Contents lists available at ScienceDirect

## Waste Management

journal homepage: www.elsevier.com/locate/wasman

Research Paper

## Precycling in the circular economy: Application of the motivation opportunity ability framework to explore the antecedents of consumers' precycling behavior in Finland

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#### ABSTRACT

Dealing with overconsumption and the waste crisis requires consumers to make a drastic lifestyle change, adopting more circular consumption patterns that support the prevention of waste generation. The goal of our study was to explore the range of precycling behaviors aimed at preventing waste generation in households. We tested the hypotheses of the Motivation Opportunity Ability framework using a nationally representative survey of consumers residing in Finland (n = 1,000). Respondents reported a high level of motivation, moderate level of opportunity and ability and engaged in precycling occasionally. Using exploratory factor analysis, we identified three types of precycling behaviors: long-term planning, resourceful behavior, and reuse for circularity. Multiple linear regression indicated that motivation (frugality and minimalism), opportunity (distance to circular economy services), ability (skills related to the circular economy), and precycling were associated. These findings suggest that policymakers need to focus on increasing consumers' precycling skills and improving the accessibility and availability of precycling services.

## 1. Introduction

Waste generation is one of the most important progress indicators in the context of UN Sustainable Development Goal 12 (SDG 12) – Responsible Production and Consumption (Carlsen, 2021). At the same time, global municipal waste production continues to grow and current improvements in waste management are insufficient to reduce the pressure on natural systems (Chen et al., 2020). Achieving the 1.5 °C climate target requires radical societal changes to be embraced, namely sufficiency-oriented lifestyles and collaborative consumption (Wiedenhofer et al., 2018). Therefore, we explore the range of diverse consumer behaviors aimed at preventing waste generation in households, which we refer to as *precycling*.

Precycling is of paramount importance considering the continuous trend toward urbanization and growing amounts of municipal waste (Sustainable Development Goals Report, 2022). At the EU-level, the amount of municipal waste per capita has remained relatively stable between 2004 (500 kg) and 2022 (513 kg), while in Finland the amount of municipal waste per capita increased from 469 kg in 2004 to 630 kg in 2022 (Eurostat, 2022). Although little municipal waste is landfilled in Finland, the material recovery in recycling has been decreasing, with more waste being recycled into energy (Statistics Finland, 2022). This

development is daunting in the context of the EU waste management hierarchy, which positions recovery into energy among the lowest-rated waste prevention strategies.

The reasons behind the growing amounts of waste are manifold. For example, along with increased consumption of goods, the total quantity of waste generated by packaging materials in the EU rose by 20.5 % from 2009 to 2019 (Eurostat, 2022). Moreover, the Covid-19 outbreak increased the use of e-commerce and consumption of takeaway meals, generating substantial amounts of packaging waste (Wenzel and Süßbauer, 2021). It has been suggested that plastic packaging waste and single-use plastics could be reduced by improving the availability of alternatives in shops and more consistent introduction of policies that ban single-use plastics (Jacobsen et al., 2022). Also, infrastructure plays a key role in facilitating circularity: for instance, it has been shown that longer distance to the waste sorting bins decreases consumer's inclination to recycle (Aprile and Fiorillo, 2019). As consumers are embedded in complex societal systems, their opportunities to participate in the CE are framed by these systems (Jaeger-Erben et al., 2021). While studies report a general decline in circularity-related skills like repair, one of the reasons may be the diminishing content on repair in school curricula (McQueen et al., 2023). On the other hand, mundane repairs have become riskier as producers tend to use ambiguous language in product

https://doi.org/10.1016/j.wasman.2024.04.004

Received 9 May 2023; Received in revised form 29 March 2024; Accepted 3 April 2024 Available online 11 April 2024







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warranties preventing do-it-yourself or third-party repair without a clear legal basis (Svensson-Hoglund et al., 2021).

Actions aimed at reducing waste generation in households have become an important research target. However, no established definition of precycling exists. In addition, previous consumer research has mainly focused on post-consumption behavior (especially recycling), with little attention given to waste prevention (Klug and Niemand, 2021, 2018). Our study aims to overcome these research gaps and provide a coherent definition of precycling by linking it to the ongoing debate on circular transition. We achieve this by combining the scattered notions related to precycling and waste prevention into a coherent definition grounded in circular value retaining strategies on the level of everyday consumer behavior (Reike et al., 2018). Moreover, SDG 12 encourages examination of the systems of production and consumption in reciprocity; thus, we employ the Motivation Opportunity Ability (MOA) framework (Ölander and Thøgersen, 1995) to explore the antecedents enabling precycling activities. While the domains of motivation and ability refer to internal factors that shape consumption behavior, the opportunity domain explores factors on the side of production and infrastructure. Our study is conducted in the context of Finland and uses a nationally representative quantitative survey to analyze a wide range of precycling behaviors and their antecedents.

## 1.1. Precycling in the CE

Greyson (2007) has characterized precycling broadly as actions that ensure the use of current resources in the future instead of accumulating them as waste in the biosphere. According to him, precycling concerns a wide range of actions aiming to minimize the problems of waste and maximize stocks of resources for the economy. For consumers, precycling has been conceptualized as activities that occur before any purchase decisions are made and may include either complete abstention from purchasing or selective opposition to consumption in the form of rejection, reduction, and reuse (Klug and Niemand, 2021, 2018).

No established definition of precycling yet exists, and it is often described in general terms as a "sustainable consumer lifestyle" (Klug and Niemand, 2021, p.1), or "environmentally ethical behavior" (Yaacob, 2007, p.17). An early definition of precycling described it as: "behaviors intended to reduce "garbage" by purchasing products/packages that will have less waste (e.g., buying the frozen dinner without a throwaway plate and extra packaging)" (Ellen, 1994, p.43). Later, Gillilan et al. (1996) described precycling as "reduction of household garbage by making smart shopping choices" (p.11) and specified that such behaviors usually include purchasing products with little or no packaging, or packaging made of recycled materials, and reusing products and their packaging. Evidently, these early definitions focus on purchasing and fail to embrace behaviors inspired by minimalism and frugality.

Considering the reviewed perspectives on precycling, we propose a closer conceptual link between precycling and the CE, which allows us to better account for behaviors not associated with purchasing per se, but emphasizes the conscious effort involved in planning and organizing a circular-oriented lifestyle. Korsunova et al. (2022) propose that circular behaviors range from refusing, reducing, reusing, repurposing, and repairing to recycling. Apart from recycling, all these constitute precycling, and in practice this may mean that consumers refuse free and single-use products, make a conscious effort to reduce their consumption of goods, creatively reuse and repurpose what they already own, and perform maintenance and repair to prolong the life of their goods. Reducing one's consumption and generated waste requires meticulous planning related to seasonality and maintenance of owned goods, creativity to make the best of what is already available in the household, and conscious efforts to resist consumerist lifestyles (Bartl, 2014) by avoiding unnecessary purchasing. Availability of services is also a significant enabler of waste prevention behavior by enabling more efficient use of goods (Cox et al., 2010). Considering the diverse range of activities constituted by precycling, performing them requires inventiveness

and a wide range of skills (Bekin et al., 2007).

Advancing research on precycling requires going beyond preventing food waste (Klug and Niemand, 2021). Hence, it is important to consider the range of household precycling activities dealing with everyday items (e.g., furniture, textiles, appliances, sports equipment) and the use of services facilitating longer use of these goods. In this connection, we propose a following definition for precycling: *precycling concerns conscious planning and organizing to minimize waste generation from daily activities, including creative reuse, repurpose, repair, and the use of valueretaining services for goods.* We maintain that our broader precycling definition has clearer conceptual links to the CE and better reflects the diverse and complex network of precycling activities than previous definitions.

### 1.2. Theoretical framework

We aim to provide insight on how to facilitate precycling behavior by investigating both internal and external factors. We do this by employing the MOA framework that focuses on three domains: motivation, opportunity, and ability (Ölander and Thøgersen, 1995). It was originally developed for marketing research purposes (MacInnis et al., 1991) but has been widely applied in consumer research (de Koning et al., 2015; Gruen et al., 2007; Ölander and Thøgersen, 1995) and has also been applied in waste avoidance studies (Soma et al., 2021; Scalvedi and Rossi, 2021; Oria and Schneeman, 2020; Vittuari et al., 2021).

Although different factors can motivate precycling, it is most often linked to frugal orientations among consumers. For instance, Klug and Niemand (2021) found an indirect relationship between frugality and precycling, and moderation between frugality and voluntary simplicity. Lastovicka et al. (1999) defined frugality in relation to more disciplined acquisition and use of products. In addition, waste prevention is closely linked with minimalism and the desire to be effective and in control of one's own daily life (Lloyd and Pennington, 2020). These conscious efforts to declutter and control one's own waste generation via consumption choices and voluntary simplicity (Hook et al., 2021) are at the heart of precycling. Thus, our study combines frugality and minimalism as motivational factors of precycling in the MOA framework. Therefore, we test Hypothesis 1: *Motivation (frugality and minimalism) is positively associated with precycling behaviors*.

In environmental research, the *opportunity* domain is broadly viewed as different external conditions that may hamper or facilitate behaviors (Thøgersen, 2009). CE studies find that the distance to recycling facilities affects consumers' willingness to sort their waste for transporting to recycling containers (González-Torre and Adenso-Díaz, 2005). It has been found that even perceptions regarding this distance strongly affect recycling behavior (Lange et al., 2014). In the context of precycling facilities and infrastructure may range from reuse centers to repair workshops to second-hand shopping malls; therefore, we frame the opportunity domain in MOA as the distance to circular services from consumer homes and test Hypothesis 2: *Opportunity is positively associated with precycling behaviors*.

The *ability* domain usually refers to consumers' skills or proficiencies (MacInnis et al., 1991). In the context of precycling this may refer a wide variety of skills for creative reuse and repurposing of materials, maintenance and repair of goods, and the communication and negotiation skills needed in trading second-hand (Råberg, 2022). Prior studies indicate that younger consumers, particularly those born between late 1990s and early 2010s need more training and education regarding food waste prevention (Thyberg and Tonjes, 2016; Kymäläinen et al., 2021). A study on textile mending skills concluded that younger people had inferior consumer skills to those of previous generations (Fisher et al., 2008). However, circular skills are far more diverse than just repair or food waste prevention. Drawing on Råberg's (2022) findings regarding consumer skills in the CE, we frame the ability domain as a set of skills and abilities to act in a way that minimizes waste generation. Consequently, we test Hypothesis 3: *Ability is positively associated with* 

#### precycling behaviors.

## 2. Materials and methods

#### 2.1. Data collection

We implemented the survey through a Finnish market research company Aistila, and the data were collected between May 11 and May 23, 2022. Our sample (n = 1,000) was representative of adult people residing in Finland in terms of age, gender, residential area, and education (Table 1). The average response time was 25 min. The duration of the responses and response behavior were monitored by Aistila to detect the poor quality of the response due to fatigue or boredom (12 % of the responses). Only high-quality responses were included in the dataset.

## 2.2. Measures

We used existing relevant scales obtained from the literature and developed them to better suit the purposes of the study. The initial survey questions were refined through consultations with representatives of the Consumers' Union of Finland and SITRA – the Finnish Innovation Fund behind the National Roadmap to a Circular Economy. Later, we piloted the survey with a sample of 31 individuals from personal networks and adjusted them according to feedback. Statements were presented to respondents in random order. A complete list of statements is available in the Online Appendix.

*Precycling behavior.* We developed a scale measuring precycling behaviors based on Wenzel and Süßbauer (2021), Klug and Niemand (2021; 2018), and Råberg (2022). The scale comprised 23 statements, for example 1) I consciously avoid excessively packaged products, 2) When purchasing products, I tend to favor durable and reusable products, and 3) I tend to avoid impulse shopping. We used a 5-point response scale (1 = never to 5 = always).

*Frugality and minimalism scale (motivation).* We adopted six statements from the minimalism scale used by Matte et al., (2021, originally developed by Iwata, 2006) and two statements from the frugality scale developed by Bayer et al. (2021). We created two additional statements based on the findings of Råberg (2022) regarding active circular

## Table 1

Sociodemographic background of the respondents (n = 1,000) and the Finnish population (Statistic Finland, 2022).

Variable		Data sample* (%)	Finnish population** (%)
Age	Min 18		
	Max 77		
	Mean 45.03 (SD 14.74)		
	18–30	21.9	23.6
	31–40	20.1	20.2
	41–50	18.5	18.6
	51–64	27.5	27.7
	65 and over	12.0	9.9
Gender	Women	52.6	49.3
	Men	46.5	50.7
	Other or unknown	0.9	n.a.
Education	Basic	18.7	25.8
	Secondary	44.5	40.6
	Tertiary	36.0	33.6
Residential	Helsinki and Uusimaa	31.9	31.1
area	province		
	Other parts of Southern	16.2	20.8
	Finland		
	Western Finland	26.7	25.1
	Northern and Eastern	25.2	23.0
	Finland		

\*The Finnish adult population between 18 and 77 years old.

\*\*Age and gender only include statistics for the adult population (18–69-yearolds). consumers in Finland. In total, this scale consisted of 10 statements, for example (1) I try to live a simple life and not to buy articles which are not necessary, (2) I do not throw things away unless they get too damaged to be repaired, and (3) I think it's sensible to buy things second-hand to save money. The respondents indicated the extent they disagree or agree with each statement using a 5-point Likert scale (1 = totally disagree to 5 = totally agree).

Distance/Accessibility of services related to precycling (opportunity). We developed a scale to measure the accessibility of precycling services. Previous studies from Finland measuring the distance to different services informed the creation of our distance scale (e.g., Kytö et al., 2003; Lankila et al., 2016). Due to low population density, distance to services in Finland varies, especially in capital vs. non-urban areas. In Finland, 10 km is often used as a limit when examining the distance to services, and up to 5 km is considered a reasonable distance to frequently needed services (Kytö et al., 2003). We created statements for this scale based on items included in the precycling scale (Q2.3 in Online Appendix) when applicable and added statements related to borrowing and renting, as well as recycling, opportunities. The scale comprised 13 statements (Q2.6 in Online Appendix). The respondents evaluated the accessibility of the services by choosing one of seven response options to best describe the distance. The distance scale included, for example, (1) a store where you can buy products loose or in wholesale packages, (2) a store where you can refill your own bottle with detergents (such as shampoo or laundry detergent), and (3) services related to renting goods. When preparing the survey for data analysis we combined some categories to create a variable with an ordinal scale. We also reverse coded the scale so that the higher values indicate better accessibility (=shorter distance) and generated a total of five categories: 1 = notavailable, 2 = available further away, 3 = available in 10 km range, 4 = close (within 5 km), and 5 = very close (within 1 km) or available online. We calculated a mean score that was used as an independent variable in the models.

Skills and abilities related to the CE and precycling behaviors (ability). This scale was developed using previous findings on skills for conscious consumption (reduce), reuse, repurpose, and repair, particularly insights from a Finnish study (Råberg, 2022). In total, we formulated 15 statements related to circular skills, for example "I have the craft skills to repair and reuse goods and materials," "I have the ingenuity to use materials or goods in a new way," and "I am open to doing things differently (e.g., trying renting instead of buying)." Respondents rated their own CE/precycling skills on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree).

*Sociodemographic variables.* We also asked respondents about their gender, age, level of education, residential area type, household type, and perceived household economic situation.

## 2.3. Research ethics and privacy

This study was conducted in accordance with the guidelines of the Research Ethics Committee in the Humanities and Social and Behavioral Sciences at the University of Helsinki. Our survey design did not require an ethical review because it was fully anonymous, minors were not involved, and our study setup neither contained exceptionally strong stimuli nor posed a potential threat to subjects.

#### 2.4. Statistical analyses

# 2.4.1. Exploratory factor analysis to form variables to measure precycling behaviors

We used IBM SPSS (version 28) in the analysis. We performed an exploratory factor analysis (EFA) to identify different types of precycling behaviors. First, we included all 23 variables measuring precycling behaviors in the EFA using the Maximum Likelihood method with Varimax rotation. Then, we removed variables with low communality (<0.3) one by one (Akhtar et al., 2022). Next, we removed variables with cross-

loadings (Akhtar et al., 2022) one by one. The KMO and Bartlett Test for the final EFA was 0.908 (p = 0.000). The final EFA included 16 variables and resulted in a three-factor solution (with Eigenvalue > 1) that accounted for 41.2 % of the variation (Table 2). The first factor, "longterm planning behavior," accounted for 15.0 % of the variance and included behaviors that required conscious planning to avoid waste. The second factor, "resourceful behavior," accounted for 14.1 % and referred to doing things in novel ways to avoid waste. The third factor, "reuse for circularity behavior," accounted for 12.1 % of the variance and referred to the use of food leftovers, expiring food, and packaging materials. Based on these factors, we formed three variables including the items

#### Table 2

Results of exploratory factor analysis on survey items measuring precycling behavior. Factor loadings > 0.40 are bolded.

	Factor 1 "Long-term planning behavior"	Factor 2 "Resourceful behavior"	Factor 3 "Reuse for circularity behavior"
I consciously avoid excessively packaged products	0.77	0.31	0.25
Before buying goods, I do research on the durability and recyclability of the materials used.	0.60	0.38	0.22
I tend to avoid unnecessary things like free give-away products.	0.56	0.18	0.02
I avoid takeaway foods and drinks in single-use packages.	0.55	0.18	0.32
When I buy products, I prefer those made from recycled materials.	0.58	0.34	0.29
I avoid impulse shopping.	0.47	-0.12	0.30
I buy food from local producers through group- based food acquisition or community-based aericulture	0.14	0.69	0.06
I make some of my cosmetics	0.10	0.64	-0.06
(e.g., deodorant). When I buy cleaning detergents, I try to find stores where I can refill products in my own bottles.	0.21	0.60	0.12
I grow some of the vegetables (or herbs) I use myself.	0.13	0.50	0.29
I utilize materials from my kitchen, such as vinegar or baking soda, as cleaning detergents.	0.29	0.44	0.27
I utilize leftovers, for example when baking or cooking.	0.21	0.11	0.58
I freeze some food to reduce food waste if I don't need it right away.	0.11	-0.10	0.57
I buy food that is soon expiring from grocery stores.	0.08	0.07	0.53
I reuse some packaging materials (e.g., plastic boxes, glass bottles and jars) for the same purpose or invent new uses for them.	0.26	0.20	0.52
I prefer large packages to reduce the amount of packaging waste.	0.27	0.29	0.41

Extraction method: Maximum Likelihood. Rotation method: Varimax with Kaiser Normalization.

with a factor loading > 0.40 as mean scores, and their reliability was acceptable (Cronbach  $\alpha \ge 0.70$ ).

#### 2.4.2. Multiple linear regression

We performed three sets of multiple linear regression analyses to test the hypotheses. We used each of three precycling behaviors (i.e., longterm planning behavior, resourceful behavior, and reuse for circularity behavior) as dependent variables in the models and included the following as independent variables: frugality and minimalism ("motivation"), perceived distance to CE services ("opportunity"), and skills and abilities ("ability"). In addition, we included the following sociodemographic variables as control variables in the regression models: age, gender, education, residential area type, perceived economic situation, and type of household. We used dummy-coding for categorical and ordinal control variables. Because of heteroscedasticity in Model 2 ("resourceful behavior"), we square root transformed the dependent variable. The Durbin–Watson test was used to assess the independence of residuals. There was no multicollinearity in the models (VIF < 3).

## 3. Results

### 3.1. Motivation, opportunity, ability, and precycling behaviors

Respondents reported a high level of motivation to precycle (Table 3). They agreed the most with the statements related to the long-term use of goods (e.g., "I try to use purchased goods for as long as possible" or "I am the type of person who continues using old items for as long as they still can be used") (Online Appendix).

The respondents reported a moderate level of opportunity to precycle (measured as the perceived distance between home and CE services) (Table 3). The most accessible services included recycling services, flea markets and other second-hand shops, and stores that sell products that will soon expire (Online Appendix). The least accessible services were stores that offer the opportunity to buy liquid products (shampoo or cleaning detergents) to refill consumers' own bottles or sell raw materials for DIY cosmetics. Participating in group-based food acquisition or community farming and special stores focusing on selling soon-to-expire food were also among the least accessible services.

Respondents reported a moderate level of skills related to CE on average (Table 3) and mostly agreed with the statements "I can recycle" and "I have planning skills that I can use to reduce food waste" (Online Appendix). On the other hand, they least agreed with the statements where they were asked to evaluate the negotiation and communication skills needed in the trade of second-hand goods.

Of the three types of precycling behavior, the most common among respondents was *reuse for circularity behavior*, which they did occasionally or regularly (Table 3), followed by *long-time planning behavior*, which was done on average occasionally, and *resourceful behavior*, which was done rarely. Moreover, these three types of precycling behavior correlated positively with each other.

## 3.2. Hypothesis testing

We tested the three hypotheses based on the MOA framework with three sets of multiple linear regressions, one for each precycling behavior (Table 4). Motivation was positively associated with long-term planning behavior and reuse for circularity behavior but not with resourceful behavior. Therefore, the first hypothesis (motivation is positively associated with precycling behaviors) was only partly confirmed. Opportunities to precycle (measured as perceived distance to precycling services) were positively associated with all three types of precycling behaviors; therefore, the second hypothesis (opportunity is positively associated with precycling behaviors) was confirmed. Ability was also positively associated with all three types of precycling behavior; therefore, the third hypothesis (ability is positively associated with precycling behaviors) was confirmed. These results suggest that the

#### Descriptive statistics of the main variables.

				correlation	correlation coefficients				
		mean	SD	1	2	3	4A	4B	4C
1	Motivation (frugality and minimalism)	4.01	0.61						
2	Opportunity (distance to CE services)	2.75	0.75	-0.03					
3	Ability (skills and abilities)	3.53	0.64	0.40**	0.31**				
4A	Long-term planning behavior	3.15	0.75	0.45**	0.22**	0.52**			
4B	Resourceful behavior	2.32	0.82	0.06	0.24**	0.38**	0.51**		
4C	Reuse for circularity behavior	3.62	0.67	0.54**	0.13**	0.48**	0.53**	0.38**	

\*\*Correlation is significant at the 0.01 level (2-tailed). The range of all variables is 1-5.

## Table 4

Results of multiple linear regressions for different types of precycling behaviors.

	Dependent variable								
	Model 1 Long-term planning behavior		Model 2 Resourceful behavior			Model 3 Reuse for circularity behavior			
	В	S.E.	Beta	В	S.E.	Beta	В	S.E.	Beta
Motivation <sup>a</sup>	0.36**	0.04	0.29	-0.02	0.01	-0.06	0.43**	0.03	0.40
Opportunity <sup>b</sup>	0.13**	0.03	0.13	0.05**	0.01	0.13	0.08**	0.03	0.09
Ability <sup>c</sup>	0.42**	0.04	0.36	0.15**	0.01	0.36	0.29**	0.03	0.28
Gender: woman (ref. man)	-0.09*	0.04	-0.06	-0.04*	0.02	-0.07	0.06	0.03	0.05
Age	0.01**	0.00	0.11	-0.00**	0.00	-0.12	0.00	0.00	0.05
Level of educ. (ref: tertiary)									
basic	-0.02	0.06	-0.01	0.00	0.02	0.01	-0.03	0.05	-0.02
secondary	-0.01	0.04	-0.01	0.02	0.02	0.04	-0.07	0.04	-0.05
Perc. econ. situation of household (ref: settling for less almost always)									
settling for less at times	0.09	0.06	0.05	0.05	0.03	0.07	-0.13*	0.06	-0.08
gets by through careful spending	0.15*	0.06	0.09	0.06*	0.02	0.10	-0.07	0.05	-0.05
comfortably off	0.14*	0.07	0.08	0.04	0.03	0.06	-0.12*	0.06	-0.08
very well off	0.28**	0.10	0.09	0.08*	0.04	0.07	0.02	0.09	0.01
Residential area type									
(ref: capital area)									
large city	-0.04	0.06	-0.03	-0.02	0.02	-0.02	0.02	0.05	0.01
urban	-0.05	0.05	-0.03	0.01	0.02	0.02	0.06	0.05	0.04
rural	-0.05	0.06	-0.03	0.06*	0.02	0.09	0.08	0.05	0.05
Household type									
(ref: single household)									
childless couple or other adult household	0.03	0.05	0.02	0.09**	0.02	0.16	0.14**	0.04	0.10
family with children	-0.04	0.05	-0.02	0.07**	0.02	0.11	0.05	0.05	0.04
$R^2$	0.37**			0.23**			0.38**		

<sup>a</sup>motivation = frugality and minimalism, <sup>b</sup>opportunity = distance to CE services, <sup>c</sup>ability = skills and abilities related to CE.

\*\*\*<0.001, \*\*<0.01, \*<0.05.

MOA framework was able to explain different types of precycling behavior with the exception that motivation was not associated with resourceful behavior.

Regarding the sociodemographic control variables, we found that older respondents were more likely to engage in long-term planning behavior than younger respondents. Moreover, respondents with higher perceived economic status were more likely to engage in long-term planning behavior than those with the lowest perceived economic status. Women were less likely to engage in long-term planning behavior than men.

Regarding *resourceful behavior*, we found that older respondents were less likely to engage in this type of precycling behavior than younger respondents. Women were less likely to engage in resourceful behavior than men. Respondents with a higher perceived economic status or those who get by through careful spending were more likely to engage in resourceful behavior than those in the weakest perceived economic situation. Furthermore, respondents living in rural areas were more likely to engage in resourceful behavior than those living in the capital region. Single households were least likely of all household types to engage in resourceful behavior.

Regarding *reuse for circularity behavior*, we found that respondents who reported settling for less at times and those who were quite comfortably off were less likely to engage in reuse for circularity than respondents with the lowest perceived economic status. Furthermore, childless couples and other adult households were more likely to engage in reuse for circularity behavior than single households.

## 4. Discussion

The objective of this study was to explore Finnish consumers' precycling behavior by applying the MOA framework (Ölander and ThØgersen, 1995). The findings suggest that precycling requires motivation, skills, and opportunities and therefore MOA appears to be a suitable framework for describing consumers' precycling behaviors. These findings are in line with previous research on avoidance of packaging materials (Jacobsen et al., 2022) and sustainable consumer behavior applying the MOA framework (Soma et al., 2021; de Koning et al., 2015). We extend these by adding precycling as an important type of sustainable consumer behavior.

In our study, three types of precycling behaviors were identified. First, *long-term planning* refers to behaviors that require conscious planning to avoid waste. Correspondingly, food waste studies have found that better planning plays an important role in reducing waste (Stancu et al., 2016; von Kameke and Fisher, 2018; Janssens et al., 2019). In addition, planning routines and household skills have been found to be positively associated (Stancu et al., 2016). Second, *resourceful behavior* refers to doing things in novel ways to avoid waste. Third, *reuse for circularity behavior* refers to the reuse of resources that would otherwise become waste. An example of resourceful behavior is productive consumption, where the consumers create products themselves, such as homemade/DIY cosmetics (Morais et al., 2018). Reuse for circularity, instead, is about creative upcycling practices whereby an old product is modified for a new purpose (Wilson, 2016) or leftovers are used to reduce food waste (Fraser and Parizeau, 2018; Stancu et al., 2016). In fact, these types of behavior emerged in Klug and Niemand's (2021) interviews with precyclers, although they were not included in their final precycling scale.

Our study is the first attempt to align the precycling concept with the wider range of circular behaviors and empirically test them with a nationally representative sample. To date, studies on waste prevention behaviors have mainly revolved around food waste (Thyberg and Tonjes, 2016) or dealt with case studies of specially dedicated communities (Bekin et al., 2007), voluntary simplifiers (McDonald et al., 2006), or zero-waste enthusiasts (Kim-Marriott, 2021). At the same time, scholars from the CE field have criticized excessive fixation on recycling as one of the only options available to consumers to participate in the CE (Hobson, 2020). In fact, scholars are concerned about the sustainability of a CE rooted in selective approaches that emphasize recycling and recycled goods (Temesgen et al., 2021). Hence, recent studies have introduced conceptual distinctions between the concepts of precycling, recycling, and upcycling (Klug and Niemand, 2021), challenging the dominant focus on recycling. In this regard, policymakers have the responsibility of channeling economic activities towards precyclingoriented approaches, prioritizing reuse, repair, refurbishing, and remanufacturing, thereby reducing the need for recycling activities (Reike et al., 2018).

On the other hand, businesses can facilitate circularity through improved access to services that enable precycling and waste prevention, and new precycling-oriented business models. This calls for improving conceptual clarity with regards to CE, precycling and recycling to enable policymakers and businesses to prioritize value retention through shorter circular loops.

Previously, precycling has been mainly framed through behaviors associated with purchasing and packaging (Ellen, 1994; Klug and Niemand, 2021; Wenzel and Süßbauer, 2021), with no conceptual links to the field of CE. Our study advances the concept of precycling by situating it at the intersection of the CE field and the literature on consumer behavior, detailing a wider range of circular behaviors important for preventing waste generation. These include, for instance, refraining from consumption; reuse, repurposing, and creative use of existing products; and making products oneself. Including these behaviors within precycling highlights the extent of conscious planning, creativity, and skills expected from circular consumers and accentuates the need for supportive services. Thus, the first contribution of our study is in conceptual advancement and refinement of the precycling concept. We build on the precycling scale of Klug and Niemand (2021) that emphasizes frugality, we further extend the scale to explicitly reflect the purposeful planning, resourceful mindset, and creative reuse of ingredients, materials, and goods required in precycling. We acknowledge that this scale does not embrace repair and maintenance or renting activities and therefore warrants further development. This limitation is rooted in the complexity of factors affecting repair. As the propensity to repair is highly product-specific (Scott and Weaver, 2014), it is difficult to reliably measure the use of repair services or self-repair with general statements.

Our findings suggest that Finnish consumers engage in precycling behavior at least occasionally. They have a good level of motivation to precycle but a moderate level of ability. These findings have practical implications concerning education and training in skills relevant for CE transitions. In particular, the findings indicate that consumers feel very confident about their recycling skills but much more uncertain about their negotiating and communication skills related to the online trading of secondhand goods. Previous studies find that younger generations have fewer skills related to seasonal waste-free cooking, basic maintenance, and repair of clothing, furniture, and other household items than previous generations (e.g., Fisher et al., 2008). Future studies could explore essential circular skills and knowledge to be included as part of basic education and detail how education could be complemented with awareness-raising instruments to facilitate recognizing durable and repairable goods.

As respondents reported a moderate level of opportunities to precycle, it appears necessary to improve precycling-oriented services. Accelerating the CE transition depends on whether conventional market actors start to offer a wider range of CE-oriented products and (digital) solutions to make precycling more convenient. This is critical, as convenience has been found to be an important factor in waste avoidance behavior (Jacobsen et al., 2022). For instance, our study showed that very few respondents lived close to a shop where they could get refills for liquid personal care or cleaning products. The availability of alternative products (e.g., solid shampoo bars in cardboard packages) was equally poor. In practice, this means that most consumers will continue to purchase liquid products in plastic packaging unless alternatives become easily available in conventional shops. In addition, close to 50 % of the respondents indicated that rental services for different goods were not available close to their home (Online Appendix). Since availability of services has been shown to enable waste prevention behaviors (Cox et al., 2010), visibility and availability of rental services need to improve to support access-based consumption models.

Our finding that precycling behaviors were associated with respondents' sociodemographic background differs from that of Park (2000). In our study gender was associated with both long-term planning behavior and resourceful behavior: women engaged in these precycling behaviors less than men. While Ellen (1994) found men to be doing significantly less precycling than women, this was limited to behaviors such as using cloth bags and recycled paper products and avoiding polystyrene. A wider conceptualization of precycling (i.e. the inclusion of a wider array of activities) in our study may explain why it appeared more relevant to men. Another possible explanation could be gender differences in shopping behavior, where hedonistic, impulsive, and compulsive shopping patterns are more common in women than men (Tarka et al., 2022). Among the different types of precycling behaviors, "long-term planning behavior" and "resourceful behavior" are quite contradictory to this type of behavior. However, further research could bring more clarity to this.

Regarding age, we found that older respondents were more likely to engage in long-term planning behavior to reduce waste. Similarly, older age has been associated with producing less food waste (Aschemann-Witzel et al., 2017; Janssens et al., 2019; Scalvedi and Rossi, 2021) and with waste prevention behaviors (Kurisu and Bortoleto, 2011). The same can be seen in other forms of pro-environmental behavior, such as sustainable energy consumption (Vainio et al., 2020). Instead, young people may be more open to adopting new ways to act pro-environmentally, such as reducing food waste through nudging (von Kameke and Fischer, 2018) or adopting plant-based diets (Niva and Vainio, 2021). Thus, in our study younger respondents were more likely to engage in resourceful behaviors (e.g., group-based food acquisition, growing herbs, making DIY cosmetics). Social media may also facilitate the spread of new practices among younger generations (e. g., productive consumption), which warrants further investigation.

Regarding the perceived economic situation of households, better-off respondents were more likely to adhere to precycling behaviors than others. Precycling can be a way of managing household resources wisely and resourcefully, which may contribute to a good perceived economic situation. Moreover, Sachdeva and Zhao (2021) found that financial abundance was associated with more sustainable choices. In this regard, precycling may be different from some other types of sustainable consumption. For example, in a previous Finnish study a good household economic situation was negatively associated with a household's sustainable energy consumption (Vainio et al., 2020). This illustrates the complexity related to sustainable behaviors and calls for future studies to investigate with precision the reasons for a positive association between precycling and a household being well-off. It remains unclear whether in household with good economic situation, families had more time and flexibility to engage with precycling activities, or whether precycling behaviors are simply more expensive.

Furthermore, respondents with a moderate or good perceived economic status were less likely to engage in reuse for circularity than respondents with the weakest perceived economic status. Engaging in these types of behaviors helps save money, although it might also be time-intensive (making use of leftover foods, buying soon-to-expire foods, and reusing packaging materials).

Residential area type was not associated with precycling with one exception. Residents living in rural areas were more likely to engage in resourceful behavior than those living in the capital area. The explanation may be that people living in the countryside have more opportunities to grow their own vegetables in the garden or purchase food directly from local producers. Household type was associated with precycling: childless couples and other adult households were more likely to engage in both resourceful behavior and reuse for circularity behavior than single households, and families with children were more likely to engage in resourceful behavior than single households. Differences between households have also been observed in the past: more waste per person is produced by single households than other types (Williams et al., 2020). The difference between household types warrants further investigation. The level of education was not associated with precycling behavior in our study.

The limitations of our study are related to measuring respondents' self-reported, instead of actual, behavior and perceptions. Self-reported behavior may be biased due to memory or social desirability. On the other hand, our survey was anonymous, and the questions did not include any sensitive issues, (e.g., concerning health issues), making them less susceptible to such bias. Moreover, a cross-sectional survey is not able to establish causal associations between variables, and therefore it is also possible that engagement in precycling behaviors may increase consumers' motivation and ability to precycle, and not only vice versa. Our study concerns Finland; hence, future studies could address precycling in other national contexts to compare precycling and its antecedents in diverse environments. Further testing and validation of the precycling scale remains a next step.

## 5. Conclusions

Transitioning to a CE implies drastic changes in the lifestyles of individuals. Yet, translating the grand circular vision into concrete everyday behaviors often remains both vague and unambitious. To address this gap, our study developed a more nuanced conceptualization of precycling as a set of diverse behaviors that embrace conscious reduction in consumption, creative reuse, and repurposing, repairing, maintaining, and renting instead of owning. The range and diversity of the behaviors associated with precycling are illustrative of the time, planning, effort, and skills needed to engage in such behaviors. Moreover, using the MOA framework we demonstrate that precycling requires a balanced interplay between internal motivation, convenience, and relevant abilities to perform the behaviors associated with waste prevention. In other words, precycling calls for a better alignment of the systems of consumption and production. This entails a significant development and expansion of circular-oriented services to support consumer engagement in precycling. Achieving a widespread transformation in behaviors calls for large-scale players such as conventional supermarkets to introduce products and services that enable precycling. On the other hand, careful consideration is needed in defining the skills and educational needs to accelerate the CE transition. For instance, while it may be reasonable to outsource repair services to professionals, many mundane maintenance tasks that prolong the life of goods are easy

to perform at home on a regular basis. The educational needs may vary according to national contexts, as different nations tend to excel in different domains of consumers' doing. We encourage future studies to explore both the educational needs and circular domains of excellence in different countries to identify opportunities for an international exchange of competences and circular education and training.

#### CRediT authorship contribution statement

**Piia Lundberg:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing. **Annukka Vainio:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing. **Mirka Råberg:** Conceptualization, Writing – original draft. **Angelina Korsunova:** Conceptualization, Funding acquisition, Supervision, Writing – original draft, Writing – review & editing.

#### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### Data availability

Data will be made available on request.

## Acknowledgements

We gratefully acknowledge the financial support of Kone Foundation for survey data collection. We would also like to thank Laura Järvinen from Sitra and Jenni Vainioranta from the Consumers' Union of Finland for their insightful comments on our survey draft. We also thank anonymous pilot study respondents for their help and comments on our survey as well as all the respondents of our survey.

#### Funding Sources

This project was funded by Kone foundation (202006996).

## Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.wasman.2024.04.004.

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