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The Influence of Message Framing on Project Managers' Behavioral Intentions Regarding Construction Waste Reduction

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Abstract: Construction waste reduction (CWR) is an important approach to tackling the environmental problems resulting from increasing construction and demolition activities. Existing studies have explored various factors influencing construction stakeholders' behavior or behavior intention regarding CWR mainly in terms of individual traits and environmental issues. With the advancement of information society, message framing has been explored as an emerging low-cost nudge approach for promoting pro-environment behavior or behavior intention in various research fields. Yet, few studies have investigated the influence of message framing on project managers' behavior intentions regarding CWR. This study explores the relationship between project managers' behavior intentions regarding CWR and message framing of CWR in terms of economic benefit vs. environmental benefit and small scale vs. large scale. A questionnaire experiment with 120 randomly selected project managers was conducted in Hangzhou. Two-way ANOVA and linear regression were performed to test the hypotheses. The results show that environmental benefit information has a higher impact on project managers' behavior intentions regarding CWR than economic benefit information, while scale framing has an insignificant influence. The findings provide an alternative approach to increasing project managers' awareness of CWR and further improve construction waste management.

Keywords: message framing; project manager; behavior intention; construction waste reduction (CWR); experimental study

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1. Introduction

With the advancement of rapid urbanization and industrialization [1–5], construction and demolition activities have experienced an explosive growth and generated substantial amounts of waste across China [6,7]. It is estimated that approximately 1.13 billion tons of construction waste (CW) were generated in China during 2014, without counting the amount from the renovation of existing buildings [8]. Statistics show that CW constitutes approximately 20–30% of all waste worldwide, with an even higher ratio in developing countries [9]. The large amount of generated CW causes a series of environmental impacts, such as raw material consumption, energy consumption, land depletion, and greenhouse gas emissions [10,11]. Efficient waste management is therefore needed to reduce the generation or increase the reuse of CW for realizing urban resilience [12]. Yet, the main treatment of CW is dumping it in landfills [13]. This situation presents a big challenge with increasing construction activities and limited land resources for landfilling in China.

Construction waste reduction (CWR) therefore is a growing concern among academics, the industry, and the government for tackling such challenges [14]. Technological and policy measures have received the most interest since the beginning [15,16]. In terms

of technological issues, for example, Jaillon [17] found that pre-casting technologies can reduce CW to almost half at the construction stage compared with traditional construction technologies. Integration of parametric design into modular coordination has great potential in reducing waste at the design stage [18]. Ding et al. [11] found that source reduction, e.g., low-waste technologies and on-site management performance, plays a great role in CWR. Daoud et al. [19] found "reducing overall material use by using prefabricated elements and highly durable materials" is the most effective factor for CWR in Egypt. With regard to policies, for example, Tam [20] analyzed the administration system of CW in Hong Kong and found that the system played positive roles in CWR. Li et al. [21] pinpointed that a policy on providing subsidy for each square meter of the prefabrication applied in buildings would have a more significant effect on promoting prefabrication and improving the CWR performance compared to an increase in income tax. Wu et al. [22] proposed promulgation of more specialized regulations, adoption of advanced recycling technologies, development of mature recycling markets, and implementation of high landfilling costs as the key directions for future improvement of CW management in Hong Kong. Wang et al. [23] found that combining guidance-incentive-mandatory policies would achieve better effects for CWR than single policies, with a simulation study. Yet, Barr [24] pinpointed that legislative regulation is insufficient to solve the problem of CWR from the root. The role of human factors in CWR, e.g., stakeholders' attitude and behavior, has therefore gained increasing attentions [25].

Existing studies have examined relevant stakeholders' behavior or behavior intention regarding CWR and the corresponding influencing factors. For example, Lingard et al. [26] found that various factors, including insufficient equipment, lack of high-level managers' attention, and material supply problems, hinder construction workers' CWR in Australia [27]. Osmani et al. [28] identified a lack of interest from clients, attitudes toward waste minimization, and training as disincentives for architects to implement CWR strategies during the design process in England. The establishment of environmental awareness for all the stakeholders was an effective measure to improve construction waste management (CWM) within Spanish construction companies [29]. Suciati et al. [30] found that organizational management, followed by personal factor, organizational culture, and attitude variables, has a significant influence on CWR in Indonesia. Ding et al. [11] claimed that improving stakeholders' waste awareness can promote CW sorting behaviors. Liu et al. [31] found that attitude, subjective norms, group norms, and group efficacy of construction professionals significantly affect CW sorting in China. Yuan et al. [32] identified attitude as the strongest predictor of project managers' waste reduction intentions, followed by subjective norms and perceived behavioral control in China.

However, most studies focus on contractor employees, designers, and construction workers and overlook project manager's CWR behavior or behavior intentions [32]. In addition, the current studies mainly use planned behavior theory to investigate the factors influencing CWR behavior or behavior intentions in terms of individual traits and environmental issues, e.g., the policies and culture established by the company, government, and society. With the advancement of information society, the role of information in influencing behavior and behavior intention has gained increasing attention as the difference in people's views of social and environmental behavior partially depends on the information they receive [33]. Message framing, which manipulates people's perceptions of the outcome of a specific behavior by explaining its benefits (gains) or costs (losses), has been explored as an emerging low-cost nudge approach for promoting pro-environment behavior and behavior intentions [34]. A large number of studies have explored the persuasive effect of message framing in pro-environmental behaviors, e.g., green consumption, reducing food waste, and idle item recycling [35–37]. Yet, the influence of message framing in CWR is kind of overlooked, which presents certain hinderances to providing an alternative approach to promote CWR in the construction industry.

This study therefore aims to investigate the influence of message framing on project managers' behavior intentions regarding CWR. Section 2 reviews relevant studies to lay a

solid basis for hypotheses development. Section 3 introduces the research methods adopted in this study. Section 4 presents the analysis results and discusses the relevant findings. Section 5 concludes the study by specifying the limitations and future studies.

2. Literature Review and Hypotheses

Existing studies investigate behavior or behavior intention regarding CWR based on the theory of planned behavior (TPB). The TPB was proposed by Ajzen [38] to explain human behavior, which claims that attitude, subjective norms, and perceived behavior control collectively explain people's behavior intentions and behaviors. In the TPB model, attitude indicates people's assessment of the performance effect of a behavior, subjective norms mean people's perceptions of others' views on whether they should display a behavior, and perceived behavior control refers to people's perceptions of the presence of the necessary resources for displaying a behavior [32,38]. The TPB provides a broad framework and has been the most widely used theory to explain pro-environment behavior at an individual level [39]. For example, Teo and Loosemore [40] employed the TPB and found that Australian operatives had positive attitudes toward CWR yet displayed few CWR behaviors. Yuan et al. [32] used the TPB and found that attitude was the strongest predictor of Chinese project managers' CW reduction intentions, followed by subjective norms and perceived behavioral control. Jain et al. [39] found that behavioral intention of Indian builders toward CW recycling is mainly driven by personal motivations, regulatory pressures, and environmental consciousness based on the TPB.

Past research demonstrates that a uniform model cannot characterize the complexity of human behavior and behavior intention [39]. The broad framework of the TPB has therefore been adjusted according to specific purposes and contexts to include more variables for increasing the prediction power. Diversified variables have been included for analysis, e.g., moral norms [41], institutions and governance [42], and technological advancements [43]. This study defines a project manager's behavior intentions regarding CWR as the perceived likelihood or subjective probability that he/she will engage in implementing CWR activities [32]. In line with the TPB and the research purpose, this study investigates the influencing factors from the inner and external perspectives of the project managers, namely, individual traits and external pressure or incentives. The individual traits mainly consider perceived behavior control, environmental morality, and self-efficacy, while the external pressure or incentives mainly include social norms and economic incentives as they are prominent issues in the environment field and included in existing TPB studies. This study further introduces message framing as a new factor influencing project managers' behavior intentions regarding CWR. Message framing indicates the technique of expressing information by emphasizing the recommended behaviors to achieve a desired effect or to avoid an undesirable effect [44]. This variable is important as project managers are easily exposed to a large amount of online information regarding CW with the advancement of information society, while the Chinese government also puts various banners on construction sites to raise the environmental awareness of the construction professionals. A large number of studies have explored the persuasive effect of message framing in the context of people's pro-environmental behaviors. In addition, the TPB model leaves room for including message framing as the framed message shows others' views on the assessment of the performance effect of a behavior. This is interconnected with both variables, attitude and social norms, specified by the TPB.

The following subsections review relevant studies on message framing and behavior intentions regarding CWR and develop hypothesis for further testing.

2.1. Message Framing

With advancement of information technologies, messages are increasingly accessible for individuals. How messages change the individual attitude and corresponding behavior is therefore gaining increasing attention. Message framing effects describe the cognitive bias emerging from the way information is communicated or presented [45]. According

to prospect theory, message framing, triggered by potential perceived losses (loss frame) or perceived gains (gain frame) from a specific reference point specified by the presented information, can influence decision making and behavior differently [46]. Past research has classified message framing into risky choice framing, attribute framing, and goal framing [44]. Risky choice framing involves a set of choices in terms of their associated risk, attribute framing describes the same object either positively or negatively, and goal framing characterizes information depending on whether it emphasizes the potential gain or loss resulting from a certain action [47]. Studies found that loss-framed messages are more effective for persuading detection behaviors, while gain-framed messages may be more effective for preventative behaviors [48]. Due to dual benefits brought by environment-friendly behaviors, namely both economic and environmental benefits, message framing effects (i.e., economic vs. environmental benefits) have been investigated. For example, Steg [49] pointed out that when individuals value the environment and are aware of the problems caused by energy use, conservation policies are relatively easy to accept. Xu et al. [50] found that a message on environmental benefits plays a greater role in energy saving awareness than a message on economic benefits. Pellerano et al. [51] found that an economic message added to an environmental message may reduce energy saving intentions. Yet, Wang et al. [36] found that an environmental or monetary benefit message on saving energy makes no difference to Chinese urban residents.

Few studies have investigated the influence of benefit framing on project managers' behavior intentions regarding CWR. By following Rothman and Salovey [48] and Wang et al. [36], we further frame the benefit (gains) message of CWR from economic and environmental perspectives. According to existing studies, CWR can also bring in both economic and environmental benefits. Yuan and Sun [52] reported that reducing 1 ton of CW per day can save RMB 43,800 in 1 year. Some studies [53,54] have also claimed that reducing the 1 ton of CW per day can save 243,455 square meters of land and reduce water pollution by 4599 m^3 in 1 year. Given that CWR and energy conservation behaviors are similar and can be regarded as environmental behavior, this study lists CWR benefit framing as an influencing factor to analyze the project managers' behavior intentions regarding CWR. Thus, the following hypothesis is proposed.

H1. *The project manager's behavior intentions regarding CWR will be greater for those exposed to a message of environmental benefits of CWR compared with those exposed to a message of economic benefits of CWR.*

A message can also be framed with different time scales. Time scales refer to the scope of time involved in a certain phenomenon or process, which is an important issue as construction projects usually vary between several months to several years. Individual perceptions of different units of measurement are different, and the green information demands of different units of measurement may have different effects. For example, Khalil et al. [35] found that more (vs. less) precise numerical information can increase consumer awareness of food waste issues. Wang et al. [36] found that scale framing (large vs. small) has significant effects on energy-saving usage behavior.

Few studies have investigated the scale framing on project managers' behavior intentions regarding CWR. This study divides time scale into small scale (1 day) and large scale (1 year). A large time scale indicates larger accumulative benefits, which is supposed to increase environmental awareness. Thus, the following hypothesis is proposed.

H2. *The project manager's behavior intentions regarding CWR will be greater for those exposed to a message of CWR benefit on a large scale compared with those exposed to a message of CWR benefit on a small scale.*

2.2. Individual Traits

Different individual traits also result in different effects on behavior intentions. Existing studies have investigated critical traits, including perceived behavior control, environmental morality, and self-efficacy.

Perceived behavior control reflects individual perceptions of the degree of difficulty in performing a specific behavior and the degree of self-control exerted in such performance [38]. Perceived behavior control has a positive effect on behavior intention, and a strong perceived behavior control can increase the intention of individuals to execute certain behaviors. For example, Klöckner [55] investigated 56 data sets and found that perceived behavioral control can predict intentions, which in turn act on environmental behavior. Liu et al. [56] identified perceived behavior control as an important influencing factor for construction workers' behavior intention and behavior regarding CWR, with 181 Chinese samples. Yuan et al. [32] claimed that perceived behavioral control has a significant impact on project managers' CWR behavior intentions. Li et al. [57] found that perceived behavioral control exerts an influential impact on contractors' CWR behavior. Jain et al. [39] found that perceived behavioral control drives Indian builders' behavioral intention toward CW recycling, with 260 samples. Thus, the following hypothesis is proposed.

H3. *Perceived behavior control is positively associated with project managers' behavior intentions regarding CWR.*

Environmental morality refers to individual perception of whether an environmental behavior is right or wrong and moral or immoral. Individuals with environmental responsibility usually show more environmentally responsible behavior than individuals without such a trait. For example, Hines [58] proposed that individuals with a sense of moral responsibility typically implement a responsible environmental behavior. Stern [59] found that individuals' environmental morality and responsibility directly affect environmental behavior. Stern [60] also confirmed that responsibility is a basic antecedent variable that affects pro-environmental behavior. Gatersleben et al. [61] found that frugal and moral consumer identities were the strongest predictors of pro-environmental behaviors. Yuan and Li [62] pinpointed that practitioners who do not perceive the waste of materials caused by extensive operations as a bad behavior, and do not feel guilty about causing bad environmental impacts, tend to be apathetic and do not exhibit positive waste reduction behaviors. Jain et al. [39] claimed that environmental consciousness is positively related with Indian builders' behavioral intention toward CW recycling. Therefore, the following hypothesis is proposed.

H4. *Environmental morality is positively associated with project managers' behavior intentions regarding CWR.*

Self-efficacy refers to the degree of self-confidence that individuals can use their own skills to complete a specific task [63–65]. Self-efficacy can determine people's choice of and adherence to an activity and affect people's attitudes and behaviors in the face of difficulties. Self-efficacy has a positive effect on the behavior intention of construction workers regarding CWR [62]. By having appropriate conditions and enhancing confidence in the implementation of waste reduction behaviors, project managers can gradually change their self-cognition and thus adopt a positive attitude for such behavior and implementation [52]. Thus, the following hypothesis is proposed.

H5. *Self-efficacy is positively associated with project managers' behavior intentions regarding CWR.*

2.3. External Pressures or Incentives

External pressures or incentives also play certain roles in individuals in addition to individual traits. This research mainly considers social norms and economic incentives as they are prominent issues in the environment field.

Taihong [66] pointed out that social pressure mainly comes from two aspects, namely, role pressure and the reference crowd effect. Qiu [67] pointed out that any individual living in a certain national culture, economic system, and social environment, and within a certain period of time, exhibits behavior that assumes a specific social role and has corresponding responsibilities, rights, and obligations. Consciously abiding by the agreed social norms is necessary [4]. Tan [68] pinpointed that situational factors influencing a designer's behavior mainly include the social pressure on the project manager regarding CWR and the interaction between peers. Liu et al. [31] identified that group norms significantly affect construction professionals' CW sorting behavior. Meanwhile, the reference group affects individual implementation of specific behaviors. Castronova [69] showed that reference groups can effectively activate people's imitation potential, which further enhances the effect of social norms. Thus, the following hypothesis is proposed.

H6. *Social norms are positively associated with project managers' behavior intentions regarding CWR.*

Economic incentives also affect the individual behavior intentions. Cost control is one of the important goals for project managers. A specific tax system or government subsidy induces the reduction behavior of construction stakeholders. Cooper [70] claimed that solving the problem of effective CW recycling relies on economic incentives, system formulation, and taxation of natural raw materials. Duran et al. [71] found that economic measures, e.g., subsides on CWR, promote CWR in the case of Irish recycling centers. Wang et al. [72] and Liu et al. [73] proposed that the collection of natural resource taxes, fees, and landfill taxes with government incentives and economic policies can guide related enterprises or individuals on CWR and promote CWR among them. Thus, the following hypothesis is proposed.

H7. *Economic incentives are positively associated with project managers' behavior intentions regarding CWR.*

3. Research Method

3.1. Experimental Material Design and Measurement

Experimental material is necessary to arouse the participants' awareness of the preset scenario in the laboratory experiment or questionnaire-based experiment. As shown in Table 1, there are four scenarios to describe the benefits of CWR, namely economic benefit on a small scale (daily), economic benefit on a large scale (annually), environmental benefit on a small scale, and environmental benefit on a large scale. The estimated economic benefit of CWR per day and per year was derived from Yuan and Sun [52], while the estimated environmental benefit of CWR per day and per year was derived from Song and Xia [53] and Su et al. [54]. The expert interview and pilot study were conducted in February 2019 to ensure the accuracy of the presented message, and the adopted material used for the experiment is indicated in Appendix A. This information was displayed as the first part of the questionnaire.

In addition to the experimental material, this study measures the key variables based on existing studies to ensure construct validity. Likert scales (from 1 to 7, ranging from strongly disagree to strongly agree) were used to characterize project managers' views on these variables. The pilot study was conducted in February 2019 to ensure the items can capture project managers' behavior intention regarding CWR and relevant influencing factors. Necessary modification was also made to make them understandable for the project managers. The detailed information on the relevant variables is provided in Table 2. The respondents were invited to provide their views in the second part of the questionnaire.

Table 1. The four scenarios regarding scale and benefit messages in the experiment.

Material	Scale	Benefit	Content
A	Small	Economic	According to the research, reducing 1 ton of CW per day can save RMB 120 in 1 day.
B	Large	Economic	According to the research, reducing 1 ton of CW per day can save RMB 43,800 in 1 year.
C	Small	Environmental	According to the research, reducing 1 ton of CW per day can save 667 square meters of land and reduce water pollution by 12.6m^3 in 1 day.
D	Large	Environmental	According to the research, reducing 1 ton of CW per day can save 243,455 square meters of land and reduce water pollution by 4599 m^3 in 1 year.

Table 2. The measurement of relevant constructs.

Construct	Item	Key References
Perceived behavior control (PBC)	PBC1. It depends entirely on my own choice to undertake CWR during the construction management process.	[74,75]
	PBC2. I can control the effectiveness of CWR during the construction management process.	
	PBC3. CWR is a simple thing for me if I am willing to take actions.	
Social norms (SN)	SN1. Public opinion pressure to ensure public energy conservation and environmental protection prompted me to reduce CW.	[76]
	SN2. I am also willing to strengthen CWR if the construction industry attaches importance to CWR.	
Self-efficacy (SE)	SE1. When I formulate a CWR plan, I will put the plan into implementation.	[77]
	SE2. I am willing to put great effort into CWR.	
	SE3. If I cannot achieve CWR at the beginning, I will keep trying to achieve it.	
Environmental morality (EM)	EM1. I feel that I have the responsibility to implement CWR during the construction management process.	[78,79]
	EM2. I would have a sense of guilt if I did not implement CWR, which causes adverse effects.	
Economic incentive (EI)	EI1. I am willing to implement CWR if it can reduce costs and improve profits.	[80]
	EI2. I am willing to implement CWR if the government policy incentive measures are reasonable and feasible.	
Behavior intention regarding CWR (BIC)	BIC1. I am interested in CWR.	[32,73,81]
	BIC2. I support CWR.	
	BIC3. I will promote CWR if I have never paid attention to CWR before.	
	BIC4. I will pay more attentions to the details of CWR if I have taken measures of CWR before.	
	BIC5. I am willing to invest more time and energy into CWR than before.	
	BIC6. I am willing to change the previous management behavior to realize CWR.	

This study also includes the general background information of the respondents themselves and the companies they work in as control variables. The control variables include gender (1 = male; 0 = female), age (1 = 21–30 years old; 2 = 31–40 years old; 3 = 41–50 years old; 4 = over 50 years old), education (1 = high school and below; 2 = college; 3 = undergraduate; 4 = graduate and above), work experience (1 = under 5 years; 2 = 5–10 years; 3 = 10–15 years; 4 = 15 years or more), company size (1 = micro size with operation revenue < 3 million RMB/year; 2 = small size with operation revenue between 3 million RMB/year and 60 million RMB/year; 3 = mid-size with operation revenue between 60 million RMB/year and 800 million RMB/year; 4 = large size with operation revenue $\geq$ 800 million RMB/year), company qualification (1 = Grade 3, the lowest grade in China; 2 = Grade 2; 3 = Grade 1, the highest grade in China), company type (1 = state-owned; 0 = private owned), and policy availability for CW management (0 = unavailable; 1 = available merely on paper; 2 = available and operated in practice). The respondents were invited to fill out the background information in the third part of the questionnaire.

3.2. Data Collection

The authors conducted the experimental survey in Hangzhou between March and April 2019. Due to difficulties in accessing project managers, the relatives and partners of the authors were contacted to seek potential project managers. After establishing a pool of 120 reachable respondents, the project managers were randomly assigned into four groups specified by the four different scenarios of message regarding CWR benefit in Table 1 for further experimental survey. Figure 1 demonstrates the procedure adopted in this study. During the survey, the academic purpose was fully explained to the participants to obtain their permission to participate in the survey. Each participant was only involved in one randomized scenario to fill the questionnaire. Explanation was made where necessary to make the participants fully understand all the questions. The background of the sample is shown in Table 3.

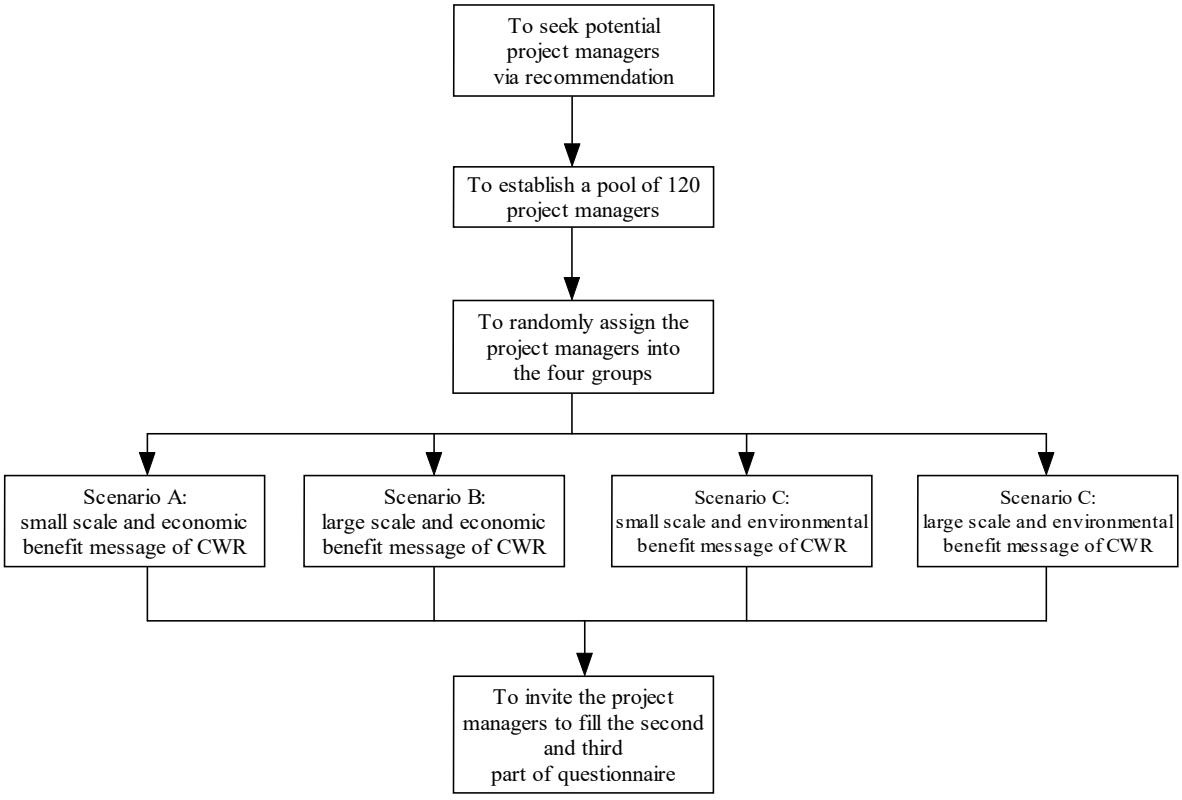

Figure 1. The procedure of the questionnaire-based experiment.

Table 3. The background information of the sample.

Variable	Attributes	Quantity	Percentage
Message scenario	Scenario A	30	25%
	Scenario B	30	25%
	Scenario C	29	24%
	Scenario D	31	26%
Gender	male	74	61.7%
	Female	46	38.3%
Age	21~30 years old	37	30.8%
	31~40 years old	52	43.3%
	41~50 years old	25	20.8%
	Over 50 years old	6	5.0%
Education	High school and below	9	7.5%
	College	32	26.7%
	Undergraduate	69	57.5%
	Graduate and above	10	8.3%
Work experience	Under 5 years	36	30.0%
	5~10 years	52	43.3%
	10~15 years	24	20.0%
	15 years or more	8	6.7%
Company size	Micro size	16	13.3%
	Small size	30	25.0%
	Mid-size	58	48.3%
	Large size	16	13.3%
Company qualification	Third grade	35	29.2%
	Secondary grade	65	54.2%
	First grade	20	16.6%
Company type	State-owned enterprise	35	29.2%
	Private enterprise	85	70.8%
Policy availability	Unavailable	20	16.7%
	Available merely on paper	81	67.5%
	Available and operated in practice	19	15.8%

3.3. Analysis Method

First, SPSS 19.0 was used to examine the inner reliability of the questionnaire with Cronbach's alpha. In general, Cronbach's alpha coefficient above 0.9 indicates excellent reliability, above 0.8 indicates good reliability, and 0.7 indicates acceptable reliability [82]. As shown in Table 4, Cronbach's alpha is fine for all the involved variables except for that of environmental morality, with the value of 0.564. This may be the result of the large age and education spans of the respondents, where the respective moral evaluation standards may not be uniform. The coefficient is close to 0.6, which is considered within the basically acceptable range. In addition, the corrected item-to-total statistics (CITC) were conducted. As shown in Table 4, the CITC values of all items pass the threshold of 0.4 and the questionnaire is considered reliable according to Yuan et al. [32]. Meanwhile, we also conducted confirmatory factor analysis (CFA) to find the factor loading for each item. The results demonstrate that all factor loading values are higher than 0.5. Thus, all items are kept for the following regression analysis, as suggested by Wang et al. [83].

Table 4. Reliability of the measurements.

Variable	Item	Factor Loading	Corrected Item-To-Total Correlation	Cronbach's Alpha
Perceived behavior control	PBC1	0.759	0.681	0.775
	PBC2	0.587	0.503	
	PBC3	0.731	0.685	
Social norms	SN1	0.661	0.747	0.854
	SN2	0.620	0.747	
Self-efficacy	SE1	0.730	0.612	0.738
	SE2	0.732	0.627	
	SE3	0.674	0.488	
Environmental morality	EM1	0.635	0.409	0.564
	EM2	0.682	0.409	
Economic incentive	EI1	0.853	0.755	0.860
	EI2	0.838	0.755	
Behavior intention regarding CWR	BIC1	0.659	0.643	0.885
	BIC2	0.723	0.651	
	BIC3	0.757	0.800	
	BIC4	0.757	0.749	
	BIC5	0.665	0.662	
	BIC6	0.670	0.682	

After confirming the reliability of the data, we further averaged the value of items of each variable to characterize the variable for further analysis by following Bao and Peng [64]. We further used two-way ANOVA statistics to find whether the behavior intention regarding CWR is significantly different between the economic benefit group (represented by 0) and the environmental benefit group (represented by 1) and between the small-scale group (represented by 0) and the large-scale group (represented by 1), by following Gasteiger et al. [84]. Finally, we used linear regression to examine the association of various influencing factors and behavior intention regarding CWR as it is commonly used in investigating influencing factors, there are insufficient samples to analyze with the structural equation model, and it lacks a reliable non-linear regression model to examine the relationship [32,64,84].

4. Results and Discussion

4.1. Two-Way ANOVA Analysis

Table 5 demonstrates the statistics of the involved variables under the four scenarios. By focusing on the research objective, it is found that the mean value of behavior intention regarding CWR is the highest under scenario D (exposed to the large-scale-environmental-benefit message), followed by that of scenario C (exposed to the small-scale-environmental-benefit message) and that of scenario B (exposed to the large-scale-economic-benefit message), and the mean value under scenario A (exposed to the small-scale-economic-benefit message) is the lowest. It seems that different messages have different influences on the project managers' behavior intentions regarding CWR. We further used two-way ANOVA analysis to find whether the benefit message and the scale message have a statistical influence on the behavior intentions regarding CWR. As demonstrated in Table 6, the test results indicate that the benefit message has a significant influence on the behavior intention regarding CWR, while it is insignificant for the scale message. Thus, hypothesis 1 is accepted and hypothesis 2 is rejected.

Table 5. Statistics of involved variables under the four scenarios.

	Scenario A (n = 30)		Scenario B (n = 30)		Scenario C (n = 29)		Scenario D (n = 31)	
	M	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
PBC	3.523	1.2716	3.073	0.8275	4.893	1.2518	5.081	1.1629
SN	4.217	0.9973	4.383	1.5519	5.155	1.5184	6.032	0.9655
SE	4.160	0.6061	4.440	0.9775	4.452	1.2746	5.006	1.1355
EM	3.800	0.7497	4.483	1.6320	5.500	1.1339	5.339	1.2409
EI	4.217	1.3110	4.700	1.5403	4.828	1.5485	5.645	1.3428
BIC	4.410	0.6392	4.617	1.0834	5.107	0.8594	5.303	0.9368

Table 6. Two-way ANOVA statistics of behavior intention regarding CWR.

	Mean Squares	**DF**	**F**	**Sig.**
Benefit	14.347	1	17.915	0.000
Scale	1.217	1	1.520	0.220
Benefit × scale	0.001	1	0.001	0.975

4.2. Linear Regression Analysis

The two-way ANOVA analysis mainly used the parametric test to identify the influence of message framing, which overlooks other potential influencing factors. We further used linear regression to jointly examine the influencing factors specified in the hypothesis. As shown in Table 7, benefit has a positive influence on the behavior intention regarding CWR at the significance level of 10%, while scale has no significant influence on the behavior intention regarding CWR. It further echoes with the result of the two-way ANOVA analysis that hypothesis 1 is accepted and hypothesis 2 is rejected. Perceived behavior control (PBC), environmental morality (EM), and social norms have a significant positive influence on the behavior intention regarding CWR at the significance level of 1%. That is to say, hypotheses 3, 4, and 6 are accepted. Furthermore, it is found that self-efficacy (SE) and economic incentive (EI) have an insignificant influence on the behavior intention regarding CWR. Therefore, hypotheses 5 and 7 are rejected. In addition, CWM policy availability among the control variables is found to have a significant positive influence on the behavior intention regarding CWR.

4.3. Discussion

This study frames a benefit message of CWR in terms of economic benefit vs. environmental benefit and in terms of small scale vs. large scale. It is found that benefit framing has a positive influence on project managers' behavior intentions regarding CWR. The project managers exposed to an environmental benefit message tend to display higher behavior intentions regarding CWR than those exposed to economic benefits, verified both by two-way ANOVA and by linear regression. The result is inconsistent with the message framing on energy-saving behavior conducted by Wang et al. [36] but consistent with other studies on energy conservation behavior, e.g., Bolderdijk et al. [85] and Xu et al. [50]. The follow-up interview demonstrates that project managers are more sensitive to the environmental benefits as economic benefits are normally indispensable for business operation but environmental benefits have a higher moral appeal. Social expectation on the behavior may adjust the behavior intention in the self-reported survey. This potential reason implies that taking actual behavior as a dependent variable is necessary to further testify the identified relationship. In addition, the study found that there is no significant influence of the message framed around small scale vs. large scale. The result is inconsistent with the message framing study on energy-saving behavior conducted by Wang et al. [36]. The existing studies demonstrate that significant numerical salience influence respondents' behavior intentions or behaviors. The follow-up interview found that project managers are usually exposed to much larger numbers as the contract sum of a building project is significantly

larger than that of common energy-saving-related cost. The difference of the designed (small vs. large) scale may not be significant enough to arouse project managers' awareness in other research fields. This implies that we should take the research targets' sensitivity to numbers as a consideration when designing the experimental materials. Different types of people (e.g., characterized by career) may have different thresholds related to increased awareness of significance of numbers indicated by existing studies.

Table 7. Regression on behavior intention regarding CWR.

Model	Non-Standardized Coefficient		Standardized Coefficient	t	Sig.
	B	Standard Error			
Constant	0.905	0.456		1.983	0.050 **
Benefit	0.273	0.156	0.143	1.746	0.084 *
Scale	0.024	0.129	0.012	0.184	0.854
PBC	0.168	0.060	0.250	2.812	0.006 ***
SN	0.268	0.055	0.410	4.872	0.000 ***
SE	0.021	0.062	0.024	0.349	0.728
EM	0.207	0.049	0.303	4.271	0.000 ***
EI	0.073	0.049	0.115	1.482	0.141
Gender	0.134	0.121	0.068	1.108	0.271
Age	0.274	0.271	0.244	1.013	0.313
Education	0.118	0.091	0.091	1.290	0.200
Work years	−0.261	0.260	−0.240	−1.005	0.317
Company size	0.123	0.083	0.113	1.481	0.142
Company quality	0.063	0.102	0.044	0.616	0.539
Company type	−0.034	0.140	−0.016	−0.246	0.807
Policy availability	0.228	0.107	0.137	2.128	0.036 **
F					12.371
P					0.000
N					120
R-square					0.641
Adjusted R-square					0.589

Note: * stands for significance at a 10% level, ** stands for significance at a 5% level, and *** stands for significance at a 1% level.

This study finds that the individual traits in terms of perceived behavior control and environmental morality have a significant influence on project managers' behavior intention regarding CWR. The results are consistent with existing studies on CWR, e.g., [32,39,56,57]. As explained by past research, higher perceived behavior control indicates that project managers' inner motivation can exert great efforts to promote CWR even though there are challenges. Project managers with higher environmental morality normally pay higher attention to the environmental impacts of certain behaviors and therefore have higher behavior intention regarding CWR. Yet this study found that self-efficacy has an insignificant influence on project managers' behavior intention regarding CWR, which is inconsistent with existing studies. The potential reason is that some other factors mediate the relationship between self-efficacy and behavior intention regarding CWR. The reason needs further examination, with practical observation and theoretical analysis.

In terms of the mentioned external pressure and incentives, this study finds that social norms have a significant positive influence on behavior intentions regarding CWR. The results are consistent with existing studies on CWR, e.g., [32,39,56,57]. The construction project manager can minimize waste management if they perceive pressure from social environment and observe CWR measures taken by peer companies. Greater and more widespread pressure results in greater understanding of the environmental problems caused by CW. Yet, economic incentive has an insignificant positive influence on behavior intentions regarding CWR. This may be the result of a reason similar to the one faced in the benefit message framing. What project managers believe in or are familiar with may influence their behavior intentions. This echoes with the finding that project managers in companies that have made CWM policy and implemented would have higher behavior intentions regarding CWR compared with those in companies with no such policies.

Based on the findings, we further propose several managerial implications. First, publicity should be paid due attention to promote project managers' behavior intentions regarding CWR. Information publicity and advertising are widely used in environmental protection in the construction industry yet few are about CWR. To stimulate project managers' behavior intention regarding CWR, it is necessary to strengthen the popularization and promotion of CWR information. Through online and offline publicity channels, in addition to using traditional publicity, such as newspapers, posters, and publicity boards, TV media, environmental protection websites, new media (including Weibo), and WeChat should be combined to enhance the appeal of CWR. In addition, CWR can be included in relevant vocational training to create a good social environment for building energy conservation and CWR. This may be useful in formulating the social norms and peer pressure to ensure project managers pay attention to CWR. Second, evidence-based design of message content is necessary. As demonstrated by this study, message framing does influence the behavior intention regarding CWR. More environmental benefit information publicity is necessary to help project managers more clearly understand the major harm to the environment caused by CW and the important value of their own actions to environment. Compared with the economic benefit, the environmental benefit of CWR makes information publicity more contextual and concrete. The message better displays the details of potential behaviors and what kind of good results these bring, to arouse the project managers' self-actualization needs. Other framing strategies investigated in other research fields can be also explored in promoting CWR. Third, company support is encouraged when project managers face challenges in implementing CWR. CWR is a complicated issue jointly influenced by various stakeholders, e.g., the company, the industry, and the government. So even if the project managers have self-efficiency in CWR, they may have problems in exerting that behavior if company support is lacking and their confidence cannot be turned into an ability to take steps toward CWR. Based on the existing CWM policy that emphasizes what should be done, the supplementary policy, focusing on what can be provided, can further push for CWR.

5. Conclusions

This study examines the influencing factors of project managers' behavior intentions regarding CWR, with special focus on benefit framing and scale framing regarding CWR. Based on a questionnaire experiment, two-way ANOVA, and regression, this study found that benefit framing of CWR influences the project manager's behavior intentions regarding CWR. Environmental benefit information has a higher influence than economic benefit information. Perceived behavior control, environmental morality, social norms, and policy availability of CWM have significant positive impacts on the project managers' behavior intentions regarding CWR. By contrast, scale framing of CWR benefit, self-efficacy, and economic incentive has an insignificant influence on the behavior intentions regarding CWR. Potential measures have also been proposed to increase project managers' behavior intentions regarding CWR.

The findings provide a reference to improve CW management and further enhance resource efficiency and environmental protection. It should also be noted that there are still several limitations in this research. First, due to the limitation of the research method and data availability, this study investigated the behavior intention rather than the behavior regarding CWR. The behavior intention obtained through self-report may not match with the real behavior adopted. Future study can measure CWR behavior with change of real CW output on construction sites. Field experiment with research logic similar to the one in this study can be undertaken to investigate the influence of benefit framing and scale framing regarding CWR on project managers' CWR behavior. Second, the sample may be insufficient, which presents certain challenges to generalizing the findings. Although the authors tried their best to reach as many project managers as possible, it is still difficult to claim that the sample is sufficient to represent the whole population of project managers. Future studies can collaborate with industry associations, e.g., various academies of architecture,

and use hierarchical random sampling to conduct the questionnaire experiment. Third, the influencing mechanism of benefit framing and scale framing on CWR needs in-depth exploration. Although this study used the experiment method to discover the influencing factor, the logic behind still needs to be uncovered. Future studies can consider a neural experiment to identify the cognition mechanism that may play a role at the individual level. Field experiment with panel data may also be useful to identify the social mechanism that may explain why the message can influence the project managers' behavior intentions regarding CWR. Fourth, other contextual factors that may influence project managers' behavior intentions regarding CWR were not included in message framing. Future studies can include the contextual factors, e.g., group efficacy and organizational performance, as control variables to better measure the effects. Fifth, variable measurement has some limitations. This study found a low inner consistency of the variable of environmental morality, which may result in misinterpretation of the regression results. In addition, this study merely framed messages in terms of economic benefit vs. environmental benefit and small scale vs. large scale, while there are also other strategies (e.g., loss vs. gain) to frame a message. Future study should improve the measurement based on updated studies and include other framing strategies for analysis. Finally, repeated study is recommended as the study was conducted in 2019. The social-economic environment has been changed since then. For example, the Chinese central government proposed the strategy of realizing the peak of carbon emission before 2030 and carbon neutrality before 2060. This strategy presents challenges and therefore requires new practices in the construction industry and CW management. Message framing with updated practices, e.g., the benefit of carbon emission reduction brought by CWR, therefore needs further exploration.

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Appendix A. The Experiment Material Description

Please read the following information carefully, **at least twice**, and then complete the following questionnaire.

Scenario A—Economical Benefit/Small Scale

Strengthening construction management is the start to reducing the generation of construction waste. The realization of construction waste reduction is under your control. Without much effort, reducing 1 ton of construction waste every day can save 120 RMB per day.

Scenario B—Economical Benefit/Large Scale

Strengthening construction management is the start to reducing the generation of construction waste. The realization of construction waste reduction is under your control. Without much effort, reducing 1 ton of construction waste every day can save 43,800 RMB per year.

Scenario C—Environmental Benefit/Small Scale

Strengthening construction management is the start to reducing the generation of construction waste. The realization of construction waste reduction is under your control. Without much effort, reducing 1 ton of construction waste every day can save 667 square meters of land and reduce 12.6 cubic meters of water pollution per day, which improves the living environment.

Scenario D—Environmental Benefit/Large Scale

Strengthening construction management is the start to reducing the generation of construction waste. The realization of construction waste reduction is under your control. Without much effort, reducing 1 ton of construction waste every day can save 243,455 square meters of land and reduce 4599 cubic meters of water pollution per year, which improves the living environment.

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