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How ocean beach recreational quality fits with safety issues? An analysis of risky behaviours in France

Jeoffrey DEHEZ¹, Sandrine Lyser

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1. Introduction

Drowning is the third leading cause of accidental death worldwide (WHO 2014). Many of these accidents occur in coastal areas (Koon, Peden *et al.* 2023), during recreational activities, especially due to rip currents (Brighton, Sherker *et al.* 2013, Short and Brander 2014, Brewster, Gould *et al.* 2019, Cooper, Ledger *et al.* 2021). Rip currents are strong, narrow seaward flowing currents that extend from the shoreline and through the surf zone. Once swept offshore by these currents, swimmers are exhausted trying to get back to shore. Furthermore, the onset of panic frequently inhibit individuals from recalling or enacting any type of beach safety message (Drozdowski, Shaw *et al.* 2012, Drozdowski, Shaw *et al.* 2015, Cornell, Brander *et al.* 2023). In the face of these dangers, the establishment of supervised swimming areas remains one of the most effective preventive measures (Hartmann 2006, Wilks, de Nardi *et al.* 2007, Gilchrist and Branche 2016). These areas are generally marked out by two flags, although the colors of the flags may vary from country to country (Tipton and Wooler 2016). However, it is still very common for people to continue recreating outside of these supervised areas (Wilks, de Nardi *et al.* 2007, Sherker, Williamson *et al.* 2010, Williamson, Hatfield *et al.* 2012, Uebelhoer, Koon *et al.* 2022).

In order to understand such risky behaviours, many beach safety studies have analyzed beachgoers' attitudes and risk perceptions (McCool, Ameratunga *et al.* 2009, Williamson, Hatfield *et al.* 2012, Short and Brander 2014, Brander 2018, Ménard, Houser *et al.* 2018). These have often shown that young men are a particularly "at risk" group, insofar as they are more attracted to intensely thrilling experiences than other members of the population (Moran 2011, Lawes, Ellis *et al.* 2021). Such attitudes are however far from being widespread among all beachgoers, who, on the whole, tend to underestimate the dangers of swimming (Ménard, Houser *et al.* 2018, Uebelhoer, Koon *et al.* 2022). Beachgoers therefore find themselves in hazardous situations without even being aware of it. The results of the above-mentioned studies have stressed the need to increase information for people going to the beach. But information is far from being a guarantee of caution. This is attested by the results of a survey by Sherker, Williamson *et al.* (2010), in which the individuals who claimed to be the best informed about the risks were also those who, more often than others, admitted to swimming outside supervised areas. Similar results were obtained by Trimble and Houser (2018), Drozdowski *et al.* (2012, 2015) and Williamson *et al.* (2012). In particular, the latter showed that people living in coastal areas reported swimming at patrolled beaches less often than people living inland.

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Although understanding risk is an important component of safe beach recreation, beachgoers are above all seeking pleasure. In this regard, beach recreational quality and activities are key components of visitor's satisfaction (Parsons and Massey 2003, Rulleau, Dehez *et al.* 2012, Ghermandi and Nunes 2013). Recreational quality defines the value of the recreational experience (Morey 1981, Loomis and Walsh 1997, Hanley, Shaw *et al.* 2003, Manning 2022), what eventually will keep visitors coming back in the future (Dodds and Holmes 2019). Recreational quality is a multidimensional concept. It ultimately depends on consumers' subjective perception. Research on water-based outdoor recreation has shown that the recreational quality of beaches is assessed against a very wide range of criteria, including water quality, beach cleanliness, crowding, activities, facilities or services (Parsons and Massey 2003, Roca, Villares *et al.* 2009, Rulleau, Dehez *et al.* 2012, Loomis and Santiago 2013, Skriver Hansen 2016, Trelohan, François-Lecompte *et al.* 2022, Wood, Vimercati *et al.* 2022). In many cases, the presence of a lifeguard unit is not necessarily a priority. For example, Hamilton *et al.* (2016) showed the presence of good waves outside the supervised area was one of the main reasons why visitors might opt out. In some cases, supervision is not considered at all (Penn, Hu *et al.* 2016). Quality attributes also influence the choice of leisure activities. Although, coastal areas are suitable for a wide range of activities (Ghermandi and Nunes 2013, Le Corre, Saint-Pierre *et al.* 2021, Skriver Hansen, Glette *et al.* 2021) some beaches are better suited to certain activities than others. For example, surfers look for beaches with good waves (Boqué Ciurana and Aguilar 2021), whereas fishermen may rather be interested by areas with plentiful of fishes (Laitila and Paulrud 2006). Families with children look for places with safety equipment and facilities (Dodds and Holmes 2019). Proximity and accessibility also remain important predictors. People often go swimming in places closest to access points or holiday accommodation (Houser, Murphy *et al.* 2015, Trimble and Houser 2018, Silva-Cavalcanti, Silva *et al.* 2020, Uebelhoer, Koon *et al.* 2022), whether or not there is lifeguard supervision.

Several risky location choices have been investigated in the beach safety literature. Most studies have focused on swimming between flags, in supervised zones, with differences depending on whether the authors analyzed past behaviours (McCool, Moran *et al.* 2008, McCool, Ameratunga *et al.* 2009) or intentions (Ballantyne, Carr *et al.* 2005, Wilks, de Nardi *et al.* 2007, White and Hyde 2010, Williamson, Hatfield *et al.* 2012, Hamilton, White *et al.* 2016). White and Hyde (2010) explored the intention to swim outside the flags, at a distance of less than or greater than 10 m respectively. Morgan *et al.* (2009b, 2009a) and Uebelhoer *et al.* (2022) focused of unsupervised beaches. Gulliver and Begg (2004) considered three types of risk behaviours (having water based activities between the flags, not between the flags at patrolled beach and at unpatrolled beach). Few studies have compared these different behaviours however.

Using a representative survey of 240 beachgoers living in the south-west of France, this study aims to

- 1) investigate the contribution of individual recreational preferences on water based recreation risky location choices and

2) investigate the differences between entering the water outside of the supervised areas at patrolled beach, on the one hand, and recreating on unpatrolled beach, on the other hand.

2. Methods

2.1. Study site

France's south-western coastline is one of the most attractive but also one of the most dangerous coastlines in Europe. It is about 250 kilometres long with a sandy strip that stretches for more than 200 kilometres, from the Garonne estuary in the north, to the rocky cliffs of the Basque Country, in the south (Figure 1a). The coast is exposed to the swells generated by the low pressure systems across the North Atlantic Ocean, which create ideal waves for surfing (GIP Littoral 2017). This type of oceanic and geomorphological configuration is also conducive to the formation of strong rip currents (Castelle, Scott *et al.* 2016, Castelle, Guillot *et al.* 2018). As an average of ten million people go to these beaches every summer (GIP Littoral 2018), the local authorities in Aquitaine provide supervision on over 130 beaches². The majority of these beaches are supervised during the months of July and August, and even before and after the season, depending on the number of visitors and the financial resources of the local authorities. Almost all beaches with an access point (car park, road, seaside resort) are supervised by lifeguards. Lifeguards are responsible for a patrolled sector, which is generally a few kilometres long. Within each patrolled sector, one or several supervised bathing zone is/are delimited between two red and yellow flags (Figure 1d). This new signage (previously marked by blue flags) in accordance with the international standard has been implemented since March 2022. During patrolling hours, a flag is hoisted on a mast with the color indicating the level of environmental hazards: (1) green flag means that bathing is supervised with no particular danger; (2) yellow-orange flag means that bathing is dangerous, but supervised; and (3) red flag means that bathing is forbidden. Although there are no official regional statistics, the lifeguards we interviewed estimated that there are between 20 and 30 fatal drownings every year. No drownings are recorded between the flags, however. These drownings constitute only a part of the overall drowning burden, as there are also high numbers of non-fatal drownings, as well as injuries related to collision between surfers and swimmers, and trauma caused by shore break waves (Castelle, Brander *et al.* 2018, Tellier, Simonnet *et al.* 2019, De Korte, Castelle *et al.* 2021).

Insert figure 1

2.2. Survey design

Our survey is based on an initial sample of 500 individuals representative of the population of south-western France. The survey was conducted by telephone from 7 to 15 December 2020. Compared to an on-site survey, this method reduces selection bias and does not over-represent avid beachgoers who go to the beach frequently (Kajala, Almik *et al.* 2007). The main

² https://www.pigma.org/public/visualiseur/donneesplages/?config=apps/donneesplages/donneesplages_prefecture.xml

questionnaire covered a number of topics relating to beach use³. The average time taken to complete the questionnaire was 13 to 14 minutes. Only the questions that were analyzed for the current paper are described here. Scales and nominal categories were determined in consideration of variable characteristics, ease of response and analysis. The interviewer asked the individual whether they had visited the beach in the year 2020. This applied to any beach along the coastline of south-west France. Lakes, estuaries and rivers were excluded therefore. Of the 500 individuals interviewed, 240 (48%) said they had been to the beach in 2020. The following analysis therefore relate to this sub-sample.

2.2.1 Demographics/personal characteristics

Respondents provided gender, age, level of education and residence information. Respondents were asked to estimate the distance they actually live away from the beach. Responses on age and distance were converted into distribution classes.

2.2.2 Visitation patterns and activities

The interviewer then asked a second set of questions about respondents' uses of the beaches. These questions involved activities and group composition. Under these conditions, respondents could choose several options for a question (e.g. several activities). Respondents were also asked about the annual frequency of visits. To assess the possible effect of the Covid-19 related restrictions (Houser and Vlodych 2021, Lawes, Strasiotto *et al.* 2021) we adapted our questions by distinguishing between the times of year depending on the restrictions in movement in place. In the questionnaire, items specific to fear of Covid-19 infection were also included among the reasons for not going to the beach or selecting unsupervised areas.

2.2.3 Recreational quality preferences

Respondents were then asked to indicate their preferences regarding the recreational quality of the beach. Recreational qualities attributes were defined both through attractiveness factors, i.e. what the respondents liked, and disturbing factors, i.e. what they disliked (Kajala, Almik *et al.* 2007, Wood, Vimercati *et al.* 2022). Based on previous studies (Dehez and Rambonilaza 2006, Rulleau, Dehez *et al.* 2012), six quality items were selected to describe natural settings, whereas eight quality items were selected to describe facilities and others services. We also selected seven dislikes characteristics. In all cases, individuals could choose several options.

2.2.4. Individuals knowledge

Following Kaminski, Bell *et al.* (2017) and Boqué Ciurana and Aguilar (2021), we included additional questions about the type of information sought before going to the beach. Such information referred to supervision hours, weather, tide and waves conditions. We also ask a very general question on whether the interviewee had heard about the "baines" (i.e. the local name for rip currents) or not (Sotés, Basterretxea-Iribar *et al.* 2020). Respondents were offered three definitions, two of which were false.

2.2.5. Risk behaviours

³ The questionnaire is available online : <https://doi.org/10.57745/YHKCUQ>

Two questions were asked to find out whether the individuals who had gone to the beach had bath outside the supervised (i.e. flagged) areas at patrolled locations, on the one hand, and whether they had gone to unpatrolled beaches, on the other hand. The first situation may mean people are entering the water near the supervised zone, possibly during the supervised hours, but also before or after the supervision hours, on a normally patrolled beach. The second situation refers to those who visited a beach that is never patrolled by lifesaving services. Both were closed (yes/no) questions.

2.3. Analysis

Our analysis is conducted in two stages.

Given the large number of potentially usable variables, we first apply a variable clustering approach to highlight the structuring factors of beach recreation. As an alternative to more common methods (such as Principal Component Analysis or Multiple Correspondence Analysis), we use the *ClustOfVar* method, developed by Chavent *et al.* (2012), which rearranges closely related variables into homogeneous clusters. At the same time as creating the clusters, this method defines their associated representative ‘synthetic variable’ (SV). The SV of each cluster is always a numerical indicator, regardless of the nature of the initial variables (numerical, categorical or a mixture of both), as it is a linear combination of the variables grouped within the associated cluster. In the case where all the initial variables are categorical, as it is the case in this study, the interpretation is based on the correlation ratio between the SV and the initial categorical variables (called *squared loading*). The interpretation is also based on the coordinates of the initial variable categories on the SV (see Kuentz-Simonet *et al.* (2013) and Kuentz-Simonet *et al.* (2015) for methodology). The SVs associated to the clusters are read as a gradient, using both the variables that make up the corresponding cluster and the coordinates of their categories on the SV. Reading the SV as a gradient is an important element in interpreting the modelling results (see Section 3.3). In our work, the *ClustOfVar* method was applied to a set of 41 variables (Table 3). These initial variables refer to recreational activities (9 variables), group composition (4 variables), frequency of visits (2 variables), liked natural recreational attributes (6 variables), liked recreational facilities (8 variables), disliked recreational attributes (7 variables), knowledge and information sought before going to the beach (5 variables).

In the second step, we use the results of this method to estimate, alongside other exogenous variables, two logistic regression models (Hosmer and Lemeshow 1990) that describe factors that influence risk behaviours (i.e. bathing outside supervision areas on a usually patrolled beach, and recreating unpatrolled beaches). This type of model is quite common in the literature on risky water based behaviours (Sherker, Williamson *et al.* 2010, Williamson, Hatfield *et al.* 2012). The models estimate the probability of an individual adopting (or not) each of the two risky behaviours. In addition to the above SVs, the predictors used to estimate the logistic regression models are gender, age, education level and distance to the nearest beach.

All methods are implemented using R Software (R Core Team 2019). The *ClustOfVar method* has a dedicated package (Chavent, Kuentz *et al.* 2017). Logistic regressions are performed with the GLM function of the STATS package.

3. Results

3.1. Population surveyed

Table 1 shows the demographic characteristics of our sample.

Insert Table 1

In the sample, more than half of the beachgoers are women (53.8%). Ages are fairly evenly distributed, although the most represented age group is 30-44 year-olds. More than 31.2% of the respondents have a level of education below the baccalaureate. Conversely, 12.9% have a master's degree or higher. More than half of the people in the sample (52.1%) declared they live 60 kilometres or less from the coast.

Insert Table 2

Among beachgoers, the most popular activities (Table 2) are swimming (82.5%) and walking (82.1%). In total, 19.2% of beachgoers surf or practice another type of board riding sport, and 14.2% are anglers. Most of them go to the beach less than once a week (65.4%) and just under half (49.6%) go to the beach both during and outside holiday periods. More than 8 out of 10 people (80.4%) go to the beach with their family, and 46.7% go with children. The landscapes (69.2%) and the open spaces (58.3%) are the most popular recreational natural quality attributes. Almost every second person (47.5%) likes waves, although 20% of beachgoers prefer it when there are no waves. Among the facilities and services, trash bins (82.5%) and parking lots (77.5%) are the most popular quality attributes, and three quarters of beachgoers (75.8%) appreciate the presence of a lifeguard unit. Crowds (69.9%) and litter (67.5%) are the most disliked elements. These results are quite consistent with the attractiveness factors stated above. Before going to the beach, people look at forecasts on the weather (71.2%), tides (40.4%) and waves (22.1%). One out of five beachgoers (20.8%) seeks information about lifeguard patrol hours. More than 8 out of 10 beachgoers (80.8%) have heard of rip currents.

Insert Table 3

Finally, 50.8% of beachgoers stated that they had enter the water at least once outside of a supervised zone, at a usually patrolled beach and 36.2% stated that in 2020 they had gone at least once to an unpatrolled beach (Table 3). Only 6.6% of the above-mentioned individuals reported having gone away from supervised areas because they were trying to isolate from others due to Covid-19 restrictions or to avoid infection. Almost 7 respondents out of 10 declared having enter the water outside supervision to stay away from the crowd. Conversely, among those who always bathed in safe areas, only 12.7% said they did so because they believed it was a legal obligation, and 2.5% said they felt they had no other choice. The majority of beachgoers who always enter the water in supervised bathing areas declared to do so because they feel safe there (64.4%).

3.2. Beach recreational variables clustering

The application of the *ClustOfVar* method highlights the way in which the 41 variables are successively associated. The dendrogram shows three main groups of variables (Figure 2), but for a finer analysis, we go down the tree to the 8-cluster partition.

Insert Figure 2

The presentation of the eight clusters and the corresponding SV follows the three branches of the tree. Additional information about the SVs are given in the Supplementary.

Insert Table 4

Cluster 6 groups together nine variables from the original set. Most of the variables relate to a positive outcome associated with the presence of facilities on the beach (Table 4) such as paths, lifeguards unit, car parks, shops, trash bins, cycle paths, picnic tables and toilets. The variable indicating that people walk on the beach is also included in this cluster, but with a low value of the squared loading (Table 4). The categories expressing positive appreciation of these facilities are positioned on the negative side of the SV (see Supplementary). It follows that the SV associated with cluster 6 refers to people who “dislike of infrastructure and services” (SV_DisInfra).

Cluster 1 groups together five variables, three of which concern information-seeking behaviour before going to the beach (Table 4). The information relates mainly to the quality of the waves and the tide, and to a lesser extent to the weather (Table 4). Cluster 1 also includes big wave’s attractiveness variables. The categories of the initial variables are distributed in such a way that seeking information about natural conditions (waves, weather, tide) have negative coordinates. We label this SV as “dislike and not seeking information about natural conditions” (SV_NoSurfReport) therefore.

Cluster 5 comprises variables referring to recreational uses (Table 3). Activities are surfing, practicing other active sports and angling. Other variables comprised in cluster 5 are frequent visits and recreating alone. Although its contribution is quite small, the knowledge of rip currents is included in cluster 5. The positive values of the associated SV correspond to specific behaviours, such as recreating alone on the beach, every day of the week or almost, being informed about rip currents, and practicing at least one of the three above-mentioned activities (i.e. surfing, active sports, angling). This SV is named “Surf and exercise on a regular basis” (SV_ActivWater).

Similar to cluster 6, cluster 7 groups together variables related to the recreational quality of the beach. In this particular case, quality attributes refer to the natural environment (Table 4). Thus, cluster 7 brings together preference for calmness, large open spaces, lack of waves and local landscapes. The categories representing the preferences for natural environment have positive values on the SV associated with cluster 7. Positive values of this SV will rather indicate interest in the natural environment. This SV is labelled “Like nature” (SV_LikeNature).

The cluster 2 comprises only three variables (Table 4). The first two are rips current aversion and wave aversion, followed by seeking information on lifeguard areas. The categories associated with aversion to waves and rip currents, and seeking information about lifeguard patrol hours have positive values on SV. We therefore name this SV “Aversion to natural hazards and seeking information about supervision” (SV_DisHazard).

Cluster 8 groups together recreational quality items that refer to the social dimension of beach recreation (Table 3). The first two variables are those related to aversion to crowds and aversion to shops. Thus, positive values of the SV correspond to aversion to crowds and to extensive commercial development. This SV is named “dislike crowd and shops” (SV_DisCrowd).

Cluster 4 groups together several activities including bathing, having rest, and being with friends. As bathing, having rest and being with friends have negative values on the SV associated with cluster 4, we label this SV “Not bathing with friends” (SV_NoBath).

Cluster 3 unites another set of recreational uses. However, compared cluster 4 and 5, activities are more ‘land-based’ than ‘water-based’ (Table 4). The latter include shell collecting, picnicking, nature observation, and recreating with family and children. Practicing such activities and spending time with family members, including children, have positive values on the associated SV. We therefore refer to this SV as “Staying on the beach with children” (SV_StayBeach).

3.3. Risky behaviour models

We conducted two logistic regressions for risky behaviours at the beach. The first logistic regression models the probability of a beachgoer to enter the water outside a supervised area, at a usually patrolled beach (model 1). The second logistic regression models the probability of a beachgoer visiting an unpatrolled beach (model 2). Results for both of the models are presented in Table 5.

Insert Table 5

In model 1, only one age group and two education levels have a significant influence on the probability of bathing outside the supervised area. Compared to people aged 15 to 29 (baseline), individuals aged 60 and over are less likely to bath outside the supervised area ($P < 0.05$). Compared to people with no qualifications or less than a bachelor’s degree, people with three and four years of higher education ($P < 0.01$) and five years or more of higher education ($P < 0.05$) were more likely to enter the water outside of supervised areas. Neither gender nor the geographical distance between residence and the coastline has a significant influence in the model. Among the synthetic variables (SVs), three have a significant influence. As the coefficient associated with SV_NoSurfReport is negative ($P < 0.05$), not seeking information about the conditions of the sea encourage bathing within rather than outside the supervised area. The negative coefficient of SV_DisHazard ($P < 0.05$) leads to similar conclusions, since individuals who do not like waves and are informed about lifeguard supervision bath outside of supervised areas less than the others. As the coefficient for SV_ActivWater is positive ($P < 0.01$), surfers, anglers and beachgoers who practice beach sports are more likely to go outside the lifeguard supervised areas at patrolled beaches than those who do not.

In model 2, neither gender nor geographical distance between residence and the coastline have a significant influence. Compared to the reference level, people aged between 30 and 44 are more likely than others to go to unpatrolled beaches ($P < 0.1$). Compared to people with no qualifications or less than a bachelor's degree, people with a bachelor's degree are more likely than others to go to unpatrolled beaches ($P < 0.05$). The coefficients associated with SV_ActivWater ($P < 0.05$) and SV_DisInfra ($P < 0.01$) are both positive. Positive coefficient of SV_DisInfra would therefore indicate that individuals who do not like facilities are more likely to go to unpatrolled beaches. The coefficient of the SV_StayBeach is also positive and significant ($P < 0.05$), meaning that people who engage in land based activities, with families and children, are more likely than others to visit unpatrolled beaches.

4. Discussion

The results of this survey show that a large proportion of beachgoers living in south-western France adopt risky behaviours despite the high drowning risks associated in this particular place. In contrast to what has been observed in other countries (Houser and Vlodarchyk 2021, Lawes, Strasiotto *et al.* 2021), the restrictions imposed by the management of the COVID-19 pandemic seem to have had little impact on French beachgoers behaviours. Slightly fewer than half the respondents (49.2%) stated that they always bath in supervised, patrolled areas. This figure is quite close to the results obtained in similar studies such as McCool *et al.* (2008) in New Zealand, or Mitchell *et al.* (2004) in Australia, where 45% and 52.7% of respondents respectively stated that they always or almost always enter the water in supervised areas. Only a small proportion of beachgoers stated that they bath between the flags because they believed it was mandatory. This result is promising, as Hamilton *et al.* (2016) showed that the feeling of being safe was a better incentive than regulatory pressure to adopt safer behaviours. Our results showed that behaviours that ultimately lead to bath outside of supervised areas at patrolled beach, on the one hand, and visiting unpatrolled beaches, on the other hand, are not all the same. It would therefore be important to make a clear distinction between these two risky behaviours in future studies. Following Gulliver and Begg (2004) or Uebelhoer, Koon *et al.* (2022), we believe that the drivers of unpatrolled beach preferences or visitation has not been studied enough to date. From beach safety management perspective, the issues are quite different also. Although Wilks *et al.* (2007) demonstrated that swimming in close proximity to the flags would not provide the same benefits than swimming between the flags, assistance of lifeguards nearby can always be expected. On unpatrolled beaches, the time needed for rescuers to arrive may be delayed and the people on hand must be able to provide first aid until the rescuers arrive.

In our analyses, few socio-demographic characteristics (gender, age, education, and geographical origin) have a significant influence on risk behaviours. In particular, neither gender nor geographical distance from the beach were significant in either model. If the results were to hold true in future surveys, it might suggest the need to rethink widespread communication and prevention policy design (Williamson, Hatfield *et al.* 2012, Ménard, Houser *et al.* 2018). The influence of age and education varies between models however. Older beachgoers are less likely than others to recreate away of supervised areas at usually patrolled beaches, while people aged between 30 and 44 are more likely to go to unpatrolled beaches. Compared to beachgoers with no qualifications or less than a bachelor's degree, people with a

bachelor's degree are more likely than others to go to unpatrolled beaches. Beachgoers with three years or more of higher education are more likely to bath outside of supervised areas at patrolled or usually patrolled beaches. The latter result shows that the level of education is not necessarily synonymous with knowledge on beach safety. We see this rather as an expression of social inequalities with regard to water-based outdoor recreation, since individuals with the most social capital are traditionally those who go to the beach more than others.

Identification of beach recreational quality as an indirect risk factor is a significant result of this work. The influence of such factors has already been suggested in the literature (Houser, Murphy *et al.* 2015, Stokes, Masselink *et al.* 2017, Ménard, Houser *et al.* 2018, Trimble and Houser 2018). To our knowledge, this is the first time that beach recreational quality attributes have been used to predict risk behaviours in regression modelling. We confirm that preferences for natural settings are important predictors, as suggested by Caldwell, Houser *et al.* (2013) or Uebelhoer, Koon *et al.* (2022). The negative influence of beach access attributes on risky behaviour (included in SV_DisInfra) must be seen in the light of the special configuration of our study site. In south-west France, most beaches with access are supervised. Consequently, unpatrolled beaches are generally located far from access points, requiring a fairly long walk. Results would undoubtedly be different in countries where beaches with facilities are not supervised and where easy access increases the number of visitors (Houser, Murphy *et al.* 2015, Uebelhoer, Koon *et al.* 2022). We also confirm that aversion for crowd lead beachgoers to choose unsafe locations (Uebelhoer, Koon *et al.* 2022). Other recreational quality attributes could be introduced in future studies as well. In any case, it is by considering the beachgoer's perspective, which is obviously very different from that of a beach safety professional, that we will best be able to understand and anticipate risky behaviours (Haegeli and Pröbstl-Heider 2016, Hamilton, White *et al.* 2016, Gstaettner, Rodger *et al.* 2017).

We also show that the role of activities is fairly ambivalent. The current debate is often limited to distinguishing between activities intended for individuals attracted to 'intensely thrilling' sensations, and more cautious ones. In our case, collecting shells or having a picnic encourages people to go to unsafe places more often. Though it is not evident that these people intend to go in the water, we have shown that such behaviours are more frequent among families with children who are highly vulnerable individuals. Moreover, in a survey conducted by Gulliver and Beggs (2004), 5% of respondents declared near drowning experiences occurred while walking next or in the water. It is therefore important to adopt a broad definition of beach related activities. In comparison, behaviours indicated by surfers and anglers are less surprising, as the risky nature of these activities has already been highlighted in the literature (Morgan, Ozanne-Smith *et al.* 2008, Kennedy, Sherker *et al.* 2013, Andkjaer and Arvidsen 2015, Castelle, Brander *et al.* 2018). Furthermore, we have identified an additional risk factor for those recreational users, as they go to the beach alone, and do so very often. Here too the conclusions must be balanced because our variable clustering showed that knowledge of rip currents is group together with surfing and angling activities. This is in line with recent studies who have stressed surfers' high level of environmental knowledge (Reineman 2016).

Our work confirms the crucial role of information seeking in order to prevent risks in outdoor recreation (Alberini, Leiter *et al.* 2009, Kaminski, Bell *et al.* 2017). In our models, two types

of information seeking behaviours can be identified. Individuals who like waves and collect marine and weather information (negative sign of SV_NoSurfReport) before going to the beach are more likely than others to bath outside of patrolled areas. Similar behaviour has already been observed in other studies (Sherker, Williamson *et al.* 2010, Trimble and Houser 2018). Once they have read the weather reports, beachgoers feel they have more control over the risk and go swimming in more dangerous places. However, there is no guarantee that they have adequate information and knowledge of the hazards. In comparison, those who do not like waves (positive coefficient of SV_DisHazard) do not necessarily seek to improve their knowledge base on the subject, but instead look for more detailed information on supervision/lifesaving patrols. Either way, greater seeking information should be encouraged.

We do not however underestimate the limitations of our work. First, as in Gulliver and Begg (2004), White *et al.* (2010) or Hamilton *et al.* (2016), our analysis is retrospective, and covers a full year of beach use. It is quite possible that risky behaviours varied throughout the year and also vary geographically according to the conditions normally experienced. For example, some people who stated that they had bathed outside the supervised areas probably did not do so all the time and may have returned to the supervised areas when they considered swimming too dangerous. Our work nevertheless contributes to a deeper understanding of risk exposure factors. Taking account of recreational activities and recreational preferences yields new insights on beachgoer exposure therefore. To date, there is still a significant lack of research in this area (Morgan, Ozanne-Smith *et al.* 2009b, Lawes, Uebelhoer *et al.* 2021, Koon, Peden *et al.* 2023). Clustering variables has been very valuable in uncovering relationships between recreational uses and preferences. Clustering was also highly relevant given the large number of variables. We defined very generic profiles, which it would be interesting to compare with in situ surveys (Uebelhoer, Koon *et al.* 2022). Our study is the first of its kind in France, and one of the few studies carried out in Europe (Sotés, Basterretxea-Iribar *et al.* 2018, Sotés, Basterretxea-Iribar *et al.* 2020). Despite the similarities observed with the findings of research conducted in other countries, the weight of cultural and institutional factors should not be underestimated. In France, beach safety is perceived as a public service provided by the state, rather than a matter of individual responsibility. This is not the case in all countries. Moreover, France has its own regulations on what uses are allowed or not at the beach, including in supervised areas. This certainly influences the role of recreational use in risky behaviours. Finally, our survey only covers residents. Several studies have shown that tourists are likely to adopt different behaviours (Ballantyne, Carr *et al.* 2005, Williamson, Hatfield *et al.* 2012).

Although we have not taken a ‘standard’ risk perception approach in this research, we definitely consider it to be of great importance and quite complementary to ours. In fact, other studies have already shown how the voluntary or involuntary nature of an activity, or the positive outcomes associated with it, can have an impact on risk perception (Barnett and Breakwell 2001, Ebert and Durbach 2022). Generally, the risks associated with voluntary and enjoyable activities such as recreating at the beach are minimized. Given the range of benefits now attributed to recreating in open water (Beute, Davies *et al.* 2020, Britton, Kindermann *et al.* 2020, Wood, Vimercati *et al.* 2022), this point should not be neglected in the future. From a management point of view, our work also confirms the need to build a comprehensive beach

safety perspective that includes lifeguards', recreational facilities designers' as well as beachgoers' representations and practices.

Acknowledgment

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Figure 1 Panel (a) presents the location of south western coastline in France (source: K. Petit - INRAE), panel (b) displays examples of sandy beaches (source: V. Marieu – CNRS), panel (c) displays examples of rocky beaches (source: J. Dehez - INRAE) and panel (d) presents an example of supervised swimming area with safety flags in La Lette Blanche beach (source: J. Dehez - INRAE).

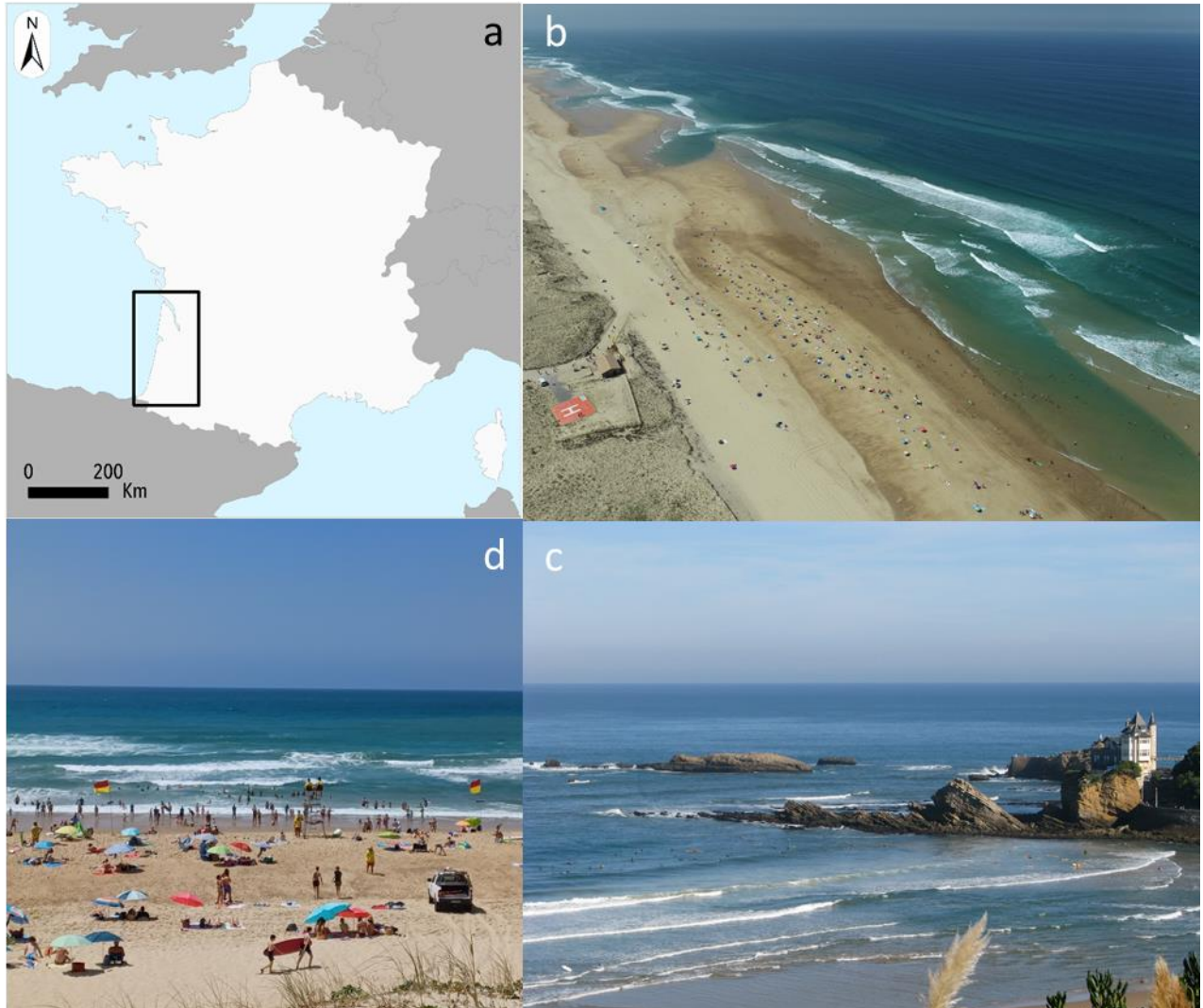


Table 1: Descriptive statistics on beachgoers sociodemographic and individual characteristics

Variable	Category	Freq
Sociodemographics		
Gender	Female	53.8%
	Male	46.2%
Age (years)	15-29	25.0%
	30-44	30.0%
	45-59	24.6%
	60+	20.4%
Education	Under Baccalaureate	31.2%
	Baccalaureate	22.1%
	Baccalaureate +1/+2	20.0%
	Baccalaureate+3/+4	13.8%
	Master's degree and above	12.9%
Distance to the nearest beach (km)	[0-15]	25.4%
	[15-60]	26.7%
	[60-100]	27.1%
	[100 +[20.8%

Table 2: Descriptive statistics on beachgoers visitation patterns and recreational preferences

Variable	Category	Freq
Visitation patterns and activities		
Activity ^a	Swimming	82.5%
	Walking	82.1%
	Having some rest	79.6%
	Picnicking	50.4%
	Collecting shells	29.6%
	Practicing sport	26.7%
	Observing nature	25.8%
	Surfing or board sports	19.2%
	Angling	14.2%
Group composition ^a	With family	80.4%
	With friends	47.1%
	With children	46.7%
	Single	17.9%
Frequency of visits ^b	Almost every day	13.4%
	Every week	19.9%
	Less than once a week	65.4%
	No longer knows	1.3%
Days and times of the year ^b	Weekends and holidays only	40.4%
	On weekdays or outside holidays only	10.0%
	All the time	49.6%
Beach recreational quality		
Valued attributes (natural environment) ^a	Landscapes	69.2%
	Open spaces	58.3%
	Calmness	53.3%
	Big waves	47.5%
	Other	24.6%
	Absence of waves	20.0%
Valued attributes (facilities) ^a	Trash bins	82.5%
	Car parks	77.5%

	Lifeguard units	75.8%
	Sanitary facilities	73.8%
	Hiking paths	68.3%
	Cycle tracks	60.4%
	Shops	58.8%
	Picnic tables	48.8%
Disliked attributes ^a	Crowd	69.6%
	Rubbish	67.5%
	Bad weather	42.1%
	Rip currents	27.9%
	Big waves	17.5%
	Lack of waves	10.8%
	Shops	10.4%
Knowledge		
Information sought after ^a	Weather	71.2%
	Tide	40.4%
	Wave quality	22.1%
	Supervision hours	20.8%
Has heard about rip currents (% yes)		80.8%

^a several answers possible

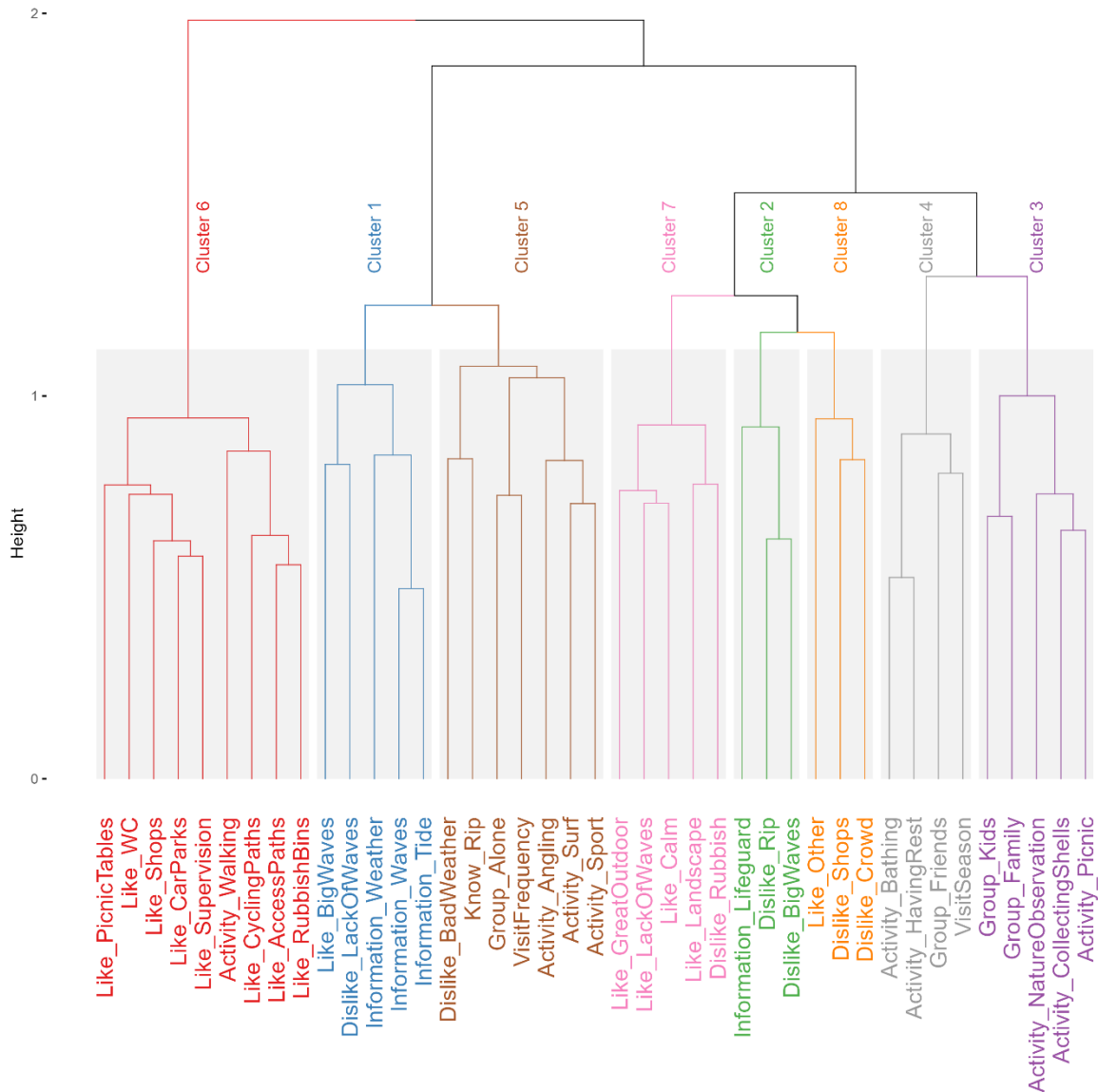
^b only one answer possible

Table 3: Descriptive statistics on risky behaviours

Risky behaviours (N=240)	
Bathes outside of supervised areas, at patrolled beaches (% yes)	50.8%
Goes to unpatrolled wild beaches (% yes)	36.2%
Reasons for bathing in supervised areas only ^a (N=118)	
Feel safe	64.4%
For kids	32.2%
It is mandatory	12.7%
No other choices	2.5%
Reasons for bathing outside supervised areas ^a (N=122)	
Aversion for crowd	68.0%
Favourite beach	19.7%
Proximity	9.8%
Nice waves	9.0%
Fear of Covid-19	6.6%

^a several answers possible

Figure 2: Dendrogram of the *ClustOfVar* analysis of the 41 recreational uses and preferences variables



*Note: the dendrogram shows the successive aggregations between the variables and the way in which they are linked together. Cluster numbers are assigned arbitrarily by the *ClustOfVar* package algorithm and do not reflect any order or ranking.*

Table 4: Clusters' composition and associated Synthetic Variables

<i>Cluster, label and name of the associated Synthetic Variable</i>	<i>Variables</i>	<i>Squared loadings</i>
Cluster 1 – Dislike big waves and not seeking information about natural conditions (SV_NoSurfReport)	Information sought before going to the beach - Waves (Information_Waves)	0.63
	Information sought before going to the beach - Tide (Information_Tide)	0.57
	Information sought before going to the beach - Weather (Information_Weather)	0.26
	Appreciated attributes - Big waves (Like_BigWaves)	0.22
	Disliked attributes - Lack of waves (Dislike_LackOfWaves)	0.13
Cluster 2 – Aversion to natural hazards and seeking information about supervision (SV_DisHazard)	Disliked attributes - Rip (Dislike_Rip)	0.70
	Disliked attributes - Big waves (Dislike_BigWaves)	0.52
	Information sought before going to the beach - Lifeguard patrol hours (Information_Lifeguard)	0.23
Cluster 3 – Staying on the beach with children (SV_StayBeach)	Activity - Collecting shells (Activity_CollectingShells)	0.54
	Activity - Picnic (Activity_Picnic)	0.37
	Group - Children (Group_Kids)	0.36
	Activity - Nature observation (Activity_NatureObservation)	0.36
	Group - Family (Group_Family)	0.29
Cluster 4 – Not bathing with friends (SV_NoBath)	Activity - Bathing (Activity_Bathing)	0.60
	Activity - Having rest, relaxing (Activity_HavingRest)	0.58
	Group - With friends (Group_Friends)	0.36
	Time of the year (VisitSeason)	0.24
Cluster 5 – Surf and Exercise on a regular basis (SV_ActivWater)	Activity - Practicing surf, board sports (Activity_Surf)	0.46
	Activity - Practicing sport (Activity_Sport)	0.33
	Frequency of beach visits (VisitFrequency)	0.30
	Activity - Angling (Activity_Angling)	0.23
	Group - Alone (Group_Alone)	0.21
	Know what a "baïne" is (Know_Rip)	0.17
	Disliked attributes - Bad weather, cold, wind (Dislike_BadWeather)	0.05
Cluster 6 – Dislike Infrastructure and services (SV_DisInfra)	Appreciated attributes - Access paths (Like_AccessPaths)	0.52
	Appreciated attributes - Supervision (Like_Supervision)	0.49
	Appreciated attributes - Car parks (Like_CarParks)	0.45
	Appreciated attributes - Shops and services (Like_Shops)	0.40

	Appreciated attributes - Rubbish bins (Like_RubbishBin)	0.40
	Appreciated attributes - Cycling paths (Like_CyclingPaths)	0.39
	Appreciated attributes - Picnic tables (Like_PicnicTables)	0.29
	Appreciated attributes - Showers and sanitary facilities (Like_WC)	0.26
	Activity - Going for a walk (Activity_Walking)	0.10
Cluster 7 – Like nature (SV_LikeNature)	Appreciated attributes - Calmness (Like_Calm)	0.43
	Appreciated attributes - Great outdoors (Like_GreatOutdoor)	0.41
	Appreciated attributes - Lack of waves (Like_LackOfWaves)	0.38
	Appreciated attributes - Landscape (Like_Landscape)	0.37
	Disliked attributes - Rubbish (Dislike_Rubbish)	0.25
Cluster 8 –Dislike crowd and shops (SV_DisCrowd)	Disliked attributes - The crowd (Dislike_Crowd)	0.52
	Disliked attributes - Shops and restaurants (Dislike_Shops)	0.44
	Appreciated attributes - Other (Like_Other)	0.26

Table 5: Significant predictors for swimming outside lifeguard supervision (model 1) and recreating at unpatrolled beaches (model 2)

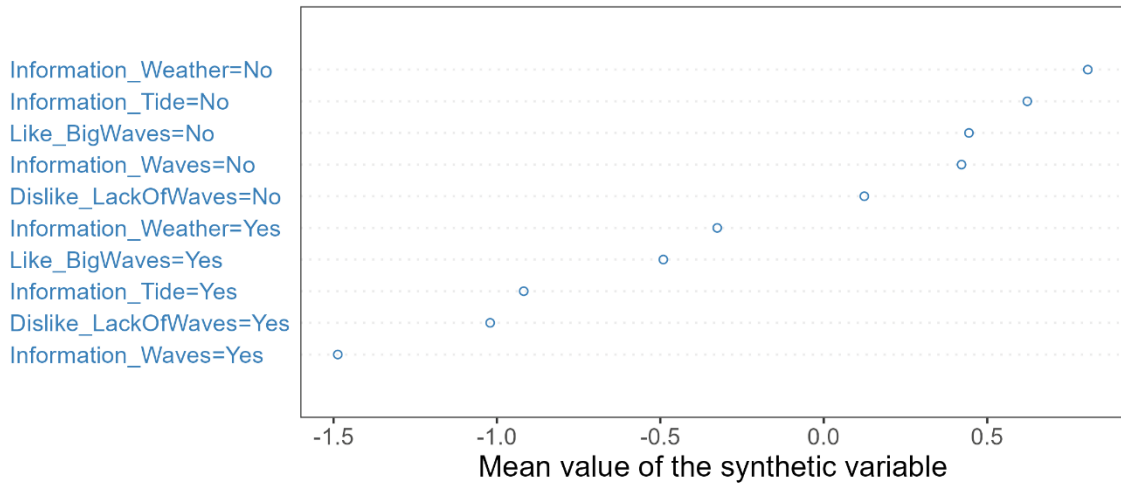
	Model 1 – Bathing outside supervision			Model 2 – Visiting unpatrolled beaches		
	coefficient	Standard Error	P value	coefficient	Standard Error	P value
(Intercept)	-0.053	0.525	-0.918	-1.378	0.551	0.012**
Gender						
Female ^a						
Male	0.174	0.323	0.590	0.339	0.320	0.288
Age						
[15-29 years] ^a						
[30-44 years]	-0.411	0.441	0.351	0.814	0.462	0.078*
[45-59 years]	-0.183	0.455	0.687	0.614	0.468	0.190
[60 years and over]	-1.067	0.511	0.036**	0.585	0.520	0.260
Education						
Less than baccalaureate ^a						
Baccalaureate	0.192	0.417	0.645	0.927	0.435	0.033**
Bac+1/+2	0.357	0.445	0.422	0.089	0.468	0.847
Bac+3/+4	1.886	0.559	0.000***	0.024	0.512	0.961
5 years or more of higher education	1.184	0.517	0.022**	-0.013	0.511	0.979
Distance to the beach (km)						
Less than 15km ^a						
[15,60 km]	-0.463	0.458	0.311	0.395	0.437	0.366
[60,100 km]	0.043	0.441	0.921	-0.615	0.445	0.167
100 km and above	0.099	0.469	0.831	-0.686	0.477	0.150
Synthetic Variable						
SV_NoSurfReport	-0.258	0.126	0.041**	0.110	0.126	0.380
SV_DisHazard	-0.265	0.137	0.053*	-0.196	0.140	0.162
SV_StayBeach	0.092	0.125	0.461	0.308	0.126	0.014**
SV_NoBath	-0.211	0.131	0.107	-0.079	0.136	0.558
SV_ActivWater	0.394	0.139	0.004***	0.343	0.136	0.012**
SV_DisInfra	0.144	0.092	0.117	0.307	0.095	0.001***
SV_LikeNature	-0.105	0.122	0.387	0.175	0.120	0.145
SV_DisCrowd	-0.036	0.142	0.795	0.094	0.145	0.515

^a reference or comparison category

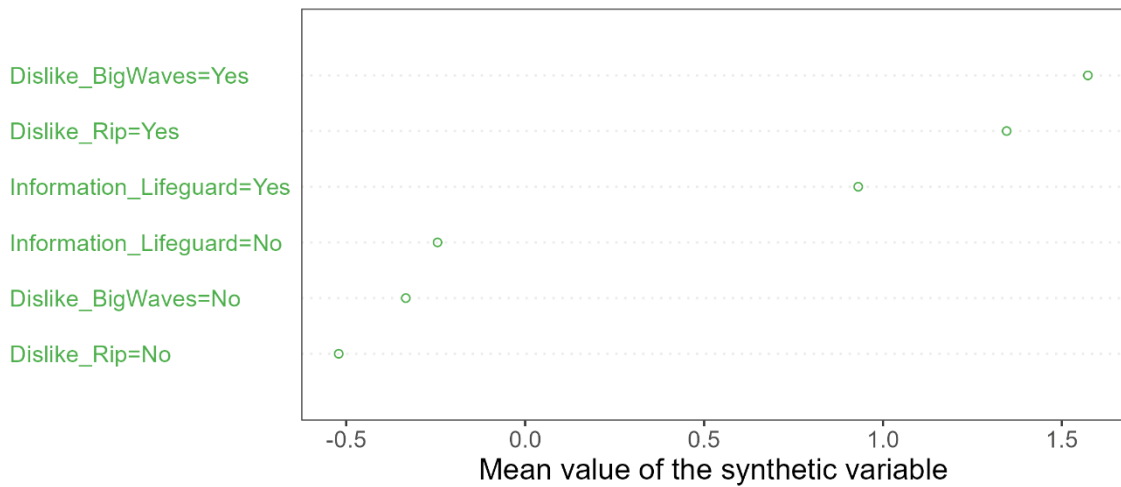
*** 1% significance level, ** 5% significance level, *10% significant level

Supplementary: Coordinates of the levels of the categorical variables on the Synthetic Variables (SVs)

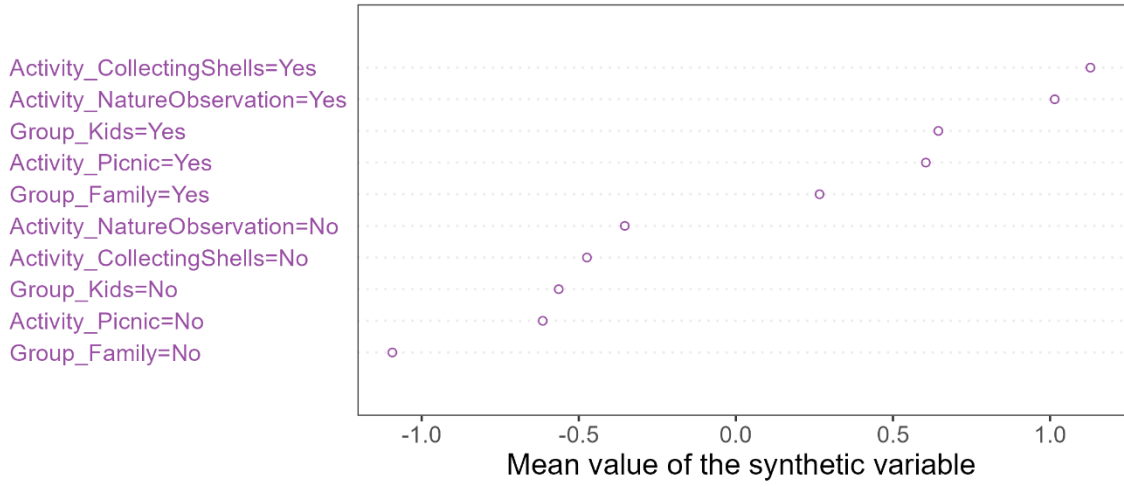
Cluster 1



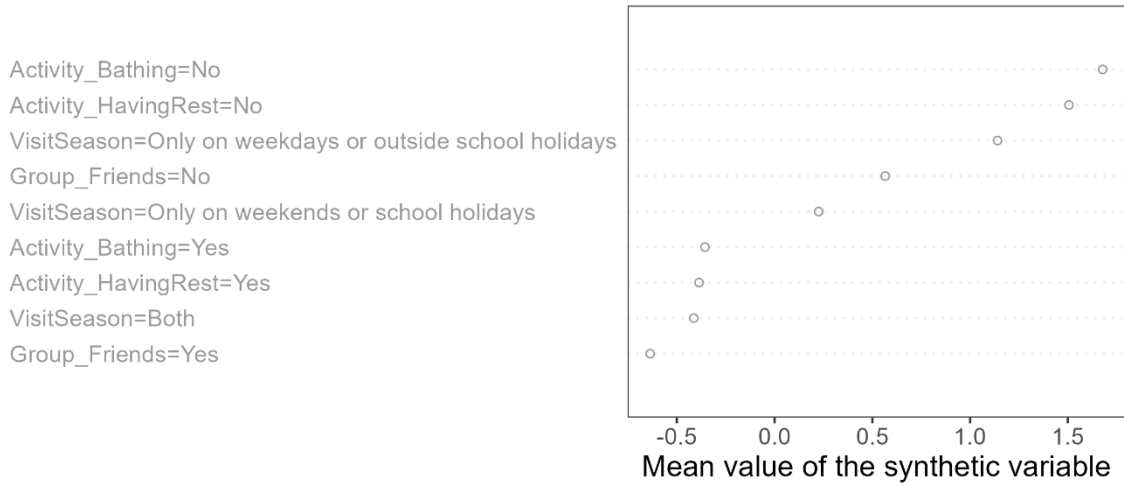
Cluster 2



Cluster 3

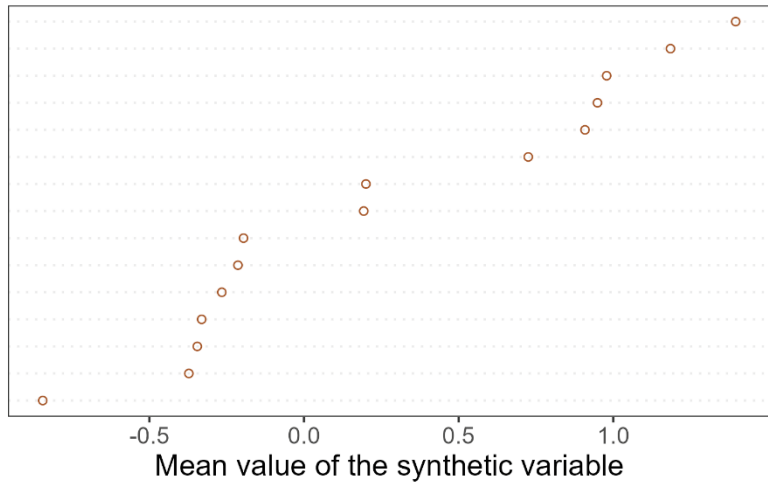


Cluster 4



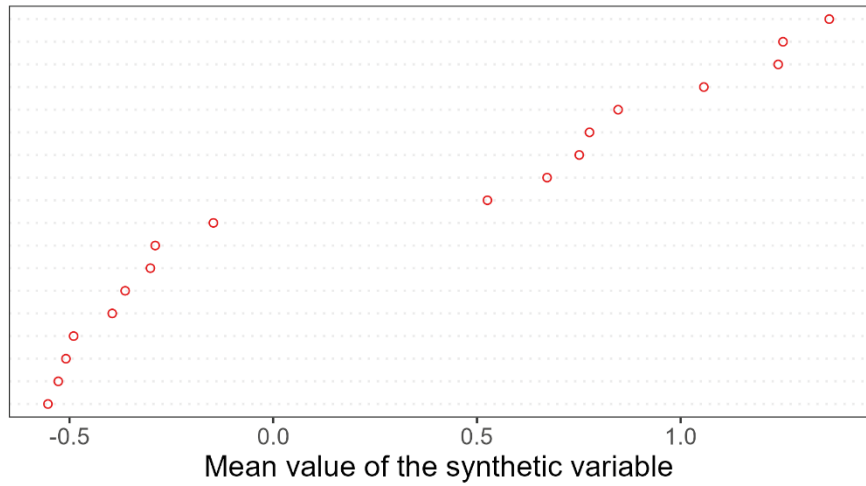
Cluster 5

Activity_Surf=Yes
 Activity_Angling=Yes
 Group_Alone=Yes
 Activity_Sport=Yes
 VisitFrequency=Almost everyday
 VisitFrequency=Every week
 Know_Rip=Yes
 Dislike_BadWeather=No
 Activity_Angling=No
 Group_Alone=No
 Dislike_BadWeather=Yes
 Activity_Surf=No
 Activity_Sport=No
 VisitFrequency=Less often
 Know_Rip=No

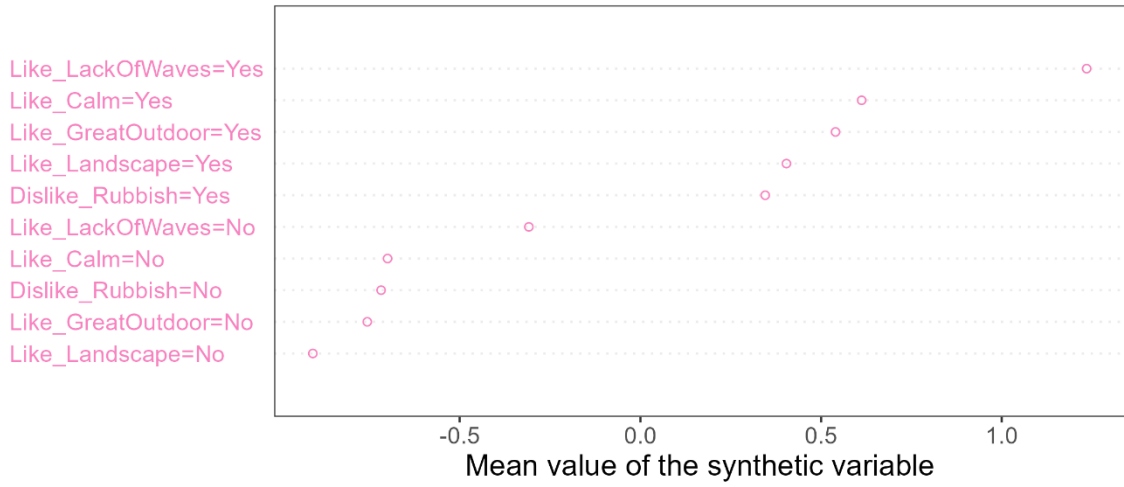


Cluster 6

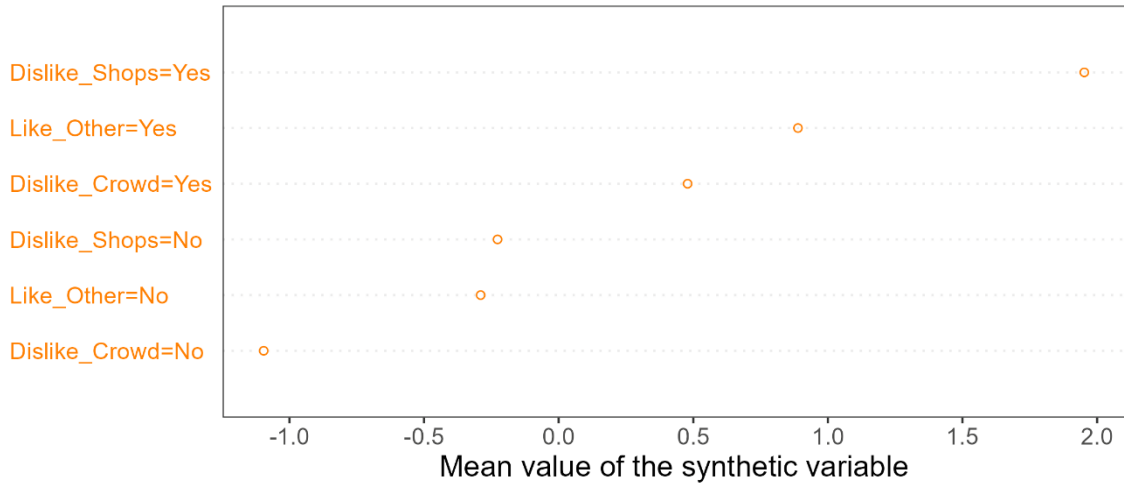
Like_RubbishBins=No
 Like_CarParks=No
 Like_Supervision=No
 Like_AccessPaths=No
 Like_WC=No
 Like_CyclingPaths=No
 Like_Shops=No
 Activity_Walking=No
 Like_PicnicTables=No
 Activity_Walking=Yes
 Like_RubbishBins=Yes
 Like_WC=Yes
 Like_CarParks=Yes
 Like_Supervision=Yes
 Like_AccessPaths=Yes
 Like_CyclingPaths=Yes
 Like_Shops=Yes
 Like_PicnicTables=Yes



Cluster 7



Cluster 8



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