The Effects of Social Ties and Local Environment on Appropriate Waste Station Maintenance of Household Waste: A Case Study in Sapporo

Yasuhiro MORI*, Susumu OHNUMA**, Christian KLÖCKNER***

Abstract : "Waste stations", where residents dispose of household waste, are usually maintained by the residents themselves; however, not all stations are well maintained. It was hypothesized that the level of waste station maintenance would correlate with the degree of social ties in the community, and would be influenced by local environment in the area around the waste station. A combination of observational and survey research methods were employed to test these hypotheses. Self-reported inappropriate disposal behavior and social ties were measured using a questionnaire survey, while the level of maintenance of waste stations and local surrounding environment were recorded using observational methods. Data from 508 residents, assigned to 102 waste stations in 23 local areas of Sapporo, Japan, were analyzed. Sequential regression analysis indicated that social ties in the community was the stronger predictor of the management level of waste station than the self-report disposal behavior. Furthermore, multi-level model tests revealed that the level of management of waste stations was predicted by the local surrounding environment, which provided spatial reminders of community interactions. This indicates that managing the local surrounding environment is an important intervention to encourage appropriate waste station management.

Key Words : household waste, inappropriate disposal behavior, waste station, social ties, local surrounding environment, observed behavior

INTRODUCTION

1)Waste station maintenance in Sapporo

In Sapporo, household waste is disposed of by placing designated disposable bags in "waste stations". Waste stations are designated areas for the collection of waste, usually located next to a road for ease of access. Each waste station is usually shared by 10–20 households but there can be more users in larger apartment buildings. The waste stations are typically managed by the residents who make use of them, with residents cleaning, and setting up the waste stations. Although the majority of waste stations are well managed, some are in a poor condition with overflowing contents and unclean surroudings. Around waste stations that are poorly managed, conflicts often develop between local residents due to inappropriate disposal. Accordingly, keeping waste stations well maintained is a crucial acitivity for local communities. Therefore, it is useful to explore the factors differentiateing well managed and poorly managed waste stations. This study aimes to examine the daily disposal of household waste and the issue of waste station maintenance in relation to both social ties (i.e., relationships in the community among neighbors) and local environment (i.e., gathering space such as parks and squares) through a case study conducted in Sapporo.

Many existing studies have focused on littering (Schultz, Bator, Large, Bruni, & Tabanico, 2013; De Kort, McCalley, & Midden, 2008) and recycling (Matthies, Selge, & Klöckner, 2012; White & Hyde, 2012). However, although these studies provide various ideas relating to changing behaviors, few studies that have involved interventions to promote behavioral changes have taken due consideration of both social ties and local

*,** Hokkaido University, Graduate School of Letters, Behavior Science.

*** Norwegian University of Science and Technology, Department of Psychology.

environmental factors. Hence, although it is useful to adopt the approaches promoted in previous finidings to encourage appropriate disposal behavior, it is also necessary to incorporate due consideration of social ties and local environments.

2)Social ties to the community and waste management

Previous studies have shown that social ties to the community play fundamental roles in establishing Gesellschaft (MacIver, 1917), social capital (Bourdieu, 1986; Putnam, *et al.*, 1993; Putnam, 2000; Sampson, *et al.*, 1997), and social networks (Berkman & Syme, 1979; Granovetter, 1973). These concepts collectively refer to the idea that social bonds are important for people to sustain a community, as they serve as part of the foundation of their daily lives.

Pretty (2003) argues that people generally display increased confidence to become involved with collective activities when they can expect that others will also do so. Moreover, under such conditions people are less likely to engage in private actions that have a negative impact on collective resources, such as the degradation of common spaces (Pretty, 2003; Pretty & Ward, 2001). Similarly, Putnam (2000) argues that participation in local community organizations creates cohesion among neighbors, generating positive resources for participants and the wider neighborhood.

Social ties in the community are used as a measure of a community involvement. Fisher (1982) argues that the number of friends within towns and communities influences attitudes and behaviors related to community life. Similarly, Weenig & Midden (1991) used the number of acquaintances as a measure of weak and strong ties when examining participation in energy saving program. Furthermore, the number of acquaintances, whom an individual has within a neighborhood, was found to correlate with recycling behavior and appropriate waste separation behavior (Ando, *et al.*, 2007; Ohnuma & Ando 2000). Based on these findings, this study employed the number of acquaintances as a measure of social ties.

It is hypothesized that the better waste stations are managed, the stronger the observed social ties in the relevant community (H1).

3)Local environment

In addition to social ties, the local environment can affect the management of waste stations in the community. Many different kinds of artificial structures are found in communities, which can be regarded as spatial reminders of the community, such as communal gathering spaces (i.e., parks and squares) and the results of community activities (i.e., flowerbeds and community bulletin boards). These are usually considered to be shared or semiprivate spaces, which can affect littering behavior (Liu & Sibley, 2004). Kelling and Coles (1996) suggest that the appearance of a surrounding physical environment can provide a message that serves to regulate individual behavior. A disordered physical environment is thus not only a consequence of neglect but also a signal that generally prohibited behaviors are tolerated (Duneier, 1999; Harcourt, 2001).

Accordingly, a second hypothesis is derived that the local environment surrounding waste stations will be related to the state of management of waste stations, that is, the more local community facilities and spaces there are, the better waste stations will be managed (H2).

1. METHODS

1.1 Overview of the data collection

Data was collected at three levels; the individual level, the waste station level, and the area level. Our main analysis focuses on the waste station level; however, additional data was also recorded at the 'area' level covering several waste stations. First, a pilot study based on observational methods was conducted, in which the state of waste station management was measured. The state of management was graded on the basis of the extent of inappropriate disposal behavior. Second, the physical features of the surrounding areas were recorded. Third, a questionnaire survey was conducted for

individuals who used well-managed or badly managed waste stations. The questionnaire consisted of items addressing the extent of inappropriate disposal behavior, social ties in the community, and demographic variables.

1.2 Observation of waste stations

Approximately 800 waste stations in Sapporo were observed for a three-week period from 8 a.m. until noon by observers walking through the areas. The observers counted the bags disposed at each waste station (specifically: the number of total disposals, appropriate disposals, and inappropriate disposals) and gathered information about waste station usage (e.g., whether the waste station belonged to an apartment building or a detached house, and the number of households using each waste station). In the case of an apartment building, observers noted the name of the building, the number of apartments occupied, and the presence or absence of an entrance with an automatic security lock. All the records were crosschecked by comparing independent reports from two or more observers. If any records did not match, they were reexamined collectively on the spot. Additionally, pictures were taken of all observed waste stations and then a random selection of pictures were compared against their ratings by an independent set of investigators to confirm that the records were accurate. Furthermore, to help visualize the information collected, the locations and other related data were entered into an online map. In well-managed waste stations, household waste was disposed in the assigned spaces (Fig. 1). Identical colored bags were disposed simultaneously, implying that there was no inappropriate disposal[1] (Fig. 2). In contrast, household waste found in poorly managed waste stations was often found to be overflowing and disorderly (Fig. 3). Furthermore, different colored bags, indicating different types of household waste, were visible, implying inappropriate disposal. Cases of inappropriate disposal are labeled by garbage collectors with red cards and are thus straightforward to identify (Fig. 4).

An aggregated waste station score was calculated on the basis of 3 weeks of observations

Fig. 1 An example of a well-managed waste station (waste disposals fit into the assigned space)

Fig. 2 An example of a well-managed waste station (appropriate types of waste disposals are lined up)

Fig. 3 An example of a poorly managed waste station (different types of waste disposals are overflowing)

Fig. 4 An example of a poorly managed waste station (labeled with red cards indicating inappropriate disposal)

of waste stations. As the criteria for inappropriate disposal differs according to the type of material collected, each waste station was observed four times on different collection days (two days for burnable waste, once for plastic containers and packaging, and once for cans, glass bottles, and PET bottles). Each waste station was assigned a score ranging from 0 to 8 points. A point was added at each observation if one or more inappropriate disposal[2] was observed at the waste station. Another point was added if one or more bags sealed with red cards were present, indicating that the garbage collector had detected inappropriate disposal. With four observations, the worst possible score was 8, while the best score was 0. We rated conditions strictly with only one inappropriate disposal adding one point to the waste station score. Because of the point distribution across waste stations, we defined well-managed waste stations as those with scores of 0–2 points and poorly managed waste stations as those with scores of 3–8 points. This grouping choice was also made in order to establish comparable sample sizes for the well-managed and poorly managed categories (Table 1). Finally, 102 waste stations were chosen in the areas monitored, consisting of an equal amount of extremely well-managed (n = 50) and poorly managed waste stations (n = 52). The study therefore used a quasi-experimental design by

Table. 1 Frequency distribution on waste station score

	Well-managed			Poorly managed					
Waste station score	0	1	2	3	4	5	6	7	8
Frequency	27	15	10	4	8	9	9	10	10
%	26.5	14.7	9.8	3.9	7.8	8.8	8.8	9.8	9.8

contrasting the extreme ends of the spectrum to obtain more readily interpretable effects.

For the next stage, areas that contained 4–6 waste stations of the same status of management were selected and then the local physical environment surrounding them was assessed. If an area contained 4–6 well-managed waste stations, it was categorized as an organized area. Similarly, an area containing 4–6 poorly managed waste stations was categorized as a disorganized area. Another criterion applied to demarcate a specific 'area' was that all waste stations had to be within walking distance from each other and uninterrupted by a large street, thereby realistically serving as a small community entity. Organized and disorganized areas were selected that contained approximately an equal number of detached houses and apartments. Following such methods, 23 areas were selected: 11 organized areas with well-managed waste stations and 12 disorganized areas with poorly managed waste stations.

1.3 Observed features of the area

In addition to the observations related to waste stations, we conducted observations of the local environment surrounding these waste stations, on an area level. Observers were sent to score each area in terms of whether the following features were present: 1) the area includes small parks (or squares), 2) schools or institutions; 3) holds extracurricular activities such as private piano schools; 4) provides public (or semiprivate) space for people to gather and interact; 5) a community bulletin board or 6) a board member's house[3] belonging to the Neighborhood Association and finally, 7) the presence of kitchen gardens or flowerbeds. There features were selected as spatial reminders of the community by parity of reasoning to features of the neighborhood related to crime (Sampson et al., 1977) and "broken window"

(Kelling and Coles, 1996) theory, which were modified to apply to the Japanese community setting. Every area was observed twice on a weekday morning (from 10 a.m. to noon) during fine weather. Pairs of observers judged whether the seven indicators listed above were present in each area (presence: 1 point, absence: 0 points), they took pictures, and marked the observed locations on the map. After observation, two independent researchers inspected the pictures and observation records to ensure uniformity in standards.

Finally, from the data collected a principal components analysis was conducted on the observed data, and two components were extracted, namely "Space to connect with people" and "Contact with evidence of community bonds" (Table 2). How often these two components were observed in organized and disorganized area were compared (Table 3). Both "Space to connect with people" and "Contact with evidence of community bonds" were more frequently observed in the organized area than disorganized area.

1.4 The questionnaire survey

A questionnaire was distributed to all of the individuals who used the surveyed waste stations. Researchers personally visited every household to distribute the questionnaires, and asked the respondents to send the completed form back if they agreed to participate. The participants enclosed their responses in an envelope with no identifiable personal information, and returned their responses by mail. The survey items included the participants' self-reported disposal behaviors and perceived quality of social ties. The researchers visited 3159 households, and obtained an acceptance rate of 19.2%. However, a higher compliance and response rate was found in the organized areas than in the disorganized areas, although for both areas most of the questionnaires accepted were returned (Table 4).

Self-reported inappropriate disposal behavior was measured by nine items (Appendix), on a four-point scale (1: not at all – 4: very frequently, α = .77). In addition, the respondents were asked about social ties in their community using four items. Three of the items were measured on a four-point scale, while one item was open-ended: "How strong are the social ties of your household to the neighborhood?" (1: not at all strong – 4: very strong); "How many acquaintances do members of

Table. 2 Principal component analysis on local surrounding environment

	F1	F2	Communality	α
● Space to connect with people				
・Small park	.86	.21	.77	.66
・School, Institution	.72	.10	.53	
・Extracurricular activities	.60	-.33	.46	
・People gathering and walking	.58	-.01	.33	
● Contact with evidence of community bonds				
・Community bulletin board	.05	.84	.70	.64
・House of a board member of Neighborhood Associations	−.20	.71	.55	
・Kitchen garden, flower bed	.34	.70	.60	
Eigenvalue	2.10	1.85		
Variance explained	.31	.25		

Note.

The figures written under F1 and F2 are factor loadings, the value varies from -1 to 1. A value closer to 0 indicates the item does not relate strongly with the factor, while a value closer to 1 indicates a closer relationship with the factor. Finally, a value closer to -1 indicates that the item has a negative relationship with the relevant factor. Communality is an indicator of how much the extracted factors explain the measured variables. The maximum value for this is 1 and the minimum value is 0. Higher communalities indicate a better fit with the measures,

α means Cronbach's alpha, which measure scale reliability. The alpha coefficient ranges in value from 0 to 1. A reliability score of 0.60 or higher is indicative of a stronger connection between items measured. Eigenvalues are an indicator used to judge which number of factors is most appropriate. The higher eigenvalues are, the stronger the relation between the factors and the measured variables. The variance explained divides eigenvalues by the number of measured variables.

Table. 3 Average and SD on local surrounding environment

	Organized areas (n=11)	Disorgnaized Areas (n=12)	
Space to connect with people	.59 (0.36)	.27 (0.20)	$t(15.303)=2.62$, $p<.05$
Contact with evidence of community bonds	.76 (0.26)	.36 (0.36)	$t(21)=2.99$, $p<.01$

Table. 4 Acceptance rate and response rate by area

	Organized areas	Disorganized areas
Acceptance rate (acceptance of visited)	31 % (362 of 1,158)	13 % (264 of 2,101)
Response rate (response of accepted)	87 % (315 of 362)	73 % (193 of 264)
Valid responses	n = 315	n = 193

your household have with local residents?" (1: 0 persons, 2: 1–4 persons, 3: 5–19 persons, 4: > 20 persons); "How much do you know about your neighborhood?" (1: do not know anything – 4: know a lot); and "How many people do you greet when you happen to meet them on the road?" The responses to this question were log transformed before analysis to obtain a normal distribution (α = .61).

Demographic data (age, occupation, residential status, belonging to a Neighborhood Association, residence duration, marital status, and the number of people living together) were also collected using the self-report questionnaire. All demographic variables were coded for the analysis: Age was categorized into eight categories (1: 10-20 years to 8: 80 years and older). Occupation was coded as to the current degree of employment (1: retired, 2: housewife, 3: part-time job, contracted and self-owned, 4: full-time employment). Residential status was coded as apartment versus house (1: apartment, 0: house) and rented versus self-owned (1: rented, 0: self-owned). Belonging to a Neighborhood Association was coded according to the degree of experience serving on a board (1: not belonging at all, 2: belonging to Resident's Association but not having experience of the board, 3: belonging to a Resident's Association and being on the board or having previously been on the board). Residential duration in the area was coded from 1 to 7 (1: less than 5 years, 2: 6 - 10 years, 3: 11 - 20 years, 4: 21 - 30 years, 5: 31 - 40 years, 6: 41 - 50 years, 7: more than 50 years) and marital status was coded in three categories (1: unmarried, 2: divorced or separated, 3: married or have a spouse). Finally, the number of people living together was coded from 1 to 5 (1: 1 person, 2: 2 persons, 3: 3 persons, 4: 4 persons, 5: more than 4 persons). Discontinuous variables among demographics variable such as occupation, residential status, belonging to a Neighborhood Association, and marital status were transformed to dummy variables in the following reported analyses.

1.5 Analysis design

Three analyses were conducted at the individual, waste station, and area level. At the individual level, the correlation between self-reported inappropriate disposal behavior and social ties in the community was analyzed (N = 508: organized areas: n = 315; disorganized areas: n = 193). At the waste station level, the correlations between overall waste station score, aggregated self-reported inappropriate disposal behavior, and aggregated self-reported social ties in the community were analyzed (N = 102: well-managed waste stations: n = 50; poorly managed waste stations: n = 52). At the area level, correlations were computed between the aggregated waste station scores, aggregated self-report data, and indicators of local circumstances recorded through observation (N = 23: organized areas: n = 11; disorganized areas: n = 12). Finally, the variables at waste station and area levels were entered into a two-level analysis.

2. RESULTS

2.1 Individual level analysis

First, demographic variables were compared between organized and disorganized areas. There were significant differences between these areas in terms of demographics (Table 5) and as such, all relevant demographic variables were controlled for in the following analyses reported.

A comparative analysis was made between organized and disorganized areas in self-reported inappropriate disposal behavior and social ties (Table 6). The difference in inappropriate disposal behavior between organized areas and disorganized areas was significant, indicating that

Table. 5 Difference between areas on demographics

		Organized areas (%)	Disorganized areas (%)	
Sex	Male	31.41	42.19	$\chi 2(1) = 6.03^{*}$
	Female	68.59	57.81	
Occupation	Housewife	31.49	10.00	$\chi^2(7) = 67.53^{***}$
	Part-time job	12.01	14.74	
	Company employee	16.23	27.89	
	Contracted employee	3.90	7.37	
	Self-employed	6.82	3.68	
	Retirement	24.68	15.79	
	Student	2.92	11.05	
Residential status	Rented apartment house	24.59	79.03	$\chi^2(3) = 139.87^{***}$
	Self-owned apartment house	23.93	3.76	
	Rented house	10.49	3.23	
	Self-owned house	40.98	13.98	
Belonging to Neighborhood Association	Not belonging	9.06	49.47	$\chi^2(2) = 116.90^{***}$
	Belonging to Neighborhood Association but not having experience of the board	47.25	38.30	
	Belonging to Neighborhood Association and on or having been on the board	43.69	12.23	
Residence duration	0–5 years	25.24	62.11	$\chi^2(6) = 82.86^{***}$
	6–10 years	16.29	14.74	
	11–20 years	17.57	8.42	
	21–30 years	18.53	4.21	
	31–40 years	9.27	8.42	
	41–50 years	8.31	1.05	
	More than 51 years	4.79	1.05	
Marital status	Unmarried	10.93	45.79	$\chi^2(2) = 114.49^{***}$
	Divorced or separeted	18.33	30.00	
	Married	70.74	24.21	

$^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$

Table. 6 The difference of inappropriate disposal behavior and social ties in the community

	Organized areas (n=11)	Disorgnaized Areas (n=12)	
Inappropriate disposal behavior	1.43, (0.37)	1.78, (0.55)	$t(282) = 7.60$, $p < .001$
Social ties in the community	2.86, (0.64)	1.98, (0.82)	$t(326) = 12.6$, $p < .001$

respondents from disorganized areas reported more inappropriate disposal behavior than those from organized areas, which was consistent with the definition attributed through observation. As for the difference in social ties in the community, a significant difference was found between organized and disorganized areas. Respondents from disorganized areas had weaker social ties with their communities compared to those from organized areas.

Table. 7 Regressions of self-reported inappropriate disposal behavior on individual level

	1	2	3
Social ties	$-.43^{***}$	$-.14^{*}$	$-.19^{***}$
Age		$-.34^{***}$	$-.34^{***}$
Occupation (Retired)		-.03	-
Occupation (Housewife)		-.07	-
The number of people living together		-.04	-
Marital status		-.08	$-.10^{*}$
Residential status (Self-owned)		-.03	-
Residential status (House)		-.07	-
Belong to Residents Association		-.05	-
R^2	$.18^{***}$	$.29^{***}$	$.28^{***}$
ΔR^2		.11	

$^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$

Note.
Figure in this table is standard partial regression coefficient.
First and second regression used the forced entry method and the third regression used the stepwise method.

Next we conducted sequential regressions to examine the predictors of self-reported inappropriate disposal behavior (Table 7). In the first step, self-reported inappropriate disposal behavior was regressed on social ties. The effect of social ties was found to be a significant predictor. Before going to the second step, as an intermediate step, a multiple regression analysis using the forced entry method was conducted to identify the significant demographic variables impacting self-reported disposal behavior. The results showed that age (β = -.37, p <.001), occupation: housewife (β = -.08, p <.10) and belonging to a resident's association (β = -.09, p <.10) were all significant. Following this, as the second step, a multiple regression was conducted using a forced entry method with combined social ties and demographic

variables as the independent variables. The results obtained showed that social ties and age predicted self-reported inappropriate disposal behavior significantly, but the other demographic variables were no longer significant. However, multicollinearity was observed in the model (VIF_{max} = 2.36, $Tolerance_{max}$ = .42). To resolve this issue, in the third step, a multiple regression analysis employing a stepwise entry method was conducted. The results proved to be very similar to those obtained with the forced entry method in step 2 (Table 7), increasing confidence in the validity of the result. In this model social ties remained significant after controlling for demographics.

2.2 Waste station level analysis

At the waste station level: first, correlation coefficients were calculated between the waste station score and aggregated scores of self-reported inappropriate disposal behavior and social ties. These correlations were significant with aggregated self-reported inappropriate disposal behavior correlating positively with waste station score (r = .48, p < .001, n = 102); and aggregated self-reported social ties correlating negatively (r = −.64, p < .001, n = 102). The correlation between the waste station score and the self-reported inappropriate disposal behavior indicated that the self-reports were reliable. Furthermore, the correlation between waste station scores and aggregated social ties indicated that H1 was supported at the waste station level in relation to observed behavior.

Following this, a sequential regression to examine the predictors of the waste station score was conducted (Table 8). In the first step, a regression of the waste station score on self-reported inappropriate disposal behavior was performed. The results revealed that self-reported inappropriate disposal behavior was a significant predictor of the waste station score. As the second step, a multiple regression of waste station scores on self-reported behavior and social ties using the forced entry method was conducted. The results showed that social ties were a stronger predictor of the waste station score than self-reported

Table. 8 Regressions of waste station score on waste station level

	1	2	3
Inappropriate disposal behavior	.48***	.11	—
Social ties		-.56***	-.39***
The number of people living together			-.33**
R^2	.23***	.40***	.44***
ΔR^2		.17	.04

***p < .001, **p < .01, *p < .05

Note.
Figure in this table is standard partial regression coefficient.

inappropriate disposal behavior, which did not produce a significant additional effect. Following this, as an intermediary step we conducted another multiple regression of the waste station score using a forced entry method, but this time using only aggregated demographic variables as the independent variables. The results revealed that, the effect of residential status (self-owned) (β = -.24, p <.10), marital status (β = -.22, p <.10) and the number of people living together (β = -.23, p <.10) were significant predictors of waste station score. Other demographic variables were not significant.

After completing this analysis, the third multiple regression was conducted using a forced entry method. Self-reported inappropriate disposal behavior, social ties, and all demographic variables were included as independent variables. The results revealed that social ties (β = -.34, p <.10) and age (β = .36, p <.10) affected waste station scores but all other variables were not significant. However, again multicollinearity was found in the model (VIF_{max} = 6.89, $Tolerance_{max}$ = .15). Therefore, another regression analysis using a stepwise entry method was conducted. The results obtained revealed that waste station score was significantly predicted by social ties and the number of people living together (Table 8). Social ties were found to be the strongest predictor of waste station score, even when controlling for demographic variables, which echoed the results found at the individual level.

2.3 Area level analysis

The area level data obtained by observational

measurements were aggregated into two scores on the basis of the principal component analysis (Table 2) and these were then used in the analysis reported below. First, a correlation analysis was conducted between the waste station scores aggregated to the area level and the two components of local surrounding environmental conditions. Negative correlations were found between the waste station score and both components of local surroundings ("contact with evidence of community bonds": $r = -.46$; "space to connect with people": $r = -.51$), which implied that the greater the possibilities each area offered for community bonding and connecting with other people, the better managed the waste stations in the area were (as the lower station scores indicated better upkeep).

Finally, a multi-level analysis was conducted to test the influence of variables that were measured on different levels. A two-level regression model was specified with waste station scores ($n = 102$) nested in 23 areas as the dependent variable (Table 9). The independent variables were social ties in the community and inappropriate disposal behavior aggregated by waste station at the individual level and the two components of local surrounding environmental conditions, "contact with evidence of community bonds" and "space to connect with people," at the area level. The results revealed that waste station score was significantly predicted by both components of the between-area variation in waste station scores local components of local surroundings, "contact with evidence of community bonds" and "space to connect with people," at the area level.

However, at the waste station level, aggregated self-report variables were not significant predictors of within-area variation in waste station scores. This implies that if between-area variation is distinguished from within-area variation, self-reported inappropriate disposal behavior and social ties lose their predictive power. This may be due to the differences in between area variance (i.e. local physical conditions) being larger than within area variance (i.e. the aggregated self-report responses of those using the waste station). Hence, when the variance of waste station scores was separated into within-area and between-area components, the two area quality components became significant predictors of variation in waste station scores between areas, whereas the within-area variation was no longer significantly predicted by aggregated individual inappropriate disposal behavior and social ties. Such findings can be accounted for primarily due to the design of the study, since areas with relatively homogenous

Table. 9 Results of the multi-level model test

	Beta	β	*SE*	*p*
Within level (Level 1: waste station)				
waste station score ← aggregated social ties	-.11	-.28	.17	.10
waste station score ← aggregated inappropriate disposal behavior	.15	.04	.14	.76
Between level (Level 2: area)				
aggregated waste station score ← contact with evidence of community bonds	-2.72	-.42	.16	.01*
aggregated waste station score ← space to connect with people	-3.15	-.42	.16	.01**

$^{**}p < .01$, $^{*}p < .05$

Note.
(Level 1: $N_{\text{waste station}} = 102$, Level 2: $N_{\text{area}} = 23$, Model fit: $Chi^2 = 14.97$; $df = 4$; $p < .01$; $Chi^2/df = 3.74$, $CFI = 1.00$; $TLI = 1.00$; $RMSEA = .00$, $SRMR_{within} = .001$; $SRMR_{between} = .000$)

high waste station scores were contrasted with areas with homogenous low waste station scores. This meant that the within area variation in waste station scores would inevitably be low.

3. DISCUSSION

This study analyzed the maintenance of waste stations in relation to social ties in the community and surrounding environmental conditions by means of data gathered at three different levels, using observation and self-reports. The results suggested that self-reported social ties and the presence of more surrounding environmental features play an important role in insuring that waste stations within a community are appropriately managed (Table 8). In other words, maintaining and increasing social ties may serve to promote appropriate waste station management. Similarly, the presence of spatial reminders of the community (or signs of gathering) also play an important role in motivating residents to manage waste stations appropriately (Table 8, 9).

To further elaborate, the results of our study revealed that social ties in the community influenced self-reported inappropriate disposal behavior, even after controlling for relevant demographic variables at the individual level (Table 7). In addition, the results from an analysis conducted at the waste station level found that social ties predicted the state of waste station management better than self-reported inappropriate disposal behavior (Table 8), although self-reported behavior did display a clear correlation with the state of waste stations. These results imply that social ties in the community play a critical role in guiding appropriate disposal behavior.

The results of the area level analyses also indicated that each identified 'area' component (contact with evidence of community bonds and space for connecting with people) also had a clear impact on aggregated waste station scores (Table 9). Therefore, H2, which connects the local physical conditions surrounding waste stations to their state of management, was supported.

The results of the differences in demographics variables between the two types of areas also provide some important insights. Residents living in the disorganized areas as compared to those in organized areas tend to be employed, live in rented apartment houses, not belong to Neighborhood Associations, have a short duration of residence, and be unmarried (Table 5). Based on these characteristics, it can be assumed that they have less opportunity and time to develop social ties with neighbors. Therefore, interventions, such as changing local physical conditions, in order to promote better connections with neighbors should be undertaken but with due consideration taken for the common profile and constraints faced by those living in disorganized areas.

Some methodological limitations of this research also need to be recognized. This study used partly aggregated data on the waste station and the area level but the meaningfulness of using aggregated demographics is unclear. However, the aggregated survey data on disposal behavior was found to correlate well with observed data. Moreover, the area level data, due to the definition applied, included only 23 areas (11 organized and 12 disorganized areas). Areas that included both well-managed and poorly managed waste stations were excluded because of the study's experimental design. This was likely to produce smaller variance within areas and thereby weakened the effect of within-area variation in the multilevel analysis.

3.1 Implications

This study has some important practical implications. During interviews conducted with residents in the areas (Ohnuma, *et al.*, 2012), some residents complained that only the board members of Neighborhood Associations and some highly committed residents take responsibility for maintaining waste stations. Residents also speculated on how such committed individuals could effectively reach out to those who had less connection with their neighbors. It is difficult for the committed residents to address others' concern by exclusively focusing on the correlation between social ties and level of waste station management, as it can be difficult in practice to create

opportunities to increase and maintain social ties. However, some of our results indicated a relationship between management of waste stations and the availability of local space for people to gather (Table 6, 9). These findings could be interpreted as supportive of other studies, which highlight the effects of social structures on inappropriate behavior, such as “broken windows” (Kelling & Coles, 1996) and “situational norms” (Aarts & Dijksterhuis, 2003). Yet, despite the similarities there have only been a small number of other studies that have analyzed social ties and local social structure at both the individual and macro levels (c.f. Sampson *et al.*, 1997). Our current results suggest that establishing spaces for gathering and connecting is likely to contribute to stronger social ties, and that this in turn might lead to better management of waste stations.

CONCLUSIONS

This study revealed the significance of social ties and local environmental conditions in Sapporo. The results of this study offer some practical recommendations on how to intervene in communities that lack social ties and have poor waste station management. Local governments resources could in such cases be strategically employed to create local environmental features, including spaces for gathering. It is always difficult for government interventions to generate social ties in target communities but changing local environmental circumstances and the available features in a community may represent positive steps that can help to plant the seeds for social ties to emerge organically.

An effective strategy could be to support the establishment of communication networks (Weenig, & Midden, 1991), as these encourage improvements to local circumstances and provide desired situational cues (Aarts, & Dijksterhuis, 2003). Employing the findings from the present study could help to address problems of inappropriate disposal and general waste station management.

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NOTES

[1] In Sapporo, assigned paid-for yellow bags should be used for burnable waste and non-burnable waste. Non-assigned translucent bags should be used for the other separate categories (cans and PET bottles, plastic containers and packaging, miscellaneous paper and branches, leave, grass and weed cuttings). In addition, the types of waste collected are assigned to specific days of the week. For example, cans and bottles are collected on Mondays, while plastics are collected on Wednesdays. Therefore, if different colored bags are found on the same day, it indicates inappropriate disposal.

[2] Examples of inappropriate disposals include: the waste and recyclable materials not being separated, the wrong material is disposed of on the wrong day, or materials being disposed at a later time, after collection. In Sapporo the collectors do not collect inappropriate bags and, instead, a “red seal” is affixed to identify them.

[3] Name plates in an official position at the entrance to the houses of Neighborhood Association board members enables observers to find them.

APPENDIX

Questionnaire items of inappropriate disposal behavior: “I dispose of cardboard, newspaper, or magazines on the day when miscellaneous paper is collected.”, “Because of my job or other evening commitments, I sometime put my household waste out at night rather than waiting till morning.”, “Sometimes, being in a rush, I cannot put my household waste out before 8:30 a. m.”, “If I’m late putting my garbage out and garbage collection has already finished for the day, I’ll sometimes just take it out anyway and leave it in the collection station.”, “On days when I accidentally take out the wrong garbage on the wrong day, I sometimes just leave it in the collection station anyway.”, “I frequently dispose of miscellaneous paper together with household waste that should not be disposed of as miscellaneous paper, such as used tissue.”, “I sometime dispose of miscellaneous paper along with burnable wastes.”, “I dispose of plastic containers and packaging on a day for disposing

bottles, cans, and PET bottles.", "When I'm unsure of how to separate household waste, I sometime just put it in the municipally-assigned paid trash bags."

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