An integrative model of waste management: situational, normative, attitudinal and selfrelated determinants of household's food waste separation intention and habits, and waste deposit at disposal centres

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1   **Abstract.**

2

3   Faced with increasing waste production, authorities are seeking to encourage better household

4   waste-management and need to identify levers for change. We propose a model integrating the

5   major determinants of pro-environmental behavior assumed in prominent theoretical models.

6   Based on meta-analytical evidence, we incorporated situational, normative, attitudinal and self-

7   processes and tested this integrative model to predict intentions to perform two overlooked

8   behaviors: food waste separation and deposit at waste disposal centers. To go beyond intention

9   we also investigated habits to sort food waste. An online survey was administered to two

10   samples (N_{total} = 2'814) and data were analyzed using structural equation modeling. The results

11   showed a good fit of an integrative model (CFIs > 0.917; TLIs > 0.910; RMSEAs < 0.043;

12   SRMRs < 0.071). Waste management intentions and habits are directly predicted mainly by

13   personal norms and perceived behavioral control. The latter is predicted by facilitating

14   conditions and pro-environmental identity. Personal norms are predicted by social norms, pro-

15   environmental identity and perceived behavioral control. Our results confirm the relevance of

16   a model integrating situational, normative, attitudinal and self-processes to explain waste

17   management intentions, and provide a basis for the development of waste-management

18   interventions.

19   **Keywords:** waste management, integrative model, environmental psychology, intention,

20   structural equation modeling

21

22   Since the beginning of this century, the serious and growing international issue of waste

23   management has led to many studies of recycling behavior, which have been widely reported

24   in the behavioral science literature (littering, Chaudhary et al., 2021; household waste

25   separation, Rousta et al., 2020; recycling of packaging materials, Miafodzyeva & Brandt, 2013).

26   Research has highlighted several determinants of waste management behaviors, all articulated

27   in four robust models: the theory of planned behavior (Strydom, 2018), the norm activation

28   model (Wang et al., 2019), the value-belief-norm model (Dursun et al., 2017), and the

29   comprehensive action determination model (Ofstad et al., 2017). A recent meta-analysis of 91

30   studies on household waste management identified numerous predictors of recycling behavior

31   in general, helping policymakers design effective strategies for waste prevention actions

32   (Geiger et al., 2019).

33   The purpose of the present study is to advance the understanding of household waste

34   management by integrating the contributions of historical models of behavioral change and

35   more recent research into a unified model, to predict intention and habits related to two

36   understudied types of waste management behaviors. The first is the source separation of food

37   waste, which makes up around 30% of the contents of a household's waste bin. European Union

38   foresees the obligation to treat it separately from January 2024, implying the individual

39   adoption of this new sorting behavior. The second behavior is the deposit at waste recycling

40   and disposal centers of various household waste types, such as bulky, toxic, electrical, or

41   electronic waste. Collected properly, the largest part of this waste volume can be recovered

42   through the resale of materials or through reuse. Some waste, however, contains hazardous

43   materials, such as toxic liquids and electronic waste, which can generate environmental

44   pollution. Therefore, it is essential to treat each waste type accordingly after it has been

45   deposited in appropriate facilities, such as a community's waste recycling and disposal center.

46   In this study, we propose a model incorporating the main determinants of recycling behaviors

47 (identified from the meta-analysis by Geiger et al., 2019) and we test its ability to account

48 for intention towards two specific behaviors: separation of food waste and deposits at waste

49 disposal centers.

50 **Models of Pro-Environmental Behavior**

51   Research in environmental psychology has fruitfully developed and tested models to

52 explain pro-environmental behavior. However, the parallel development of multiple models has

53 revealed a large diversity of potential determinants of pro-environmental behavior. The present

54 study is in line with recent attempts to integrate models and the most important determinants of

55 pro-environmental behavior (see e.g., Gkargkavouzi et al., 2019; Klöckner & Blöbaum, 2010).

56 Our approach is to integrate prominent theoretical models by relying on empirical meta-

57 analytical evidence. In what follows, we provide an overview of four prominent theoretical

58 models.

59 *Theory of Planned Behavior*

60   In 1991, Ajzen proposed a theory of planned behavior to explain any deliberate

61 behavior, including deliberate pro-environmental behavior (e.g., choice of travel mode,

62 Bamberg et al., 2003; food consumption, Ajzen, 2016; implication in pro-environmental

63 education, de Leeuw et al., 2015). As shown in Figure 1a, this rational choice model assumes

64 that behavioral intention is the main predictor of deliberate behaviors. Intention reflects the will

65 to exert effort to perform a behavior and is guided by three types of beliefs. First, an individual's

66 intention is guided by attitudes in terms of a favorable or unfavorable evaluation of the behavior,

67 derived from beliefs about the possible consequences of the behavior and the rational evaluation

68 of those consequences. Second, intention is guided by subjective norms—perceived social

69 pressure resulting from beliefs about what relevant others approve or disapprove (injunctive

70 norm) or do (descriptive norm)—and the motivation to fulfill those social expectations. Third,

71 intention is guided by perceived behavioral control (Ajzen, 1991), which results from beliefs

72 about one's ability to perform the target behavior (i.e., self-efficacy) and about control over that

73 behavior (Kraft et al., 2005). According to this model, individuals form a rational intention to

74 act, weighing the three types of behavioral beliefs. The determinants modeled in the theory of

75 planned behavior have been associated with a wide range of recycling behaviors (Aguilar-

76 Luzón et al., 2012; Tonglet et al., 2004).

The Norm Activation Model

78 The norm activation model developed by Schwartz (1973, 1977), shown in Figure 1b,

79 proposes that individuals act in a pro-social and pro-environmental way because they feel

80 morally obligated to do so (Bamberg et al., 2003; Steg & Groot, 2010). The sense of moral

81 obligation, also referred to as personal norms, arises from the internalization of social

82 expectations. Indeed, social learning about what is and what is not valued by significant others

83 forms a solid basis for the moral principles that individuals embrace (Thøgersen, 2006).

84 However, the influence of personal norms on behavior differs from the influence arising from

85 social norms, as it primarily results from implications for the self. First, sanctions following

86 personal norm violations differ from those that follow the violation of social norms—violating

87 personal norms calls into question one's self-concept, whereas violating social norms has

88 consequences for social interactions (Bamberg et al., 2007). Second, the feeling of moral

89 obligation to comply exerts a stronger influence than social norms on individual decisions .

90 Behaviors consistent with personal norms protect the self, whereas inconsistent behaviors lead

91 to self-criticism. Personal norms play a role in behavioral decisions because individuals

92 anticipate and compare the cost of their behavior (in effort or time, for example) with the cost

93   of the violation for the self. People do not enact the behavior if doing so is more costly than

94   violating personal norms.

95   The norm activation model further suggests that personal norms are not always active.

96   Their activation depends on awareness of the need to act and of the consequences, for the

97   environment, of performing or not performing the action, and of the individual's ascription of

98   responsibility in the situation. Thus, the higher the awareness of the need for action and of the

99   impact of the solution, and the higher the self-ascribed responsibility, the stronger the personal

100   norms. In the domain of pro-environmental behavior, the norm activation model has proven

101   useful in explaining energy conservation (van der Werff & Steg, 2015), food waste reduction

102   (Kim et al., 2022), and recycling (Wang et al., 2019). Numerous other studies have shown that

103   the impact of personal norms on behavior is mediated by behavioral intention (for meta-

104   analyses, see Bamberg & Möser, 2007; Onwezen et al., 2013).

105   ***The Value-Belief-Norm Model***

106   Stern (2000) proposed an extended version of the norm activation model by integrating

107   the new environmental paradigm (Stern, Dietz, et al., 1995) and the values-based theory (Stern,

108   Kalof, et al., 1995). According to Schwartz (1992), values are the most stable beliefs

109   transcending any situation to guide decisions and behaviors, such that they match what is

110   important to individuals. The different types of values classified by Schwartz (1994) constitute

111   a priority system for the individual. If an individual's value system prioritizes self-transcendent

112   values, such as biospheric values (concerns about nature) and altruistic values (concerns about

113   other humans), at the expense of self-enhancement values (egoistic values, concerns about self-

114   interest), then that person will be more inclined to adopt environmentally friendly behaviors

115   (Steg et al., 2005).

116   The value-belief-norm model, presented in Figure 1c, postulates a causal chain in which

117   self-transcendent values predict the new environmental paradigm – a general ecological

118   worldview measured through individuals' beliefs about human-nature interactions. This belief,

119   in turn, affects awareness of adverse and beneficial consequences. Awareness of consequences

120   influences beliefs about one's personal responsibility in those consequences, which then

121   activates personal norms. Activated personal environmental norms act as a general

122   predisposition to pro-environmental actions. The value-belief-norm model has shown a good

123   predictive validity for pro-environmental behaviors (Jakovcevic & Reyna, 2016) and

124   specifically for recycling behaviors (Dursun et al., 2017).

125   ***The Comprehensive Action Determination Model***

126   Klöckner and Blöbaum (2010) proposed a comprehensive model, presented in figure 1d,

127   that integrates the main determinants from both the theory of planned behavior and the norm

128   activation model, and adds constructs from the ipsative theory of behavior (Tanner, 1999;

129   Tanner et al., 2004). The comprehensive action determination model aims to explain a wide

130   range of pro-environmental behaviors by modeling three direct sources of influence on pro-

131   environmental behaviors: intentional processes, habitual processes and situational processes. A

132   fourth indirect source of influence is also proposed—the normative processes.

133   Intentional processes designate reflexive processes leading to the formation of a will to

134   make an effort to produce the behavior. They comprise attitudes and behavioral intentions. In

135   the case of uncommon or new practices, intentional processes are the proximal antecedent of

136   the behavior.

137   Habitual processes are the results of the automation of a gesture or practice through its

138   frequent repetition over time. Habits can be in line with or in conflict with the expected

139 behavior. They will therefore moderate—positively or negatively—the link between intentional

140 processes and behavior, and the strength of the moderation increases with the degree of

141 automaticity (Triandis, 1980).

142   Situational processes involve the context and how it facilitates the correct

143 implementation of the behavior. These include subjective constraints, namely perceived

144 behavioral control, and objective constraints. The objective constraints are the physical,

145 material and informational characteristics of the situation in which the behavior occurs (e.g.,

146 access to a recycling bin, knowledge of the deposit center location). These conditions can hinder

147 or facilitate the behavior depending on the situation. Therefore, objective constraints influence

148 the perceived control that the individual has over the expected behavior.

149   Normative processes refer to the influence of standards related to the behavior. These

150 norms can be conveyed by others - social norms - or internalized - personal norms. Their

151 influence on behavior is mediated by intentional and habitual processes. The personal norms

152 held the strongest normative influence on behavioral intention and habits, and this influence

153 must be activated by beliefs about the behavior (Schwartz, 1977; Thøgersen, 2006). Therefore,

154 the normative processes include awareness of a need to fix an issue and awareness of

155 consequences of the targeted behavior.

156   Lastly, although situational processes directly influence behavior, they also do so

157 indirectly via intentional, habitual and normative processes. Indeed, the situation must provide

158 individuals with a subjective sense of ability to produce the behavior in order for their personal

159 norms to be activated, the intention to act to be evaluated and the habit pattern to be triggered.

160 Furthermore, the objective conditions in the environment must allow the habit to take place.

161   The comprehensive action determination model has been used to explain pro-

162   environmental behavior such as clothing consumption (Joanes et al., 2020), sustainable

163   purchase (Jovarauskaitė et al., 2020) and recycling (Klöckner & Oppedal, 2011; Ofstad et al.,

164   2017).

165   - Insert figure 1 about here –

166   **Identifying the Main Determinants**

167   Recently, a meta-analysis classified the most important factors predicting waste

168   management across different contexts (e.g., households, employees) and types of waste (e.g.,

169   plastic, general recycling, Geiger et al., 2019). The authors conducted their analyses on the

170   effect sizes from 91 studies that tested the link between the determinants of a large variety of

171   models and behavioral intention, self-reported behavior or observed behavior.

172   The results showed the predictive importance of most of the determinants included in

173   the comprehensive action determination model. The meta-analysis confirmed the influence of

174   normative processes, including social norms ($r = .33$), personal norms ($r = .42$), and awareness

175   of consequences ($r \approx .19$[1]). The results also supported the importance of attitudes ($r = .34$) and

176   of situational processes (i.e., perceived behavioral control, $r = .39$; contextual factors, $-.17 \leq r$s

177    $\geq .26$).

178   In line with the value-belief-norm model, and a broader version of the Comprehensive

179   action determination model (Klöckner, 2013), the meta-analysis also showed that values are

180   related to recycling ($r = .24$). Furthermore, Geiger et al. (2019)'s meta-analysis highlights the

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[1] The exact effect size for awareness of consequences is not provided

181 importance of another factor that we have not mentioned so far: environmental self-identity (r

182 $= .30$), defined as the degree to which individuals see themselves as eco-friendly (van der Werff

183 & Steg, 2016). Environmental self-identity and values refer to self- processes—general beliefs

184 linking the self to the domain in which behavior takes place (e.g., the environment). Many

185 studies have shown a link between pro-environmental behavior and general beliefs related to

186 the self (De Groot & Steg, 2007), such as biospheric values and environmental self-identity

187 (Carmona-Moya et al., 2017).

188   The results of this meta-analytical work reveal the main determinants of recycling

189 behavior that are only partially included in the current models. To move away from the

190 multiplication of separate models, we propose to integrate these determinants in a unified

191 framework. Hence, we offer a model that includes the normative, attitudinal, and situational

192 processes from Klöckner and Blöbaum's comprehensive model (2010). Importantly, we add a

193 fourth source of influence: the self-processes (from the meta-analysis by Geiger, 2019). The

194 first objective of the present research is to test the new integrative model and document the

195 relative predictive strength of the main determinants of recycling behavior and how they relate

196 to each other. This should contribute to scientific knowledge by providing cumulative evidence

197 about previously observed relations between psychological determinants and pro-

198 environmental intentions or habits. An integrative model however provides a stricter test of

199 those relations, as the effect of each determinant on the outcome (i.e., intention or habit) is

200 estimated beyond the influence of the other determinants, and while the relations between the

201 determinants are also simultaneously estimated. The proposed integrative model should further

202 widen our understanding of pro-environmental intentions and habits by considering the

203 upstream influence values and identity. The second contribution of the present research is to

204 use this integrative model to foster our understanding of two waste management behaviors that

205 are overlooked, although they are at high stake considering the prospect of regulation changes:

206   sorting food waste and dropping off waste at a disposal center. This should bring knowledge

207   about whether the influence of determinants widely documented in the literature transfers to

208   those specific behaviors. This is also important, in the prospect of policy-making, as it could

209   inform about the most relevant levers for behavioral change.

Integrative Model

211   Our model first integrates the attitudinal, situational, and normative processes identified

212   in the comprehensive action determination model (Figure 2). Given that we could not measure

213   behavior, the main outcome predicted in our study was intention to act. We assume that

214   behavioral intention is *directly* predicted by four determinants: attitudes (**H1**), perceived

215   behavioral control (**H2**), social norms (**H3**), and personal norms (**H4**) (Ajzen, 1991; Bamberg

216   et al., 2007; Klöckner, 2010, 2013).

217   As for situational processes, perceived behavioral control should be influenced by

218   facilitating conditions (**H5**). The more facilitating the conditions, the more individuals will

219   perceive that they have control over their behavior. Regarding normative processes, personal

220   norms should be activated by awareness of need (**H6**), awareness of consequences (**H7**), and

221   social norms (**H8**) (Schwartz, 1977). We expect that the more people are aware that there is a

222   problem and that the targeted behavior is a means to solve it, the higher the sense of moral

223   obligation. Further, the more individuals perceive that the behavior is valued and/or generally

224   adopted by significant others, the more they should feel a moral obligation. Personal norms

225   should mediate the relationship between social norms and intention (**H9**) (Helferich et al.,

226   2023). Moreover, normative processes should be influenced by situational processes, such that

227   personal norms will be predicted by the level of perceived behavioral control (**H10**) (Klöckner

228   et al., 2010): the less individuals feel able to perform the behavior, the less they feel obliged to

229 do so. We expect the influence of perceived control on intention to be mediated by personal

230 norms (**H11**).

231   The main innovation of our model is the integration of self-processes as a new source

232 of influence. These processes refer to self-identity and values. Self-processes provide an overall

233 framework of conduct for individuals; thus, we propose that they act at the early stages of the

234 behavioral performance decision. This idea is supported by the value identity personal norm

235 model, which indicates that values predict identity, which in turn predicts personal norms (Steg

236 & Van der Werff, 2016). Support for this view also comes from the value-belief-norm model,

237 which shows that values are the antecedents of beliefs (Stern, 1999). Recent work has further

238 shown that biospheric values and self-identity are antecedents of social norms, perceived

239 behavioral control, and attitudes (Ateş, 2020; Carfora et al., 2017; Gkargkavouzi et al., 2019).

240 Therefore, we hypothesize that self-processes have an upstream influence on the set of the

241 previously mentioned proximal determinants of behavioral intention. Values should impact the

242 level of awareness individuals have regarding the need to act (**H12**) and the consequences of

243 the solution behavior (**H13**). We expect that the more individuals endorse biospheric values,

244 the stronger their awareness of the problem and the solution's relevance. Values should also

245 affect pro-environmental self-identity (**H14**), which will directly affect personal norms (**H15**),

246 social norms (**H16**), perceived behavioral control (**H17**), and attitudes (**H18**). The stronger the

247 pro-environmental identity, the higher the sense of moral obligation to act, the higher the

248 perception of social norms, the higher the perceived ability to perform the behavior and the

249 more favorable the evaluation of the behavior. The influence of environmental self-identity on

250 personal norms should also be mediated by social norms (**H19**).

251   Lastly, besides intention, we measured habits as an outcome for food waste separation.

252 Habits refer to past behaviors that, through repetition over time, have become automatic,

253 frequent, and non-conscious (Ouellette & Wood, 1998). Habits are a strong proximal predictor

254 when the behavior is frequent (Klöckner, 2013). With respect to the two behaviors investigated

255 here, habits do not apply to dropping off waste at a disposal center as this behavior is not

256 frequent. It can apply to food waste separation, although this specific behavior is not yet

257 required from the population and is therefore not widely enforced. In the prospect of

258 enforcement planned in 2024 in the present country, it is important to know what is related to

259 the development of this habit. We hypothesize that habits will be directly predicted by perceived

260 behavioral control (**H20**), facilitating conditions (**H21**), and personal norms (**H22**) (Klöckner,

261 2013; Klöckner & Blöbaum, 2010). The more individuals feel able to perform, the more the

262 conditions facilitate the performance, and the more individuals feel obliged to do so, the

263 stronger the habit formation. Furthermore, habits should also be influenced indirectly by

264 perceived behavioral control via personal norms (**H23**) and by facilitating conditions via

265 perceived behavioral control (**H24**).

266   - Insert figure 2 about here -

267 **Methods**

268 *Sample Size*

269   According to Kline (2011), structural equation models need to have at least 5 to 1 ratio

270 of observations to estimated parameters. We estimated 169 parameters in the model addressing

271 food waste sorting and 164 parameters in the model for deposit at waste disposal centers,

272 leading to minimal sample sizes of 845 and 820 observations, respectively.

273 *Participants*

274   Participants voluntarily filled in an online questionnaire that took approximately 30

275 minutes to complete and asked about one of the two targeted behaviors. The final samples

276 consisted of 1,198 usable observations for the food waste sorting questionnaire and 1,616

277 observations for the (deposit at) waste disposal centers questionnaire. Table 1 and 2 provides

278 an overview of the socio-demographic characteristics of the participants included in the data

279 analyses for both samples. Participants mostly identified as women, and the distribution of their

280 level of education and income was skewed to the right. Moreover, half of the respondents lived

281 in peri-urban areas (49% and 52% for food waste and waste disposal center questionnaires,

282 respectively), and about a quarter in rural areas (28% and 19%, respectively) or urban areas

283 (23% and 26%, respectively).

284   -Insert Table 1 and 2 about here-

285 ***Measures***

286   All variables in the study were latent variables with multiple indicators. All items were

287 adapted from previous studies and translated into French. Unless otherwise specified,

288 respondents rated each item on a seven-point scale, ranging from 1 (*totally disagree*) to 7

289 (*totally agree*). Negatively worded items were reverse-scored. Analyses were conducted on

290 the basis of all items related to the construct mean score.

291 A first block of items measured general beliefs about waste:

292 *Awareness of need* about waste in general was measured with four items (e.g., "Our society

293 produces too much waste").

294 *Awareness of consequences* about general waste management on the environment was

295 measured with four items (e.g., "If I manage my waste properly, my local quality of life will

296 improve").

297 In the second block, participants answered questions about one of the two specific behaviors.

298 *Social norms* about the specific waste management were measured on both injunctive and

299 descriptive sides. *Social injunctive norms* were measured with three items (e.g., "Dropping off

300 waste at disposal centers is encouraged by people whose opinion I value"). *Social descriptive*

301 *norms* were measured with three items (e.g., "Everyone in my neighborhood deposits waste at

302 disposal centers"). A mean score of the six items has been calculated.

303 Participants' *personal norms* about specific waste management were measured with three

304 items, for example, "I feel morally obliged to sort my food waste", translated from van der

305 Werff et al., (2013) and Klöckner & Blöbaum (2010).

306 Participants' *perceived behavioral control* about specific waste management was assessed with

307 four items, for example, "It is up to me to deposit my waste at disposal centers," adapted from

308 Kraft et al. (2005).

309 Participants' *attitudes* about specific waste management were assessed by asking them to

310 respond to the statement, "Dropping off my waste at the disposal center/Sorting my food waste

311 is…." on six pairs of bidimensional components of instrumental attitude, for example,

312 "pointless–useful," adapted from Graham-Rowe et al. (2019).

313 *Facilitating conditions* related to specific waste management were measured with 10 items for

314 food waste, for example, "I know where to find information to sort my food waste" and 15

315 items for bulky waste, for example, "I know where to find the closest disposal center", adapted

316 from Klöckner and Oppedal (2011).

317 Participants' *habits* were only assessed for food waste separation, with four items (e.g., "Sorting

318 my food waste is something I do without thinking" from the self-report habits index,

319 Verplanken & Orbell, 2003).

320 *Behavioral intention* to manage the specific waste was assessed with four items, for example,

321 "Over the next twelve months, I intend to sort, or to continue to sort, my food waste."

322 In the last block, participants were asked about their *values*, *environmental self-identity*, and

323 *socio-demographic* variables. *Biospheric values* were measured with four items, for example,

324 "Being close to nature is important to me," translated into French from Steg et al., (2014).

325 *Environmental self-identity* was measured with three items, for example, "I consider myself to

326 be a waste management sensitive person", adapted from Nigbur et al., (2010).

327 We collected six socio-demographic variables: age, gender, highest diploma, annual income,

328 familial status and type of habitation (Table 1 and 2).

329 ***Procedure***

330 An online survey was distributed via social networks and mailing lists of local

331 associations. Participants over 18 years old were invited to fill in a questionnaire about 30

332 minutes long. After consenting to participate, they answered the first block of questions on

333 general beliefs about waste management: awareness of need and consequences. Participants

334 were then pseudo-randomly assigned to two out of three behaviors (60% for waste disposal

335 centers and 40% for food waste separation). Indeed, data collection was performed in the

336 context of collaboration with local authorities initially interested in fostering their

337 understanding of three specific behaviors: food waste separation, deposit at waste disposal

338 centers, and green waste reuse in situ. The last behavior was not included in the present paper

339 because we did not reach an acceptable sample size. The second block of questions randomly

340 assessed determinants specifically referring to the targeted behavior, namely, social norms,

341 personal norms, perceived behavioral control, facilitating conditions, attitudes, and habits.

342 Participants then filled in the intention measure at the end of the block. The last block measured

343 pro-environmental values and identity, and participants filled in socio-demographic

344 information on an optional basis. Within each block, the items measuring each determinant

345 were counterbalanced.

346 *Analysis Strategy*

347   Two correlation matrices, reported in Tables 3 and 4, present the zero-order correlations

348 between each determinant and behavioral intention (i) to sort food waste and (ii) to deposit

349 waste at disposal centers.

350   To test each model, analyses were run using the R package lavaan (Rosseel, 2012).

351 Structural equation modeling (SEM) with robust maximum likelihood estimation was applied

352 with a two-stage procedure to test the fitness of the proposed model with the gathered data. In

353 the first step, the reliability and validity of the measurement instruments were determined by

354 confirmatory factor analyses. In the second step, the fitness of the proposed model and the

355 relationships between variables were evaluated by structural equation modeling tests. The

356 model fit was examined based on the following indices: items saturation with related construct

357 (std. str) greater than .40 (Stevens, 2012), robust comparative fit index (Robust CFI), robust

358 Tucker-Lewis index (Robust TLI) equal or greater than .92, robust root mean square error of

359 approximation (Robust RMSEA) lower than .08 and robust standardized root mean squared

360 error (Robust SRMR), lower than .08 (Hair, 2019).

361 **Results**

362 *Food Waste Separation*

363 *Descriptive Results*

364   -Insert Table 3 about here-

365   *Measurement Model Analysis*

366   The initial CFA results indicated that several items should be deleted due to poor

367   standardized factor loadings (< .40). We deleted one item from the personal norms scale, and

368   two items measuring facilitating conditions. The modification indices suggested correlating

369   nine error terms within the same latent constructs to improve the model fit. The final CFA

370   results revealed an acceptable fit for the proposed model: Robust $\chi2 = 2172.742$; df = 972;

371   $p = .000$; df/$\chi2 = 1.141$; Robust CFI =.961; Robust TLI =.957; Robust RMSEA =.034; 90% CI

372   [.032; .036]; SRMR = .045. All standardized factor loadings were significant at $p < .001$. Factor

373   loadings and Cronbach's alphas are presented in Table 4.

374   -Insert Table 4 about here-

375   *Structural Equation Modeling*

376   The results from the SEM analysis showed that the proposed model yielded a good fit

377   to the data: $\chi2 = 2666.302$; df = 1006; $p < .001$; df/$\chi2 = 1.144$; Robust CFI = .946, Robust

378   TLI = .942, Robust RMSEA = .039 90% CI [.038; .041]; SRMR = .075. The model accounted

379   for 54.7% of the variance in intention to sort food waste and 65.5% of variance in habits to sort

380   food waste.

381   We observed three out of the four hypothesized direct influences on intention. Intention

382   to sort food waste had a strong relationship with both personal norms, $\beta = .35$, $p < .001$, and

383   perceived behavioral control, $\beta = .43$, $p < .001$, suggesting that the stronger the moral obligation

384   and ability individuals feel, the higher their intention to sort food waste. Attitudes were

385   significantly but more weakly linked with intention, $\beta = .08$, $p = .005$. Contrary to expectations,

386   social norms were not significantly related to intention, $\beta = 0.06$, $p = .072$.

387   Regarding the antecedents of those four proximal determinants of intention, the model

388   accounted for 67% of the variance in perceived behavioral control, 75% in personal norms,

389   17% in social norms and 23% in attitude. Among the situational processes, the more facilitating

390   the conditions of implementing the food waste sorting, the higher the perceived behavioral

391   control, $\beta = .77$, $p < .001$. Regarding normative processes, personal norms are predicted by

392   social norms, $\beta = .12$, $p = .007$, and awareness of need, $\beta = .15$, $p = .001$, but the results showed

393   no significant relationship with awareness of consequences, $\beta = -0.046$, $p = .226$. A sense of

394   moral obligation to sort food waste seemed activated by the perception that others value and

395   produce that behavior and the awareness of a need to address waste management issues. The

396   expected relationship between situational and normative processes was observed, as personal

397   norms are predicted by perceived behavioral control, $\beta = .30$, $p < .001$. As for self-processes,

398   biospheric values predicted the level of awareness of need, $\beta = .64$, $p < .001$, awareness of

399   consequences, $\beta = .52$, $p < .001$ and environmental self-identity, $\beta = .82$, $p < .001$. In turn,

400   environmental self-identity predicted personal norms, $\beta = .58$, $p < .001$, social norms, $\beta = .41$,

401    $p < .001$, attitude, $\beta = .48$, $p < .001$, and to a lesser extent perceived behavioral control, $\beta = .13$,

402    $p < .001$.

403   Lastly, for the second outcome – habits – the results supported the hypothesized direct

404   influences such that stronger habits were reported by participants who had a higher sense of

405   moral obligation, $\beta = .25$, $p < .001$, felt more capable of sorting food waste $\beta = .36$, $p < .001$

406   and reported more facilitating conditions, $\beta = .32$, $p < .001$. The relationship between perceived

407   control and habits is partially mediated by personal norms, $\beta = .07$, $p < .001$. The influence of

408   facilitating conditions on habits is partially mediated by perceived behavioral control, $\beta = .28$,

409    $p < .001$. Table 5 and Figure 3 present the results.

410   -Insert Table 5 and Figure 3 about here-

411 **_Deposit at a Disposal Center_**

412 _Descriptive Results_

413   -Insert Table 6 about here-

414 _Measurement model analysis_

415   Due to poor standardized factor loadings, we deleted two items referring to the

416 facilitating conditions. The modification indices suggested correlating ten error terms within

417 the same latent constructs to improve the model fit. The final CFA results revealed an

418 acceptable fit for the proposed model, Robust $\chi2$ = 3042.374; df = 978; p < .001; df/$\chi2$ = 3.111;

419 Robust CFI = .937, Robust TLI = .931, Robust RMSEA = .038 90% CI [.037; .040];

420 SRMR = .044. All standardized factor loadings are significant at p < .001 (factor loadings and

421 Cronbach's alphas are presented in Table 7).

422   -Insert Table 7 about here-

423 _Structural Equation Modeling_

424   The results from the SEM analysis showed that the proposed model had an acceptable

425 fit to the data: Robust $\chi2$ = 3557.990; df = 963; p < .001; df/$\chi2$ = 3.695; Robust CFI = .917,

426 Robust TLI = .910, Robust RMSEA = .043 90% CI [.042; .045]; SRMR = .071. The model

427 accounted for 52.8% of the variance in intention to deposit waste at a disposal center.

428   The four hypothesized direct influences on intention were observed. The intention to

429 deposit waste at disposal centers was predicted by personal norms, β = .51, p < .001, indicating

430 that the more participants feel morally obliged to drop off their waste at a disposal center, the

431 more they intend to do so. Perceived behavioral control, social norms and attitude were also

432 significantly linked with intention, β = 0.23, p < .001, β = 0.10, p = .003, and β = 0.16, p < .001,

433   respectively. The stronger the ability individuals felt, the more they perceived others to adopt

434   or value the behavior, and the more positive their attitude toward the behavior, the higher their

435   intention to drop off their waste at a disposal center.

436   Regarding the four proximal determinants of intention, the model accounted for 56% of

437   the variance in perceived behavioral control, 46% in personal norms, 14% in social norms and

438   10% in attitude. Perceived behavioral control was significantly predicted by facilitating

439   conditions, $\beta = .69$, $p < .001$. Regarding normative processes, personal norms is linked to social

440   norms, $\beta = 0.19$, $p < .001$, whereas results showed no significant relationship with awareness

441   of need, $\beta = 0.04$, $p = .309$ and awareness of consequences, $\beta = 0.03$, $p = .439$. Personal norms

442   had a significant relationship with perceived behavioral control, $\beta = 0.23$, $p < .001$. On the self-

443   processes side, biospheric values predicted the level of awareness of need, $\beta = .57$, $p < .001$,

444   awareness of consequences, $\beta = .46$, $p < .001$ and environmental self-identity, $\beta = .82$, $p < .001$.

445   In turn, environmental self-identity predicts personal norms, $\beta = .44$, $p < .001$, and had

446   significant relationships with social norms, $\beta = .37$, $p < .001$, attitude, $\beta = .32$, $p < .001$, and

447   perceived behavioral control, $\beta = .23$, $p < .001$. Table 8 and Figure 4 show the hypotheses

448   testing results.

449   -Insert Table 8 and Figure 4 about here-

450   **Testing alternative models**

451   In line with our theoretical framework, we evaluated several existing models, including

452   the theory of planned behavior, the norm activation model [2], the value-belief-norm model, and

453   the comprehensive action determination model. The goodness-of-fit indices for the intention to

454   sort food waste are presented in Table 9, while Table 10 displays the indices for the intention

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[2] The questionnaire did not contain measure of ascription responsibility, thus the norm activation model tested here is not complete.

455 to deposit waste at a disposal center. All five models demonstrated an acceptable fit based on

456 the goodness-of-fit indices. While the two integrative models did not perform as well as the

457 more parsimonious models, our model showed comparable performance to the previous

458 integrative model (i.e., comprehensive action determination model) for both behaviors. The

459 value-belief-norm model had the best comparative fit indices (AIC and BIC). Nevertheless, our

460 model explained more variance in intention and personal norms, and therefore provides a more

461 comprehensive explanation of the data.

462   -Insert Table 9 and 10 about here-

463 **Discussion**

464   The first objective of this study was to test an integrative model that relies on the three—

465 normative, attitudinal, and situational—processes of the comprehensive action determination

466 model (Klöckner et al., 2010) and includes an additional process based on a recent meta-

467 analysis (Geiger et al., 2019): self-processes. Our model is supported by the results of structural

468 equation modeling which are consistent with 21 out of the 24 hypotheses. The indices showed

469 a good fit of the model, accounting for 52.8% and 54.7% of the variance in intentions and 65.5%

470 of the variance in habits. As expected, each of the four processes included in the model had a

471 significant direct or indirect impact on the outcomes studied here. This finding shows the value

472 of including all identified sources of influence to achieve a more complete and detailed

473 understanding of the intention (or habit) to produce the target behaviors.

474   Analyses confirmed our proposal that self-processes have an upstream influence on all

475 other processes (Gkargkavouzi et al., 2019; Steg et al., 2014). By proposing both values and

476 pro-environmental identity as early antecedents, the present integrative model showed that

477 attitudes and social norms – only treated as antecedents in the other models – are predicted by

478   self-processes (.10 < R^2 < .23). The comparison with more classical models showed that

479   adding these early antecedents increased the explanation of personal norms, reaching 46% and

480   75% of explained variance. This suggests that self-processes are a promising venue for better

481   understanding how a personal sense of moral obligation emerges and is activated. These

482   findings are consistent with recent work showing that self-processes (i.e., values) predict

483   attitudes, social norms, personal norms and perceived behavioral control (Ateş, 2020). Overall,

484   the observed influence of self-processes on the attitudinal, normative and situational processes

485   is consistent with previous claims that values and self-identity indirectly affect behavioral

486   intentions by providing a general orientation for the perception and evaluation of any specific

487   situation (Bamberg et al., 2003; Udall et al., 2021).

488   This study focused on two specific waste management behaviors: food waste separation

489   and deposit at disposal centers. The results revealed a common basis of understanding for both

490   behaviors. The main common finding is that the intention and habit to manage one's waste are

491   related to two proximal determinants: personal norms and perceived behavioral control. This

492   suggests that, across two types of waste, individuals who feel a strong moral obligation to

493   manage their waste in an environmentally friendly manner and who are highly confident in their

494   ability to do so, are more likely to have a positive intention to engage in proper waste

495   management. Another result observed for both behaviors in our integrative model is that

496   attitudes and social norms are weakly linked to intention. This finding is consistent with a recent

497   study on residential households' waste behavior, that similarly showed the influence of

498   perceived behavioral control and personal norms on waste separation, while attitudes and social

499   norms had no significant relationship with the behavior (Goh et al., 2022). The weaker or

500   absence of influence of attitudes has been observed in other studies when normative influences

501   are included in the models (Oehman et al., 2022; Wu et al., 2022). This may indicate that the

502   presence of personal norms in the model absorbs much of the predictive power of attitudes. The

503   weak and even non-significant effect of social norms in the case of food waste separation may

504   be due to the private nature of the behaviors. Managing food waste, bulky, toxic, or electronic

505   waste mostly takes place in private contexts (e.g., one's own home), which may explain the

506   lower importance of the influence of others' behavior (Aguilar-Luzón et al., 2012).

507   Regarding the path of influence of the proposed model, the results show that the first

508   proximal determinant of intention –personal norms– is predicted by the perception of high

509   levels of social norms and environmental self-identity, but also by a strong sense of control over

510   the behavior. For both behaviors, the more people perceive that those around them value

511   (injunctive norms) or practice (descriptive norms) good waste management, the more people

512   perceive themselves as pro-environmental persons, the more they feel able to perform the waste

513   behavior, and the more they develop a sense of moral obligation to do so. However, contrary to

514   our prediction, the results did not show a significant relationship between personal norms and

515   awareness of consequences. A possible explanation for this null result, which contradicts many

516   studies (Klöckner, 2013), is that the measure we used referred to the consequences of waste

517   management in general and not of the target behavior.

518   As for the second stable and proximal determinant of waste management intention –

519   perceived behavioral control – it is strongly predicted by facilitating conditions. The more

520   supportive the material and informational conditions are in individuals' performance

521   environment, the stronger their sense of performance ability. Our findings, along with others

522   (e.g., Cheng et al., 2022; Concari et al., 2022b; Vijayan et al., 2023; Zaikova et al., 2022; Zhang

523   et al., 2022), outline the importance of access to information and material conditions that

524   facilitate the production of waste management behaviors. Such facilitating conditions enrich

525   psychological models with contextual factors that contribute to alleviate constraints.

526   Although the results revealed a common core for understanding both targeted behaviors,

527   they also highlighted specificities in the determinants of food waste sorting and deposit at waste

528   disposal centers. In the case of food waste separation, situational processes appear to be the

529   most influential of the four sources of influence. In fact, the key-predictor of the intention to

530   sort food waste is perceived behavioral control, directly and indirectly through personal norms.

531   That is, when individuals feel control over their behavior, their sense of moral obligation is

532   likely to be activated, which in turn changes their intention to behave accordingly. The results

533   concerning habits also support the predominance of situational processes, as facilitating

534   conditions are strongly related to the presence of sorting habits, both directly and indirectly via

535   perceived behavioral control. The more favorable the material and informational conditions for

536   the act of sorting, the easier the behavior is perceived to be and the higher the habits are. The

537   model predicting intention towards waste disposal emphasizes normative processes over

538   situational and attitudinal processes. Personal norms showed the strongest association with

539   intention. The stronger the principle of depositing toxic or bulky waste at the disposal center,

540   the higher the intention to do so. However, it is interesting to note that the variance of personal

541   norms explained by the antecedents included in the model is lower when the target behavior is

542   depositing at waste disposal centers ($R^2 = .46$) than when it is food waste separation ($R^2 = .74$).

543   Moreover, in the waste disposal model, the awareness that waste generation is a problem that

544   needs to be addressed does not have a significant effect on personal norms. This suggests that

545   the sense of moral obligation to deposit waste at disposal centers is influenced by factors other

546   than those we identified in the pro-environmental literature. This raises the question of the

547   perception of this behavior as being strictly pro-environmental. It is possible that people are not

548   fully aware of how waste is treated and reused in these infrastructures, which have long been

549   perceived as mere landfills.

550   Our second objective was to use our integrative model to promote an understanding of

551   two overlooked waste management behaviors: food waste separation and waste deposit at

552   disposal centers. The behaviors studied in this paper are of practical relevance, with food waste

553   responding to regulatory developments in Europe, and the deposit of waste in a disposal center

554   enabling the reuse of materials (e.g., metal, wood, electronic components), in a context of

555   accelerating resource depletion. This study also contributes to the advancement of the research

556   field on the identification of factors related to waste sorting behavior. Recent bibliometric

557   research suggests that the study of waste sorting behavior is generating a growing literature

558   (Concari et al., 2022). Research on waste management focuses on different types of waste,

559   sometimes grouped under the umbrella term recycling. Our study addresses the need to

560   differentiate and clarify the waste management behaviors studied by identifying both common

561   factors and differentiating elements for understanding two specific behaviors.

562   **Limitations**

563   The main limitation of our study is the absence of measurement of actual behavior. As

564   in many other studies, we measured intention, as a key determinant of behavior (Sheeran &

565   Webb, 2016. Meta-analytic findings on pro-environmental behavior have shown a moderate to

566   strong relationship between intention and behavioral enactment (Morren & Grinstein, 2016). In

567   a longitudinal study, Passafaro et al. (2019) showed that intentions predicted self-reported waste

568   sorting behavior one month later. Despite these strong associations, people do not always do

569   what they intend to do, and thus there is a gap between stated intention and action (Hassan,

570   2016; Rhodes & Dickau, 2012). Indeed, meta-analyses of the impact of interventions aimed at

571   changing health-related behaviors have shown greater intervention-induced changes in

572   intentions than in measured behaviors (Rhodes & Dickau, 2012; Webb & Sheeran, 2006).

573   However, the gap between intentions and behavior depends on the context, particularly whether

574   the behavior is habitual or not. Specifically, the link between change in intention and change in

575   behavior is stronger for nonhabitual behaviors (d = .74) than for habitual behaviors (d = .22,

576   Webb & Sheeran, 2006). It is worth noting that the behaviors examined in the present study

577   were unlikely to be habitual. The behavior of dropping off food waste at a waste disposal center

578   does not meet the criteria of regularity and frequency that constitute a habit and is therefore a

579   nonhabitual behavior. As for the sorting of food waste, this is a new behavior that is not yet

580   required in the study area. Therefore, the habitual nature of food waste sorting can vary from

581   zero, or very low, to strong. In addition to intentions, we also studied the habit of sorting food

582   waste. This allowed us to establish the relevance of our integrative model to understand what

583   is associated with the emergence of this behavioral variable. Indeed, it appears that regular

584   sorting performance is related to performance conditions, perceived control, and sense of moral

585   obligation, and that these processes, both situational and normative, are not independent since

586   perceived control predicts personal norms. However, habits remain a measure of self-reported

587   behavior that was realized at the same time as the measures of determinants tested in the model.

588   In future work, it would be critical to test the influence of the determinants proposed here in a

589   longitudinal study that would include measures of self-reported or observed waste management

590   behavior (e.g., trash can weighing). We recognize that the explanatory power of the model for

591   actual behavior will be certainly less than that reported here for intention (see e.g., Yuriev et

592   al., 2020). Nevertheless, from an intervention perspective, our study provides a broader

593   understanding of the articulation of the determinants of sorting intentions, which may help in

594   the design of research or interventions targeting the actual realization of these behaviors.

595   Considering the intention-behavior gap, interventions must include complementary elements

596   that strengthen the transformation of intentions into actual actions, such as planning of the

597   action, monitoring progress, or information and conditions that facilitate the production of the

598   behavior (e.g., Rosenthal, 2018; Schwarzer, 2008; Sheeran & Webb, 2016).

599   A second limitation of this study pertains to the representativeness of the samples.

600   Women, highly educated, and high-income individuals are overrepresented in both samples.

601   This may be due first to the recruitment strategy, which relied in part on the social network of

602   the researchers. In addition, a self-selection of respondents is highly likely, as participants

603   completed the questionnaire without retribution, and studies consistently show that women and

604   highly educated people are more concerned about the environment (e.g., Diamantopoulos et al.,

605   2003; Franzen & Meyer, 2009). It is important to replicate this study with a more diverse sample

606   to improve the generalizability of the findings.

607   From an intervention perspective, proposing a comprehensive model may have practical

608   implications. A model that allows for the testing of a wide range of determinants can enable

609   stakeholders and public policymakers to conduct comprehensive diagnostic studies to identify

610   the most important determinants of target behaviors in the population and then develop fine-

611   tuned interventions. For example, in this study, we found that environmental self-identity is a

612   common and early source of influence. Thus, to encourage better waste management, it may be

613   relevant to design general incentive strategies based on the identity lever. However, the model

614   also highlights specificities related to each behavior that suggest more specific strategies. For

615   example, if the goal of a public policy is to specifically encourage the sorting of food waste, the

616   strategy should focus on increasing the sense of control, the key predictor, in particular by

617   providing the conditions that facilitate the practices.

618   In conclusion, this research supports a model that integrates the main determinants of

619   behavior identified in the recycling literature into four sources of influence: normative,

620   attitudinal, situational and self-processes. It adds to our knowledge of the main determining

621   factors of two overlooked behaviors of greatest concern to local authorities: food waste

622   separation and deposits at waste disposal centers. It appears that normative and situational

623   processes are consistently directly related to intentions and habits, while attitudinal processes

624   show weak links. The study also supports the idea that self-processes – values and identity –

625   should be integrated, as they have an upstream influence on the other processes. We believe

626   that the present research contributes to the efforts to move from multiplicity of specific models

627   to a more integrative approach applicable to a wide range of pro-environmental behaviors.

628   **Acknowledgements**

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847

An integrative model of waste management

1   **Abstract.**

2

3   Faced with increasing waste production, authorities are seeking to encourage better household

4   waste-management and need to identify levers for change. We propose a model integrating the

5   major determinants of pro-environmental behavior assumed in prominent theoretical models.

6   Based on meta-analytical evidence, we incorporated situational, normative, attitudinal and self-

7   processes and tested this integrative model to predict intentions to perform two overlooked

8   behaviors: food waste separation and deposit at waste disposal centers. To go beyond intention

9   we also investigated habits to sort food waste. An online survey was administered to two

10   samples (N_{total} = 2'814) and data were analyzed using structural equation modeling. The results

11   showed a good fit of an integrative model (CFIs > 0.917; TLIs > 0.910; RMSEAs < 0.043;

12   SRMRs < 0.071). Waste management intentions and habits are directly predicted mainly by

13   personal norms and perceived behavioral control. The latter is predicted by facilitating

14   conditions and pro-environmental identity. Personal norms are predicted by social norms, pro-

15   environmental identity and perceived behavioral control. Our results confirm the relevance of

16   a model integrating situational, normative, attitudinal and self-processes to explain waste

17   management intentions, and provide a basis for the development of waste-management

18   interventions.

19   **Keywords:** waste management, integrative model, environmental psychology, intention,

20   structural equation modeling

21

22   Since the beginning of this century, the serious and growing international issue of waste

23   management has led to many studies of recycling behavior, which have been widely reported

24   in the behavioral science literature (littering, Chaudhary et al., 2021; household waste

25   separation, Rousta et al., 2020; recycling of packaging materials, Miafodzyeva & Brandt, 2013).

26   Research has highlighted several determinants of waste management behaviors, all articulated

27   in four robust models: the theory of planned behavior (Strydom, 2018), the norm activation

28   model (Wang et al., 2019), the value-belief-norm model (Dursun et al., 2017), and the

29   comprehensive action determination model (Ofstad et al., 2017). A recent meta-analysis of 91

30   studies on household waste management identified numerous predictors of recycling behavior

31   in general, helping policymakers design effective strategies for waste prevention actions

32   (Geiger et al., 2019).

33   The purpose of the present study is to advance the understanding of household waste

34   management by integrating the contributions of historical models of behavioral change and

35   more recent research into a unified model, to predict intention and habits related to two

36   understudied types of waste management behaviors. The first is the source separation of food

37   waste, which makes up around 30% of the contents of a household's waste bin. European Union

38   foresees the obligation to treat it separately from January 2024, implying the individual

39   adoption of this new sorting behavior. The second behavior is the deposit at waste recycling

40   and disposal centers of various household waste types, such as bulky, toxic, electrical, or

41   electronic waste. Collected properly, the largest part of this waste volume can be recovered

42   through the resale of materials or through reuse. Some waste, however, contains hazardous

43   materials, such as toxic liquids and electronic waste, which can generate environmental

44   pollution. Therefore, it is essential to treat each waste type accordingly after it has been

45   deposited in appropriate facilities, such as a community's waste recycling and disposal center.

46   In this study, we propose a model incorporating the main determinants of recycling behaviors

47 (identified from the meta-analysis by Geiger et al., 2019) and we test its ability to account

48 for intention towards two specific behaviors: separation of food waste and deposits at waste

49 disposal centers.

Models of Pro-Environmental Behavior

51   Research in environmental psychology has fruitfully developed and tested models to

52 explain pro-environmental behavior. However, the parallel development of multiple models has

53 revealed a large diversity of potential determinants of pro-environmental behavior. The present

54 study is in line with recent attempts to integrate models and the most important determinants of

55 pro-environmental behavior (see e.g., Gkargkavouzi et al., 2019; Klöckner & Blöbaum, 2010).

56 Our approach is to integrate prominent theoretical models by relying on empirical meta-

57 analytical evidence. In what follows, we provide an overview of four prominent theoretical

58 models.

Theory of Planned Behavior

60   In 1991, Ajzen proposed a theory of planned behavior to explain any deliberate

61 behavior, including deliberate pro-environmental behavior (e.g., choice of travel mode,

62 Bamberg et al., 2003; food consumption, Ajzen, 2016; implication in pro-environmental

63 education, de Leeuw et al., 2015). As shown in Figure 1a, this rational choice model assumes

64 that behavioral intention is the main predictor of deliberate behaviors. Intention reflects the will

65 to exert effort to perform a behavior and is guided by three types of beliefs. First, an individual's

66 intention is guided by attitudes in terms of a favorable or unfavorable evaluation of the behavior,

67 derived from beliefs about the possible consequences of the behavior and the rational evaluation

68 of those consequences. Second, intention is guided by subjective norms—perceived social

69 pressure resulting from beliefs about what relevant others approve or disapprove (injunctive

70 norm) or do (descriptive norm)—and the motivation to fulfill those social expectations. Third,

71 intention is guided by perceived behavioral control (Ajzen, 1991), which results from beliefs

72 about one's ability to perform the target behavior (i.e., self-efficacy) and about control over that

73 behavior (Kraft et al., 2005). According to this model, individuals form a rational intention to

74 act, weighing the three types of behavioral beliefs. The determinants modeled in the theory of

75 planned behavior have been associated with a wide range of recycling behaviors (Aguilar-

76 Luzón et al., 2012; Tonglet et al., 2004).

The Norm Activation Model

78 The norm activation model developed by Schwartz (1973, 1977), shown in Figure 1b,

79 proposes that individuals act in a pro-social and pro-environmental way because they feel

80 morally obligated to do so (Bamberg et al., 2003; Steg & Groot, 2010). The sense of moral

81 obligation, also referred to as personal norms, arises from the internalization of social

82 expectations. Indeed, social learning about what is and what is not valued by significant others

83 forms a solid basis for the moral principles that individuals embrace (Thøgersen, 2006).

84 However, the influence of personal norms on behavior differs from the influence arising from

85 social norms, as it primarily results from implications for the self. First, sanctions following

86 personal norm violations differ from those that follow the violation of social norms—violating

87 personal norms calls into question one's self-concept, whereas violating social norms has

88 consequences for social interactions (Bamberg et al., 2007). Second, the feeling of moral

89 obligation to comply exerts a stronger influence than social norms on individual decisions .

90 Behaviors consistent with personal norms protect the self, whereas inconsistent behaviors lead

91 to self-criticism. Personal norms play a role in behavioral decisions because individuals

92 anticipate and compare the cost of their behavior (in effort or time, for example) with the cost

93   of the violation for the self. People do not enact the behavior if doing so is more costly than

94   violating personal norms.

95   The norm activation model further suggests that personal norms are not always active.

96   Their activation depends on awareness of the need to act and of the consequences, for the

97   environment, of performing or not performing the action, and of the individual's ascription of

98   responsibility in the situation. Thus, the higher the awareness of the need for action and of the

99   impact of the solution, and the higher the self-ascribed responsibility, the stronger the personal

100   norms. In the domain of pro-environmental behavior, the norm activation model has proven

101   useful in explaining energy conservation (van der Werff & Steg, 2015), food waste reduction

102   (Kim et al., 2022), and recycling (Wang et al., 2019). Numerous other studies have shown that

103   the impact of personal norms on behavior is mediated by behavioral intention (for meta-

104   analyses, see Bamberg & Möser, 2007; Onwezen et al., 2013).

The Value-Belief-Norm Model

106   Stern (2000) proposed an extended version of the norm activation model by integrating

107   the new environmental paradigm (Stern, Dietz, et al., 1995) and the values-based theory (Stern,

108   Kalof, et al., 1995). According to Schwartz (1992), values are the most stable beliefs

109   transcending any situation to guide decisions and behaviors, such that they match what is

110   important to individuals. The different types of values classified by Schwartz (1994) constitute

111   a priority system for the individual. If an individual's value system prioritizes self-transcendent

112   values, such as biospheric values (concerns about nature) and altruistic values (concerns about

113   other humans), at the expense of self-enhancement values (egoistic values, concerns about self-

114   interest), then that person will be more inclined to adopt environmentally friendly behaviors

115   (Steg et al., 2005).

116   The value-belief-norm model, presented in Figure 1c, postulates a causal chain in which

117   self-transcendent values predict the new environmental paradigm – a general ecological

118   worldview measured through individuals' beliefs about human-nature interactions. This belief,

119   in turn, affects awareness of adverse and beneficial consequences. Awareness of consequences

120   influences beliefs about one's personal responsibility in those consequences, which then

121   activates personal norms. Activated personal environmental norms act as a general

122   predisposition to pro-environmental actions. The value-belief-norm model has shown a good

123   predictive validity for pro-environmental behaviors (Jakovcevic & Reyna, 2016) and

124   specifically for recycling behaviors (Dursun et al., 2017).

The Comprehensive Action Determination Model

126   Klöckner and Blöbaum (2010) proposed a comprehensive model, presented in figure 1d,

127   that integrates the main determinants from both the theory of planned behavior and the norm

128   activation model, and adds constructs from the ipsative theory of behavior (Tanner, 1999;

129   Tanner et al., 2004). The comprehensive action determination model aims to explain a wide

130   range of pro-environmental behaviors by modeling three direct sources of influence on pro-

131   environmental behaviors: intentional processes, habitual processes and situational processes. A

132   fourth indirect source of influence is also proposed—the normative processes.

133   Intentional processes designate reflexive processes leading to the formation of a will to

134   make an effort to produce the behavior. They comprise attitudes and behavioral intentions. In

135   the case of uncommon or new practices, intentional processes are the proximal antecedent of

136   the behavior.

137   Habitual processes are the results of the automation of a gesture or practice through its

138   frequent repetition over time. Habits can be in line with or in conflict with the expected

139 behavior. They will therefore moderate—positively or negatively—the link between intentional

140 processes and behavior, and the strength of the moderation increases with the degree of

141 automaticity (Triandis, 1980).

142   Situational processes involve the context and how it facilitates the correct

143 implementation of the behavior. These include subjective constraints, namely perceived

144 behavioral control, and objective constraints. The objective constraints are the physical,

145 material and informational characteristics of the situation in which the behavior occurs (e.g.,

146 access to a recycling bin, knowledge of the deposit center location). These conditions can hinder

147 or facilitate the behavior depending on the situation. Therefore, objective constraints influence

148 the perceived control that the individual has over the expected behavior.

149   Normative processes refer to the influence of standards related to the behavior. These

150 norms can be conveyed by others - social norms - or internalized - personal norms. Their

151 influence on behavior is mediated by intentional and habitual processes. The personal norms

152 held the strongest normative influence on behavioral intention and habits, and this influence

153 must be activated by beliefs about the behavior (Schwartz, 1977; Thøgersen, 2006). Therefore,

154 the normative processes include awareness of a need to fix an issue and awareness of

155 consequences of the targeted behavior.

156   Lastly, although situational processes directly influence behavior, they also do so

157 indirectly via intentional, habitual and normative processes. Indeed, the situation must provide

158 individuals with a subjective sense of ability to produce the behavior in order for their personal

159 norms to be activated, the intention to act to be evaluated and the habit pattern to be triggered.

160 Furthermore, the objective conditions in the environment must allow the habit to take place.

161   The comprehensive action determination model has been used to explain pro-

162   environmental behavior such as clothing consumption (Joanes et al., 2020), sustainable

163   purchase (Jovarauskaitė et al., 2020) and recycling (Klöckner & Oppedal, 2011; Ofstad et al.,

164   2017).

165   - Insert figure 1 about here –

166   **Identifying the Main Determinants**

167   Recently, a meta-analysis classified the most important factors predicting waste

168   management across different contexts (e.g., households, employees) and types of waste (e.g.,

169   plastic, general recycling, Geiger et al., 2019). The authors conducted their analyses on the

170   effect sizes from 91 studies that tested the link between the determinants of a large variety of

171   models and behavioral intention, self-reported behavior or observed behavior.

172   The results showed the predictive importance of most of the determinants included in

173   the comprehensive action determination model. The meta-analysis confirmed the influence of

174   normative processes, including social norms ($r = .33$), personal norms ($r = .42$), and awareness

175   of consequences ($r \approx .19$[1]). The results also supported the importance of attitudes ($r = .34$) and

176   of situational processes (i.e., perceived behavioral control, $r = .39$; contextual factors, $-.17 \leq r$s

177    $\geq .26$).

178   In line with the value-belief-norm model, and a broader version of the Comprehensive

179   action determination model (Klöckner, 2013), the meta-analysis also showed that values are

180   related to recycling ($r = .24$). Furthermore, Geiger et al. (2019)'s meta-analysis highlights the

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[1] The exact effect size for awareness of consequences is not provided

181 importance of another factor that we have not mentioned so far: environmental self-identity (r

182 = .30), defined as the degree to which individuals see themselves as eco-friendly (van der Werff

183 & Steg, 2016). Environmental self-identity and values refer to self- processes—general beliefs

184 linking the self to the domain in which behavior takes place (e.g., the environment). Many

185 studies have shown a link between pro-environmental behavior and general beliefs related to

186 the self (De Groot & Steg, 2007), such as biospheric values and environmental self-identity

187 (Carmona-Moya et al., 2017).

188 The results of this meta-analytical work reveal the main determinants of recycling

189 behavior that are only partially included in the current models. To move away from the

190 multiplication of separate models, we propose to integrate these determinants in a unified

191 framework. Hence, we offer a model that includes the normative, attitudinal, and situational

192 processes from Klöckner and Blöbaum's comprehensive model (2010). Importantly, we add a

193 fourth source of influence: the self-processes (from the meta-analysis by Geiger, 2019). The

194 first objective of the present research is to test the new integrative model and document the

195 relative predictive strength of the main determinants of recycling behavior and how they relate

196 to each other. This should contribute to scientific knowledge by providing cumulative evidence

197 about previously observed relations between psychological determinants and pro-

198 environmental intentions or habits. An integrative model however provides a stricter test of

199 those relations, as the effect of each determinant on the outcome (i.e., intention or habit) is

200 estimated beyond the influence of the other determinants, and while the relations between the

201 determinants are also simultaneously estimated. The proposed integrative model should further

202 widen our understanding of pro-environmental intentions and habits by considering the

203 upstream influence values and identity. The second contribution of the present research is to

204 use this integrative model to foster our understanding of two waste management behaviors that

205 are overlooked, although they are at high stake considering the prospect of regulation changes:

206   sorting food waste and dropping off waste at a disposal center. This should bring knowledge

207   about whether the influence of determinants widely documented in the literature transfers to

208   those specific behaviors. This is also important, in the prospect of policy-making, as it could

209   inform about the most relevant levers for behavioral change.

210   **Integrative Model**

211   Our model first integrates the attitudinal, situational, and normative processes identified

212   in the comprehensive action determination model (Figure 2). Given that we could not measure

213   behavior, the main outcome predicted in our study was intention to act. We assume that

214   behavioral intention is *directly* predicted by four determinants: attitudes (**H1**), perceived

215   behavioral control (**H2**), social norms (**H3**), and personal norms (**H4**) (Ajzen, 1991; Bamberg

216   et al., 2007; Klöckner, 2010, 2013).

217   As for situational processes, perceived behavioral control should be influenced by

218   facilitating conditions (**H5**). The more facilitating the conditions, the more individuals will

219   perceive that they have control over their behavior. Regarding normative processes, personal

220   norms should be activated by awareness of need (**H6**), awareness of consequences (**H7**), and

221   social norms (**H8**) (Schwartz, 1977). We expect that the more people are aware that there is a

222   problem and that the targeted behavior is a means to solve it, the higher the sense of moral

223   obligation. Further, the more individuals perceive that the behavior is valued and/or generally

224   adopted by significant others, the more they should feel a moral obligation. Personal norms

225   should mediate the relationship between social norms and intention (**H9**) (Helferich et al.,

226   2023). Moreover, normative processes should be influenced by situational processes, such that

227   personal norms will be predicted by the level of perceived behavioral control (**H10**) (Klöckner

228   et al., 2010): the less individuals feel able to perform the behavior, the less they feel obliged to

229   do so. We expect the influence of perceived control on intention to be mediated by personal

230   norms (**H11**).

231   The main innovation of our model is the integration of self-processes as a new source

232   of influence. These processes refer to self-identity and values. Self-processes provide an overall

233   framework of conduct for individuals; thus, we propose that they act at the early stages of the

234   behavioral performance decision. This idea is supported by the value identity personal norm

235   model, which indicates that values predict identity, which in turn predicts personal norms (Steg

236   & Van der Werff, 2016). Support for this view also comes from the value-belief-norm model,

237   which shows that values are the antecedents of beliefs (Stern, 1999). Recent work has further

238   shown that biospheric values and self-identity are antecedents of social norms, perceived

239   behavioral control, and attitudes (Ateş, 2020; Carfora et al., 2017; Gkargkavouzi et al., 2019).

240   Therefore, we hypothesize that self-processes have an upstream influence on the set of the

241   previously mentioned proximal determinants of behavioral intention. Values should impact the

242   level of awareness individuals have regarding the need to act (**H12**) and the consequences of

243   the solution behavior (**H13**). We expect that the more individuals endorse biospheric values,

244   the stronger their awareness of the problem and the solution's relevance. Values should also

245   affect pro-environmental self-identity (**H14**), which will directly affect personal norms (**H15**),

246   social norms (**H16**), perceived behavioral control (**H17**), and attitudes (**H18**). The stronger the

247   pro-environmental identity, the higher the sense of moral obligation to act, the higher the

248   perception of social norms, the higher the perceived ability to perform the behavior and the

249   more favorable the evaluation of the behavior. The influence of environmental self-identity on

250   personal norms should also be mediated by social norms (**H19**).

251   Lastly, besides intention, we measured habits as an outcome for food waste separation.

252   Habits refer to past behaviors that, through repetition over time, have become automatic,

253 frequent, and non-conscious (Ouellette & Wood, 1998). Habits are a strong proximal predictor

254 when the behavior is frequent (Klöckner, 2013). With respect to the two behaviors investigated

255 here, habits do not apply to dropping off waste at a disposal center as this behavior is not

256 frequent. It can apply to food waste separation, although this specific behavior is not yet

257 required from the population and is therefore not widely enforced. In the prospect of

258 enforcement planned in 2024 in the present country, it is important to know what is related to

259 the development of this habit. We hypothesize that habits will be directly predicted by perceived

260 behavioral control (**H20**), facilitating conditions (**H21**), and personal norms (**H22**) (Klöckner,

261 2013; Klöckner & Blöbaum, 2010). The more individuals feel able to perform, the more the

262 conditions facilitate the performance, and the more individuals feel obliged to do so, the

263 stronger the habit formation. Furthermore, habits should also be influenced indirectly by

264 perceived behavioral control via personal norms (**H23**) and by facilitating conditions via

265 perceived behavioral control (**H24**).

266   - Insert figure 2 about here -

267 **Methods**

268 *Sample Size*

269   According to Kline (2011), structural equation models need to have at least 5 to 1 ratio

270 of observations to estimated parameters. We estimated 169 parameters in the model addressing

271 food waste sorting and 164 parameters in the model for deposit at waste disposal centers,

272 leading to minimal sample sizes of 845 and 820 observations, respectively.

273 *Participants*

274   Participants voluntarily filled in an online questionnaire that took approximately 30

275 minutes to complete and asked about one of the two targeted behaviors. The final samples

276   consisted of 1,198 usable observations for the food waste sorting questionnaire and 1,616

277   observations for the (deposit at) waste disposal centers questionnaire. Table 1 and 2 provides

278   an overview of the socio-demographic characteristics of the participants included in the data

279   analyses for both samples. Participants mostly identified as women, and the distribution of their

280   level of education and income was skewed to the right. Moreover, half of the respondents lived

281   in peri-urban areas (49% and 52% for food waste and waste disposal center questionnaires,

282   respectively), and about a quarter in rural areas (28% and 19%, respectively) or urban areas

283   (23% and 26%, respectively).

284   -Insert Table 1 and 2 about here-

285   ***Measures***

286   All variables in the study were latent variables with multiple indicators. All items were

287   adapted from previous studies and translated into French. Unless otherwise specified,

288   respondents rated each item on a seven-point scale, ranging from 1 (*totally disagree*) to 7

289   (*totally agree*). Negatively worded items were reverse-scored. Analyses were conducted on

290   the basis of all items related to the construct mean score.

291   A first block of items measured general beliefs about waste:

292   *Awareness of need* about waste in general was measured with four items (e.g., "Our society

293   produces too much waste").

294   *Awareness of consequences* about general waste management on the environment was

295   measured with four items (e.g., "If I manage my waste properly, my local quality of life will

296   improve").

297   In the second block, participants answered questions about one of the two specific behaviors.

298   *Social norms* about the specific waste management were measured on both injunctive and

299   descriptive sides. *Social injunctive norms* were measured with three items (e.g., "Dropping off

300   waste at disposal centers is encouraged by people whose opinion I value"). *Social descriptive*

301   *norms* were measured with three items (e.g., "Everyone in my neighborhood deposits waste at

302   disposal centers"). A mean score of the six items has been calculated.

303   Participants' *personal norms* about specific waste management were measured with three

304   items, for example, "I feel morally obliged to sort my food waste", translated from van der

305   Werff et al., (2013) and Klöckner & Blöbaum (2010).

306   Participants' *perceived behavioral control* about specific waste management was assessed with

307   four items, for example, "It is up to me to deposit my waste at disposal centers," adapted from

308   Kraft et al. (2005).

309   Participants' *attitudes* about specific waste management were assessed by asking them to

310   respond to the statement, "Dropping off my waste at the disposal center/Sorting my food waste

311   is…." on six pairs of bidimensional components of instrumental attitude, for example,

312   "pointless–useful," adapted from Graham-Rowe et al. (2019).

313   *Facilitating conditions* related to specific waste management were measured with 10 items for

314   food waste, for example, "I know where to find information to sort my food waste" and 15

315   items for bulky waste, for example, "I know where to find the closest disposal center", adapted

316   from Klöckner and Oppedal (2011).

317   Participants' *habits* were only assessed for food waste separation, with four items (e.g., "Sorting

318   my food waste is something I do without thinking" from the self-report habits index,

319   Verplanken & Orbell, 2003).

320   *Behavioral intention* to manage the specific waste was assessed with four items, for example,

321   "Over the next twelve months, I intend to sort, or to continue to sort, my food waste."

322   In the last block, participants were asked about their *values*, *environmental self-identity*, and

323   *socio-demographic* variables. *Biospheric values* were measured with four items, for example,

324   "Being close to nature is important to me," translated into French from Steg et al., (2014).

325   *Environmental self-identity* was measured with three items, for example, "I consider myself to

326   be a waste management sensitive person", adapted from Nigbur et al., (2010).

327   We collected six socio-demographic variables: age, gender, highest diploma, annual income,

328   familial status and type of habitation (Table 1 and 2).

329   ***Procedure***

330   An online survey was distributed via social networks and mailing lists of local

331   associations. Participants over 18 years old were invited to fill in a questionnaire about 30

332   minutes long. After consenting to participate, they answered the first block of questions on

333   general beliefs about waste management: awareness of need and consequences. Participants

334   were then pseudo-randomly assigned to two out of three behaviors (60% for waste disposal

335   centers and 40% for food waste separation). Indeed, data collection was performed in the

336   context of collaboration with local authorities initially interested in fostering their

337   understanding of three specific behaviors: food waste separation, deposit at waste disposal

338   centers, and green waste reuse in situ. The last behavior was not included in the present paper

339   because we did not reach an acceptable sample size. The second block of questions randomly

340   assessed determinants specifically referring to the targeted behavior, namely, social norms,

341   personal norms, perceived behavioral control, facilitating conditions, attitudes, and habits.

342   Participants then filled in the intention measure at the end of the block. The last block measured

343 pro-environmental values and identity, and participants filled in socio-demographic

344 information on an optional basis. Within each block, the items measuring each determinant

345 were counterbalanced.

346 *Analysis Strategy*

347 Two correlation matrices, reported in Tables 3 and 4, present the zero-order correlations

348 between each determinant and behavioral intention (i) to sort food waste and (ii) to deposit

349 waste at disposal centers.

350 To test each model, analyses were run using the R package lavaan (Rosseel, 2012).

351 Structural equation modeling (SEM) with robust maximum likelihood estimation was applied

352 with a two-stage procedure to test the fitness of the proposed model with the gathered data. In

353 the first step, the reliability and validity of the measurement instruments were determined by

354 confirmatory factor analyses. In the second step, the fitness of the proposed model and the

355 relationships between variables were evaluated by structural equation modeling tests. The

356 model fit was examined based on the following indices: items saturation with related construct

357 (std. str) greater than .40 (Stevens, 2012), robust comparative fit index (Robust CFI), robust

358 Tucker-Lewis index (Robust TLI) equal or greater than .92, robust root mean square error of

359 approximation (Robust RMSEA) lower than .08 and robust standardized root mean squared

360 error (Robust SRMR), lower than .08 (Hair, 2019).

361 **Results**

362 *Food Waste Separation*

363 *Descriptive Results*

364   -Insert Table 3 about here-

365 *Measurement Model Analysis*

366   The initial CFA results indicated that several items should be deleted due to poor

367 standardized factor loadings (< .40). We deleted one item from the personal norms scale, and

368 two items measuring facilitating conditions. The modification indices suggested correlating

369 nine error terms within the same latent constructs to improve the model fit. The final CFA

370 results revealed an acceptable fit for the proposed model: Robust $\chi 2$ = 2172.742; df = 972;

371 p = .000; df/$\chi 2$ = 1.141; Robust CFI =.961; Robust TLI =.957; Robust RMSEA =.034; 90% CI

372 [.032; .036]; SRMR = .045. All standardized factor loadings were significant at $p < .001$. Factor

373 loadings and Cronbach's alphas are presented in Table 4.

374   -Insert Table 4 about here-

375 *Structural Equation Modeling*

376   The results from the SEM analysis showed that the proposed model yielded a good fit

377 to the data: $\chi 2$ = 2666.302; df = 1006; $p < .001$; df/$\chi 2$ = 1.144; Robust CFI = .946, Robust

378 TLI = .942, Robust RMSEA = .039 90% CI [.038; .041]; SRMR = .075. The model accounted

379 for 54.7% of the variance in intention to sort food waste and 65.5% of variance in habits to sort

380 food waste.

381   We observed three out of the four hypothesized direct influences on intention. Intention

382 to sort food waste had a strong relationship with both personal norms, β = .35, $p < .001$, and

383 perceived behavioral control, β = .43, $p < .001$, suggesting that the stronger the moral obligation

384 and ability individuals feel, the higher their intention to sort food waste. Attitudes were

385 significantly but more weakly linked with intention, β = .08, p = .005. Contrary to expectations,

386 social norms were not significantly related to intention, β = 0.06, p = .072.

387   Regarding the antecedents of those four proximal determinants of intention, the model

388   accounted for 67% of the variance in perceived behavioral control, 75% in personal norms,

389   17% in social norms and 23% in attitude. Among the situational processes, the more facilitating

390   the conditions of implementing the food waste sorting, the higher the perceived behavioral

391   control, $\beta = .77$, $p < .001$. Regarding normative processes, personal norms are predicted by

392   social norms, $\beta = .12$, $p = .007$, and awareness of need, $\beta = .15$, $p = .001$, but the results showed

393   no significant relationship with awareness of consequences, $\beta = -0.046$, $p = .226$. A sense of

394   moral obligation to sort food waste seemed activated by the perception that others value and

395   produce that behavior and the awareness of a need to address waste management issues. The

396   expected relationship between situational and normative processes was observed, as personal

397   norms are predicted by perceived behavioral control, $\beta = .30$, $p < .001$. As for self-processes,

398   biospheric values predicted the level of awareness of need, $\beta = .64$, $p < .001$, awareness of

399   consequences, $\beta = .52$, $p < .001$ and environmental self-identity, $\beta = .82$, $p < .001$. In turn,

400   environmental self-identity predicted personal norms, $\beta = .58$, $p < .001$, social norms, $\beta = .41$,

401    $p < .001$, attitude, $\beta = .48$, $p < .001$, and to a lesser extent perceived behavioral control, $\beta = .13$,

402    $p < .001$.

403   Lastly, for the second outcome – habits – the results supported the hypothesized direct

404   influences such that stronger habits were reported by participants who had a higher sense of

405   moral obligation, $\beta = .25$, $p < .001$, felt more capable of sorting food waste $\beta = .36$, $p < .001$

406   and reported more facilitating conditions, $\beta = .32$, $p < .001$. The relationship between perceived

407   control and habits is partially mediated by personal norms, $\beta = .07$, $p < .001$. The influence of

408   facilitating conditions on habits is partially mediated by perceived behavioral control, $\beta = .28$,

409    $p < .001$. Table 5 and Figure 3 present the results.

410   -Insert Table 5 and Figure 3 about here-

411 **_Deposit at a Disposal Center_**

412 _Descriptive Results_

413   -Insert Table 6 about here-

414 _Measurement model analysis_

415   Due to poor standardized factor loadings, we deleted two items referring to the

416 facilitating conditions. The modification indices suggested correlating ten error terms within

417 the same latent constructs to improve the model fit. The final CFA results revealed an

418 acceptable fit for the proposed model, Robust χ2 = 3042.374; df = 978; p < .001; df/χ2 = 3.111;

419 Robust CFI = .937, Robust TLI = .931, Robust RMSEA = .038 90% CI [.037; .040];

420 SRMR = .044. All standardized factor loadings are significant at $p < .001$ (factor loadings and

421 Cronbach's alphas are presented in Table 7).

422   -Insert Table 7 about here-

423 _Structural Equation Modeling_

424   The results from the SEM analysis showed that the proposed model had an acceptable

425 fit to the data: Robust χ2 = 3557.990; df = 963; p < .001; df/χ2 = 3.695; Robust CFI = .917,

426 Robust TLI = .910, Robust RMSEA = .043 90% CI [.042; .045]; SRMR = .071. The model

427 accounted for 52.8% of the variance in intention to deposit waste at a disposal center.

428   The four hypothesized direct influences on intention were observed. The intention to

429 deposit waste at disposal centers was predicted by personal norms, $β = .51$, $p < .001$, indicating

430 that the more participants feel morally obliged to drop off their waste at a disposal center, the

431 more they intend to do so. Perceived behavioral control, social norms and attitude were also

432 significantly linked with intention, $β = 0.23$, $p < .001$, $β = 0.10$, $p = .003$, and $β = 0.16$, $p < .001$,

433   respectively. The stronger the ability individuals felt, the more they perceived others to adopt

434   or value the behavior, and the more positive their attitude toward the behavior, the higher their

435   intention to drop off their waste at a disposal center.

436   Regarding the four proximal determinants of intention, the model accounted for 56% of

437   the variance in perceived behavioral control, 46% in personal norms, 14% in social norms and

438   10% in attitude. Perceived behavioral control was significantly predicted by facilitating

439   conditions, $\beta = .69$, $p < .001$. Regarding normative processes, personal norms is linked to social

440   norms, $\beta = 0.19$, $p < .001$, whereas results showed no significant relationship with awareness

441   of need, $\beta = 0.04$, $p = .309$ and awareness of consequences, $\beta = 0.03$, $p = .439$. Personal norms

442   had a significant relationship with perceived behavioral control, $\beta = 0.23$, $p < .001$. On the self-

443   processes side, biospheric values predicted the level of awareness of need, $\beta = .57$, $p < .001$,

444   awareness of consequences, $\beta = .46$, $p < .001$ and environmental self-identity, $\beta = .82$, $p < .001$.

445   In turn, environmental self-identity predicts personal norms, $\beta = .44$, $p < .001$, and had

446   significant relationships with social norms, $\beta = .37$, $p < .001$, attitude, $\beta = .32$, $p < .001$, and

447   perceived behavioral control, $\beta = .23$, $p < .001$. Table 8 and Figure 4 show the hypotheses

448   testing results.

449   -Insert Table 8 and Figure 4 about here-

450   **Testing alternative models**

451   In line with our theoretical framework, we evaluated several existing models, including

452   the theory of planned behavior, the norm activation model [2], the value-belief-norm model, and

453   the comprehensive action determination model. The goodness-of-fit indices for the intention to

454   sort food waste are presented in Table 9, while Table 10 displays the indices for the intention

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[2] The questionnaire did not contain measure of ascription responsibility, thus the norm activation model tested here is not complete.

455   to deposit waste at a disposal center. All five models demonstrated an acceptable fit based on

456   the goodness-of-fit indices. While the two integrative models did not perform as well as the

457   more parsimonious models, our model showed comparable performance to the previous

458   integrative model (i.e., comprehensive action determination model) for both behaviors. The

459   value-belief-norm model had the best comparative fit indices (AIC and BIC). Nevertheless, our

460   model explained more variance in intention and personal norms, and therefore provides a more

461   comprehensive explanation of the data.

462   -Insert Table 9 and 10 about here-

463   **Discussion**

464   The first objective of this study was to test an integrative model that relies on the three—

465   normative, attitudinal, and situational—processes of the comprehensive action determination

466   model (Klöckner et al., 2010) and includes an additional process based on a recent meta-

467   analysis (Geiger et al., 2019): self-processes. Our model is supported by the results of structural

468   equation modeling which are consistent with 21 out of the 24 hypotheses. The indices showed

469   a good fit of the model, accounting for 52.8% and 54.7% of the variance in intentions and 65.5%

470   of the variance in habits. As expected, each of the four processes included in the model had a

471   significant direct or indirect impact on the outcomes studied here. This finding shows the value

472   of including all identified sources of influence to achieve a more complete and detailed

473   understanding of the intention (or habit) to produce the target behaviors.

474   Analyses confirmed our proposal that self-processes have an upstream influence on all

475   other processes (Gkargkavouzi et al., 2019; Steg et al., 2014). By proposing both values and

476   pro-environmental identity as early antecedents, the present integrative model showed that

477   attitudes and social norms – only treated as antecedents in the other models – are predicted by

478 self-processes (.10 < R² < .23). The comparison with more classical models showed that

479 adding these early antecedents increased the explanation of personal norms, reaching 46% and

480 75% of explained variance. This suggests that self-processes are a promising venue for better

481 understanding how a personal sense of moral obligation emerges and is activated. These

482 findings are consistent with recent work showing that self-processes (i.e., values) predict

483 attitudes, social norms, personal norms and perceived behavioral control (Ateş, 2020). Overall,

484 the observed influence of self-processes on the attitudinal, normative and situational processes

485 is consistent with previous claims that values and self-identity indirectly affect behavioral

486 intentions by providing a general orientation for the perception and evaluation of any specific

487 situation (Bamberg et al., 2003; Udall et al., 2021).

488 This study focused on two specific waste management behaviors: food waste separation

489 and deposit at disposal centers. The results revealed a common basis of understanding for both

490 behaviors. The main common finding is that the intention and habit to manage one's waste are

491 related to two proximal determinants: personal norms and perceived behavioral control. This

492 suggests that, across two types of waste, individuals who feel a strong moral obligation to

493 manage their waste in an environmentally friendly manner and who are highly confident in their

494 ability to do so, are more likely to have a positive intention to engage in proper waste

495 management. Another result observed for both behaviors in our integrative model is that

496 attitudes and social norms are weakly linked to intention. This finding is consistent with a recent

497 study on residential households' waste behavior, that similarly showed the influence of

498 perceived behavioral control and personal norms on waste separation, while attitudes and social

499 norms had no significant relationship with the behavior (Goh et al., 2022). The weaker or

500 absence of influence of attitudes has been observed in other studies when normative influences

501 are included in the models (Oehman et al., 2022; Wu et al., 2022). This may indicate that the

502 presence of personal norms in the model absorbs much of the predictive power of attitudes. The

503   weak and even non-significant effect of social norms in the case of food waste separation may

504   be due to the private nature of the behaviors. Managing food waste, bulky, toxic, or electronic

505   waste mostly takes place in private contexts (e.g., one's own home), which may explain the

506   lower importance of the influence of others' behavior (Aguilar-Luzón et al., 2012).

507   Regarding the path of influence of the proposed model, the results show that the first

508   proximal determinant of intention –personal norms– is predicted by the perception of high

509   levels of social norms and environmental self-identity, but also by a strong sense of control over

510   the behavior. For both behaviors, the more people perceive that those around them value

511   (injunctive norms) or practice (descriptive norms) good waste management, the more people

512   perceive themselves as pro-environmental persons, the more they feel able to perform the waste

513   behavior, and the more they develop a sense of moral obligation to do so. However, contrary to

514   our prediction, the results did not show a significant relationship between personal norms and

515   awareness of consequences. A possible explanation for this null result, which contradicts many

516   studies (Klöckner, 2013), is that the measure we used referred to the consequences of waste

517   management in general and not of the target behavior.

518   As for the second stable and proximal determinant of waste management intention –

519   perceived behavioral control – it is strongly predicted by facilitating conditions. The more

520   supportive the material and informational conditions are in individuals' performance

521   environment, the stronger their sense of performance ability. Our findings, along with others

522   (e.g., Cheng et al., 2022; Concari et al., 2022b; Vijayan et al., 2023; Zaikova et al., 2022; Zhang

523   et al., 2022), outline the importance of access to information and material conditions that

524   facilitate the production of waste management behaviors. Such facilitating conditions enrich

525   psychological models with contextual factors that contribute to alleviate constraints.

526   Although the results revealed a common core for understanding both targeted behaviors,

527   they also highlighted specificities in the determinants of food waste sorting and deposit at waste

528   disposal centers. In the case of food waste separation, situational processes appear to be the

529   most influential of the four sources of influence. In fact, the key-predictor of the intention to

530   sort food waste is perceived behavioral control, directly and indirectly through personal norms.

531   That is, when individuals feel control over their behavior, their sense of moral obligation is

532   likely to be activated, which in turn changes their intention to behave accordingly. The results

533   concerning habits also support the predominance of situational processes, as facilitating

534   conditions are strongly related to the presence of sorting habits, both directly and indirectly via

535   perceived behavioral control. The more favorable the material and informational conditions for

536   the act of sorting, the easier the behavior is perceived to be and the higher the habits are. The

537   model predicting intention towards waste disposal emphasizes normative processes over

538   situational and attitudinal processes. Personal norms showed the strongest association with

539   intention. The stronger the principle of depositing toxic or bulky waste at the disposal center,

540   the higher the intention to do so. However, it is interesting to note that the variance of personal

541   norms explained by the antecedents included in the model is lower when the target behavior is

542   depositing at waste disposal centers ($R^2 = .46$) than when it is food waste separation ($R^2 = .74$).

543   Moreover, in the waste disposal model, the awareness that waste generation is a problem that

544   needs to be addressed does not have a significant effect on personal norms. This suggests that

545   the sense of moral obligation to deposit waste at disposal centers is influenced by factors other

546   than those we identified in the pro-environmental literature. This raises the question of the

547   perception of this behavior as being strictly pro-environmental. It is possible that people are not

548   fully aware of how waste is treated and reused in these infrastructures, which have long been

549   perceived as mere landfills.

550   Our second objective was to use our integrative model to promote an understanding of

551   two overlooked waste management behaviors: food waste separation and waste deposit at

552   disposal centers. The behaviors studied in this paper are of practical relevance, with food waste

553   responding to regulatory developments in Europe, and the deposit of waste in a disposal center

554   enabling the reuse of materials (e.g., metal, wood, electronic components), in a context of

555   accelerating resource depletion. This study also contributes to the advancement of the research

556   field on the identification of factors related to waste sorting behavior. Recent bibliometric

557   research suggests that the study of waste sorting behavior is generating a growing literature

558   (Concari et al., 2022). Research on waste management focuses on different types of waste,

559   sometimes grouped under the umbrella term recycling. Our study addresses the need to

560   differentiate and clarify the waste management behaviors studied by identifying both common

561   factors and differentiating elements for understanding two specific behaviors.

562   **Limitations**

563   The main limitation of our study is the absence of measurement of actual behavior. As

564   in many other studies, we measured intention, as a key determinant of behavior (Sheeran &

565   Webb, 2016. Meta-analytic findings on pro-environmental behavior have shown a moderate to

566   strong relationship between intention and behavioral enactment (Morren & Grinstein, 2016). In

567   a longitudinal study, Passafaro et al. (2019) showed that intentions predicted self-reported waste

568   sorting behavior one month later. Despite these strong associations, people do not always do

569   what they intend to do, and thus there is a gap between stated intention and action (Hassan,

570   2016; Rhodes & Dickau, 2012). Indeed, meta-analyses of the impact of interventions aimed at

571   changing health-related behaviors have shown greater intervention-induced changes in

572   intentions than in measured behaviors (Rhodes & Dickau, 2012; Webb & Sheeran, 2006).

573   However, the gap between intentions and behavior depends on the context, particularly whether

574 the behavior is habitual or not. Specifically, the link between change in intention and change in

575 behavior is stronger for nonhabitual behaviors ($d = .74$) than for habitual behaviors ($d = .22$,

576 Webb & Sheeran, 2006). It is worth noting that the behaviors examined in the present study

577 were unlikely to be habitual. The behavior of dropping off food waste at a waste disposal center

578 does not meet the criteria of regularity and frequency that constitute a habit and is therefore a

579 nonhabitual behavior. As for the sorting of food waste, this is a new behavior that is not yet

580 required in the study area. Therefore, the habitual nature of food waste sorting can vary from

581 zero, or very low, to strong. In addition to intentions, we also studied the habit of sorting food

582 waste. This allowed us to establish the relevance of our integrative model to understand what

583 is associated with the emergence of this behavioral variable. Indeed, it appears that regular

584 sorting performance is related to performance conditions, perceived control, and sense of moral

585 obligation, and that these processes, both situational and normative, are not independent since

586 perceived control predicts personal norms. However, habits remain a measure of self-reported

587 behavior that was realized at the same time as the measures of determinants tested in the model.

588 In future work, it would be critical to test the influence of the determinants proposed here in a

589 longitudinal study that would include measures of self-reported or observed waste management

590 behavior (e.g., trash can weighing). We recognize that the explanatory power of the model for

591 actual behavior will be certainly less than that reported here for intention (see e.g., Yuriev et

592 al., 2020). Nevertheless, from an intervention perspective, our study provides a broader

593 understanding of the articulation of the determinants of sorting intentions, which may help in

594 the design of research or interventions targeting the actual realization of these behaviors.

595 Considering the intention-behavior gap, interventions must include complementary elements

596 that strengthen the transformation of intentions into actual actions, such as planning of the

597 action, monitoring progress, or information and conditions that facilitate the production of the

598 behavior (e.g., Rosenthal, 2018; Schwarzer, 2008; Sheeran & Webb, 2016).

599   A second limitation of this study pertains to the representativeness of the samples.

600   Women, highly educated, and high-income individuals are overrepresented in both samples.

601   This may be due first to the recruitment strategy, which relied in part on the social network of

602   the researchers. In addition, a self-selection of respondents is highly likely, as participants

603   completed the questionnaire without retribution, and studies consistently show that women and

604   highly educated people are more concerned about the environment (e.g., Diamantopoulos et al.,

605   2003; Franzen & Meyer, 2009). It is important to replicate this study with a more diverse sample

606   to improve the generalizability of the findings.

607   From an intervention perspective, proposing a comprehensive model may have practical

608   implications. A model that allows for the testing of a wide range of determinants can enable

609   stakeholders and public policymakers to conduct comprehensive diagnostic studies to identify

610   the most important determinants of target behaviors in the population and then develop fine-

611   tuned interventions. For example, in this study, we found that environmental self-identity is a

612   common and early source of influence. Thus, to encourage better waste management, it may be

613   relevant to design general incentive strategies based on the identity lever. However, the model

614   also highlights specificities related to each behavior that suggest more specific strategies. For

615   example, if the goal of a public policy is to specifically encourage the sorting of food waste, the

616   strategy should focus on increasing the sense of control, the key predictor, in particular by

617   providing the conditions that facilitate the practices.

618   In conclusion, this research supports a model that integrates the main determinants of

619   behavior identified in the recycling literature into four sources of influence: normative,

620   attitudinal, situational and self-processes. It adds to our knowledge of the main determining

621   factors of two overlooked behaviors of greatest concern to local authorities: food waste

622   separation and deposits at waste disposal centers. It appears that normative and situational

623   processes are consistently directly related to intentions and habits, while attitudinal processes

624   show weak links. The study also supports the idea that self-processes – values and identity –

625   should be integrated, as they have an upstream influence on the other processes. We believe

626   that the present research contributes to the efforts to move from multiplicity of specific models

627   to a more integrative approach applicable to a wide range of pro-environmental behaviors.

628   **Acknowledgements**

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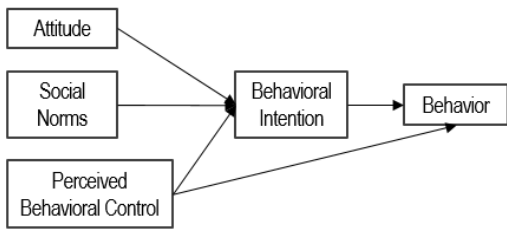
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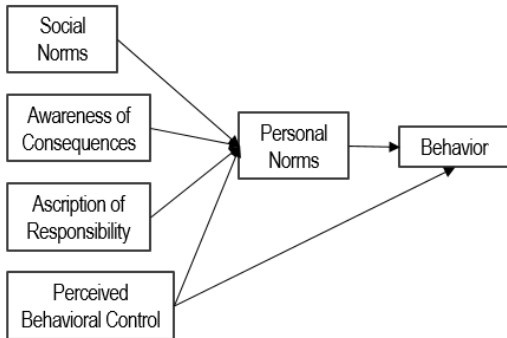
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847

a. The theory of planned behavior (Ajzen, 1991)

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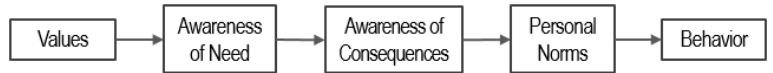
d. The comprehensive action determination model (Klöckner, 2010)
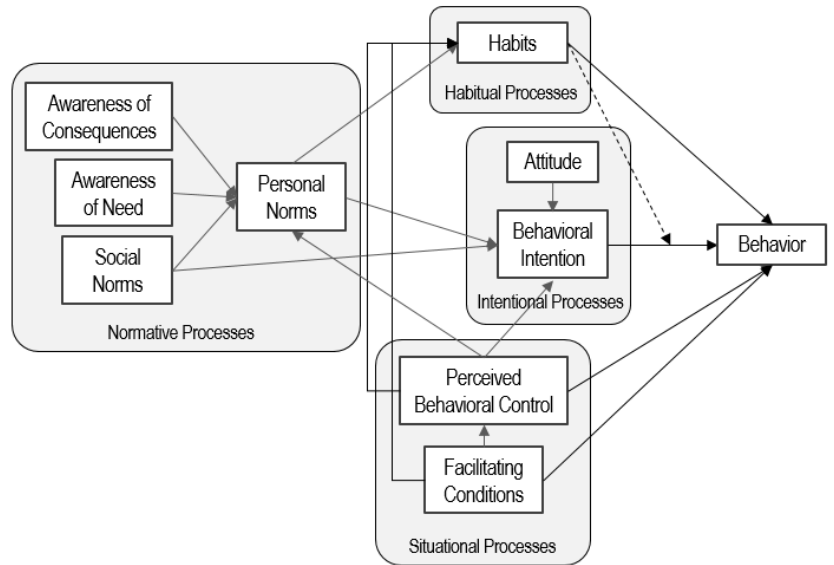
Figure 1. Four prominent models in environmental psychology
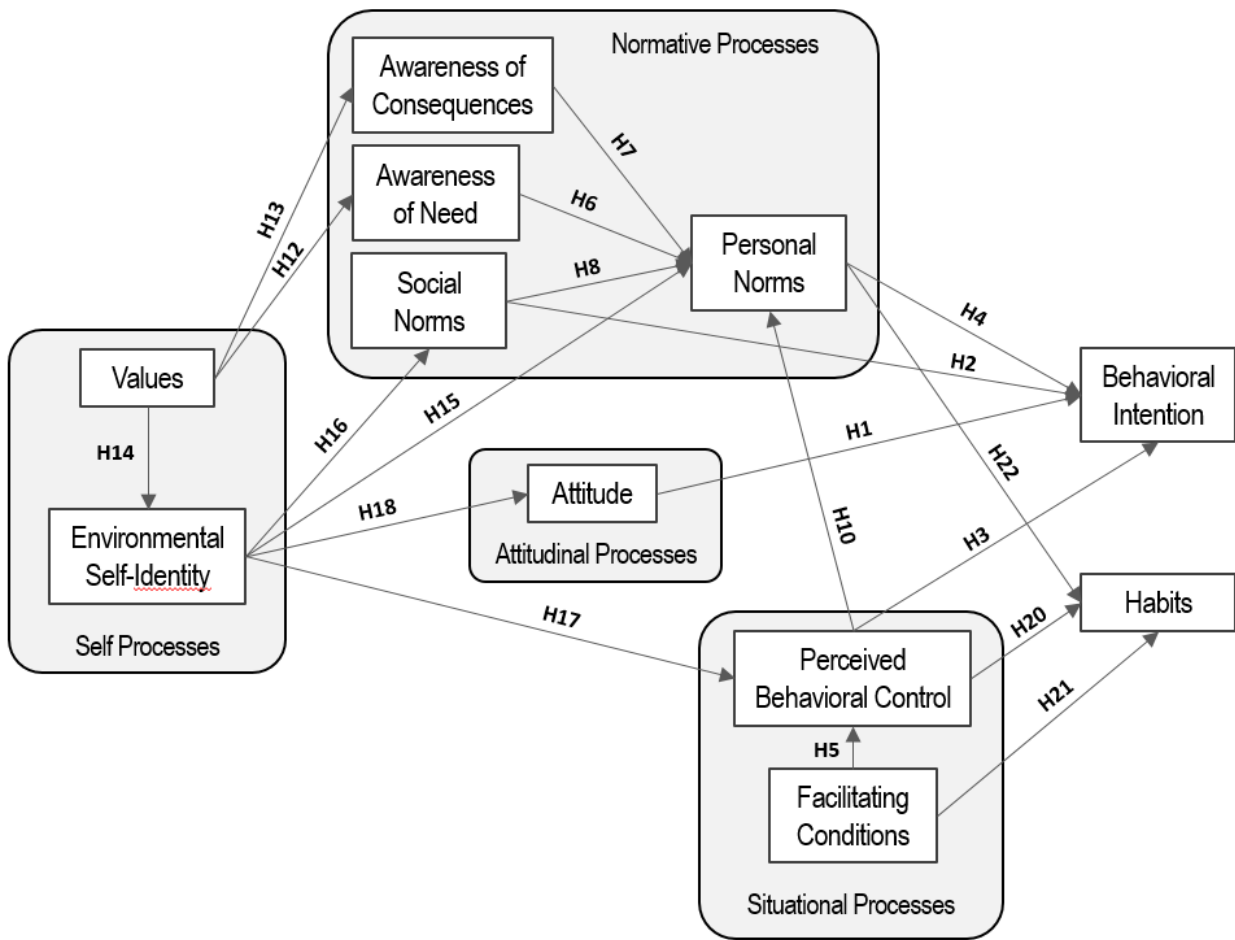
Figure 2. Integrative model.

Table 1. Description of the socio-demographic profile of participants of the food waste sub sample ($N = 1198$)

Gender		Age	Educational attainment		Familial Status		Income per year		Housing type	
Women	74.00% (757)	41.77 (XX)	no diploma	1.48% (13)	Single without children	23.80% (239)	Lowest bracket	6.67% (65)	Room	0.33% (4)
Men	25.71% (263)		Lower secondary education / vocational secondary education	11.36% (100)	Single with children	7.07% (71)	2nd bracket	7.28% (71)	Studio	4.39% (53)
Other	0.29% (3)		Upper secondary education - General	19.32% (170)	Couple without children	29.68% (298)	3rd bracket	6.36% (62)	Flat with separated kitchen	15.82% (191)
			Short-cycle tertiary education/ Bachelor's degree or equivalent	36.93% (325)	Couple with children	39.44% (396)	4th bracket	4.82% (47)	House	76.97% (929)
			Master's degree or equivalent and higher	30.91% (272)			5th bracket	5.74% (56)	Farm	1.57% (19)
							6th bracket	7.18% (70)	Other	0.91% (11)
							7th bracket	7.08% (69)		
							8th bracket	8.72% (85)		
							9th bracket	14.46% (141)		
							10th bracket	24.00% (234)		
							Highest bracket	7.69% (75)		

Table 2. Description of the socio-demographic profile of participants of the disposal center subsample ($N = 1616$)

Gender		Age	Educational attainment		Familial Status		Income per year		Housing type	
Women	65.51 (870)	46.07 (XX)	no diploma	1.30 (17)	Single without children	36.00 (459)	Lowest bracket	7.73% (98)	Room	0.31% (5)
Men	34.04 (452)		Lower secondary education / vocational secondary education	9.78 (128)	Single with children	5.80 (74)	2nd bracket	5.84% (74)	Studio	9.05% (146)
Autre	0.45 (6)		Upper secondary education - General	15.58 (204)	Couple without children	29.96 (382)	3rd bracket	5.60% (71)	Flat with separated kitchen	22.81% (368)
			Short-cycle tertiary education/ Bachelor's degree or equivalent	35.75 (468)	Couple with children	28.24 (360)	4th bracket	4.26% (54)	House	66.27% (1069)
			Master's degree or equivalent and higher	37.59 (492)			5th bracket	4.50% (57)	Farm	0.68% (11)
							6th bracket	6.39% (81)	Other	0.87% (14)
							7th bracket	6.71% (85)		
							8th bracket	8.29% (105)		
							9th bracket	14.68% (186)		
							10th bracket	24.78% (314)		
							Highest bracket	11.21% (142)		

Table 3. Correlation matrix and descriptive statistics of latent variables: food waste separation.

Correlation Matrix

	1	2	3	4	5	6	7	8	9	10	11
1.Biospheric values	-										
2.Awareness of need	.480***	-									
3.Awareness of consequences	.377***	.470***	-								
4.Environmental self-identity	.664***	.460***	.347***	-							
5.Social norms	.232***	.106***	.180***	.328***	-						
6.Personal norms	.462***	.353***	.277***	.561***	.375***	-					
7.Attitude	.360***	.285***	.225***	.354***	.169***	.313***	-				
8.Facilitating Conditions	.339***	.188***	.218***	.422***	.385***	.447***	.258***	-			
9.Perceived behavioral control	.323***	.215***	.226***	.346***	352***	.444***	.261***	.618***	-		
10.Habits	.320***	.180***	.193***	.461***	.453***	.556***	.247***	.663***	.614***	-	
11.Behavioral intention	.472***	.294***	.271***	.495***	.396***	.568***	.342***	.570***	.580***	.666***	-
Mean (SD)	6.36 (0.76)	6.28 (0.76)	5.78 (0.89)	5.64 (1.08)	4.04 (1.10)	5.55 (1.32)	6.34 (1.05	4.94 (1.18)	5.60 (1.32)	5.02 (2.04)	5.91 (1.34)

Note. * $p > .05$, ** $p > .01$, *** $p > .001$

Table 4. Factor loadings and Cronbach's alphas: food waste separation.

Construct	Items	Standardized factor loadings	Cronbach's alpha
Biospheric values	BV1	.753	.89
	BV2	.879	
	BV3	.838	
	BV4	.829	
Environmental self-identity	ESI1	.792	.86
	ESI2	.818	
	ESI3	.756	
Awareness of need	AN1	.617	.76
	AN2	.727	
	AN3	.709	
	AN4	.670	
Awareness of consequences	AC1	.846	.81
	AC2	.798	
Attitude	ATT1	.741	.86
	ATT2	.719	
	ATT3	.795	
	ATT4	.812	
	ATT5	.699	
Social norms	SN1	.501	.83
	SN2	.672	
	SN3	.572	
	SN4	.768	
	SN5	.793	
	SN6	.636	
Facilitating conditions	FC1	.408	.79
	FC2	.462	
	FC3	.653	
	FC4	.452	
	FC5	.779	
	FC6	.546	
	FC7	.414	
	FC8	.710	
Perceived behavioral control	PBC1	.949	.79
	PBC2	.640	
	PBC3	.448	
	PBC4	.719	
Personal norms	PN1	.587	.64
	PN2	.849	
Behavioral intention	BI1	.932	.96
	BI2	.958	
	BI3	.956	
Habits	H1	.978	.98
	H2	.942	
	H3	.923	
	H4	.977	

Table 5. Evidence support for the hypothesized relations: food waste separation.

| Paths	Coefficients	*z*-values	Hypothesis	Results
Attitude→ Intention	.08**	2.791	H1	Supported
Social norms→ Intention	.06, p = .07	1.797	H2	Not supported
Perceived control→ Intention	.43***	7.788	H3	Supported
Personal norms→ Intention	.35***	6.500	H4	Supported
Facilitating conditions→ Perceived control	.77***	11.588	H5	Supported
Awareness of need→ Personal norms	.14**	3.218	H6	Supported
Awareness of consequences→ Personal norms	-.05, p = .23	-1.212	H7	Not supported
Social norms→ Personal norms	.13**	2.699	H8	Supported
Social norms→ Personal norms→ Intention	.04*	2.304	H9	Supported
Perceived control→ Personal norms	.30***	6.873	H10	Supported
Perceived control→ Personal norms→ Intention	.11***	5.203	H11	Supported
Biospheric values→ Awareness of need	.64***	12.509	H12	Supported
Biospheric values→ Awareness of consequences	.52***	13.289	H13	Supported
Biospheric values→ Environmental self-identity	.82***	20.077	H14	Supported
Environmental self-Identity→Personal norms	.58***	9.418	H15	Supported
Environmental self-Identity→Social norms	.41***	8.206	H16	Supported
Environmental self-Identity→Perceived control	.13***	3.598	H17	Supported
Environmental self-Identity→Attitude	.48***	10.147	H18	Supported
Environmental self-Identity→Social norms→ Personal norms	.09***	4.135	H19	Supported
Perceived control→ Habits	.36***	6.010	H20	Supported
Facilitating conditions→ Habits	.32***	5.340	H21	Supported
Personal norms→ habits	.25***	6.094	H22	Supported
Perceived control→ Personal norms→ habits	.08***	4.949	H23	Supported
Facilitating conditions→ Perceived control→ Habits	.28***	5.780	H24	Supported

Note. * p >.05, ** p > .01, *** p > .001
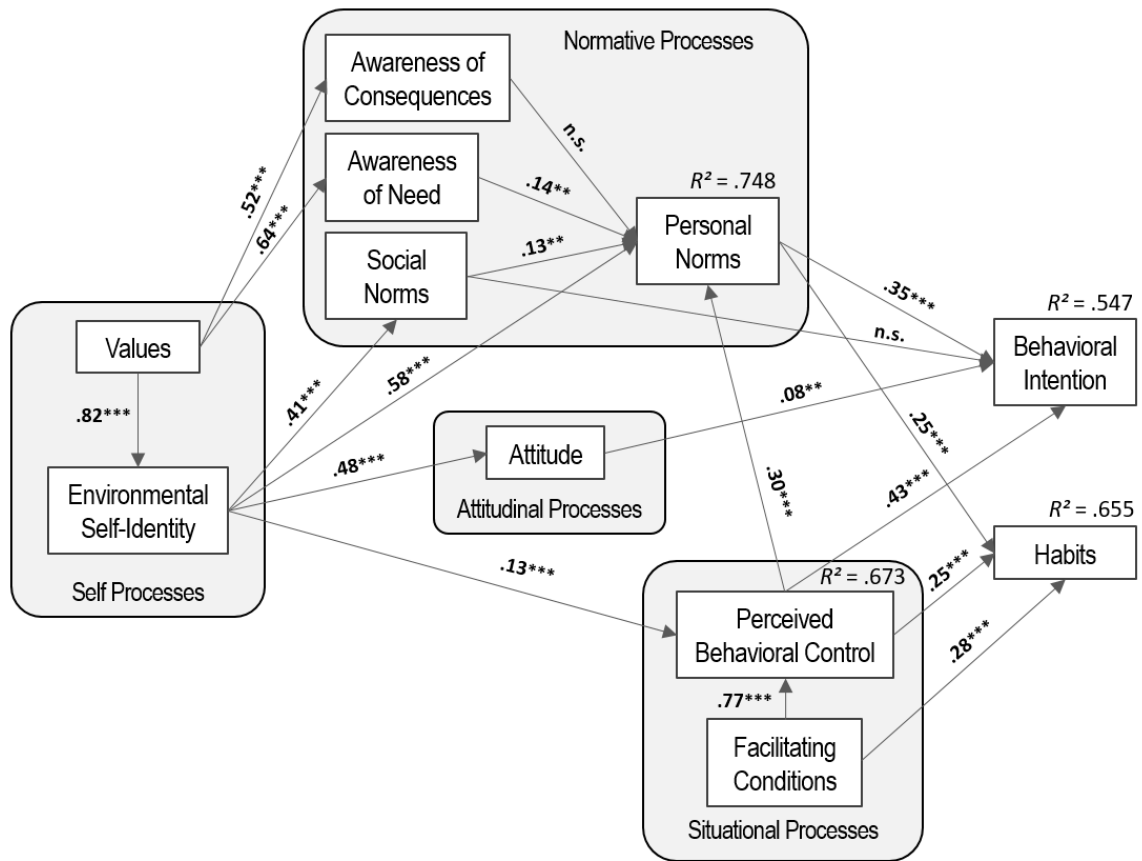
Figure 3. Results of the structural equation modeling: food waste separation.

Table 6. Correlation matrix and descriptive statistics of latent variables: the waste deposit at a disposal site.

Correlation Matrix

	1	2	3	4	5	6	7	8	9	10
1.Biospheric values	-									
2.Awareness of need	.423***	-								
3.Awareness of consequences	.334***	.449***	-							
4.Environmental self-identity	.670***	.432***	.345***	-						
5.Social norms	.218***	.125***	.141***	.267***	-					
6.Personal norms	.353***	.264***	.250***	.413***	.333***	-				
7.Attitude	.180***	.148***	.173***	.197***	.156***	.325***	-			
8.Facilitating conditions	.123***	.032***	.131***	.195***	.287***	.201***	.218***	-		
9.Perceived behavioral control	.205***	.136***	.212***	.258***	.331***	.290***	.266***	.714***		
10.Behavioral intention	.326***	.217***	.220***	.367***	.372***	.540***	.379***	.361***	.444***	-
Mean (SD)	6.39 (0.76)	6.43 (0.66)	5.88 (0.87)	5.83 (1.01)	4.80 (1.02)	5.91 (1.14)	6.15 (0.99)	4.48 (1.08)	5.15 (1.18)	6.11 (1.10)

Note. * $p > .05$, ** $p > .01$, *** $p > .001$

Table 7. Factor loadings and Cronbach's alphas: the waste deposit at a disposal center.

Construct	Items	Standardized factor loadings	Cronbach's alpha
Biospheric values	BV1	.713	.88
	BV2	.896	
	BV3	.820	
	BV4	.834	
Environmental self-identity	ESI1	.778	.85
	ESI2	.824	
	ESI3	.719	
Awareness of need	AN1	.608	.73
	AN2	.728	
	AN3	.637	
	AN4	.648	
Awareness of consequences	AC1	.846	.81
	AC2	.806	
Attitude	ATT1	.761	.81
	ATT2	.679	
	ATT3	.533	
	ATT4	.754	
	ATT5	.776	
Social norms	SN1	.801	.82
	SN2	.542	
	SN3	.729	
	SN4	.618	
	SN5	.735	
	SN6	.477	
Facilitating conditions	FC1	.703	.86
	FC2	.745	
	FC3	.623	
	FC4	.454	
	FC5	.468	
	FC6	.484	
	FC7	.632	
	FC8	.545	
	FC9	.531	
	FC10	.646	
	FC11	.498	
	FC12	.522	
Perceived behavioral control	PBC1	.802	.83
	PBC2	.751	
	PBC3	.733	
	PBC4	.647	
Personal norms	PN1	.829	.63
	PN2	.555	
Behavioral intention	BI1	.877	.93
	BI2	.819	
	BI3	.926	
	BI4	.902	

Table 8. Evidence support for the hypothesized relations: the waste deposit at a disposal site.

Paths	Coefficients	z-values	Hypothesis	Results
Attitude→ Intention	.16***	4.963	H1	Supported
Social norms→ Intention	.10**	2.972	H2	Supported
Perceived control→ Intention	.23***	6.920	H3	Supported
Personal norms→ Intention	.51***	11.517	H4	Supported
Facilitating conditions→ Perceived control	.69***	16.321	H5	Supported
Awareness of need→ Personal norms	.04, p = .31	1.017	H7	Not supported
Awareness of consequences→ Personal norms	.03, p = .44	0.775	H8	Not supported
Social norms→ Personal norms	.19***	5.399	H6	Supported
Social norms→ Personal norms→ Intention	.10***	4.498	H11	Supported
Perceived control→ Personal norms	.23***	6.592	H9	Supported
Perceived control→ Personal norms→ Intention	.12***	5.895	H10	Supported
Biospheric values→ Awareness of need	.57***	8.916	H12	Supported
Biospheric values→ Awareness of consequences	.46***	12.012	H13	Supported
Biospheric values→ Environmental self-identity	.82***	20.401	H14	Supported
Environmental self-Identity→ Personal norms	.44***	8.533	H15	Supported
Environmental self-Identity→ Social norms	.37***	10.054	H16	Supported
Environmental self-Identity→ Perceived control	.23***	7.495	H17	Supported
Environmental self-Identity→ Attitude	.32***	8.481	H18	Supported
Environmental self-Identity→ Social norms→ Personal norms	.12***	7.318	H19	Supported

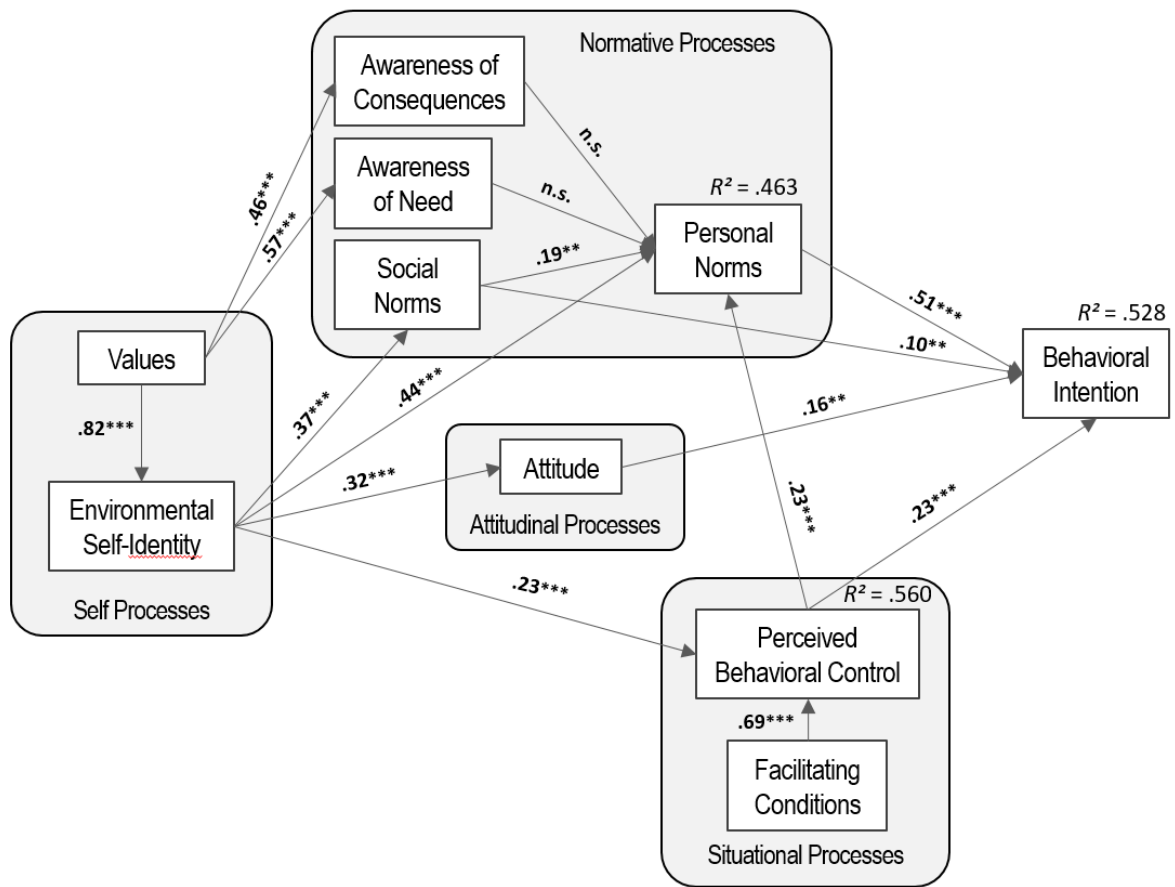Note. * p >.05, ** p > .01, *** p > .001

Figure 4. Results of the structural equation modeling: the waste deposit at a disposal site.

Table 9. Model comparison for food waste sorting intention.

Alternative Models explaining food waste sorting

Indices	TPB	NAM	VBN	CADM	Integrative Model
CFI	.971	.961	.957	.948	.946
TLI	.966	.955	.949	.943	.942
RMSEA	.047	.045	.060	.042	.039
SRMR	.036	.037	.106	.046	.075
AIC	65819	69693	49855	146135	162441
BIC	66125	70024	50135	146864	163302
R^2 Intention	.52	.583	.472	.586	.547
R^2 Personal Norms	NA	.626	.208	.64	.748
R^2 Attitude	NA	NA	NA	NA	.227
R^2 Perceived Control	NA	NA	NA	.711	.673
R^2 Social Norms	NA	NA	NA	NA	.167
R^2 Habits	NA	NA	NA	.674	.655

Note: TPB - Theory of Planned Behavior, NAM - Norm Activation Model, VBN - Value Belief Norm Model, CADM - Comprehensive Action Determination Model, NA - variable not present in the model or variable that does not have the status of an exogenous variable

Table 10. Model comparison for the intention to waste deposit at a disposal center

Alternative Models explaining desposit at a disposal centre

Indices	TPB	NAM	VBN	CADM	Integrative Model
CFI	.960	.968	.961	.902	.917
TLI	.953	.963	.954	.893	.910
RMSEA	.051	.039	.052	.052	.043
SRMR	.032	.028	.053	.053	.071
AIC	89581	102842	68903	173198	161939
BIC	89922	103281	69216	173841	162974
R^2 Intention	.384	.559	.498	.542	.528
R^2 Personal Norms	NA[1]	.390	.135	.354	.46
R^2 Attitude	NA	NA	NA	NA	.103
R^2 Perceived Control	NA	NA	NA	.535	.560
R^2 Social Norms	NA	NA	NA	NA	.137

Note: TPB - Theory of Planned Behavior, NAM - Norm Activation Model, VBN - Value Belief Norm Model, CADM - Comprehensive Action Determination Model, NA - variable not present in the model or variable that does not have the status of an exogenous variable