

Article

The Effects of Environmental Management Systems on Source Separation in the Work and Home Settings

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Abstract: Measures that challenge the generation of waste are needed to address the global problem of the increasing volumes of waste that are generated in both private homes and workplaces. Source separation at the workplace is commonly implemented by environmental management systems (EMS). In the present study, the relationship between source separation at work and at home was investigated. A questionnaire that maps psychological and behavioural predictors of source separation was distributed to employees at different workplaces. The results show that respondents with awareness of EMS report higher levels of source separation at work, stronger environmental concern, personal and social norms, and perceive source separation to be less difficult. Furthermore, the results support the notion that after the adoption of EMS at the workplace, source separation at work spills over into source separation in the household. The potential implications for environmental management systems are discussed.

Keywords: source separation; attitudes; spill-over effect; environmental management; norms

1. Introduction

Source separation is an activity that takes place both in professional life (at the workplace) and in private life (management of household waste). In 2008, the amount of waste generated in Sweden from

households and business activities was 10.9 tonnes per inhabitant, with household waste accounting for an average of 515 kg per inhabitant [1]. Even though the amounts of waste from households are low in comparison to business waste, there is still a potential for increased recycling of household waste [2]. To achieve effective waste management, it is of the utmost importance to increase source separation, both in the business and household settings.

In the workplace, environmental management systems (EMS) act as a policy instrument to facilitate source separation. However, in private households, such measures do not currently exist and instead, information provided by, for example, the municipal waste manager encourages people to perform source separation. It is well-established in environmental psychology that the use of less forceful policy tools, such as information, increases reliance on psychological factors, such as pro-environmental attitudes and norms, so that people adopt environmentally relevant behaviors (e.g., [3]). Thus, pleading for voluntary agreement relies on the knowledge and willingness to sacrifice of the individual, with the result that no recommendations or informational policies will be complied with if households are not willing to engage in source separation. Therefore, an interesting question to address is: What can be learnt from waste management policy measures in workplaces in relation to source separation in households? The present study explores the relationships between EMS and psychological variables, and whether EMS determine whether source separation behaviour at work affects source separation at home, *i.e.*, whether or not there is a spill-over effect. The results of the present study provide important information regarding how policies aimed at making waste management sustainable can be designed, supported, and implemented.

1.1. Environmental Management Systems

Establishing a source separation system at a workplace is one of many strategies that organisations use to achieve national environmental goals. A company or any other organisation working with measures to decrease environmental impact often needs to structure the work undertaken, and also to work on a strategic level. In a small organisation, this can be accomplished quite easily. However, as the size of the company increases the need for some tool or framework becomes more urgent. Two such tools are EMS and environmental certification. EMS is intended to provide a structural framework for continuous improvement of the environmental management in an organisation. The ISO 14001 system is by far the most widely used system in Sweden [4]. Environmental certification is tailored to small- and medium-sized enterprises, and it is a cost-effective alternative to a complete EMS. The receipt by an organisation of ISO 14001 certification represents official recognition of environmental management in progress. Currently, more than 750 companies and organisations in Sweden hold such certification [5].

A prerequisite for a successful EMS is the success with which the system is communicated to the employees. How well the EMS is communicated to the staff is included in the third-party revision of an EMS. Since people who are interested in environmental issues are more responsive to environmental information, the degree to which employees are aware of EMS is expected to correlate with the psychological variables related to people's environmental interest [6]. Therefore, it is more relevant to measure employees' awareness of EMS than to compare different psychological variables between organisations with and without EMS.

1.2. The Impact of Psychological Variables on Source Separation

1.2.1. Environmental Attitudes, Environmental Concern and Beliefs

If a person has positive environmental attitudes, does this mean that the person is likely to have intentions to recycle? The relationship between attitudes and behaviour has been an area of major interest in social psychology for a long time. In the psychology literature, the conventional definition of an attitude is a psychological tendency that is expressed by evaluation of a particular attitude object (*i.e.*, an object that your attitude is directed towards) with some degree of favour or disfavour [7]. Attitude formation starts in general with cognitive beliefs about an attitude object, such as facts about the attitude object. These beliefs, together with, for example, direct experiences, may in turn form an attitude. The evaluation of an attitude object results in negative, positive or ambivalent attitudes, which in turn may impact behaviour. Thus, in general, people have positive attitudes towards their behaviour. This is however not equivalent to the phenomenon whereby a change in attitudes corresponds to a change in behaviour.

In the extensive studies conducted to date on the relationships between environmental beliefs and re-cycling behaviour, environmental beliefs have been assessed in different ways. Bratt [8] measured beliefs regarding general environmental effects of recycling, and found no evidence that these beliefs affected recycling behaviour. In contrast, Hopper and Nielsen [9] found an impact on recycling using a measure that addressed specific environmental consequences of recycling. Thus, the results regarding the effect of beliefs about environmental consequences on recycling point in different directions, and more research in this area is needed.

Environmental concern is a more wide-ranging attitudinal measure, which is generally defined as a positive attitude towards environmental issues [10,11]. According to a previous study, the ability of environmental concern to predict behaviour is moderate (*cf.* [7]), and it does not directly determine environmental behaviour but rather influences indirectly via behavioural intention or a more specific attitude towards the act (in line with theory of planned behaviour, TPB; [12,13]). Empirical results regarding the relationship between environmental concern and recycling behaviour, are mixed [14]. This may be explained by the idea that the amount of effort is a moderator of the relationship between environmental concern and recycling behaviour, which implies that environmental concern predicts recycling behaviour when the amount of effort is relatively high, whereas no significant relationship is observed when the amount of effort is relatively low [15].

1.2.2. Norms

A norm is generally defined as an expectation held by an individual about how he or she ought to act in a particular social situation [16]. Norms can be divided into norms at the group level (social norms) and individual level (personal norms). Social norms express what most people actually do (descriptive norms) or what significant others think one ought to do (prescriptive norms) [17]. Social moral norms limit egoistic behaviour to favour collective behaviour, such as different pro-environmental activities [18]. If social norms are violated, they will be met by sanctions managed externally from the society or group members. When social moral norms are internalised, they are

referred to as personal norms [16]. Sanctions, e.g., feelings of guilt, are then managed internally by the individual.

Norms are strongly linked to pro-environmental behaviour. In a recent meta-analysis based on 46 studies of pro-environmental behaviour [13], it was established that social norms are an indirect determinant of intention to act in an environmentally benign manner. The possible impact of norms on recycling has also been recognised [8,19–22]. The results regarding the unique influence of social norms on recycling are mixed and indirect in nature (for a review, see [23]), whereas personal norms are directly related to recycling behaviour [8,19,20]. The effect on recycling of personal norms also appears to be stronger than the effect of social norms [3,24].

1.3. Spill-Over Effects

As evident from reviews of the literature (e.g., [25]), most studies aimed at enhancing understanding for successful environmental policy implementation have focused on providing insights into behavioural changes within specific domains, such as the consumption of organic food. An interesting topic is whether and how environmentally benign behaviours in different situations are linked to each other. Such behavioural chain reactions are referred to as a spill-over effect, which implies that specific behaviours constitute more general domains of behaviour [26]. A possible mechanism underlying the spill-over effect is that positive attitudes towards one type of behaviour (*i.e.*, recycling) may be inconsistent with negative attitudes towards another behaviour (*i.e.*, purchasing of organic food). This in-consistency may cause cognitive distress, so attitudes towards organic food are changed to be more favourable. Then, when positive attitudes towards one behaviour lead to positive attitudes towards a different behaviour, it is referred to as positive spill-over. An alternative is negative spill-over, which refers to reducing the cognitive dissonance associated with conflicting attitudes by viewing the behaviour less favourably.

Spill-over effects can only occur if the behaviours from a general behavioural domain are similar [26]. For example, recycling can only spill over to ecologic consumption if both behaviours are some-how related to each other. In general, pro-environmental behaviours are however considered to be in-dependent [27]. In line with this, studies that have investigated behaviours from different and distant domains have failed to find spill-over effects across domains, such as recycling and buying organic food (e.g., [28]). However, Thøgersen and Ölander [29] identified signs of transfer of environment-friendly conduct between behavioural categories, albeit only when the categories were not distant from one another. Given these results, an interesting topic of research is whether the same behaviour, in this case source separation, is likely to spill-over across different settings.

A recently performed national survey on waste fraction inventories [30] reported that households that were amenable to separate collection of food waste were also better at sorting packaging and newspapers. One conclusion from this report is that an increase in the information provided to households when introducing source separation of food waste appears to have a spill-over effect on other aspects of waste management.

1.4. Problem and Hypothesis

EMS aim to aid peoples' decision making in environmental terms and operate as a policy. A prerequisite for this function is that the employees at an EMS workplace are aware of the diploma/certification. However, this is not always the case, often as a result of inconclusive communication from the management team or detachment regarding environmental issues among the staff. In the present study, we investigate whether psychological variables, such as environmental concern, beliefs, personal norms and social norms, as well as source separation differ between employees who are aware of EMS and employees who are unaware of EMS at different workplaces. Based on previous research on recycling (here measured as the degree of source separation), we expect that environmental concern, personal and social norms, perceived difficulty, and awareness of EMS can predict the degree of source separation at the workplace. Furthermore, we expect that the awareness of EMS at the workplace increases source separation not just within the policy frame (the workplace), but also in other areas (home). The results have practical implications for the implementation of policies.

2. Method

2.1. Participants

The survey was distributed to three workplaces (a university, a hospital, and a construction site) in the city of Gävle, Sweden. The questionnaires were distributed to 623 respondents in May 2009. In September 2009, 344 completed surveys were collected, giving a total response rate of 55.2%. The characteristics of the sample population are listed in Table 1.

Table 1. Description of the sample.

Variable	n	Descriptive
Population and households		
Gender (% men)	342	21.3
Mean age \pm SD (years)	332	45.6 \pm 12.2
Average number of persons/household	340	2.7
Dwelling (% of total sample)		
Detached house	174	52.1
Semidetached house	58	17.4
Flat/apartment	99	29.6
Other	3	0.9
Workplace (% response rate)		
Hospital	227	59.7
University	97	50.2
Construction site	20	40.0

The three workplaces included in the sample were chosen based on a previous study [3]. The sites differ substantially with respect to waste intensity (kg waste per employee and year) and the share of handled hazardous waste in relation to total waste amount, with the university having the lowest and the construction site having the highest total amount of waste per employee. However, owing to the

low number of completed questionnaires returned from the construction site, it was not possible to draw reliable conclusions regarding the differences in these factors between the groups. Therefore, the 20 respondents from the construction site were excluded from the analyses in the present report.

2.2. Questionnaire

The survey was devised to examine employees' source separation behaviours at their workplace and household. Emphasis was placed on understanding the reasons and psychological mechanisms for recycling in the workplace in relation to the adoption of EMS, and on elucidating source separation behaviour at work has a spill-over effect on source separation behaviour at home.

On the first page of the questionnaire, participants were informed that the aim was to investigate source separation behaviour and opinions regarding waste management at different workplaces. Participants were informed that their responses would be treated anonymously.

The survey comprised 22 forced-choice questions and statements that required the respondent to indicate the level of agreement. In the present study, although the reported values for several variables are high, we have no reason to believe that the responses to some items are subject to a greater degree of social desirability bias than the responses to others. Therefore, there is no hindrance to comparing and analysing the data. The questionnaire items that are relevant to the present study are described below.

The questionnaire asked general questions about the workplace, as well as the respondents' environmental concern and perceptions of the efficacy of source separation. Participants were asked to categorise their workplace as being within the healthcare or education sector. They then indicated their awareness of whether their workplace is engaged in an EMS by choosing one of the following response alternatives: (1) 'Yes, the EMS work has been on-going during a long period'; (2) 'Yes, the EMS work has just started'; (3) 'Not yet'; or (4) 'I don't know'. Other questions asked participants to rate to what extent they view themselves as environmentally concerned, whether source separation requires too much time and effort, and if it is still worth the effort. The responses were made on a 7-point scale, which ranged from (1) 'strongly disagree' to (7) 'strongly agree'.

Respondents were also asked to rate the perceived difficulty of performing source separation at their workplace. Another question assessed participants' beliefs regarding the efficiency of source separation in terms of decreasing energy consumption in society, and the contribution of source separation to conservation of resources. Respondents' personal norms were assessed by asking the participants to state their degree of personal responsibility to source separate their waste at work. Social norms were evaluated by asking to what extent respondents believe their colleagues' feel personal responsibility to source separate (prescriptive social norm), and whether their colleagues actually engage in source separation behaviour at work (descriptive social norm). All these items were rated on the 7-point scale described above. Respondents were also asked to define the proportion of the total amount of waste at their workplace they source separate and to state the extent to which they have the possibility to de-crease this amount on a 5-point scale, ranging from (1) 'small part' to (5) 'large part'.

Source separation behaviours within the household were also investigated. One question asked to what extent the respondent source separates their waste, and two other questions asked the respondent to rate the extent of source separation before and after their workplace adopted EMS, respectively. The items were rated on a 7-point scale, which ranged from (1) 'not at all' to (7) 'very much'.

Questions about demographics (age, residence, gender, and level of education) concluded the questionnaire.

2.3. Measures

One way of stabilising statistical results is to use indices that are constructed from a number of items instead of single items. These indices can be created if the variations in responses to a number of items largely reflect the variations in a single latent variable. A statistical method that describes variability among observed variables is factor analysis, which is commonly used in behavioural sciences. In the present study, we used a form of factor analysis, called principal component analysis (PCA), to cluster items that measure the same constructs. By averaging the items loading on the same factor, indices were constructed. Items with factor loadings less than 0.45 were not included in the indices. The indices of single items were used in the subsequent analyses.

The items that captured environmental concern in everyday behaviour were subjected to PCA with Varimax rotation, which resulted in a two-factor solution that explained 72.3% of the variance (KMO = 0.70; Bartlett's test, approximate $\chi^2 = 76.65$, $p < 0.001$). The first factor, which was labelled "environmental concern", consisted of the items that captured whether respondents are environmentally conscious, act in environmentally benign manners, and do what they can to reduce the amount of waste (Cronbach's $\alpha = 0.77$). The second factor consisted of two items, *i.e.*, that source separation requires too much time and commitment, and that the net contribution of waste separation is not worth the effort (Cronbach's $\alpha = 0.67$). This factor was not included in the subsequent analysis.

PCA was also performed on the items that captured perceived difficulty associated with waste separation in the workplace. A one-factor solution that explained 56.3% of the variance (KMO = 0.61; Bartlett's test, approximate $\chi^2 = 108.76$, $p < 0.001$) consisted of the following three items: the belief that the recycling site is too distant in order for the respondent to engage in source separation at the workplace; that there are limited possibilities for source separation at the workplace; and a reversed item stating that it is easy to source separate (Cronbach's $\alpha = 0.60$). The factor was labeled 'Perceived difficulty'. To create an index of the items that corresponded to beliefs about the efficiency of source separation, an additional PCA was conducted. The result was a one-factor solution that explained 57.2% of the variance (KMO = 0.54; Bartlett's test, approximate $\chi^2 = 148.84$, $p < 0.001$) and consisted of the following three items: 'Source separation contributes to decreasing energy consumption in society'; 'Source separation contributes to conservation of environmental resources'; and the reversed item 'Source separation does not have a large impact on the decrease of environmental stress' (Cronbach's $\alpha = 0.55$). The factor was labelled 'Beliefs'. The Cronbach's α -values for the indices of 'perceived difficulty' and 'beliefs' are low. According to George and Mallery [31], α -values of about 0.60 are questionable. However, we argue that the indices still can be used in the analysis of theoretical terms.

The items that captured the normative components were submitted to PCA, which resulted in a two-factor solution that explained 66.6% of the variance (KMO = 0.71; Bartlett's test, approximate $\chi^2 = 311.38$, $p < 0.001$) and consisted of the items: 'measured personal responsibility to source separate at the workplace'; 'feeling a personal obligation to contribute to handling waste in an environmentally friendly way'; and 'not engaging in source separation creates a feeling of bad conscience'. These items were loaded on a single factor, which was labelled 'Personal norms' (Cronbach's $\alpha = 0.77$). Two items

that captured social norms were loaded on the second factor but due to a low Cronbach's α value of 0.34 the index of these items was not used in the subsequent analyses. Instead, one item that corresponded to the belief that the respondents' colleagues thinking that the respondent should source separate represented a social norm.

3. Results

3.1. Descriptive Statistics

At the time the survey was conducted, both the hospital and the university had been working on a strategic level with environmental issues for approximately 2 years. However, awareness of whether or not the workplace was engaged in EMS differed between the employees of the hospital and the university (Table 2).

Table 2. Reported levels of awareness of environmental management systems (EMS) use in the hospital and university.

<i>Response</i> ¹	Hospital	University	Total
	(n = 227)	(n = 97)	(n = 324)
Yes, on-going over a long period	30.8%	79.4%	45.4%
Yes, just started	2.2%	5.2%	3.1%
No, not yet	14.1%	0%	9.9%
I don't know	52.9%	15.5%	41.7%

Note: ¹ Responses to the question "Is your employer working with EMS?"

A high percentage of the employees in the university reported that work with EMS has been ongoing over a long period, whereas in the hospital, the majority of respondents reported that they did not know if EMS were being used. To enable a comparison of respondents who were aware of their workplace being environmentally certified and those who were unaware of this, the variable was dichotomised so that the respondents who were aware that EMS work had been underway for a long time or started recently constituted a category labelled 'aware of EMS' (n = 157). Those who reported that the workplace was not engaged in EMS work or that they didn't know constituted a separate category, named 'not aware of EMS' (n = 167). The mean ratings and the correlations between the psychological and the behavioural variables are shown in Table 3.

Respondents reported high mean ratings for environmental concern and beliefs about efficiency of source separation, and low mean ratings for the perceived difficulty of source separation. It is worth noting that the participants reported fairly high levels of personal norms, and significantly lower levels of social norms.

The Pearson product-moment correlations between the variables exhibited the expected signs. Personal norms were positively related to environmental concern, beliefs, and social norms. However, social norms were unrelated to environmental concern and beliefs. Perceived difficulty was negatively correlated with environmental concern and personal norms, implying that the higher their environmental concern or personal norms, the easier the respondents perceived source separation at their workplace to be.

Table 3. Ratings (mean, SD) and Pearson product moment correlations between indices.

	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7
1. Environmental concern ^a	5.97	0.86	—						
2. Perceived difficulty ^a	2.63	1.28	−0.16 *	—					
3. Beliefs ^a	5.81	1.10	0.37 **	−0.12 *	—				
4. Personal norms ^a	5.49	1.18	0.45 **	−0.34 **	0.25 **	—			
5. Social norms ^a	4.02	1.80	0.04	−0.12 *	0.06	0.21 **	—		
6. Source separation at work ^b	3.85	1.11	0.27 **	−0.48 **	0.07	0.39 **	0.07	—	
7. Decrease waste ^b	2.32	1.16	−0.02	−0.08	−0.08	0.13 *	0.20 **	0.21 **	—
8. Source separation at home ^a	5.93	1.17	0.49 **	−0.05	0.23 **	0.32 **	0.01	0.23 **	0.01

Note: ^a The scale ranges from 1 to 7; ^b The scale ranges from 1 to 5; * $p < 0.05$; ** $p < 0.01$.

Regarding the behavioural variables, source separation at the workplace, perceived possibility to decrease the amount of waste at the workplace, and source separation in the household, environmental concern correlated more strongly with source separation in the household, whereas perceived difficulty and personal norms correlated more strongly with source separation at the workplace. This is in line with our expectations, since the norms assess personal obligation to contribute to source separation at work. Nevertheless, the correlation between personal norms and source separation in the household was significant. It is worth noting that the correlation between perceived possibilities to decrease the amount of waste at the workplace did not show a high correlation with any of the other variables.

3.2. Differences in Psychological Variables Between Respondents Who Were Aware or Unaware of EMS Work at the Workplace

The first step was to investigate whether awareness of EMS work in the workplace was related to respondents' environmental concern, beliefs, personal norms, and social norms. The results of independent samples *t*-test revealed that respondents aware of EMS work at their workplace perceived source separation as being less difficult, compared to those who were unaware of EMS being implemented at their workplace (higher mean values for all variables) (Table 4).

Table 4. Ratings (mean, SD), *t*-tests analyses, and effect sizes (Cohen's *d*) of influencing variables for respondents reporting that their workplace is engaged (or not engaged) in EMS work.

Variable	Aware of EMS	Not Aware of EMS	<i>t</i> (df)	<i>p</i>	α^a	<i>d</i>
	<i>M</i> (SD)	<i>M</i> (SD)				
Environmental concern	6.07 (0.83)	5.87 (0.88)	2.17(322)	0.031	0.013	0.24
Perceived difficulty	2.30 (1.08)	2.93 (1.37)	4.58 (316)	0.001	0.007	0.51
Beliefs	5.84 (1.10)	5.78 (1.10)	0.50 (319)	0.617	0.050	0.05
Personal norms	5.66 (1.03)	5.33 (1.28)	2.55 (319)	0.001	0.008	0.29
Social norms	4.27 (1.92)	3.79 (1.65)	2.37 (307)	0.045	0.025	0.27
Source separation at work ^b	4.32 (0.75)	3.42 (1.21)	7.89 (317)	0.001	0.006	0.89
Decrease waste ^b	2.46 (1.10)	2.18 (1.20)	2.17 (318)	0.031	0.013	0.24

Note: ^a Bonferroni-adjusted alpha values [32]; ^b The scale is from 1 to 5; The other items was measured with scales of 1 to 7.

Both personal and social norms were stronger among employees aware of the EMS being used at work, but only personal norms reached significance. Regarding behaviour, both the degree of source separation and the possibilities to decrease waste amounts were rated as higher among respondents who were aware of EMS being used at the workplace. After Bonferroni corrections, only source separation at work reached significance. Although the effect sizes are not large, except for source separation which showed a large effect, all differences are in the expected direction.

3.3. Predictors of Source Separation at the Workplace

To investigate how different psychological factors and awareness of EMS affect the degree of source separation, a multiple linear regression analysis was performed with the adoption of waste sorting at work as the dependent variable and the psychological variables (environmental concern, beliefs, personal norm, social norms, and perceived difficulty) and awareness of EMS being used at work as predictors. The results of the regression analyses are presented in Table 5.

Table 5. Linear regression analyses of predictors of source separation at the workplace.

Variable entered	Degree of source separation
	β
Environmental concern	0.11 *
Perceived difficulty	-0.33 ***
Beliefs	-0.08
Personal norms	0.23 ***
Social norms	0.05
Awareness of EMS	-0.27 ***
R^2_{adj}	0.36

Note: * $p < 0.05$; ***, $p < 0.001$.

Environmental concern, personal norms, perceived difficulty of source separation (the β -coefficient is negative, since a higher degree of perceived difficulty is related to a lower degree of source separation), and awareness of EMS being implemented at work accounted for significant variability in the frequency of source separation in the workplace. In the preliminary regression analyses, a hierarchical procedure was used to examine whether awareness of EMS being used at work mediated the psychological variables. No evidence of such mediation was found. This reveals that perceived difficulty, personal norms, social norms, and environmental concern are more common when respondents are aware of EMS at the workplace (as evident from the t -tests, above), although these variables provide evidence of a unique variance in the degree of waste sorting at the workplace, which is not due to EMS. Overall, the variables accounted for 36% of the variance in degree of source separation ($F(6,306) = 30.27, p < 0.001$).

3.4. Does Source Separation Behaviour Spill-Over from the Workplace to the Household?

Another aim of the present research was to investigate whether the application of source separation at the workplace is related to the extent of source separation in the household, and whether the awareness of EMS at the workplace has an impact on this potential relationship. To investigate this, self-reported source separation in the home was used as a dependent variable in a regression analysis

that applied environmental concern, perceived difficulty of source separation (at work), beliefs, personal and social norms, awareness of EMS, and source separation at the workplace as antecedents. After controlling for the independent variables, an effect of source separation at the workplace on source separation at home was detected (Table 6), which suggests a spill-over effect. The regression model was significant, ($F(7,306) = 15.88, p < 0.001$).

Table 6. Linear regression analyses of predictors of source separation at home.

Variable entered	Degree of source separation
	β
Environmental concern	0.39 ***
Perceived difficulty	0.12 *
Beliefs	0.06
Personal norms	0.11
Social norms	0.00
Awareness of EMS	-0.05
Source separation at the workplace	0.12 *
R^2_{adj}	0.27

Note: * $p < 0.05$; ***, $p < 0.001$.

A supplementary analysis was performed on these responses (regarding retrospective accounts) on the extent to which participants sorted their waste in the household *before* their workplace adopted EMS compared to their degree of source separation in the household *after* their workplace adopted EMS. Only participants who were aware of EMS were included in the analysis. A paired samples *t*-test revealed that the degree of source separation after the work with EMS started was significantly greater than before the work with EMS started ($M_{after} = 5.91$ vs. $M_{before} = 5.31$; $t(154) = 6.00$; $p < 0.001$). This indicates that the adoption of EMS had an impact not only on source separation at the workplace but also in the household, indicating a spill-over effect. It is worth noting that the reported levels of source separation were high even before the respondents' workplaces adopted EMS. To investigate whether it was those respondents who reported relatively low or high levels of source separation before the adoption of EMS who accounted for the significant change in behaviour, an additional analysis was conducted. Separation of those who reported relatively low and relatively high levels of source separation before the adoption of EMS showed that it was mainly the respondents who reported low levels of source separation before the adoption of EMS who increased their source separation behaviour. Thus, the adoption of EMS at the workplace had the greatest impact on household source separation among respondents who did not separate their household waste to a significant extent before the workplace adopted EMS.

Furthermore, an independent samples *t*-test showed that the respondents who were aware of EMS recycled to a greater extent in the household than those respondents who were unaware of EMS ($M_{aware} = 6.10$ vs. $M_{unaware} = 5.77$; $t(320) = 2.52$; $p = 0.012$).

4. Discussion

In the Introduction, we reviewed the current research on the potential importance of psychological variables for source separation, and the possible spill-over effect of source separation from the workplace to the household. The aim of the present study was to investigate whether these topics are related to employees' awareness of EMS at their workplace. In conclusion, the results showed that awareness of EMS is related to source separation and stronger norms, and that source separation at work spills over to source separation in the household.

4.1. Interpretation of the Results

The results reveal distinct differences in the psychological and behaviour variables related to respondents' awareness of EMS. The fact that respondents who are aware of EMS not only report higher levels of source separation, but also have stronger personal and social norms indicates that awareness of EMS is related to psychological variables, and not only perceived ease of engaging in source separation through available waste management systems. The results not only target source separation behaviour, but also behaviours connected to the top level of the waste hierarchy: waste prevention. The results show that respondents who are aware of EMS also report higher scores regarding the perceived possibility to decrease waste amounts at work. This may be interpreted as demonstrating that awareness of EMS makes respondents more critical towards the amounts of wasted produced in the workplace, which induces them to identify ways to engage in waste prevention. This could be an indication of how far along work with waste prevention is within the organisation. In the analysis of whether psychological variables differ between respondents who are aware or unaware of EMS, while the observed causal relationship is of interest, the analysis does not provide conclusive evidence in this respect.

Introduction of EMS at a workplace could imply that more people behave in a similar manner, which in turn could promote the creation of social norms. However, the results did not support our expectation that social norms affect peoples' waste sorting, which is probably due to the weak measure of social norms used in the present study. Another result that ran counter to our expectation was that environmental concern had an effect on the degree of source separation when controlling for the other variables, whereas beliefs about the efficiency of source separation had no such effect. Previous studies have emphasised the correspondence principle (e.g., [12]), which implies that the gap between attitude and behaviour decreases when the constructs have the same degree of specificity. Thus, a specific behaviour (source separation) should show a stronger correlation with an attitude towards the specific environmental consequences of source separation (measured as beliefs in the present study) than with a general attitude (such as general environmental concern). Consequently, our measures of beliefs about environmental consequences should have an even greater impact on source separation than a measure of environmental concern. However, this notion is refuted by our results. Taken together, beliefs and social norms seem to play less prominent roles in the present study than in previous studies. Instead, in line with previous findings [13], personal norms play an important role, so we propose that in devising policies to increase the degree of source separation, personal norms should be emphasised and targeted.

We also examined whether the effects on source separation at work of environmental concern, perceived difficulty, and personal norms were mediated by awareness of EMS. The findings that (1) the impacts of environmental concern, personal norms, and perceived difficulty significantly predicted the degree of source separation, and (2) that the effects of the independent variables did not differ between the preliminary and the reported regression analyses, reveal that no mediation occurred. Thus, awareness of EMS should be regarded as one factor that affects source separation separately, and the other significant variables are also important. Since previous results (e.g., [3,13]) have shown that personal norms partly mediate other factors, such as social norms and knowledge of where to dispose of different waste fractions, an additional analysis tested whether personal norms mediate awareness of EMS. Such mediation would imply that EMS is more easily accepted by people who hold stronger environmental personal norms. However, this analysis did not yield statistically significant results. Overall, the interpretation of these findings is that awareness of EMS is strongly related to source separation, while perceived difficulty of source separation and personal norms are also important.

Furthermore, our present results support the notion that source separation at work spills over to source separation in the household. The increase in source separation at home after the adoption of EMS at the workplace is accounted for by the respondents who separated to a lesser extent before the EMS work started. A possible explanation for this spill-over effect is that environmentally benign behaviours themselves have an influence on pro-environmental attitudes, which may cause people to behave in environmentally benign manners in other areas as well. This interpretation is in line with the paper of Thøgersen and Ölander [29], who found that the act of recycling appears to improve attitudes towards pro-environmental behaviour in general. In the present context, this explanation is more likely to be valid, since the effect concerns the *same* behaviour in different contexts (at work and at home). Overall, awareness of EMS increases the degree of source separation at work, which spills over to the household. The present results also show that other psychological factors are important in determining the degree of source separation, and that these factors are related to awareness of EMS, although causality must be addressed in future studies.

4.2. Implications

A waste policy that is aimed at information on national and regional goals and measures towards a sustainable waste management must be supported by measures that affect personal norms. People may not always be aware of the environmental impact associated with their behaviours and may not be able to figure out which behaviour would be the most environmentally friendly. As prescriptive environmental norms direct environmental behaviour, they need to be well-supported to withstand economic or hedonic goals [33]. Enforcing norms and easing the translation of norms into behaviour may be facilitated by the dissemination of environmental information and knowledge. According to Thøgersen [34], people are more likely to pay attention to environmental information when they trust the informational source, have pro-environmental attitudes, and think they can help to protect the environment by adopting the behaviour. This step could be taken through strengthening peoples' beliefs that their behaviours do have effects on the environment. The introduction of EMS in the workplace may be such a measure. If the employer seriously addresses environmental impact by introducing an EMS, this may affect personal norms and willingness to engage in source separation.

From an environmental perspective, the insight regarding spill-over effects may turn out to be critically important in policy terms. Investment in EMS involving source separation possibilities, for example, may be justifiable not just in terms of the improvement in source separation that it would be likely to generate, but also in terms of the consequences that source separation behaviour has on source separation behaviours at other places and on environmental attitudes in general (and consequently, on other pro-environmental behaviours). This suggests the interesting prospect of spill-over effects for policies that aim to improve facilitating conditions.

4.3. Future Research

The results of this study are novel and they open up new possibilities for research in this field. While the regression analysis and the analysis of the source separation spill-over effect from work to the household provide some indications in the present study as to causality, the design of the study was not optimal in terms of addressing this question. For example, it would be valuable to know whether strong personal norms regarding source separation increase the possibility that employees become aware of EMS, and whether awareness of EMS strengthens personal norms. A study that captures the psychological variables before and after the introduction of EMS could add to our understanding of the causality between the role of EMS and other factors in the case of source separation. However, a potential problem is that in an organisation that decides to start the certification process, it is often the case that employees have been working with environmental issues to some extent. This means that the starting point within a non-certified organisation is probably not null, and this has to be taken into account when designing such a study. Furthermore, employees' awareness of EMS must be controlled for in the analysis.

Another topic for future research is the design of a study that captures the reversed causality, *i.e.*, to examine whether the degree of source separation at home affects waste sorting performance at work. In particular, the influence of EMS should be scrutinised.

Another aspect that should be investigated is the degree of source separation between workplaces with high or low waste intensity. The expectation is that workplaces with high waste intensity often have systems in place for source separation and therefore, a high degree of sorting could be expected. In such contexts, the additional effect of EMS would be particularly interesting. If the response rate from the construction site in the present study had been higher we might have been able to provide answers to these questions.

It would also be interesting to look in detail at the most significant environmental aspects from EMS in place at different organisations. Aspects related to energy and transport should be observed for most organisations, and probably also waste management. Does it matter to what extent waste management is central to the EMS? What results can be obtained for organisations that lack EMS, but with high waste intensity, where waste management is a core function?

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Conflict of Interest

The authors declare no conflict of interest.

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