, with scores ranging from strongly agree to strongly disagree. Scores have been calculated using the average score of each section for each respondent. Some questions are dichotomous and list questions for easier response and to occupy less space in the questionnaire. The literature review indicated that several statistical analyses would be appropriate for examining the TPB. In the present study, regression analysis was used to assess whether behaviour could be predicted through intention or any of the other factors noted earlier. The preliminary investigation of the TPB was the correlation analysis for the constructs introduced earlier. Assumptions for Pearson and Spearman correlation tests were not met so Kendall's tau_b correlation was run to determine the relationship between the constructs. Assumptions of normality, linearity, homoscedasticity and independence have been checked and were not violated. First, a stepwise linear regression analysis was carried out to predict intention from the TPB components. According to the TPB, Intention as the first predictor of behaviour is examined as a dependent variable and all other components as independent variables. After considering Intention as the dependent variable, Behaviour was examined as the dependent variable and all other components of NEP, Perceived Behavioural Control, Subjective Norm and Intention as independent variables.

3.1. Validity and reliability

Reliability was checked for all questions contributing to the five constructs set out in **Table** *2*.
Reliability analysis was done using Cronbach's coefficient alpha. The NEP scale is set up to measure environmental attitude, which is a key construct of the TPB. The reliability test results of all constructs are in **Table** *2*. Cronbach's Alpha range was from 0.604 to 0.874, being higher than in similar studies but within the acceptable range for measuring attitudes [33, 34].

Table 2. Reliability test results, New Environmental Paradigm (NEP), Perceived Behavioral Control (PBC), Intention (Int).

Constructs	NEP	PBC1	PBC2	Int1	Int2
Cronbach's Alpha Based on Standardized Items	.664	.604	.696	.874	.817
N of Items	6	5	4	3	3

There is evidence from other studies that the NEP scale possesses criterion, content and construct validity [31]. The content and criterion validity of this study was checked through a pilot study (reference will be added later for anonymity) and a comparison was made with expected results. Assumptions made prior to the stepwise linear regression analysis were also examined based on the literature. Linking concepts with questions underlies the validity of the questionnaire, and different techniques in designing questions have been used to increase validity. Potential threats to validity could come from participants not wanting to show their true feelings, despite the anonymity of the survey, for instance, giving an answer that complies with social norms rather than their real opinion. Also, in order to improve the accuracy of the questionnaire, questions were directed at respondents' own behaviour and opinions, and not those of other stakeholders. Putting the "no opinion" option is another way of making choices more explicit. The three most populated New Zealand cities of Auckland, Wellington and Christchurch yielded 159 architect participants in this survey of attitudes and behaviours. While this paper is focused on the architect group, more information on demographic differences in the entire study sample is available elsewhere [35].

4. Findings and Discussion

4.1. Correlation

The results of Kendall's tau_b correlation are presented in the **Table *3***.

Table 3. Correlation among the TPB components, [**. Correlation is significant at the 0.01 level (2-tailed). Behavior (Beh), Perceived behavioral control (PBC), Intention (Int), Subjective norm (SN)].

	PBC1	PBC2	PBC3	Int1	Int2	Beh1	Beh2	SN
NEP	.019	-.058	.034	.292**	.228**	.246**	.240**	0.116
	PBC1			-.077	--.079	-.001	.027	-.140
		PBC2		-.042	-.091	.088	.117	.066
			PBC3	.102	.162	-.092	-.017	.070
				Int1		.334**	.291**	.156**
					Int2	.320**	.231**	.113
						Beh1		.132
							Beh2	.104

In the light of these results, the NEP scale measurement showed a positive but low degree of correlation with reuse and recycling behaviour in both personal life and practice. This is consistent with similar studies suggesting there is a relationship between environmental attitudes and practices and this relationship can be better revealed when the NEP scale is used for measuring attitudes [9, 20, 26, 27, 36]. The highest degree of correlation was between Intention and general reuse and recycling behaviour, then Intention1 with environmental attitude and reuse and recycling in professional practice.

The fact there is no correlation between factors stated in **Table *3*** and perceived behavioural control and subjective norm can be due to the fact that architects believe the social motives, abilities and

opportunities are not sufficient for encouraging RRBMs. This might be because architects suggest using RRBMs, but it is the client who decides to accept or refuse the suggestion. Overall, it seems that environmental attitudes, Intention and Behaviour make a good triangle of correlation and this correlation is stronger than for other components of the TPB.

4.2. Regression

4.2.1. Prediction of Intention by using NEP results and perceived behavioural control components. Results showed that NEP is a significant predictor of Intention1, with the equation of Intention 1 = 3.206 + 0.313 NEP, p = .001, R2 = .074. Both NEP and Perceived Behavioural Control 3 also predicted Intention2 (statistically significant). The equation was Intention 2 = 2.621 + 0.239 (NEP) + 0.149 (Perceived Behavioural Control 3), p = .010, R2 = .063. When the p-value is less than 0.05, the predictor can be a meaningful addition to the model. It means that changes in the values of the predictors are related to changes in the response values. Coefficients for significant variables are reported regardless of the R-squared value, since studies that attempt to predict human behaviour generally have low R-squared values. A low R-squared does not negate the importance of any significant variables when the interest is in understanding the relationships between variables. Even with low r-squared, relationships and coefficients have the same interpretation and value. All other variables including Perceived Behavioural Control components did not significantly add to the prediction. The present information from the predictors of Intention shows that environmental attitude is the strongest predictor of Intention both for Intention1, which concerns the general intention of acquiring and building sustainable buildings, and Intention2 which is about the use of reclaimed and recycled building materials. When examining Intntion2, Perceived Behavioural Control3 is also a predictor, as Perceived Behavioural Control3 concerns price as an influential factor on purchasing environmentally friendly products. This is consistent with the literature [9, 37, 38]. This component of Perceived Behavioural Control is a stronger predictor of Intention compared to other Perceived Behavioural Control components. It seems that knowing the level of architects' environmental attitudes their Intention can be predicted, and when it comes to the Intention of using RRBMs, knowledge of price would also be important.

*4.2.2. Prediction of behaviour by using the results of NEP and perceived behavioural control and Intention components.*According to the results, Intention2, NEP and Perceived Behavioural Control 2 statistically significantly predicted Behaviour1, Behaviour 1 = -3.486 +1.111 (Intention 2) + + 0.840 (NEP) + 0.433 (Perceived Behavioural Control2), p = .000, R2 = .279. Behavior2 was statistically significantly predicted from NEP and Intention2, Behaviour 2 = -3.810 + 1.201 (NEP) + 0.812 (Intention 2), p = .000, R2 = .158.

It is clear from the results that Intention2, NEP and Perceived Behavioural Control are the strongest predictors of behaviour. For Behavior1, strong predictors are Intention2, NEP and Perceived Behavioural Control2. For Behavior2, strong predictors are only NEP and Intention2. From these results, it appears that Intention2, the intention to RRBMs, is more related to general recycling behaviour and then to this behaviour in construction practices. This is consistent with the literature that environmental attitude (NEP) can be a good predictor of both recycling behaviours in general and in construction practices, but more in construction practices [9, 20, 36], although it is not always a good predictor for other environmental behaviours. Also, another reason as Thøgersen (1994) said, is that in affluent countries like New Zealand, environmental actions can be more predicted from attitudes. Interestingly, Perceived Behavioural Control2 which is associated with related regulations and certification for RRBMs proved to be a stronger predictor for Behavior2, which is about recycling in construction practices and shows the validity of the core intent of the questions asked as another proof of the content validity. This mirrors the results of Klöckner 's study [11].

Measuring the environmental attitudes and intention of architects can thus help in predicting reuse and recycling in the building construction process; that said, the knowledge of architects about regulations and certification can also have an effect on their general recycling behaviour. Since

architects have one of the most critical roles in encouraging clients to use RRBMs, knowing their responsibilities can be a trigger for greater use of these. As mentioned by Ajzen (1991), specifying questions and having a specific target population can better show the correspondence of the components of the TPB. Regression analysis results also revealed an understanding of the whole set of relationships in the TPB (**Figure *2***). From a purely statistical standpoint, standardised coefficients signify the most important variables which are indicated in **Figure *2***.

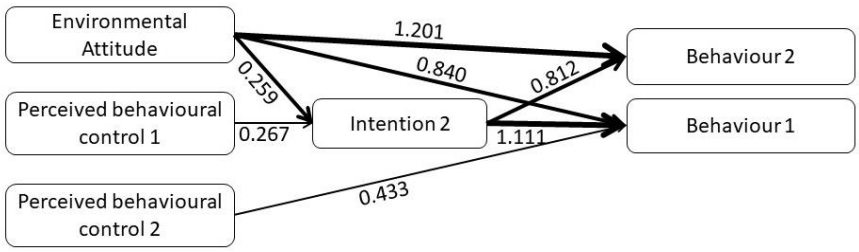

Figure 2. Predictors of Behaviour according to the regression analysis results

The findings of this statistical analysis are consistent with the study of Li et al. (2015), who found attitudes and Perceived Behavioural Control were the two most important predictors of behaviour for designers and architects. **Figure *2*** shows environmental attitude, perceived behavioural control and intention play a role in the relationship model, but the main contributor is environmental attitude and intention. So, a higher degree of environmental attitude should lead to more use of RRBMs and more reuse and recycling activities. Besides, intention as the next predictor is influenced by environmental attitude and perceived behavioural control. Therefore, facilitating the purchase of RRBMs, and increasing knowledge of related regulations and certification will increase their use and lead to more reuse and recycling activities through intention or directly. These factors represent the control over the behaviour, and intention is how hard someone is willing to perform the behaviour. So as long as these opportunities and resources are provided, if someone intends to use RRBMs or undertake reuse and recycling he or she should succeed in performing that behaviour.

5. Conclusion

The present study addresses the gap in knowledge regarding the relationship of the NEP scale to recycling and buying recycled building materials as pro-environmental behaviour. This study also adds to the literature by examining the TPB using a particular population (New Zealand architects). The most important predictor components were the intention of using reclaimed and recycled building materials, environmental attitudes, and perceived behavioural control. This means that architects with stronger environmental attitudes (NEP) have stronger intentions to do more recycling or buy more recycled materials. However, their intentions for these behaviours are also influenced by the cost of these. Also, when architects know more about regulations and certificates related to the use of RRBMs, they will increase these pro-environmental practices. An additional finding was that subjective norm can be removed from the model for this group of people. The main findings of this study were consistent with previous studies that have examined the TPB. However, small modifications were made to the TPB model based on the results in **Figure *2***. Further studies could examine this theory for other professionals in the building construction sector. Based on this study, recommendations can be made in terms of policy and certification to facilitate the purchase of RRBMs and more reuse and recycling activities in the building construction process. Moreover, an integrated design process means involving all stakeholders from the very beginning so they can understand the goal of the project, and thus increase the awareness of all involved. Sharing lessons learned from case studies or projects using RRBMs could help spread knowledge. Educating architectural students on design for disassembly should also provide a future for RRBMs.

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