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The Contribution of Thinking Modes to Better Understand the Impact of Place on Sorting Behavior: An Abstract

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INTRODUCTION

To help organizations in charge of waste management, it is essential to better understand the decisive factors influencing waste sorting. Sorting is a behavior within the reach of all citizens, which saves resources and reduces the negative impact on the environment. Yet many recyclable materials are not systematically sorted, particularly in densely populated urban areas (Knickmeyer, 2020). While the literature on sorting has focused mainly on individual beliefs and information (Geiger et al. 2019), dual models of decision stress the importance of mental automatisms and shortcuts that can influence behavior (Kahneman, 2011; Evans and Stanovich, 2013). These automatisms depend not only on the individual, but also on the place in which decisions are made (Gibson, 1977). A better understanding of how location affects sorting behavior could significantly improve the modeling of sorting behavior and promote more effective actions.

Our study postulates that dual models help to better understand the effect of place, independently of the information and beliefs associated with sorting. Raymond et al. (2017) proposed integrating work on place attachment into a dual model of decision-making. Place attachment refers to an individual's cognitive and emotional relationship with a given place (Low and Altman, 1992). The more attached a person is to a given place, the more likely they are to sort or engage more generally with the environment (Daryanto and Song, 2021). From the perspective of dual models, a person more attached to a place could make the decision to sort on the basis of everyday automatisms and simple emotions (fast system), or on the basis of a conscious mental effort that involves a representation of the place and its inhabitants (slow system). Place could thus influence sorting not only automatically, but also slowly via mental simulations and working memory.

To assess the effect of location on sorting behavior, we tested a theoretical model using a questionnaire survey method. We mobilized two variables that could automatically influence sorting: human density in the dwelling and time required to access the garbage room. We also selected two place-related variables that could influence sorting in a more reasoned way and via mental simulations: residential satisfaction and bonding with surrounding nature. Unlike individual variables (e.g., moral norms) embedded in theories such as the Values-Beliefs-Norms theory (Stern, 2000) or the Theory of Planned Behavior (Fishbein and Ajzen, 2011), there is no theoretical framework that would identify a restricted set of key variables associated with place. This study is in line with this desire to progressively build an integrative theory that takes location into account in sorting decisions.

BACKGROUND

The influence of location on sorting: automatic and reflective routes

While the literature on determinants focuses on individual factors, field interventions show the importance of place in decisions. In their meta-analysis, Geiger et al (2019) showed that most studies focus on individual factors (e.g., attitudes) and few incorporate place-related variables. What's more, these studies are better at explaining intentions than behaviors. At the same time, field interventions seek to modify behavior. According to a meta-analysis (Varotto and Spagnoli, 2017), environmental alteration (e.g., flower stickers on a bin) and social modeling (e.g., calling on neighbors to show how to sort) are the two most effective interventions. A better understanding of the effect of place could help improve the explanation of sorting behaviors.

We believe that the diversity of results illustrates the failure to take into account not only the different influencing variables, but also the way in which they exert this influence. This research is therefore in line with work on "naturalistic decision making" (NDM). A theory, which seeks to explain how people use their experiences to make decisions in everyday settings (Klein 2011). In particular, we draw on the work of Kahneman et al (1982), which shows that individuals rarely make optimal or rational decisions, and instead tend to rely on biases and heuristics. This research and its extension to dual models could help us to better understand the effect of location on sorting. Indeed, dual models (Kahneman, 2011) distinguish between two modes of thinking: intuitive and deliberative. The former is fast, the latter is analytical and slow. In an intuitive mode, people make decisions quickly and effortlessly, anchoring their choices in their particular abilities or skills, while in a deliberative mode, they make decisions more slowly, analytically and with effort.

The location could automatically influence sorting. For example, a sorting terminal with a round slot invites people to throw bottles into it. The perception of this slot directly generates motor anticipations (throwing bottles), independently of beliefs and information about sorting. Location may also influence sorting in a more reflexive way. For example, an individual may feel that sorting is not useful in a given location, due to the poor quality of the collection service (e.g. recyclable waste collected by a garbage truck). This assessment implies a cognitive effort and depends on the location in which sorting takes place. Dual models therefore help to build a place-centric theoretical model that incorporates factors based on automatisms or reasoned evaluation (Evans and Stanovich, 2013).

The theoretical model tested in this study

In order to assess the effect of location on sorting, we have selected four as yet little-studied variables (see Figure 1). For the moment, there is no theoretical framework that would specify the most compelling location-related variables. Human density in the dwelling and time to sort could influence sorting automatically, independently of the beliefs and information associated with sorting. Human density in the dwelling (number of inhabitants per m²) is a location-related factor that can negatively influence sorting. The greater the density, the greater the volume of waste for a given surface area. Studies have shown a negative relationship between neighborhood size and the probability of sorting (Derksen and Gartrell, 1993; DeYoung, 1990). However, no studies have examined human density within the household itself.

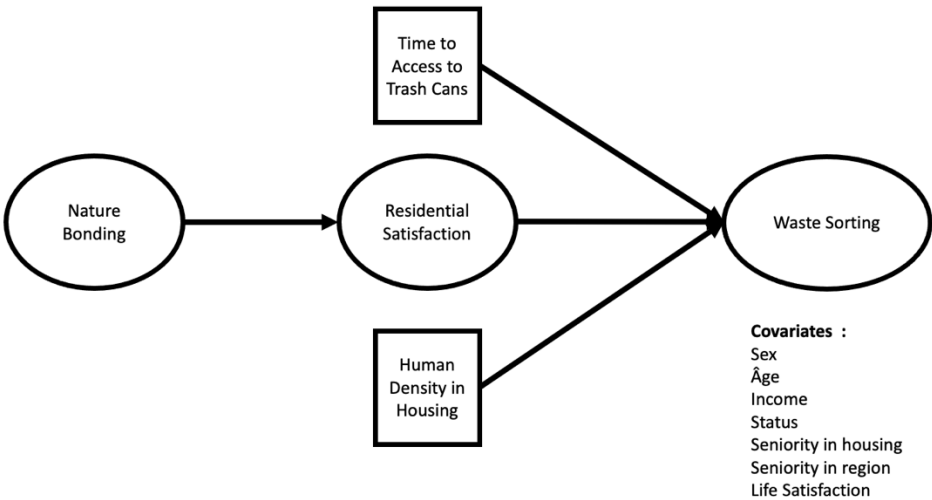
In addition to human density, the time it takes to get to the garbage can may have a negative influence on sorting. Various studies have also shown that distance from the collection point has a negative influence on sorting (Schultz et al. 1995; Gonzalez-Terre and Adenso-Diaz, 2005). As distance increases, people sort less. Roustae et al. (2013) tested the effect of a collection point close to homes and observed a significant reduction in sorting errors. Insofar

as our population of interest lives mainly in vertical housing, we have focused on the similar notion of time needed to reach the garbage room. The time required is easy for the respondent to estimate, and takes into account the number of floors to be covered and the person's speed of movement according to his or her physical capabilities.

From the perspective of dual models, location could also influence sorting in a more reasoned way. Bonding with nature and residential satisfaction could influence sorting in ways that are not strictly automatic. Bonding with nature (Raymond et al. 2011) is a sub-dimension of the general concept of place attachment and refers to an individual's connection with the non-human natural world. Unlike the notions of nature's inclusion in the self (Schultz, 2002) or biospheric values (Stern, 2000), bonding with nature is associated with a geographically delimited territory (e.g. regional scale) and with memories, behaviors, projections into the future. What's more, a link to nature leads to a restoration of attentional (Bratman et al. 2015) and emotional (Ulrich, 1991) capacities. This restoration could positively influence a person's conscious evaluation of their living environment.

This link to (regional) nature could positively influence residential satisfaction. Residential satisfaction is an individual's cognitive evaluation of his or her home. This evaluation does not focus on the surrounding nature, but on the dwelling, the building, the neighborhood or the relationships between residents. In contrast to the general notion of attachment to place, residential satisfaction is limited to a cognitive and concrete evaluation at the neighborhood level. During interviews in social housing, Grassias and Piris (2023) noted that water leaks, dampness, drug dealing and garbage in the staircase were reasons spontaneously cited by non-sorters to explain why they refused to sort. This is why we believe that residential satisfaction could have a positive influence on sorting.

Table 1. Conceptual diagram of the theoretical model



METHODOLOGY

To assess the effect of location on sorting in a densely populated urban context, an online questionnaire survey method was used in Paris and the surrounding departments. A diverse sample (404 respondents) in terms of age, gender, income completed scales on frequency of sorting behavior (Barr, 2007), bonding with nature (Raymond et al. 2011), residential

satisfaction (Adriaanse, 2007), as well as questions on time to access the garbage can, number of adults and children, floor space, and other covariates (e.g. age, income). Several precautions were taken to reduce potential bias: cover story that distinguished two studies (one on sorting, one on location) and randomization of items within the scales. In order to measure the effect of variables simultaneously and to integrate measurement models, a structural equation approach was chosen. Since the model contains a ratio variable (human density), structural least-squares equations were used (Shmueli et al. 2019).

RESULTS AND DISCUSSION

Results

The measurement model is satisfactory in terms of loadings, cronbach's alpha, composite reliability, average variance extracted, and variance inflation factors, Heterotrait-Monotrait ratio of correlations. The four variables explain 12% of self-reported sorting behavior. A bootstrap approach was used on 10,000 samples to assess the significance of the relationships. We observed a positive effect of the bonding with nature on residential satisfaction ($\beta = 0.505$, $p < 0.001$, CI = [0.425, 0.597]), and of residential satisfaction on sorting ($\beta = 0.186$, $p < 0.01$, CI = [0.070, 0.301]). We also observe the negative impact of time to access the garbage can on sorting ($\beta = -0.187$, $p < 0.001$, CI = [-0.276, -0.096]) and human density in the dwelling on sorting ($\beta = -0.191$, $p < 0.001$, CI = [-0.294, -0.084]). There was no impact of bonding with nature on sorting ($\beta = -0.000$, $p > 0.05$, CI = [-0.108, 0.109]). A mediation analysis showed a positive and significant indirect effect of the bonding with nature ($\beta = 0.094$, $p < 0.01$, CI = [0.035, 0.158]). These results confirm the importance of location in sorting decisions.

Discussion

Our study completes the literature by assessing the effect of location on the frequency with which materials are sorted by households. Our results show that only four location-related variables explain 12% of self-reported sorting behavior. The more positively persons evaluate their residential area, the more likely they are to sort. Unlike the general notion of place attachment (Low and Altman, 1992), residential satisfaction is a simpler, delimited concept that lends itself easily to managerial recommendations. Bonding with nature is an important antecedent of residential satisfaction. The more attached a person is to the region's natural heritage, the more positively they evaluate their home, building and neighborhood. This relationship holds even in the presence of control variables, such as income or a person's level of satisfaction with life. Finally, our research shows the importance of human density in the dwelling and the time it takes to reach the garbage room. The greater the number of inhabitants per square metre in a dwelling, the less likely the inhabitants are to sort. This association could be explained by the relationship between waste produced and available space, as well as by coordination difficulties between household members. In addition to human density, the results also show the negative effect of the time required to sort. The longer it takes, the less likely people are to sort. This result reinforces the few studies that have shown a negative link between distance to sort and sorting behavior. (Derksen and Gartrell, 1993; Roustae et al. 2015).

CONCLUSION AND IMPLICATIONS FOR THEORY AND PRACTICES

These results should serve to encourage local authorities, social landlords and urban planners to integrate more nature into the urban environment, to improve living conditions for residents (e.g. housing condition) and not to underestimate purely practical aspects (human density, time

to sort) in order to speed up the spread of sorting. Further studies are needed to demonstrate the causal effect of location-related variables on sorting (e.g. residential satisfaction) through experimentation. The use of objective measures of sorting (e.g. radio frequency identification technology) and the integration of individual factors such as attitudes or moral standards within the framework of an integrative theoretical model are also promising avenues.

References Available Upon Request