LITTERING BEHAVIOR ANALYSIS BASED ON SURVEY AND QUESTIONNAIRE ABOUT LITTERING IN THE NAGASE RIVER

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ABSTRACT: The present study aims at understanding the quantities and types of litter in and along the Nagase River, and analyzes littering behavior using a questionnaire. Plastic bags, including shopping bags and confectionery wrappers, were the most frequently observed items in the Nagase River. Cigarette-related litter (e.g. cigarette butts and packaging) and drink bottles (e.g. PET bottles, beverage cans) were the most frequently observed types of litter on the streets along the Nagase River. The questionnaires completed by passers-by and students in the schools and a university near the Nagase River were analyzed (N=731). The rate of those who actually littered in the Nagase River and the streets along the river was 14%, and the main kinds of litters were confectionary wrappers, cigarette-related, PET and glass bottles, cans, and plastic bags. The questionnaire results were subjected to covariance structure analysis to determine factors contributing to littering behavior. The results show that, social norms are the most important factor influencing the act of littering, and awareness of the anti-social nature of littering in daily life is strongly related.

Keywords: Litter, Field survey, Questionnaire, Covariance structure model

1. INTRODUCTION

Littering has become a notable problem for urban areas since the formation of modern society in the mid-19th century. It has serious effects on our residential and natural environments, and various regulations are in place around the world, including laws, fines, and bylaws placing obligations on citizens (although the force of these regulations differs). Despite this, littering remains an unresolved global problem [1]–[4].

Much attention is given to the problem of littering, and many researchers have conducted questionnaire surveys on the topic [5]–[12]. However, these have not led to significant reductions in litter. It is necesary to investigate the reasons for littering, and develop effective measures to combat this problem.

This study surveyed littering at Nagase River in Osaka Prefecture. A field survey was conducted in and along Nagase River to investigate what major kinds of garbage were recently being thrown away there, as well as in which areas people were more likely to litter. A questionnaire survey was done to passers-by and students attending schools in the area. In addition to comparing these results with those of the field survey, the covariance structure analysis to analyze behavioral factors behind littering and yielding some useful insights was used.

2. FIELD SURVEY ON LITTERING AT NAGASE RIVER

2.1 Nagase River

The object of this study, Nagase River, runs through Kashiwara, Yao, and Higashi-osaka Cities in Osaka Prefecture of Japan. The river is between 6 and 10m wide, and is approximately 14km long. Factories are concentrated 2km from the river source, but most of the remainder of the riverside is general residential areas. A relatively large number of beautification initiatives are carried out at Nagase River by Tsukidome-tochikairyou Ward, which manages the river, as well as by local residents and elementary school children. These initiatives include litter cleanup, planting of aquatic vegetation, and releasing young fish into the river.

A field survey of garbage littered in and along the river was conducted. Initially, a survey of the river itself was conducted as this facilitate the investigation of a specific location to ascertain the realities of littered garbage. However, this provides the insight into the garbage floating in the river. Therefore, a survey of the streets along the river to the study was also demonstrated.

2.2 Results of the Littering Survey in Nagase River

Screens are installed at ten locations along the river to collect garbage and vegetation etc. at regular intervals. Three selected screens are: Site A (34° 59′ 36 N, 135° 62′ 12 E), Site B (34° 64′ 77 N, 135° 57′ 60 E), and Site C (34° 67′ 70 N, 135° 57′ 40 E), and surveyed the litter found there. Site A is located approximately 1.5km

from the source of the river, Site B 10km, and Site C 12.5km. The survey was conducted on November 10 and 24, 2010.

Some garbage have man-made items and excluded naturally occurring items such as fallen leaves and vegetation. At each of the three sites we collected the garbage caught in the screens and within the temporary storage baskets, separated it, and measured the volume of garbage for each category of garbage on site. We then took the separated garbage with us and dried it for 1-3 days before measuring its dry weight.

Table 1 shows the dry weight and volume of each category of garbage. Site B is close to a railway station and has more pedestrian traffic, resulting in a much greater amount of garbage being collected here than at other sites. In terms of the total dry weight at all of the sites, papers and magazines made up the largest proportion with 24%, followed by shopping bags at 22%, and plastic trays at 20%. In terms of total volume at all the sites, shopping bags made up the largest proportion with 41%, followed by confectionary wrappers and trays at 17% each. In conclusion, plastic bags stood out as a common type of litter.

2.3 Results of the Littering Survey on Streets along Nagase River

Figure 1 gives the aggregate results of the litter found walking on the streets along Nagase River for four days in October 2011. We found 186 items of littered garbage, falling into 14 different categories. The most common item was cigarette butts, of which there were 54, followed by cans at 31. Cigarette butts and boxes together totaled 70 items, and beverage-related items were also common with the total for PET bottles, glass bottles, and cans coming to 51 items. The plastic bags that we found in large quantities in Nagase River were not common on the streets along the river. Other than cigarettes, litter was found in specific places. These were typically in inconspicuous places such as around street-side greenery where there were many shrubs and leaves,

in bushes and flowerbeds, or in the corners of benches, and tended to be near railway stations, convenience stores, supermarkets, and vending machines. Cigarettes were an exception, and were littered over a wide area. This tendency could be explained by the fact that cigarettes are smaller than other items of garbage, or that the age group throwing them away is predominantly adults.
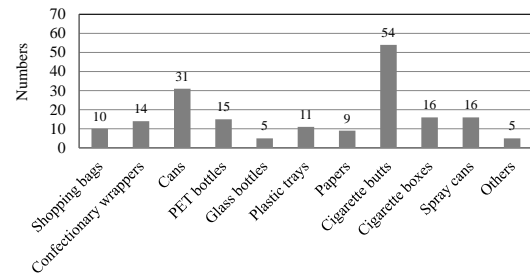

Fig.1 Garbage found littered on the streets along Nagase River

3. QUESTIONNAIRE SURVEY ON LITTER AND SUBSEQUENT ANALYSIS OF LITTERING BEHAVIOR

3.1 Overview of Questionnaire Survey

A questionnaire was administered face-to-face to passers-by in December 2011, and by dissemination method to students attending schools along Nagase River from April to December 2012. We received a total of 73 responses to the 2011 survey, of which 73 were valid (effective response rate of 100%). For the 2012 survey we received a total of 679 responses, of which 658 were valid (effective response rate of 96.9%). Table 2 shows the number of respondents to both the 2011 and 2012 surveys by gender and age. The gender distribution was fairly equal, with males making up 46% of respondents, and females 54%. As the proportion of shopping bags and confectionary wrappers was high in the field survey,

Table 1 Dry weight and volume of each category of litter collected in Nagase River

Garbage category	Site A		Site B		Site C	
	DW [g]	V [L]	DW [g]	V [L]	DW [g]	V [L]
Shopping bags	217	15.0	486	28.0	167	15.0
Confectionary wrappers	117	9.5	109	7.0	73	8.0
PET bottles, cans, and drink boxes	29	1.0	360	5.0	145	2.5
Plastic trays	95	4.5	316	6.0	378	13.5
Papers and magazines	3	0.01	897	12.5	63	1.0
Others	113	6.5	121	3.0	344	3.5
Total	574	36.5	2289	61.5	1170	43.5

Note: DW and V means dry weight and volume of garbage.

the questionnaire focused mainly on young people, and students made up 90% of the respondents. Table 3 shows the questions included in the questionnaire. All of the questions, with the exception of Q1, Q11, Q11-1 and Q11-2, asked respondents to answer on a 3-point scale. This design was chosen with elementary and junior high school students in mind.

3.2 Overall Questionnaire Results

In response to Q1, which asked how often respondents came by Nagase River, 64% answered five days a week or more, and 73% said they came by at least once a week. Interest in the littering issue was low; in response to Q2 'Are you interested in the garbage problem at Nagase River?', 39% and 43% of respondents answered 'No' or 'Neither', respectively. In response to Q4 'Do you think places where people have littered are unpleasant?', 77% answered that they did.

In response to Q3 'Do you think Nagase River has been dirtied by garbage?', 49% of respondents said they did. In contrast, in response to Q5 'Do you think that the streets along Nagase River are dirty?', 17% said 'Yes' while 27% said 'No'. Thus, Nagase River itself was seen as dirtier than the streets along the river.

Table 2 Age and gender composition of questionnaire respondents

Age	M	F	NA	Total
ES (Age 7-12)	24	18	0	42
JHS (Age 13-15)	95	80	2	177
HS	3	243	0	246
U	177	15	1	193
Age 20-39 (exc U)	16	11	0	27
Age 40-59	9	9	0	18
Age 60+	12	14	0	26
Unanswered	2	0	0	2
Total	338	390	3	731

Note: ES, JHS, HS, and U mean elementary school students, junior high school students, high school students, and university students. Most HS and U students are age 16-18 and age 19-22. Age 20-39 (exc U) means respondents aged from 20 to 39 except for university students. M, F, and NA mean male, female, and unanswered, respectively.

Table 3 Questions asked in the questionnaire survey on litter

	Questions	ES	JHS	HS	U	O
Q1	How often do you come by Nagase River?	●	●	●	●	●
Q2	Are you interested in the garbage problem at Nagase River?		●	●	●	●
Q3	Do you think Nagase River has been dirtied by garbage?	●	●	●	●	●
Q4	Do you think places where people have littered are unpleasant?		○	●	△	●
Q5	Do you think that the streets along Nagase River are dirty?		○	●	△	●
Q6	Do you say anything to those who litter?	●	●	●	●	●
Q7	Are you careful not to litter?		●	●	●	●
Q8	What do you do when you can't find a garbage bin?	●	●	●	●	●
Q9	How far would you go to throw garbage in a bin?		○	●	△	●
Q10	Do we need some kind of strategy for reducing garbage at Nagase River?		○	●	△	●
Q11	Have you ever littered at Nagase River?	●	●	●	●	●
Q11-1	Please tell us what kind of garbage this was.		□	□	□	□
Q11-2	Please tell us what you were thinking when you littered.		□	□	□	□
Q11-3	Was there already litter where you threw your garbage?		□	□	□	□
Q12	Reasons that littering occurs,					
Q12-1	Because no one is watching.	●	●	●	●	●
Q12-2	Because there are no garbage bins.	●	●	●	●	●
Q12-3	Because it's too much effort to carry it around.	●	●	●	●	●
Q12-4	Because the river is already dirty so people don't mind doing it.	●	●	●	●	●
Q12-5	The garbage problem can be solved through hard work by ourselves and governments.		○	●	△	●
Q13	Do you think people would stop littering if there was a 1000 yen fine?	●	●	●	●	●

Note: ES, JHS, HS, U, and O mean elementary school students, junior high school students, high school students, university students, and others. ● mean that all respondents in each age group answered. ○ mean that two respondents among JHS age group answered. △ mean that 80 respondents among U age group answered. □ mean that respondents except for ES said 'Yes' in Q11 answered.

The responses to Q3 by age group, among elementary school respondents, the proportion of respondents answering 'Yes' was very high at 95%. On the other hand, 'I have no strong opinion' was selected by 25% of high school age respondents and above, showing that their disinterest in the problem was relatively high.

In response to Q6 'Do you say anything to those who litter?', 52% of elementary school students said that they did, with only 5% saying that they did not. In contrast, 53% of junior high school students, 65% of high school students, 79% of university students, and 69% of other respondents said that they do not, showing an upward trend with age. In response to Q7 'Are you careful not to litter?', the proportion of those answering 'No' was highest among junior high school students at 18%, and this was 6% for high school students, 10% for university students, and 7% for other respondents.

In response to Q8 'What do you do when you can't find a garbage bin?', 57% of elementary school students said 'Carry it until I get home'. Junior high school students were the most likely to say they would litter, at 20%. Among high school students, 64% said they would 'Throw it in a garbage bin at a nearby train station or shop', and this figure was 65% for university students. In response to Q9 'How far would you go to throw garbage in a bin?', 37% said 'Within 5m,' a further 37% said '6-10m,' and 26% said '11m or more.' In response to Q10 'Do we need some kind of strategy for reducing garbage at Nagase River?', 37% answered 'Yes.'

In response to Q11 'Have you ever littered at Nagase River?', 14% said that they had (99 out of 731 respondents). This was 28% of junior high school students, 10% of elementary school students, and 4% of high school and university students. In terms of gender, 19% of males and 9% of females said that they had littered at the river. The groups with the highest proportion of those who had experience of littering at Nagase River were male junior high school students with 32% and female junior high school students with 24%.

In response to Q11-1 'Please tell us what kind of garbage this was,' confectionary scored the highest with 41 instances, followed by cigarettes at 16, PET bottles, glass bottles and cans at 15, and bags at 8. 'Confectionary/Candy' was written by respondents under 'Other,' and is assumed to include confectionary wrappers. In other words, items found to be common in our field survey were also in the top items given by respondents in the questionnaire. In response to Q11-2 'Please tell us what you were thinking when you littered,' 25% of respondents said that 'There was nowhere to throw the garbage away,' and 21% said 'It was too much effort to carry it around. Meanwhile, 17% said that

'No one was watching,' 12% said 'Just because I don't know,' and 6% said 'The river was already dirty.' In this way the results showed that many people littered when there was no garbage bin in the area and they had garbage that they did not want to make the effort to carry with them. In response to Q11-3 'Was there already litter where you threw our garbage?', 40% answered 'Yes' and 28% answered 'No,' revealing that the pre-existence of garbage was an inducing factor for littering, albeit not a very strong one.

For Q12 'Reasons that littering occurs,' the responses for Q12-1 to Q12-4 are given in Figure 2 for all respondents and Figure 3 for those who had ever littered at Nagase River (hereafter, simply `litterers`). 'Because it's too much effort to carry it around' was the most popular answer, selected by 69% of all respondents and 54% of litterers. There was also a relatively high proportion of respondents who answered either 'Because there are no garbage bins' or 'Because no one is watching.' For all respondents as well as litterers, around 40% answered 'Yes' to 'Because the river is already dirty so people don't mind doing it,' making the effect of this smaller than any of the above three factors. In Q12-5, 40% of respondents said that they agreed with the statement 'The garbage problem can be solved through hard work by ourselves and governments.'

In response to Q13 'Do you think people would stop littering if there was a 1000 yen fine?', around 30% of all respondents and a similar proportion of litterers said 'Yes,' and 40% said 'No,' lending weight to the idea that introducing a fine system may not be an effective littering deterrent.
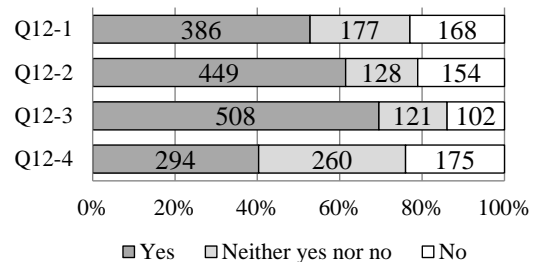
	Yes	Neither yes nor no	No
Q12-1	386	177	168
Q12-2	449	128	154
Q12-3	508	121	102
Q12-4	294	260	175

Fig.2 Responses to Q12 'Why do you think littering occurs?' – all respondents

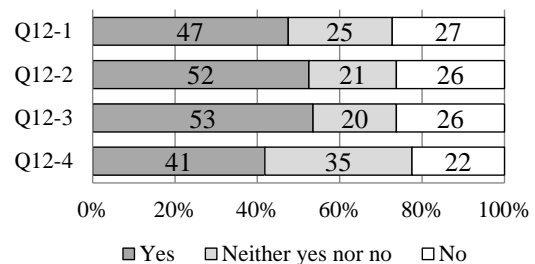|	Yes	Neither yes nor no	No
Q12-1	47	25	27
Q12-2	52	21	26
Q12-3	53	20	26
Q12-4	41	35	22

Fig.3 Responses to Q12 'Why do you think littering occurs? – litterers

3.3 Analysis of the Factors Contributing to Littering Behavior

3.3.1 Exploring the contributory factors for littering behavior

In order to investigate and model the factors contributing to littering, we conducted exploratory factor analysis. We used the principal factor method to extract factors with oblique rotation (Promax). SPSS 20.0 was used to conduct the exploratory factor analysis.

The questions included in the analysis were those with a large number of responses: Q1 to 3, Q6 to 8, Q11, Q12-1 to Q12-4, and Q13 – a total of 12 questions. Individuals with missing values were excluded, leaving n = 618. (Including missing values when constructing a model means an associated inability to completely calculate goodness of fit for the model.) Factor analysis, rotating only those factors with an eigenvalue greater than, extracted three factors, accounting for a cumulative 34% of variance, as shown in Table 4. No strong correlation was found between any of the factors: the correlation coefficient between Factors 1 and 2 was -0.094, between Factors 2 and 3 was 0.343, and between Factors 1 and 3 was 0.062. Given the variables in each factor loading, 'selfishness' was regarded as Factor 1, 'environmental awareness' as Factor 2, and 'social norms' as Factor 3.

3.3.2 Building a covariance structure analysis model

The exploratory factor analysis revealed that littering behavior was built on three factors: selfishness, environmental awareness, and social norms (latent variables). We constructed a causal model of these latent variables and each question in the questionnaire (observed variables), which we called Model 1 (see Figure 4). Then, given that the

Table 4 Results of exploratory factor analysis

	Factor		
	1	2	3
Q12-2	**0.691**	0.042	-0.045
Q12-3	**0.682**	-0.092	0.056
Q12-1	**0.557**	0.041	-0.032
Q12-4	**0.493**	0.028	0.021
Q3	0.035	**0.652**	-0.064
Q2	-0.017	**0.443**	0.143
Q7	0.041	-0.019	**0.587**
Q8	-0.049	0.046	**0.429**
E	1.507	0.836	0.367
C (%)	18.838	10.449	4.588
CC (%)	18.838	29.287	33.875

Note: E, C, and CC mean eigenvalue, contribution, and cumulative contribution.

correlation coefficient between environmental awareness and social norms was larger than that between other factors, we added this correlation to construct Model 2 (see Figure 5). In these figures, the path coefficient from each observed error variable (e) and disturbance variable (d) to their corresponding latent variable was set at 1, while the path coefficient for one path from each latent variable to one corresponding observed variable was also set at 1 (i.e. Q12.1 for selfishness, Q2 for environmental awareness, Q7 for social norms, and Q11 for littering behavior). Amos 20.0 was used to conduct covariance structure analysis.

3.3.3 Results and discussion

The covariance structure analysis determined the path coefficients for Model 1 and Model 2 as shown in Figures 4 and 5, respectively. The path coefficients for each model were significant at the 95% level. The fit indicators for each model are also given in Table 5. Both models would be rejected if we considered the P value of the chi-square test, but
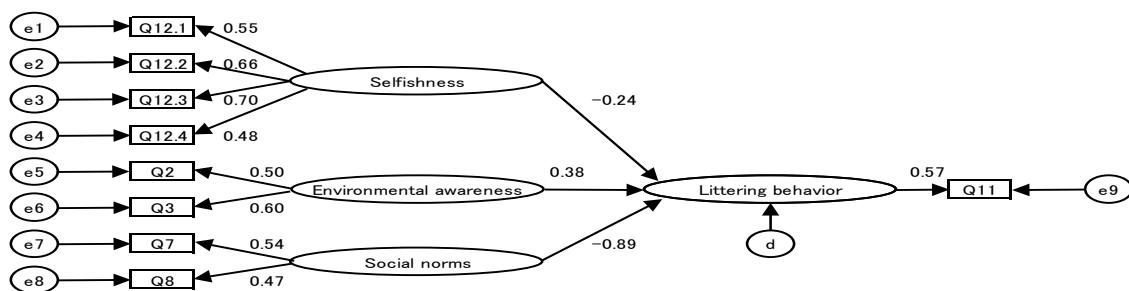

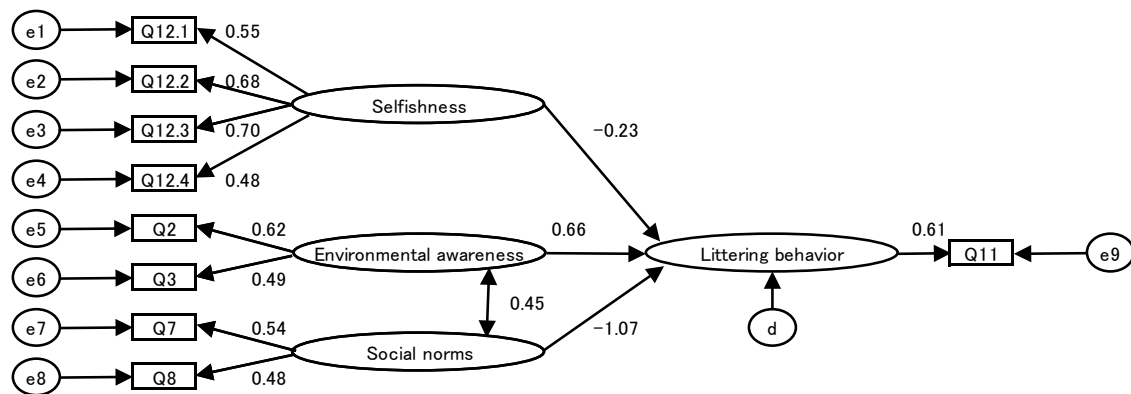Fig. 4 Model 1 - Path coefficients of covariance structure analysis

Fig. 5 Model 2 - Path coefficients of covariance structure analysis

as a large amount of data was used (618 cases), the use of other indicators such as GFI could be considered appropriate. For GFI, AGFI, and CFI, both models scored at least 0.9, meaning their fit was good. In terms of RMSEA and RMR, both models scored close to 0, also indicating a good fit. A smaller AIC value indicated a better fit, meaning that Model 2 had the better fit of the two. Comparing the fit indicators for the two models, Model 2 could be considered the most accurate model. If we look at the path coefficients for Model 2, the factor exerting the most influence on littering behavior is social norms: with the social norm of whether the respondent usually tries not to litter especially strongly related.

4. STRATEGIES FOR REDUCING LITTER

Based on the model constructed from the field and questionnaire surveys at Nagase River, potential effective strategies for reducing litter was considered. In the questionnaire described above, we also asked junior high school students the following: 'Have you ever learned about the environment at school (Environmental Education)? If so, what did you learn about?' The responses to this are given in Figure 6. Responses included reference to litter cleanup activities, environmental education lectures, and initiatives for environmental preservation. Of the 19 students who said that they had participated in litter cleanup activities, only 4 had littered. Actually picking up litter appears to give students awareness that litter dirties our community and does not simply go away on its own, making such activities potentially effective ways of educating students not to litter. With regard to preventing cigarette-related litter, a further questionnaire survey focusing on smokers and other adults will need to be carried out in the future.

Table 5 Indicators of fit of each model

		Model 1	Model 2
$\chi 2$ test	CSV	64.168	40.345
	DF	25	24
	SP	0.000	0.020
GFI		0.979	0.986
AGFI		0.961	0.974
CFI		0.937	0.974
RMR		0.023	0.015
RMSEA		0.050	0.033
AIC		104.168	82.345

Note: CSV, DF, and SP mean chi square value, degree of freedom, and significant probability.
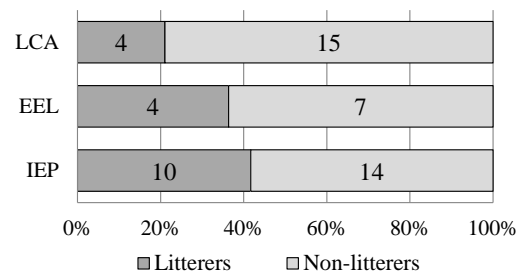

Fig. 6 Proportion who had littered of those who had participated in each type of environmental educational activity
Note: LCA, EEL, IEP mean 'Litter cleanup activities', 'Environmental education lectures', and 'Initiatives for environmental preservation'.

5. CONCLUSION

In this study, littering behavior was analyzed by a field survey of garbage littered in and along Nagase River and a questionnaire to passers-by and students attending schools in the area. The results are summarized as follows.

(1) In a field survey of garbage littered in Nagase River, plastic bags, including shopping

bags and confectionery wrappers, were the most frequently observed item of litter.

(2) In a field survey of garbage littered on the streets along the Nagase River, cigarette-related litter (e.g. cigarette butts and packaging) and drink bottles (e.g. PET bottles, beverage cans) were the most frequently observed types of litter.

(3) The rate of those who actually littered in the Nagase River and the streets along the river were 14% for all respondents and 28% for junior high school students, and the main kinds of litters were confectionary wrappers, cigarette-related, PET and glass bottles, cans, and plastic bags.

(4) Factors contributing to littering behavior were determined by a covariance structure analysis using questionnaire results. Social norms are the most important factor influencing the act of littering.

(5) Litter cleanup activities as well as picking up litter appear to give students awareness that litter dirties our community and does not simply go away on its own, making such activities potentially effective ways of educating students not to litter.

6. ACKNOWLEDGEMENTS

7. REFERENCES

[1] Keep America Beautiful, Littering Behavior in America Results of a National Study, 2009.

[2] ENCAMS, London: Its People and their Litter, 2009.

[3] Environmental Resources Planning, LLC, 2012 Toronto Streets Litter Audit, 2012.

[4] Keep Australia Beautiful Council WA, Litter Prevention Strategy for Western Australia 2015-2020, 2015.

[5] Cialdini R.B., Reno R.R., and Kallgren C.A., A focus theory of normative conduct: Recycling the concept of norms to reduce littering in public places, Journal of Personality and Social Psychology, Vol.58, 1990, pp.1015–1026.

[6] Huffman K.T., Grossnickle W.F., Cope J.G., and Huffman K.P., Litter reduction: A review and integration of the literature, Environment and Behavior, Vol.27, 1995, pp.153–183.

[7] Milfont T.L. and Duckitt J., The structure of environmental attitudes: A first- and second-order confirmatory factor analysis, Journal of Environmental Psychology, Vol.24, 2004, pp.289-303.

[8] Sibley C.G. and Liu J.H., Differentiating active and passive littering: A two-stage process model of littering behavior in public spaces, Environment and Behavior, Vol.35, 2003, pp.415–433.

[9] Liu J.H. and Sibley C.G., Attitudes and behavior in social space: Public good interventions based on shared representations and environmental influences, Journal of Environmental Psychology, Vol.24, 2004, pp.373-384.

[10] Larson L.R., Stedman R.C., Cooper C.B., and Decker D.J., Understanding the multi-dimensional structure of pro-environmental behavior, Journal of Environmental Psychology, Vol.43, 2015, pp.112-124.

[11] Schultz P.W., Bator R.J., Large L.B., Bruni C.M., and Tabanico J.J., Littering in Context: Personal and Environmental Predictors of Littering Behavior, Environment and Behavior, Vol.45, 2013, pp.35‑59.

[12] Renée J. Bator R.J., Bryan A.D., and Schultz P.W., Who Gives a Hoot? : Intercept Surveys of Litterers and Disposers, Environment and Behavior, Vol.43, 2011, pp.295–315.