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Short Title: General Versus Domain Specific Recycling Behaviour

General versus domain specific recycling behaviour – applying a multilevel comprehensive action determination model to recycling in Norwegian student homes

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Abstract

This paper reports the results of a multilevel structure equation model predicting general and fraction specific self-reported recycling behaviour. The model was tested on a sample of 697 undergraduate students from four Norwegian universities who each reported their degree of participation in the local recycling schemes for paper/cardboard, glass, metal, and plastic. It was demonstrated that variance in recycling behaviour can be divided into a smaller general part that is relatively stable across waste fractions and a specific part that depends on the respective fraction. General recycling behaviour is well predicted by intentions to recycle and recycling habits, whereas perceived behavioural control is to a large extend fraction specific and influences the fraction specific recycling. Perceived behavioural control mediates the influence of the recycling scheme type, distance to recycling containers, and transport mode used to reach the recycling containers.

Keywords: Multi-level analysis, paper, glass, metal, plastic, intention, perceived behavioural control.

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1. Introduction

Separating the recyclable fractions like paper, glass, metal or plastic from household waste is considered a significant contribution to environmental protection both because it saves natural resources and it reduces the amount of household waste that has to be treated otherwise (e.g., Patel, von Thienen, Jochem, & Worrell, 2000; Merrild, Damgaard, & Christensen, 2008). A life-cycle based simulation tool modeling different strategies of municipal solid waste management and its economic and environmental implications demonstrated the large environmental benefits of recycling in different scenarios (Solano, Ranjithan, Barlaz, & Brill, 2002; Solano, Dumas, Harrison, Ranjithan, Barlaz, & Brill, 2002). As participation of individual household members in (pre-)separating waste fractions is crucial for an effective recycling process, understanding motivations for people to take part in municipal recycling systems is important. Whereas general attitudes towards waste recycling are extremely positive in many countries and waste recycling is by far the environmental action European citizens endorse the most (Eurobarometer, 2005) actual recycling rates are lower than the theoretical potential (e.g., Timlett & Williams, 2008). The capture rates[1] in recycling vary significantly between waste fractions, between countries, and even between cities or neighbourhoods within a city (e.g., CEPI, 2006; Kipperberg, 2007; Clarke & Maantay, 2006). Different capture rates have also been reported for different family types (e.g., Tucker, Lamont, Murney, & Smith, 1998). This mismatch between rather uniform positive attitudes towards waste recycling on the one hand and the extremely diverse household waste

[1] The capture rate is the percentage of waste that actually is recycled compared to the total amount of potentially recyclable material in the waste stream within one fraction.

separation patterns on the other calls for an explanation. Two different approaches can be taken to understand individual waste separation: a psychological perspective focusing on motivational factors within the potential participant of a recycling scheme and a system analysis perspective focusing on characteristics of recycling systems that foster or hinder effective participation in recycling. Both perspectives overlap to a certain degree when subjective representations of system characteristics are analysed. Whereas the first perspective is usually more general, trying to identify personal factors influencing recycling *across* situations, is the second perspective usually specific to a given set of recycling system characteristics. This paper aims to present a broader understanding of participation in recycling schemes by means of a multilevel analysis which combines the person centred focus with the situation centred. A rather comprehensive psychological model that was introduced to predict travel mode choice (Klöckner & Blöbaum, 2010) will be adapted to participation in the local recycling scheme and extended by fraction specific characteristics of the waste collection system. In the next paragraph a brief overview of psychological models of recycling will be presented, followed by a summary of findings about the influence of recycling system characteristics on participation. In the closing paragraph of the theoretical part an integrated perspective will be developed.

2. Psychological models of recycling behaviour

In the last decades researchers have presented numerous studies that linked psychological variables to participation in recycling schemes. Different model traditions highlight different variables in this process: Tonglet, Phillips, and Read (2004) applied the *theory of planned behaviour* (Ajzen, 1991) to explain people's participation in the recycling program of the British city Brixworth. Cheung, Chan, and Wong (1999) successfully used the same theory to explain students' participation in wastepaper recycling in Hong Kong. The basic assumption of the theory is that people recycle if they form an *intention* to do so, which in turn is predicted by positive *attitudes* towards recycling, *subjective norms*[2] which are a representation of expectations of relevant other people (one may call it “social pressure”), and *perceived behavioural control* which is a feeling of being able to perform the intended behaviour. Cheung et al. (1999) outlined that perceived behavioural control is a multidimensional construct and that the sub-dimension of behavioural difficulty is important in recycling behaviour. In a classical study Hopper and Nielsen (1991) applied the norm-activation model (Schwartz & Howard, 1981) to participation in a kerbside recycling program in a US neighbourhood. The model assumes that in behavioural domains that carry a reference to morality – such as altruistic behaviour or pro-environmental behaviour – *personal norms* which are a feeling of moral obligation to act are a potent motivator of behaviour. Thøgersen (2006) also demonstrated that personal norms are a strong predictor of environmentally relevant behaviours including organic waste separation. However, these personal norms have to be activated when encountering a situation to become relevant. The activation of personal norms occurs in a cascade of different steps including becoming aware of the need to act (*awareness of need,* AN), becoming aware of the consequences of one’s own behaviour (*awareness of consequences,* AC), and becoming aware of the expectation of other people (*social norms*). Furthermore, a person has to be convinced that he or she is able to perform the behaviour in question (*perceived behavioural control,* PBC). Applied to recycling this means that people might develop a feeling of moral responsibility to recycle, if they are aware of the negative consequences of not recycling, if they are aware that their behaviour has a significant impact on the waste problem, if they feel capable of recycling, and if they finally experience the expectation of other people they value to participate in the

[2] Subjective norms have in other contexts also been referred to as ”social norms”. We use the two terms interchangeably in this paper.

recycling program. As recycling is a highly repetitive behaviour that is performed both often and under the same situational circumstances it should be one of the behaviours with a high potential of becoming habitual (Wood, Quinn, & Kashy, 2002). If behaviour becomes habitual the influence of deliberate processes such as intentions or personal norms diminishes and behavioural patterns become automatically activated as soon as a situational setting previously associated with the behaviour is encountered (Klöckner & Matthies, in press). Cheung et al. (1999) were able to show that past behaviour impacts recycling behaviour over and above the impact of the theory of planned behaviour context and Holland, Aarts and Langendam (2006) also demonstrated the role of habits in recycling.

The need to integrate psychological and objective situational variables to fully understand recycling behaviour has been repeatedly stated (Thøgersen, 1994; Guagnano, Stern, & Dietz, 1995; Ölander & Thøgersen, 2006). Ölander and Thøgersen (2006) proposed an A-B-C model of recycling behaviour that states that the link between positive attitudes (A) on recycling behaviour (B) is only strong, if structural conditions (C) facilitate performance of the behaviour on a mediate level. Several attempts have been made to integrate the psychological theories described in the first paragraph of this section and structural conditions in the domain of recycling behaviour (e.g., Thøgersen, 1994; Harland, Staats, & Wilke, 1999; Valle, Rebelo, Reis, & Menezes, 2005). Recently, Klöckner & Blöbaum (2010) published a comprehensive model that combines the aforementioned psychological variables and adds objective behavioural constraints or facilitators as additional group of predictors. They successfully tested the model on travel mode choice but explicitly claimed that the model should be applicable to other domains of environmental behaviour. The model proposes that environmental behaviour – hence also recycling behaviour – is determined directly by variables from three different areas: intentional processes, habitual processes, and situational conditions. The model predicts that people take part in recycling if they have the intention to recycle, if it is consistent with their recycling habits, and if they feel capable of recycling (PBC). The three factors may in some cases point into different directions: A strong intention to recycle might for example be counteracted by perceived barriers to the intended behaviour, or strong routines to throw all garbage into the same bin might interfere with the intended sorting of waste. PBC and intention should also relate to recycling habits as they develop over time by repeat performances of originally intentional behaviour (Klöckner & Matthies, in press). Personal norms are considered to be an additional direct predictor of habits because of their stability. Intentions are according to the model a product of attitudes towards recycling, social norms, personal norms and perceived control as intentions will be adjusted to anticipated problems of enacting the behaviour. Hence, normative processes (both social and personal norms) are considered to only have a mediated influence on behaviour. Personal norms are predicted by awareness of need, awareness of consequences, and social norms as proposed by the norm-activation model. The final assumption is that perceived behavioural control depends on the related objective situational conditions but is not identical to them. It means that people might develop a subjective ability that is uncorrelated to the objective situational conditions but usually a medium to large correlation between objective and subjective will show. This link between subjective and objective facilitators and barriers to behaviour makes the comprehensive action determination model (Klöckner & Blöbaum, 2010) an interesting starting point for an integrated analysis of the psychological and the system analysis perspective.

3. The influence of system characteristics on recycling rates

Numerous characteristics of recycling systems have been shown to influence participation rates. The picture is diverse and confounding of different factors is common, thus a systematic approach is necessary to identify cause-effect relationships. Dahlén and Lagerkvist (2010) systematically analysed possible influences and grouped them into nine factors: 1) Property close collection vs. drop-off systems, 2) number and types of recycling materials collected separately, 3) mandatory vs. voluntary programs, 4) economic incentives, 5) differences in information strategies, 6) residential structure, 7) socio-economic differences, 8) households with private composting, 9) availability for alternative places of discharge. Most of those factors lie outside the scope of this study, because the population analysed was either almost homogeneous with respect to the factors[3] or the necessary information was not accessible to the researchers.[4] In the remainder of this section we focus on previous results regarding factor 1 (property close collection vs. drop-off systems) and the related question of accessibility of the recycling system. Dahlén and Lagerkvist (2010) show that property close collection systems – also referred to as kerbside schemes – produce about twice as much collected recyclables as drop-off systems. This result is accompanied by findings of Robinson and Read (2005) that more than four out of five of the respondents in their survey reported to use a kerbside scheme if they recycled. If drop-off collection points were used, most people reached them on foot. Both findings outline that easy to use recycling systems seem to produce higher participation rates. Ando and Gosselin (2005) present evidence that recycling rates decrease with the distance to the drop-off container increasing. Gonzáles-Torre and Adenso-Díaz (2005) confirm this finding and identify a too large distance between the ordinary waste bins and the recycling bins as the main (subjective) hindrance in participating in a recycling scheme.

[3] Students who formed the population for this study have a rather homogenous socio-economic structure. Furthermore were the recycling schemes in all four analyzed municipalities comparable with respect to the factors 2, 3 and 4.

[4] It was not known to the researchers how information strategies in the municipalities looked like, if there were alternative places of discharge. Organic waste was not in the focus of this study, thus private composting was not relevant.

4. A multilevel approach to modeling recycling behaviour

Taking the findings together we assume that both psychological and system characteristics jointly influence recycling behaviour. The psychological factors should with exception of perceived behavioural control be rather general and determine recycling behaviour across situations whereas the situational constraints should have a specific influence for the given situation. In other words, we expect that attitudes and norms to recycle should be rather stable between situations and vary only between persons but situational conditions may vary even for one person influencing perceived behavioural control which therefore should also have a certain variability between situations. In this study we conceptualize the different "situations" as recycling of four selected fractions of waste, namely paper/cardboard, glass, metal and plastic.[5] Between the different fractions, between the analysed municipalities and even between different urban districts the characteristics of the recycling systems for these fractions differ: Some fractions are collected at the house in a kerbside system, others are collected at drop-off points, distance to the drop-off points varies, and so does the interval waste is collected. We expect on the one hand that the different system characteristics impact recycling rates for the respective fraction. We expect on the other hand that there is a certain degree of stability in recycling behaviour across situations that can be predicted by psychological factors. In detail, we like to test the following hypotheses with this study:

H1: Variation in participation in recycling schemes can be divided into one part that is specific for each acting person and one part that is specific for recycling conditions this person meets with respect to the different fraction. This means in other words that we expect

[5] We are aware that even within recycling of one fraction situations may vary but we consider this variation to be rather unimportant compared to the variation between recycling of the fractions.

that people show differences in general recycling rates across fractions, but at the same time each person may have different recycling rates for different waste fractions.

H2: Differences in general recycling rates between people can be predicted by psychological factors as described in the comprehensive action determination model (Klöckner & Blöbaum, 2010).

H3: Differences in fraction specific recycling rates within a person can be predicted by system characteristics.

- *H3a: Kerbside recycling results in higher recycling rates than drop-off point collection.*
- *H3b: Drop-off points in walking distance result in higher recycling rates than drop-off points that have to be reached by car or public transport.*
- *H3c: A longer distance to the drop-off points reduces recycling rates.*

H4: Perceived behavioural control and to a smaller degree intentions link the influence of specific situational conditions to the unspecific psychological predictors.

- *H4a: Variance in both perceived behavioural control and intention can be divided into a fraction specific part and a fraction unspecific part.*
- *H4b: The fraction specific part of variance in intention is small, the fraction specific part of variance in perceived behavioural control is large. This means that intentions to recycle should be only to a small degree be influenced by recycling conditions whereas the perceived ability should be to a large degree depend on the conditions.*
- *H4c: The fraction specific part of variance in perceived behavioural control is to a large extent predicted by system characteristics.*

5. Method

To test the proposed model (see figure 1) a paper-pencil survey with 697 students from four Norwegian universities was conducted in spring 2009. Seven students had to be excluded from the analysis because they had missing values in crucial variables. Indicators for the model variables, recycling behaviour for the fractions paper/cardboard, glass, metal and plastic, and the characteristics of the recycling systems for each fraction were recorded. Only recycling at home was analysed, recycling at other places (for example at the university) was explicitly excluded. The analysis was conducted as a multilevel structural equation model utilizing MPLUS (Muthén & Muthén, 1998-2007).

5.1 Sample

Undergraduate students in nine lectures at four Norwegian universities were approached to participate in the survey, thus forming a convenient sample which is not representative for the student population in the universities. Anything else but a convenient sample was not viable within the time frame and financial budget of this study. The Universities and lectures were selected to include a variation of study programs to minimize confounding effects. A member of the research team explained the aim of the study to the students and two vouchers from a local record store (value: approximately 25 Euro each) was given away in a lottery in each lecture to motivate participation. Only very few of the students resisted participation which was resulting in 38-121 questionnaires per lecture. The participation rate was estimated at 95%. The participating universities were Norwegian University of Science and Technology, NTNU, Trondheim (n=203), University of Bergen (n=208), University of Agder (n=102), and University of Oslo (n=187). Lectures in the study programmes of history, economy, law, physics, mathematics, and social science were included. Two versions of the questionnaire were used with different order of the items to minimize order effects. 57.0% of the participants were female, 43.0% male; 76.0% were between 19 and 22 years old, 17.0% were 23-26 years old, 6.5% older.

5.2 Measures

All variables for the psychological model were measured by two to 12 indicators. Table 1 gives an overview about the variables, the number of items used and the internal consistency of the scales (Cronbach's alpha). The items for intention, perceived behavioural control, social norms, personal norms, awareness of consequences and awareness of need were adapted from the study by Klöckner and Blöbaum (2010). Habit strength was measured using an adapted version of the self-report habit index (Verplanken & Orbell, 2003). The twelve indicators for habit strength were for the SEM analysis collapsed into three parcels of four indicators each to decrease the complexity of the measurement model for this variable. The attitude towards recycling was recorded with five items (agreement to recycling is necessary, satisfying, useful, likeable, reasonable). Perceived behavioural control and intention were recorded specifically for each fraction, the other variables were recorded for recycling in general. Perceived behavioural control measured the subjective *difficulty* to recycle the respective fraction. Because of the high correlation between AN and AC (r=.84) the two constructs could not meaningfully be separated. Thus a joined construct AN/AC was used in the analysis. Internal consistencies are at least satisfactory, most are very good. A list of all used items can be obtained from the first author on request. Two pilot tests with 8 and 84 students were conducted to optimize the measurement instruments.

– Insert Table 1 about here –

Recycling behaviour was recorded as the self-reported portion that was recycled within each fraction in the last two weeks on a seven point scale (1=nothing, 4=about half, 7=all). The authors are aware that self-reports about recycling rates tend to be unreliable or exaggerated (e.g., Perrin & Barton, 2001) but an objective analysis of the individual recycling performance lay far outside the financial budget of this study. The limited reliability of self-reported recycling behaviour has to be accounted for when interpreting the results. On average self-reported recycling of paper and cardboard at home lay considerably above 50% of the recyclable material, glass and metal around 50% and plastic significantly under 50%. At least the order of most to least recycled fraction is identical to that reported in another paper also based on self-reports (Kipperberg, 2007). CEPI (2006) report a collection rate for paper in Norway of about 70%. In total 53% of all household waste was sent to recovery in Norway in 2009 of which paper was by far the largest portion (Statistics Norway, 2010).[6]

Three aspects of the recycling system characteristics were individually recorded for each of the four fractions: 1) Is the respective fraction picked up at the house (kerbside collection), at a drop-off point or not at all? 2) How long is the distance to the container in minutes? 3) How do you usually get to the container (walking, by car, by public transport, other)? Because the distance variables were highly skewed they were dichotomized before the analysis into less or equal to 5 minutes (0) and more than 5 minutes (1). No recycling vs. kerbside vs. drop-off point was re-coded into dummy variables for the analysis with "no recycling" as a reference category. The same was done for the preferred mode to the container with "other" as reference category. Two sets of control variables were added to the model to test if the three

[6] The number refers to weight percentage.

characteristics are sufficient to explain intra-individual variance in recycling between the fractions: Firstly, the university the students were approached in was entered as a predictor as a proxy for structural differences between the cities not covered (with the university in Bergen as a reference category). Secondly, the four fractions were entered as predictors to test if other aspects connected to selected fractions not covered in this study account for unexplained variance (paper was used as a reference category here).

6. Results

A two-level structural equation model was specified as displayed in Figure 1. Each participant reported recycling behaviour, intention (2 items), and PBC (3 items) individually for each fraction plus the respective recycling system characteristics and control variables. This results in 2,692 reports nested in 697 individuals. Each person reported about four different waste types on the within level. Three variable types are modelled both on the within person and between person level: Behaviour, the indicators for intention, and the indicators for PBC. This means that the variance in each of these variables is divided into one part that is person specific (people have different recycling rates, intentions, PBC in general) and one that is fraction specific within one and the same person. This results in two types of latent variables for intention and PBC, one type reflects the general intention and PBC and varies between participants, the other is the fraction specific intention and PBC that varies within each person. The model was tested on the collected data and model fit statistics displayed in Figure 1 indicate a good fit.

Table 2 and Figure 1 display the results of the analysis. The intraclass correlation coefficients for the six variables modelled on both levels are as follows: Recycling behaviour *ICC*=.198, intentions (indicator 1) *ICC*=.597, intentions (indicator 2) *ICC*=.609, PBC (indicator 1)

ICC=.274, PBC (indicator 2) *ICC*=.341, PBC (indicator 3) *ICC*=.289. The intraclass correlation reflects how similar the response patterns in one variable are across different within-person units, in this case the four fractions. The closer to 1 an ICC is the more similar are the response patterns, the less important is the influence of the individual situation. The pattern in this study is clear: self-reported recycling in the four fractions is comparably different within an average person, whereas intentions are relatively stable over situations although there is a significant fraction-specific variation of intention. PBC is also to a large extend specific to the fractions.

– Insert Table 2 and Figure 1 about here –

On the between person level which reflects generalized recycling behaviour[7] 44% of variance in general recycling behaviour can be explained by the model variables. The strongest predictor is a general recycling habit, which means the implementation of recycling patterns into everyday routines. General intentions to recycle also predict general recycling to a significant extent while the influence of a general perceived behavioural control is limited (but significant). The other model paths on the person level show the expected pattern of results with the exception that general PBC does not influence a general intention, personal norms do not significantly impact habits and social norms lack a significant influence on intentions. Explained variance in general recycling intentions is high and personal norms and attitudes are the by far strongest predictors. Personal norms are to a large extent predicted by the combined AN/AC variable, but social norms also show the expected relation.

[7] Or to be more precise differences in recycling behaviour that can be attributed to differences between people not to differences between recycling situations.

On the within level which reflects explaining variation in recycling behaviour across the four fractions 68% of variance in recycling behaviour can be explained by specific intentions, specific perceived behavioural control and the system characteristics. Specific PBC has the strongest influence of the psychological variables on this level, intentions are a significant but weak predictor. A strong relation exists between specific PBC and specific intentions. Some but not all of the tested system characteristics have an impact on recycling (either direct or indirect mediated by specific PBC and/or specific intentions, see Table 2 and Table 3). Both a kerbside recycling system and a drop-off point recycling system lead – not surprisingly – to more recycling than no recycling system. About half of these effects are direct, half of them are mediated by specific PBC (see Table 3). Both types of recycling systems have, however, the same impact which means that kerbside recycling systems do not lead to more (self-reported) recycling in out sample. A drop-off point within walking distance is also contributing to more recycling, an effect that is almost completely mediated by specific PBC. Even if the waste is transported by car to the container, more is recycled. If the distance to the drop-off point is more than five minutes less materials are recycled, which is again an indirect effect, mediated by specific PBC. The control variables “waste type” show still significant effects (both direct and indirect) after including the system characteristics, which indicates that the lower recycling rates for plastic, metal, and glass are not completely explained by the type of collection system, distance to the drop-off point and transport mode. After controlling for the tested system characteristics and material types the university (as a proxy for the city the students lived in) has no significant total effect, which indicates that no unmeasured systematic variation between the cities exists that impacts recycling rates.

– Insert Table 3 about here –

7. Discussion

The described model test confirmed most of our hypotheses. Firstly, there is a meaningful proportion of variance in recycling behaviour that is general across different recycling situations (in this case recycling of four different fractions), which means that people show general differences in the amount they report to recycle. Some recycle more than others irrespective of recycling conditions connected to the various fractions. On the other hand, the larger proportion of variance in recycling lies actually within each person between the different waste fractions, which means that people have systematic general differences in recycling but the differences for each person between paper/cardboard, glass, metal, and plastic recycling are larger than the differences between people. However, both portions of variance are meaningful and can be used as dependent variables in modelling (hypothesis H1). A significant proportion of between-people variation in general recycling behaviour can be explained by variables specified in the comprehensive action determination model (Klöckner & Blöbaum, 2010; hypothesis H2). General recycling intentions and general recycling habits both predict recycling behaviour about equally strong. The impact of general perceived behavioural control is minor but significant. The last finding is interesting from a theoretical perspective, because it underlines that perceived behavioural control is a variable that has to be matched to the specificity of a behavioural situation to be an important predictor. Most remaining model paths on the between-person level confirm the model with three exceptions: First, general intentions are not as expected influenced by general PBC. An explanation could be that general PBC is – as said before – a weak variable because it is not related to the specific behavioural situation. It reflects the general subjective estimation of the ability to recycle across situations. This estimation is built on large variation in individual recycling experiences. The evaluation most likely is that sometimes recycling is possible, sometimes it is not. As such, a close connection to intention and behaviour is unlikely.

Second, personal norms do not have the expected direct impact on recycling habits, but are mediated by general intentions. It may be that general intentions (unlike specific intentions) are much closer related to personal norms and are themselves more stable. The stronger impact of personal norms on intentions compared to the model presented in the paper by Klöckner and Blöbaum (2010) supports this assumption. Third, social norms lack a direct influence on intention. When personal norms are included in the model, the direct influence of social norms usually becomes small (see also Klöckner & Blöbaum, 2010, Thøgersen, 1999, 2006, 2009), sometimes insignificant, which means that people usually incorporate social norms into their system of personal norms. Thus, the influence of social norms is mediated rather than direct.

On the level of the different fraction specific intentions and specific perceived behavioural control explain a large proportion of intra-individual differences in behaviour together with recycling system specific characteristic. The most important impact on specific recycling behaviour is – not surprisingly – that a recycling scheme exists for the respective fraction. Whether it is a kerbside system or a drop-off point system does, however, not make a difference. This disconfirms hypothesis H3a and is against previous results reported in Dahlén and Lagerkvist (2010). For the students in our sample both systems seem to be equally convenient, maybe because most drop-off points in student homes are rather close by. Hypothesis H3b is partly confirmed because drop-off points in walking distance are related to more recycling. However, also when the drop-off point is reached by car more recycling is reported than when it is reached by public transport or other modes. This seems to reflect that compared to public transport, availability of a car – which is not self-evident in a student sample – enhances recycling when the drop-off point is not in walking distance. A distance of more than 5 minutes to the drop-off point reduces recycling behaviour significantly which confirms hypothesis H3c and replicates previous results presented by Ando and Gosselin (2005). A part of the non-existing difference between kerbside and drop-off point systems may be captured in this variable.

The analysis of intraclass correlations of the indicators for intention and perceived behavioural control confirm the hypotheses H4a and H4b. Both types of indicators show variation that can be meaningfully divided between the person level and the fraction level. As expected the fraction level constitutes a large proportion of variation in perceived behavioural control but only a rather small in intention. Recycling intentions are to a larger extent overarching different waste fractions. However, the impact of intentions on fraction specific recycling is small and perceived behavioural control which is to a large extent specific to each fraction becomes important. Specific perceived behavioural control significantly mediates the influence of all recycling system characteristics but taking the car to the container which again supports the notion that ”taking the car” and its small positive impact captures something outside the scope of this paper, maybe car-availability. This shows that specific perceived behavioural control is the expected link between system characteristics and their psychological representation which then impacts behaviour (confirming hypothesis H4c).

The significant remaining impact of fraction type on recycling behaviour while controlling for recycling scheme type, distance, and transport mode indicates that there seem to be fraction specific factors that influence recycling behaviour that were not captured in this study. Glass, plastic, and metal have for example to be cleaned to be stored in a hygienic way in the student apartment. Hygienic considerations may therefore have reduced the recycling rate of these fractions. The importance of hygienic aspects for recycling of glass and metal has also been discussed in the paper by Perrin and Barton (2001). Other aspects could have been differences in collection intervals between the fractions. Fractions which are collected only seldom could have a lower recycling rate because the containers are full before the collection interval is over.

Before concluding on the results important weaknesses of this study will be discussed that call for a careful interpretation of the results: First, the sample of the study was a convenient student sample. Although considerable effort was made to reduce sampling effects on the results the sample is neither representative for the Norwegian population nor for Norwegian students. Of course, replications with more representative samples are desirable. Second, the study is based on self-reported recycling behaviour, which is known to be exaggerated (Perrin & Barton, 2001). As the focus of this study was more on the relation of the four fractions to each other within each person and not a correct estimation of recycling rates we consider this bias of minor importance. However, an objective measure of recycling behaviour would have been desirable although not viable within the budget of this study. Third, the system characteristics were also recorded as a self-report which might have resulted in a bias, especially of the distance to the drop-off point and the used transport mode.[8] Again, an objective measure would have been preferable though not viable in this study. Considering the given limitations we suggest interpreting the results carefully.

8. Conclusions

The analysis in this paper – although based on a restricted sample and some potentially biased self-reports – has shown that recycling behaviour can be analysed both on the relatively stable person level and the fraction specific level. The person level contributes with a general

[8] It is not very likely that the type of recycling scheme is prone to a bias.

tendency to be more or less open to recycling which is mostly influenced by intentions to recycle and general recycling habits. The fraction specific level contributes with characteristics of the respective recycling scheme and their psychological representation. On both levels the proposed variables explain a significant proportion of behavioural variation. On the one hand, influencing people's general willingness to recycle via attitudes may therefore have a result on actual recycling behaviour via the person level. On the other hand us a person's recycling behaviour to a larger extent dependent on the situational conditions. People with a strong intention to recycle need to encounter situations in which they perceive the ability to act upon their intentions. The perceived ability to act was shown to be a crucial variable and is closely linked to system characteristics.

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Table 1: List of constructs used in the structural equation model.

	Number of items	*M*	*SD*	Cronbach's alpha
Intention (paper, cardboard)	2	5.96	1.48	.62
Intention (plastic)	2	5.02	1.69	.73
Intention (glass)	2	5.40	1.61	.71
Intention (metal)	2	5.08	1.69	.72
PBC (paper, cardboard)	3	1.85	1.34	.73
PBC (plastic)	3	3.63	2.06	.85
PBC (glass)	3	3.00	1.82	.83
PBC (metal)	3	3.55	1.98	.84
Habit	12	4.51	1.46	.96
Social norm	4	3.63	1.60	.89
Personal norm	4	4.97	1.36	.90
Awareness of need (AN)	4	5.65	1.17	.82
Awareness of consequences (AC)	4	5.59	1.15	.83
AN/AC	8	5.62	1.11	.91
Attitude	5	5.16	1.34	.89
Behaviour (paper, cardboard)	1	5.50	1.77	-
Behaviour (plastic)	1	2.82	2.16	-
Behaviour (glass)	1	4.26	2.54	-
Behaviour (metal)	1	3.30	2.50	-

Note: All variables may have values between 1 and 7, 7 indicating strong intentions, low perceived control, strong recycling habits, strong social norms, strong personal norms, strong AN and AC, positive attitudes and strong participation in recycling.

Table 2: Results of the two-level-analysis of students' recycling behaviour in Norway (N_{level2}=697; N_{level1}=2,692).

WITHIN LEVEL					
		B	*S.E.*	*p*	*β*
MM	INT1[a] ← INT_w	1.000	-	-	.828
	INT2[a] ← INT_w	.900	.032	<.001***	.750
	PBC1[a] ← PBC_w	1.000	-	-	.830
	PBC2[a] ← PBC_w	.858	.020	<.001***	.801
	PBC3[a] ← PBC_w	1.018	.023	<.001***	.847
SM	INT_w ← PBC_w	-.460	.016	<.001***	-.748
	BEH ← INT_w	.242	.060	<.001***	.109
	BEH ← PBC_w	-.569	.052	<.001***	-.417
	BEH ← at the house	1.353	.125	<.001***	.283
	BEH ← container	1.355	.116	<.001***	.308
	BEH ← walking	.140	.084	.095	.033
	BEH ← car	.274	.136	.043*	.036
	BEH ← public transportation	.180	.335	.591	.008
	BEH ← more than 5 minutes	.041	.085	.626	.009
	BEH ← plastic	-.708	.084	<.001***	-.141
	BEH ← glass	-.186	.089	.036*	-.038
	BEH ← metal	-.432	.091	<.001***	-.087
	BEH ← NTNU	.129	.112	.252	.027
	BEH ← UiA	-.193	.137	.160	-.032
	BEH ← UiO	.137	.114	.232	.028
	PBC_w ← at the house	-1.902	.087	<.001***	-.542
	PBC_w ← container	-1.676	.083	<.001***	-.519
	PBC_w ← walking	-.389	.070	<.001***	-.123
	PBC_w ← car	-.099	.115	.390	-.017
	PBC_w ← public transportation	.716	.285	.012*	.044
	PBC_w ← more than 5 minutes	.840	.067	<.001***	.252
	PBC_w ← plastic	.655	.068	<.001***	.178
	PBC_w ← glass	.450	.074	<.001***	.125
	PBC_w ← metal	.578	.075	<.001***	.159
	PBC_w ← NTNU	.005	.098	.960	.001
	PBC_w ← UiA	.066	.120	.583	.015
	PBC_w ← UiO	.200	.100	.045*	.056
BETWEEN LEVEL					
		B	*S.E.*	*p*	*β*
MM	INT1[b] ← INT_B	1.000	-	-	.723
	INT2[b] ← INT_B	.877	.064	<.001***	.617
	PBC1[b] ← PBC_B	1.000	-	-	.805
	PBC2[b] ← PBC_B	1.048	.095	<.001***	.791
	PBC3[b] ← PBC_B	.651	.068	<.001***	.518
	ATT1 ← ATT	1.000	-	-	.705
	ATT2 ← ATT	1.076	.058	<.001***	.736
	ATT3 ← ATT	1.199	.055	<.001***	.895
	ATT4 ← ATT	1.066	.055	<.001***	.796

	ATT5 ← ATT	1.060	.053	<.001***	.827
	HAB1-4 ← HAB	1.000	-	-	.915
	HAB5-8 ← HAB	1.021	.023	<.001***	.945
	HAB9-12 ← HAB	.962	.025	<.001***	.900
	PN1 ← PN	1.000	-	-	.798
	PN2 ← PN	1.126	.043	<.001***	.880
	PN3 ← PN	1.002	.040	<.001***	.854
	PN4 ← PN	.926	.042	<.001***	.776
	SN1 ← SN	1.000	-	-	.834
	SN2 ← SN	1.047	.037	<.001***	.888
	SN3 ← SN	.950	.042	<.001***	.772
	SN4 ← SN	.933	.040	<.001***	.786
	AN1 ← ANAC	1.000	-	-	.712
	AN2 ← ANAC	1.112	.059	<.001***	.747
	AN3 ← ANAC	1.118	.062	<.001***	.714
	AN4 ← ANAC	1.155	.061	<.001***	.745
	AC1 ← ANAC	1.081	.061	<.001***	.702
	AC2 ← ANAC	1.088	.059	<.001***	.741
	AC3 ← ANAC	1.131	.056	<.001***	.797
	AC4 ← ANAC	1.032	.053	<.001***	.770
SM	BEH ← INT_B	.309	.067	<.001***	.301
	BEH ← PBC_B	-.176	.063	.005**	-.156
	BEH ← HAB	.267	.048	<.001***	.359
	INT_B ← ATT	.418	.054	<.001***	.481
	INT_B ← PN	.379	.051	<.001***	.472
	INT_B ← SN	.036	.030	.224	.054
	INT_B ← PBC_B	.107	.066	.109	.097
	PN ← ANAC	.943	.060	<.001***	.718
	PN ← SN	.166	.026	<.001***	.200
	HAB ← INT_B	.643	.160	<.001***	.468
	HAB ← PBC_B	-.396	.081	<.001***	-.263
	HAB ← PN	.180	.111	.105	.163
	ATT ↔ PBC_B	-.376	.061	<.001***	-.344
	SN ↔ PBC_B	-.210	.073	.004**	-.147
	SN ↔ ATT	.617	.084	<.001***	.342
	ANAC ↔ PBC_B	-.220	.048	<.001***	-.244
	ANAC ↔ ATT	.802	.071	<.001***	.704
	ANAC ↔ SN	.481	.068	<.001***	.323

Notes: *** p<.001, ** p<.01, * p<.05; MM=measurement model, SM=structural model; [a,b] Intention and PBC were modelled on both levels. That implicates that the indicator variance in INT1&2 and PBC1-3 is divided into level 1 ([a]) and level 2 ([b]) variance. Therefore, the latent constructs INT_W and PBC_W capture only the fraction specific variance whereas INT_B and PBC_B capture only the cross fraction variance (person specific). Cross fraction variance is modelled as random intercepts also for BEH. No random slopes were modelled.

Table 3: Total, direct, and indirect effects of the level 1 situation variables on recycling behaviour.

	Total effect	Direct effect	Total indirect	Mediated by PBC_{within}	Mediated by PBC_{within} and INT_{within}
Waste bin at the house	.554***	.283***	.271***	.226***	.044***
Container in the area	.567***	.308***	.259***	.217***	.042***
Walking to container	.094***	.033^{ns}	.061***	.051***	.010**
Car to container	.044*	.036*	.009^{ns}	.007^{ns}	.001^{ns}
Public transportation to container	-.014^{ns}	.008^{ns}	-.022*	-.018*	-.004*
Distance to container more than 5 min	-.117***	.009^{ns}	-.126***	-.105***	-.021***
Plastic	-.230***	-.141***	-.089***	-.074***	-.015***
Glass	-.100***	-.038*	-.062***	-.052***	-.010**
Metal	-.166***	-.087***	-.079***	-.066***	-.013***
NTNU	.027^{ns}	.027^{ns}	-.001^{ns}	-.001^{ns}	-.000^{ns}
UiA	-.039^{ns}	-.032^{ns}	-.007^{ns}	-.006^{ns}	-.001^{ns}
UiO	.000^{ns}	.028^{ns}	-.028*	-.023*	-.005^{ns}

Notes: Displayed are standardized effects. A gray shading indicates if the strongest influence is direct or indirect. *** p<.001; ** p<.01; * p<.05

Figure 1: The tested multilevel structural equation model of recycling behaviour.