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Improving relocation acceptability by improving information and governance quality/results from a survey conducted in France

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Abstract

This article focuses on the acceptability of relocation of the goods the most exposed due to sea level rise, and this increasingly recommended strategy to reduce coastal vulnerability. However, the implementation of these measures raises significant individual and political resistance. The themes of this research relate specifically to the role of communication and to trust in the institutions responsible for implementing this measure. Communication has to be designed in a way to decrease distortions in individuals' risk perception and to help improving quality of the governance of the adaptation to coastal flooding due to sea level rise. We conducted a questionnaire among 782 French coastal residents to deal with these two main dimensions of the acceptability of relocation. Firstly, we question the conditions for a favourable communication strategy by estimating the differentiated impact of communication using fear or conversely humour. Secondly, we study trust in institutions in charge of the implementation of relocation policies with several criteria of governance quality. Our results underline that humour-based communication has the comparative advantage of inducing a stronger emotional response in terms of stimulating interest and thought. Furthermore, the survey highlighted the influence of governance quality. These results confirm the decisive role of governance mechanisms for the acceptability of relocation. They also suggest a need for ongoing support to awareness-raising measures taking into account, among other psychological factors, the need for people to feel that they have some control over implemented measures.

Highlights

- This is the first national survey in France on the acceptability of relocation policies.
- This article evaluates climate change adaptation acceptability depending on whether communication is based on humour or fear.
- The acceptability of relocation measures is evaluated before and after the questions relating to governance quality in order to measure its impact.
- The results show that communication and awareness-raising are decisive for relocation in anticipation of sea level rise.
- Taking psychological factors into account tends to increase the acceptability of relocation measures.

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1 Introduction

Sea level rise related to climate change is a strategic challenge for coastal areas where a large and growing proportion of the permanent and tourist population concentrates, concomitant with urban activities and development. Hence, in mainland France, some 7.8 million people (around 10% of the French population) have their main residence in a coastal area with a demographic density (272 inhabitants per km^2) two and a half times higher than the national average (Colas et al. 2015). Given the magnitude of the consequences of sea level rise (human loss and material damage), adaptation policies advocate a reduction in these areas' vulnerability notably by relocation as it decreases the extent of goods exposure. Indeed, the originality of relocation policies is to reduce the exposure to risk while certain measures such as dikes aim to reduce its consequences and impact. That is why relocation policies are very different in their logic and more effective for adaptation over time. In addition, the restoration of beaches and the natural environment in these areas would create natural protective infrastructure and promote their resilience. Furthermore, this kind of adaptation tends to stabilize the housing market and insurance systems. However, relocation measures meet with significant opposition from residents who are attached to their location (Bonaiuto et al. 2016) and to the amenities derived from the proximity of the sea. In addition to the political risk, due to the opposition of residents (Gibb 2015; Rocle et al. 2016), elected representatives are also reluctant to implement relocations not only because of the size of the necessary budget but also, and mainly, due to the economic and demographic impact of the territorial reorganizations that are required (King et al. 2014; Taylor et al. 2014). In fact, relocation may involve population transfers between municipalities and therefore losses of tax revenue for the municipalities of origin, of activities related to demography and, more generally, of attractiveness. In the event that these flows are important, they can impact the whole action strategy of the municipality and imply to set up mechanism of compensation and solidarity between them. A non-intervention attitude is tempting, even though it has significant perverse effects in the medium term on residents' real estate assets (loss of property value) and on the attractiveness of the areas (tourist wasteland). More generally, these relocation policies mark a distinct change in representations and lines of action relative to the adaptation to climate change. It is a question of changing representation, that is, of moving from a logic in which people find technical solutions because they think they can control nature to a humbler logic implying they must adapt to nature, which requires more complex developments in values and social representations. These can depend on numerous factors and are partially constrained by the controversies concerning climate change.

The acceptability of public policy, here coastal risk adaptation, can be improved by studying the determinants of behaviour in a way to predict individuals' choices in terms of political support and resistance at the time of implementation of the relocation policy. Our aim is to use the theory of planned behaviour (TPB, Ajzen 1985) in a way to incorporate the extent to which the feeling of having some control over adaptation policies could influence their acceptability. In line with this theory, we hypothesize that individuals' perception of the degree of control over the policy implemented is a determining variable in the acceptability of this policy. The TPB gives a central role to intentions in the explanation of behaviour. These intentions should be in line with the individuals' attitudes, (sensitive to values, representation, and cultural and historical backgrounds) that together with social interactions (the so-called subjective norms of Ajzen) and the information disclosed about the choice being studied,

should enable the subjects' behaviour to be explained. According to Ajzen and Fishbein (1977), in the case of specific decisions, the perception of control is important to justify the choice and behaviours of individuals. The degree of perceived control intervenes between the intention of the individual and their final decision. In short, if the degree of control is perceived as weak, the final decision may be different from that expected on the basis of the individual's attitudes. In our case, this degree of control was measured in the survey by the perception of the quality of governance of these policies, apprehended on the basis of several criteria: the information provided, the perceived effectiveness of implemented measures, the perceived level of competence of public officials and the risks of diversion linked to lobbying by some types of population, particularly those located in front of sea. Effectively, the impact of governance on acceptability is often mentioned in the literature (Myatt et al. 2003; Ledoux et al. 2005; Kahan et al. 2012; Lo 2013; King et al. 2014; Gibbs 2015; Hino et al. 2017; Treuer et al. 2018). In 2015, De Leeuw et al. studied the pro-environmental behaviour of students as part of the TPB focusing on the degree of control perceived by individuals. They showed that it is of particular significance and strengthens motivations and intentions to adopt pro-environmental behaviour. In our case, the specific decision comes from the fact that the flooding risk is a specific risk, at two levels: first in terms of interest expressed by individuals and second, more operationally, in terms of its scale, recurrence and ineluctability. This duality results in potential alterations in risk perception (i.e. optimism bias, denial) and the perceived degree of individuals' risk exposure. These specificities give particular significance to two questions in our study: communication on risk and perceived governance quality.

Effectively, another important dimension of acceptability, evoked in the literature, deals with raising awareness of populations exposed to the risk; thanks to information efforts. Thus, given the many recommendations on the importance of raising citizens' awareness to improve acceptability, we also want to test the impact of the form of communication messages, depending on whether they are based on positive (humour) or negative (fear) emotions. Damasio (1994) showed that positive and negative emotions affect the decision-making process and the selection of alternatives and that they can therefore be exploited to guide behaviour. One of the objectives, among others, of the psychological approach to communication, is to elucidate the characteristics that increase the effectiveness of a preventive information campaign. Resorting to negative emotions can be a problem (Witte and Allen 2000; Ruiter et al. 2001) as it generates various resistance strategies by those who feel threatened by the message. Conversely, using positive emotions in communication (particularly humour) is recommended as it promotes the adhesion to the message, its memorization and transmission (Alden et al. 1993; Spotts et al. 1997; Campo et al. 2013). More generally, in 2017, Börger and Hattam focused on the role of knowledge and information on the choices of action assuming that information would increase the feeling of control. The low impact of information they observed was attributed to the weak motivation of individuals to undertake the proposed actions. Many other examples of studies on knowledge give the same result, however counterintuitive it may be (Wallace 2002).

Various studies have been undertaken on flooding perceptions and the resulting planning measures that support our research hypotheses as they underline perception differences. These differences can depend on the type of user (main- or second-home owners, day-trippers, tourists...) as well as on sociodemographic factors such as age and educational level (King et al. 2014; Rocle et al. 2016). Hence, the influence of the risk-exposure level can be noted with an optimism bias shown by those who are directly concerned; see Bracha and Brown (2012). Attachment and previous experience of flooding are also important (Rulleau and Rey-

Valette 2017) as is the attractiveness of the relocation areas (distance, job opportunities) (King et al. 2014). Furthermore, research in psychology and behavioural economics has shown the role of emotion on risk perception and on adaptation behaviour (Lerner and Keltner 2000; Leiserowitch 2006). At a sociopolitical level, governance is important, in particular dimensions the trust placed in the institution designated to carry out the project, the management and the integration into the area's planning mechanisms and the level of information and dialogue (Myatt et al. 2003; Hurlimann et al. 2014). This work shows the importance of information provision to improve risk perceptions and support behaviours in line with an increased acceptability of adaptation. Such information may be magnified by the media (Kasperson 2003) in that it may be sensitive to the choice of images and examples that may emphasize the dramatic dimension, or the dangerousness, or the perceived proximity of the phenomena. The frequency by which information is displayed may also increase the perceived exposition to risk.

The rest of the paper is organized as follows: we present the methodological protocol in Section 2 and the results in Section 3 that we discussed in Section 4.

2 Presentation of the methodological protocol

2.1 Area of study

Our survey was undertaken in line with a panel of residents representing all coastal towns and villages ("communes") in mainland France. The notion of "coastal commune" is defined in the 1986 Coastlines Act. In addition to towns and villages close to the sea, this Act includes those located near estuaries and deltas and a few nearby towns and villages which participate in the economic and ecological coastal equilibrium. Questionnaires completed offered a relatively even distribution between the different seaboards: 40% Mediterranean, 17% English Channel and 43% Brittany and Atlantic.

2.2 Survey design

Our survey was built in a way to measure the impact of (1) the kind of communication depending on whether it was humour-based or fear-based, assuming humour-based communication may have a greater and positive impact (hypothesis 1), and (2) residents' perceptions concerning the quality of governance, assuming that a low level of perceived quality of governance would decrease acceptability of relocation policies (hypothesis 2). Perceptions concerning the quality of governance is, in our work, a proxy of the perceived degree of control of Ajzen's TPB (1977). Our first hypothesis on the impact of communication according to the types of positive emotion (humour) or negative (fear) involves testing two forms of messages on the basis of a sentence of recommendations accompanied by images to arouse emotions either of fear or humour (Fig. 1). Concerning fear, we had available images of storms affecting houses by the sea. Conversely, it was more difficult to find humorous images on this type of subject. After consulting the available databanks offering standardized images for psychology surveys, we proposed a caricature drawing that could be considered humorous.

The humorous nature of the second picture was checked beforehand in a face-to-face survey of 50 men and 50 women in Montpellier. (Subjects were randomly selected from

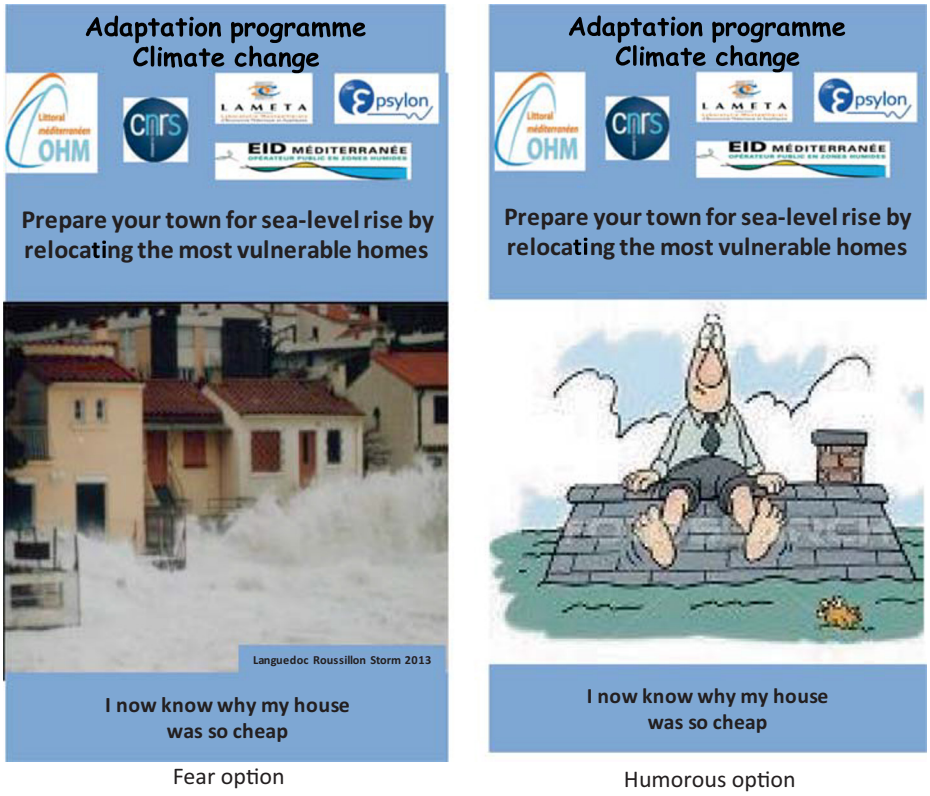

Fig. 1 Presentation of the communication module flyers

the streets in different neighbourhoods with the aim of varying their age.) As recommended by Spotts et al. (1997), our humour was based on incongruity. As part of this test, we asked people what emotions they felt after seeing one of the two pictures. The results confirmed contrasting emotions depending on the types of images and its humorous nature, with 68% of people finding it to be so (65% of men and 71% of women). Subsequently, our questionnaire was tested in an exploratory survey of 198 people located in the near towns of Montpellier (Grau du Roi, Grande Motte, Carnon and Palavas les Flots). The results confirmed contrasting emotions depending on the types of images with a high proportion of subjects (70%) reporting they felt emotions favouring reasoning and awareness after viewing the humoristic image. This preliminary survey enabled in particular several open questions to be posed that were subsequently standardized in a closed format.

To assess the impact of communication, the survey used an experimental repeated measures design (Grondin et al. 2003; Myers and Hansen 2012). We asked three key questions on relocation acceptability before and after the presentation of a visual based on humour or fear and several questions relating to management institutions and relocation perceptions.

Finally, in order to obtain objective data on the exposure to flooding risk of respondents' towns and villages, we undertook a search on the "Prim Net commune" site,[1] which lists all the

natural disasters that have occurred in France. For each location, two variables were developed relating to (1) the total number of floods and (2) the date of the last flood. Comparing the date of the last flooding with the number of years lived in the town or village enabled the creation of a new flooding memory variable, given that the risk memory is generally a determining factor in the willingness to adapt (Lupton 1999).

2.3 Questionnaire

Our questionnaire was tested beforehand in an exploratory survey of 198 people located in four coastal towns near Montpellier (Grau du roi, Grande Motte, Carnon and Palavas les Flots). This preliminary survey enabled in particular several open questions to be posed that were subsequently standardized in a closed format. The questionnaire organized into eight modules (see Appendix 1) took 15 to 20 min to complete. Most questions involved choices on a decimal scale where Likert-type qualitative items were added in order to maximize comprehension.

At the beginning of the communication module which aimed to test the influence of the type of communication, an image involving either humour or fear (Fig. 1) was presented to the respondents, randomly and in balanced proportions (395 respondents for the humorous image and 387 for the one evoking fear). The impact of the means of communication and of governance quality was investigated through three questions on relocation acceptability which were asked identically before (module 3) and after the presentation of the visuals (module 6). Given the importance in the ordering of our questionnaire, Table 1 set out the content of the different modules. A summary of the questionnaire is available in Appendix 1.

2.4 Method of issuing the questionnaire

Our sample was constituted by SSI (Survey Sampling International), a private independent firm. All information about SSI procedures and pool of respondents may be found at the following URL address: www.surveysampling.com. Note that at the beginning of 2019, SSI has been the object of a merger and the new name is Dynata (www.dynata.com). We provided SSI with specific quotas: localization of respondent was the most important one but we also put quotas on gender and age. Our online questionnaire has been sent on the French platform and members of the French pool (between 300,000 and 400,000 taxpayers in 2015) could connect and fill the survey if they were pre-selected by SSI's algorithm calibrated to implement our quotas. The online sample was made of an initial pool of 1177 answers. Nevertheless, those questionnaires that were completed too quickly and/or were incomplete were removed, reducing the number of respondents from 1177 to 782.

2.5 Selection of variables and statistical analysis

Going beyond the descriptive questions aiming to convey perceptions concerning the different modules, we selected variables relating to the structuring factors that could explain the differences in acceptability; these are displayed in Table 2[2]. This selection was made based on the statistical

[0] Site of the Ecology, Sustainable Development and Energy Ministry; http://www.georisques.gouv.fr/un-Descriptif-des-risques-la-commune

Table 1 Presentation of the questionnaire structure (cf. questionnaire in Appendix 1)

1	Choice of and attachment to place of residence
2	Perception of coastal flooding risk
3	Perception of management policies and relocation acceptability (preceded by photos of management policies) Question selected to measure differences • Relocation acceptability of the most exposed houses (score from 1 to 10) • Feeling that it is courageous for an elected official to implement a relocation policy (score from 1 to 10)
4	Information about and trust in management institutions
5	Perception of relocation Question selected to measure differences • Willingness to pay more taxes to fund the policy of relocation (score from 1 to 10)
6	Perception of and feelings about means of communication (random presentation of one of the two visuals) Repetition of the three questions, initially posed in block 3 and 5 about relocation acceptability of the most exposed houses, courageous for an elected official to implement a relocation policy and willingness to pay more taxes to fund the policy of relocation (score from 1 to 10)
7	Measuring environmental awareness
8	Sociodemographic profile

contribution of the variables and their importance in the literature. Most variables were quantitative using scores on a 1 to 10 scale (Table 7). The few of a qualitative nature were divided into classes.

We used the lmer function in the lme4 package (Bates et al. 2013) in R (R Core Team 2013) and the maximum likelihood method to assess how well the data fit the mixed-effects model M_{ij}. We used regression models to model several outcome variables: relocation acceptability, political courage of the mayo and willingness to participate in relocation funding. The measures for each participant are interdependent (i.e. repeated measures). Consequently, we adjusted estimates of model parameters for "subjects" by estimating between-subjects variance in the mean of the dependent variable (i.e. random intercepts). We computed the amount of variance between the levels of the factor included in the random part of the model by adding random effect to the intercept. The intercept and the subsequent covariates were modelled using fixed effects parameters: the time variable was modelled as a dummy, with the pre-task measure as the reference level (pre-task measure = 0; post-task measure = 1); the visuals were modelled as two dummies—and the humorous visual used as the reference level, gender was modelled as a dummy with "female" as the reference level (female = 0; male = 1), housing was modelled as a dummy with "tenant" as the reference level (tenant = 0; owner = 1), influence of the sea proximity residential area located by the sea, coastal childhood, level of given information, competence of institutions in charge of management, beach submersion, donations to environmental associations was modelled as a dummy with "no" as the reference level (no = 0; yes = 1), and education level was modelled as dummy with "lower than baccalaureate" as the reference level (lower than baccalaureate = 0, higher than baccalaureate = 1).

For the sake of clarity and illustration, we present the Eq. 1 for the model M_{1a} (see the predictor's selection section below):

$$\begin{aligned} \mathrm{Acceptreloc}_{it} = {} & \beta_0 + \beta_t \mathrm{Time}_{\mathrm{it}} + \beta_e \mathrm{Efficiencyinfo}_{\mathrm{i}} + \beta_{sk} \mathrm{Skillinstitution}_{\mathrm{i}} + \beta_g \mathrm{Gender}_{\mathrm{i}} \\ & + \beta_{sb} \mathrm{Subbeach}_i + \beta_{don} \mathrm{Donationenv}_i + \eta_{it} \end{aligned} \quad (1)$$

In M_{1a}, relocation acceptability is one outcome variable included in the model as the dependent (i.e. explained) variable. We measured our dependent variables for each participant $_{\mathrm{i}}$ at each time $_{\mathrm{t}}$.

[0] Having studied the correlations between variables in order to avoid duplication.

Table 2 Variables selected for the analysis

Variable	Modalities	Acronym
Variables concerning attachment to the coast		
Residential area located by the sea	Yes/no	Sea district
Childhood spent in coastal town or village		childlit
Influence of sea proximity on choice of residential area	Decimal evaluation (Table 2)	Seainfluence
Variables related to the risk		
Experience of floods (number of floods in the town or village since the person has been living there)	From 0 to 26	Experimentsub
Feeling that it is not worth protecting the beaches as sooner or later they will be swamped by the sea	Decimal evaluation (Table 2)	Subbeach
Variables of perception of governance quality related to risk management		
Level of information given by the managers on the effectiveness of coastline management	Decimal evaluation (Table 2)	Efficiencyinfo
Perception of the competence of institutions in charge of risk management		Skillinstitution
Control variables		
Relocation acceptability	Decimal evaluation (Table 2)	Acceptreloc
Perception that elected representatives undertaking relocation are courageous		Couragemayor
Willingness to participate in relocation funding		Taxreloc
Sociodemographic characteristics		
Gender	Man/woman	Gender
Age	From 19 to 82 years old	Age
Educational level	≤Baccalaureate/>baccalaureate	Graduation
Housing status	Owner/tenant	Housing
Donations to environmental associations	Yes/no	Donationenv

Time, efficiency of provided info, skill of the institution, gender, the feeling that it is not worth protecting the beaches as sooner or later they will be swamped by the sea and the act of giving in favour of environmental protection were included in the model as exogenous variables (acronyms are presented in Table 2). Our objective was to estimate the effect (denoted as *B* in Table 6) of each exogenous variable on the dependent variable. The random intercept (with one instance per subject) was denoted η_{it} to characterize within-participant variability.

We used the leaps package in R (Lumley and Miller 2015) to select which of the predictors had to be added to our regression models as explanatory variables. This method enables to obtain the most parsimonious model and to reduce the risk of collinearity between predictors included in the same model. We used a stepwise forward selection to search models that best adjusted the data and lying in the range between M_{1j} and models including all possible predictors. The quality of our models fit was estimated using the Akaike's information criterion (AIC). AIC estimates the quality of a statistical model for a given set of date. AIC also takes into account the number of regression coefficients being tested and penalizes the less parsimonious model. The significance of the improvement in the quality of our models fit was estimated using the distributed chi-squared likelihood-ratio test (L. Ratio). We tested several models labelled "M_{ij}". The letter "i" refers to the number of the model. The letter "j" refers to the label of the variable used as the outcome variable (e.g. the letter A is used when the acceptability of relocation policies is used as the outcome variable). For example, M_{1a} refers to the first model that we tested with relocation acceptability "Accepterelocˮ used as the outcome variable. All our models M_{1j} included only the intercept as a predictor.

Our results revealed that the fit of the model M_{1a} (AIC = 6206.79) was improved by adding the following predictors in the model: time, gender, efficiency of provided information, skill of

institution, the feeling that it is not worth protecting the beaches as sooner or later they will be swamped by the sea and the act of giving in favour of environmental protection. We included this set of predictors in M_{2a} (AIC = 6150.2) and none of the remaining predictors improved the fit of M_{2a}. The fit of the first model M_{1c} treating political courage of the mayor as the outcome variable (AIC = 5982.6) was improved by adding the following predictors in the model: time, age, efficiency of provided information, skill of the institution, the feeling that it is not worth protecting the beaches as sooner or later they will be swamped by the sea and the act of giving in favour of environmental protection. We included this set of predictors in M_{2c} (AIC = 5913.8) and none of the remaining predictors improved the fit of M_{2c}. The fit of the first model M_{1t} treating taxes raised to fund relocation policies (Taxreloc) "as the outcome variable (AIC=6373.5) was improved by adding the following predictors in the model: influence of the sea, efficiency of provided information, skills of the institution, the act of giving in favour of environmental protection and the education level. We included this set of predictors in M_{2t} (AIC = 6312.3) and none of the remaining predictors improved the fit of M_{2t}. In conclusion, we retained M_{2a}, M_{2c} and M_{2t} for further analyses. Finally, these statistical results show significant correlations for the first two outcome variables ("relocation acceptability" and "courage major"), whereas for the last one ("tax relocation"), only the three variables about information efficiency, skill of institutions and donation for environmental purposes show a significant correlation. For all details, see Table 7 in Appendix 2.

2.6 Sample description

The coastal population shows some specificity in terms of age, qualification and attachment to area they live in. As shown in Table 1 below that describes our sample, there is a high proportion of couple owning a house on the coasts (57%). The sample is thus balanced between men and women with 65% of couples, 33% aged of more the 60 years old and mostly retired ones (28%) attracted by recreative opportunities offered by the proximity of the sea. The housing market in coastal area also implies that the houses owned are in the family for long (47% owned the house for more than 10 years) or were bought by wealthy people (with an average monthly income of 2453 euros). We also denote that for 48% people have obtained a higher education diploma and intermediate professions, employees and unskilled workers represent 39% of coastal resident in our sample. Of course, some geographical heterogeneity exists along the shore but marked differences oppose coast residents from other French residents.

3 Results

3.1 A few benchmarks concerning respondents' perceptions and communication

The influence of sea proximity was very important in the choice of dwelling for the respondents, with 49% being very sensitive to this proximity giving a score of 8 to 10, 28% a score of 5 to 7 and a third (33%) scoring less than 5 with 16% giving 0. Some 52% of the respondents had spent their childhood in a coastal town or village and slightly less than half (46%) had lived in a neighbourhood close to the sea. However, only 6% felt that relocation concerned them, whereas, according to the objective data on the number of floods, 29% of towns or villages have never been affected by coastal flooding, 50% have suffered of flood once or

twice and 21% at least three times (7 maximum). The risk memory variable, which is not discriminatory in our analysis, turned out to be rather weak with 58% of respondents having never experienced floods in their town or village,[3] 22% who have had one such experience, but it was over 5 years ago, and 20% who have been affected recently (within the last 5 years). Information provided by the authorities was perceived as average and very homogenous across all topics with scores between 5.57 (risk probability) and 5.42 (cost of the measures), the other two issues being the effectiveness of management measures and the types of alternative measures. On average, for the four issues as a whole, 26% thought they had little information (score below 5), 27% thought they had reasonable information (score equal to 5) and 47% thought they were quite well informed (score over 5). As regards the criteria on the basis of which respondents place their trust in institutions, the distribution is fairly well balanced. Effectively, although transparency and the credibility and reliability of the measures were slightly more frequently cited with respectively 30 and 28% of answers, 21% underlined the importance of dialogues and proximity of elected representatives as well as the fairness of the measures.

3.2 Multiple regression analysis

Our results revealed that the fit of the model M_{1a} (AIC = 6206.79) was improved by adding the following predictors in the model: time, gender, level of information given by the managers on the effectiveness of coastline management, perception of the competence of institutions in charge of risk management, feeling that it is not worth protecting the beaches as sooner or later they will be swamped by the sea and donations to environmental associations. We included this set of predictors in M_{2a} (AIC = 6150.2) and none of the remaining predictors improved the fit of M_{2a}. In sum, our results revealed significant effects of all our covariates on relocation acceptability (model M_{2A}). All the details of Tables 3, 4, and 5 can be found in Appendix 3.

The fit of the first model M_{1c} treating "Perception that elected representatives undertaking relocation are courageous" as the outcome variable (AIC = 5982.6) was improved by adding the following predictors in the model: time, age, level of information given by the managers on the effectiveness of coastline management, perception of the competence of institutions in charge of risk management, feeling that it is not worth protecting the beaches as sooner or later they will be swamped by the sea and donations to environmental associations. We included this set of predictors in M_{2c} (AIC = 5913.8) and none of the remaining predictors improved the fit of M_{2c}. In sum, our results revealed significant effects of all our covariates on the political courage of the mayor (model M_{2C}).

Finally, the fit of the first model M_{1t} treating "Willingness to participate in relocation funding" as the outcome variable (AIC = 6373.5) was improved by adding the following predictors in the model: influence of sea proximity on choice of residential area, level of information given by the managers on the effectiveness of coastline management, perception of the competence of institutions in charge of risk management, donation to environmental associations and educational level. We included this set of predictors in M_{2t} (AIC = 6312.3) and none of the remaining predictors improved the fit of M_{2t}. In conclusion, we retained M_{2a}, M_{2c} and M_{2t} for further analysis. In sum, our results revealed significant effects of all our

[3] It must be noted that this refers to floods in the town or village and it does not necessarily concern the respondents.

Table 3 Parameter values from the mixed-effects models that best adjusted the data for acceptability relocation ("Acceptreloc" (M_{2A}))

	Fixed effect p value
Time	.001***
Gender	.002**
Effectiveness of measures	.001***
Skill of institutions	.02
Inexorable beach submersion	.002**
Donation for environment	<.001***

covariates on the tax levy to fund relocation policies (model M_{2T}) except for the covariate on the influence of the sea ($B = .03$; $p = .11$).

The first point to note is that almost all our predictors included in our models have significant effects on outcome variables (except the effect of the influence of the sea on taxes raised to fund relocation policies). These results were expected, given that we selected sets of predictors that significantly improved the amount of variance in the outcome variable explained by the model. In multivariate models, the variance explained is equal to the square of the coefficient of multiple correlations. Consequently, the higher are the correlations between the variables, the higher is the value of the variance explained. The second point to note is that variables conveying governance quality (that is, the level of information on the effectiveness of management measures and the respondents' perception of the institutions' competence) act as an explanatory factor for our three control variables, as does the fact of making donations to environmental associations which reflects environmental awareness. A third noteworthy point is that relocation acceptability is higher for women and for those who think that it is useful to protect beaches against sea level rise. This sensitivity to beach protection also intervenes in the recognition of courage of elected representatives who implement relocation policies. Recognizing this courage also increases with the age of the respondent. Finally, the willingness to contribute to these policies through taxation depends not only on the perception of governance quality but also on education level and attachment to the sea. This attachment is evaluated through the influence of sea proximity on the choice of the dwelling, which has a positive effect, and a childhood spent in a coastal area, which has a negative effect. As regards tax contribution, there is no time influence, i.e. there is no significant difference between the answers given at the start and at the end of the questionnaire. But this time factor has a negative effect on the other two variables, i.e. relocation acceptability decreases at the end of the questionnaire as people integrate more information in forming their opinion.

Table 4 Parameter values from the mixed-effects models that best adjusted the data for Courage mayor for relocation ("Couragemayor" (M_{2C}))

	Fixed effect p value
Time	.01*
Age	<.001***
Effectiveness of measures	.02
Skill of institutions	.001***
Inexorable beach submersion	.003**
Donation for environment	<.001***

Table 5 Parameter values from the mixed-effects models that best adjusted the data for paying taxes to relocate ("Taxreloc" (M_{2t}))

	p value
Sea influence on choice of housing	.11
Effectiveness of measures	<.001***
Skill of institutions	<.001***
Donation for environment	<.001***
Graduation	.02
Childhood in littoral zone	.03

Finally, from Table 6, we can point that humour-based communication have the comparative advantage of inducing a stronger emotional response in terms of stimulating interest and thoughts.

4 Discussion

4.1 Communication method has no effect

As there is no significant difference in the evaluation undertaken "before" and "after" seeing the flyer images, our hypothesis that humour-based communication is more effective cannot be validated. Several explanations can be put forward. As noted by Grondin et al. (2003), this type of pre- and post-communication evaluation approach has to contend with perception variability. Also, the impact of other factors that are frequently mentioned when the post-communication survey is undertaken with a certain delay (Grondin et al. 2003) cannot be considered in our case as the evaluation was undertaken immediately after the flyer presentation. This absence of impact, which concerns both fear- and humour-based flyers, shows that communication cannot be based solely on an informative poster. Indeed, these results, although contrary to our expectations, are in line with numerous studies which insist on the need for long-term awareness and concerted action. Awareness and communication must take into account the frequent existence of risk perception bias which, in the case of sea level rise, is accentuated by the absence of a memory of the risk. According to Reser et al. (2014), the

Table 6 Comparison between the types of emotion felt according to the type of communication

	Storm image	Humorous image
Deeply moved	4%	4%
Frightened	17%	6%
Troubled	12%	11%
Afraid	4%	4%
Irritable	4%	5%
Subtotal	**41%**	**30%**
Attentive	28%	27%
Interested	9%	15%
Active	0%	1%
Vigilant	19%	24%
Determined	3%	3%
Subtotal	**59%**	**70%**

Source: @2016 Survey LAMETA

psychological adjustment of individuals involves time to change values. More generally, various researches (Van der Linden 2015; Lee et al. 2015; Hornsey et al. 2016) emphasize the role of experiential and sociocultural factors which imply culturally appropriate communication strategies. Thus, Weber (2010) testifies to the importance of the role of moral conceptions rather than the description of the anticipated effects of climate change, which stem from an overly rationalist approach. Concerning the evocation of the effects, Brügger et al. (2015) insist on the need to contextualize these effects at the level of the usual living environment of people, which was not the case with our very general images.

These different findings explain the fact that we observed no significant difference in perceptions of flyer effectiveness as 60% of respondents found the fear-based image very or moderately effective compared with 63% for the humour-based image. However, the survey also helped to measure the level of respondents' interest in the flyers' message, using the Likert scale. It emerged that this variable is related to sea proximity. Those people who felt most concerned by the fear-based flyer usually lived near the sea (p value 0.02) or had a sea view (p value <0.01). Those who did not feel concerned by either flyer were often sceptical of the risk of sea level rise (p value 0.01). Over and above the crude analysis of fear- or humour-based communication of relocation acceptability, it is interesting to compare the types of emotion felt by respondents following their exposure to one or other flyer (Table 7). As a matter of fact, this means of communication, and in particular scaremongering, is known in psychology to trigger resistance perhaps even denial (Witte and Allen 2000; Ruiter et al. 2001). Conversely, positive emotions can encourage the reflection process by limiting the appearance of psychological defences. Emotions felt following the viewing of storm images were derived of course from the fear category, whereas humour-based communication helps to generate interest and alertness, both good bases for calling into question and changing behaviour. Ces constats sont conformes aux comportements de résistance à la communication observés dans le cas des risques relatifs à la santé (Witte and Allen 2000; Ruiter et al. 2001; Campo et al. 2013).

4.2 Specificities of flooding risks

In accordance with the work mentioned above on the specificity of determinants and the existence of biases (Van der Linden 2015; Hornsey et al. 2016; Lee et al. 2015), it is important to address the role of determinants linked to psychological factors. Individuals' motivations (internal and external to the individual) are numerous and their interactions are complex. Among internal motivations that pre-exist any external action, such as public communication policies, three are essential in environmental issues: the environmental ethic, the degree of self-control (Reeson 2008) and efforts made and empathy towards others (Falk and Kosfeld 2006). They stipulate that some individuals are interested in environmental problems and are likely to take action to find answers (internal motivations). The attachment and environmental awareness variables belong to this group. We observe consistently that environmental awareness has a positive effect on our three endogenous variables and hence on the acceptation of relocation policies (endogenous variables no. 1), the evaluation of elected representatives' courage (endogenous variables no. 2) and the participation in relocation funding (endogenous variables no. 3). Attachment only affects the endogenous variable of funding, respectively, positively and negatively for those who declare that proximity to the sea is important to them (sea influence on choice of housing) and those who spent their childhood on the coast (childhood in littoral zone). The lack of impact on the acceptation of relocation policies and the courageous image credited to elected representatives (endogenous variables no. 1 and no. 2) can be

explained by a bias arising from the strong level of attachment which may distort the reality of the risk to the extent of obscuring it. This impact of attachment on coastal risk perception was already noted in 2015 by Michel-Guillou et al. On the other hand, the different impact on the funding variable would suggest that those individuals who chose their dwelling because of the proximity to the sea (sea influence on choice of housing), and who are attached to the coast, would be ready to invest towards its preservation, including through a relocation. In contrast, people who have spent their childhood by the seaside (childhood in littoral zone) are attached to it but do not feel responsible for the problem that necessitates relocation and do not wish to bear the costs.

Our framework of analysis allows to complement the analysis of relocation policies acceptability by an analysis of how perceived control can affect the decision-making process. In some cases, the latter may explain behaviour which is the complete opposite of individuals' motivations and attitudes. In order to induce behavioural change, it is therefore crucial that individuals' beliefs should not be distorted as regards the positive or negative consequences of their actions. Finally, they must be convinced that their choice of action will lead to an expected and effective outcome, that is to say, that there is no obstacle or hindrance to this outcome (degree of perceived control). In this study, variables are relative to governance quality condition control. The role of the elected representatives, trust in the institutions and hence the general state of governance are thus likely to impact significantly relocation acceptability. These variables respectively, the level of information provided and the effectiveness of institutions are correlated positively with the three endogenous variables (endogenous variables no. 1, no. 2 and no. 3). Taking these factors into account is in line with numerous studies emphasizing the institutional dimension of acceptability (Myatt et al. 2003; Ledoux et al. 2005; Hurlimann et al. 2014; Clément et al. 2015; Kahan et al. 2012; Lo 2013; Gibbs 2015; Touili et al. 2014; Rocle 2017; Hino et al. 2017). Emphasis is placed in particular on trust in the institutions, transparency and the level of concertation, the perception of the skills and the effectiveness of the measures, but also their fairness.

A final variable was added to estimate the degree of fatalism in our sample concerning sea level rise (*inexorable beach submersion)*. Unsurprisingly, it had a negative impact on relocation acceptation and on the appreciation of the courage of elected representatives' actions. These respondents felt that it was a vain exercise to battle against flooding as the latter will inevitably lead to the destruction of beaches. In line with the literature (Weber 2010; Reser et al. 2014; Van der Linden 2015; Lee et al. 2015; Hornsey et al. 2016), our results thus underline the importance of psychological factors, through those variables accounting for perceptions and representations, rather than the traditional sociodemographic factors. The latter are less often explanatory of the tested models. It thus appears that the proximity to the place and environmental values are decisive which is in line with numerous works in this field. As evidenced by the recent work of Lemée et al. (2019), indeed, representations about relocation policies depend heavily on the experience of risk. In addition, Nicholls et al. (2011) emphasize that scenarios do not take enough account of the influence of lifestyles and social representations to understand behaviours. Simulation work from a survey conducted in Florida by Treuer et al. (2018) also demonstrate the existence of bias and the role of social norms. In addition, they observe for 75% of respondents a positive impact of experimentations of relocation schemes as well as an improvement of acceptability in time. Finally, the mobilization of Ajzen's TPB theory (1977) proved to be relevant by showing the role of trust and the quality of governance often evoked in the literature (Myatt et al. 2003; Ledoux et al. 2005; Kahan et al. 2012; Lo 2013; King et al. 2014; Gibbs 2015; Hino et al. 2017; Treuer et al. 2018).

4.3 Limits of our approach

Our questioning on the influence of communication forms was ambitious and proved difficult to operationalize due to anticipatory behaviours and risks marked by specificities and strongly related to social representations and values. Our protocol was built with the aim to identify a change of perceptions and attribute this change to the type of communication. Despite the fact that this type of protocol is commonly used in the health field, it has proved difficult to transpose for adaptation to climate change. We may explain this by the implied changes in the value involved. Therefore, we rather face progressive processes of change, reinforced by risk experience (King et al. 2014; Lemée et al. 2019). However, any message based on humour is hindered by the subjective cultural nature of the latter. In fact, as shown by our preliminary survey, some people in the sample may not find the flyer to be amusing. While the role of perceptions and confidence in the quality of institutions constitute institutional factors determining acceptability, the quantitative evaluation of these factors through a few variables is difficult, as evidenced by the small number of studies on the assessment of the quality of governance at the territorial level (Rowe and Frewer 2000; Halvorsen 2003). Most often, the research carried out at this level is rather comprehensive in nature and endeavours to describe the functioning and the constraints of the governance arrangements. The aim here was to account for the perception that residents have of the quality of these systems, through their perception of (1) the level of information given in relation to the measures implemented and (2) the level of competence of managers. We are obviously aware of the reducing nature of the evaluation of the quality of governance through these two variables alone, but they make it possible to account for the two axes of governance, namely piloting skills and information and consultation (Adger 2001; Biesbroek et al. 2013).

5 Conclusion

Given the difficulty of implementing relocation policies, our research sought to explore the role of communication, information and governance quality on the acceptability of such policies. We tested the impact of means of communication and of governance quality by comparing relocation acceptability before and after the presentation of a communication medium based on either humour or fear and by asking questions about institutional quality. While differences in the means of communication did not make a significant difference to acceptability, this communication medium affected the residents differently according to their proximity to the seafront and their risk perception. Similarly, the images chosen triggered different emotions. Humour tended to trigger more emotion conducive to attention and reflection. In order to convey the feeling of citizens' control over adaptation policies, we also tested the impact of perceptions of governance quality. Our survey shows that it has a significant effect on acceptability according to several publications which confirm the determinant role of the quality of governance mechanisms (Touili et al. 2014; Kloos and Baumert 2015; Gibbs 2015). They call for the implementation of policies that have been discussed with all residents, rather than just those concerned with relocation, in order to avoid the influence of lobbying. Likewise, research undertaken in the field of behavioural economics (Pollitt and Shaorshadze 2013; Stern and de Groot 2018), seldom applied to these adaptation issues, can provide interesting avenues to improve acceptability. Furthermore, many studies (King et al. 2014; Hino et al. 2017; Treuer et al. 2018) stress other factors (increase the acceptability of

relocation measures, for example, the role of storms, the significance of damage and the characteristics of retreat areas).

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Appendix 1: Summary of the questionnaire

1. Choice of and attachment to place of residence

Municipality of residence, impact of the proximity of the sea on the choice of your home (score from 1to10), distance from the neighbourhood to the beach and the sea, length of stay in the neighbourhood.

2. Perception of coastal flooding risk

Emergency level to intervene in relation to the risk of sea level rise for the area (4 items), opinion on the ability to fight the rise of the sea (score from 1 to 10), type of worries concerning an increased frequency of coastal flooding (8 items).

3. Perception of management policies and relocation acceptability

Introductory part with photos illustrating current policies (protection and reloading) and an explanation of relocation policies.

Choice of the type of adaptation policy considered the most appropriate to adapt to sea level rise after 2050 (4 items), feeling that the choice is shared by other inhabitants and elected officials (score from 1 to 10), perceptions relative to relocation policies (5 items), relocation acceptability of the most exposed houses (score from 1 to 10) (question selected to measure differences), feeling that it is courageous for an elected official to implement a relocation policy (score from 1 to 10) (question selected to measure the differences), feeling that the respondent's home could well be affected by relocation? YES/NO/do not know.

4. Information about, and trust in, management institutions

Type of determinants of trust in an institution (technical skills, credibility and reliability, proximity of elected officials, transparency of choices, fairness of measures, consultation possibilities) (1 choice).

Opinions on management measures carried out so far in link with coastal risks in terms of their efficiency, related skills, consultation of concerned populations, integration in urbanization policies, research of collective interest and transparency (score from 1 to 10 for each item)

Satisfaction with information given about alternative measures, cost, probability of risk occurrence and effectiveness of measures (score from 1 to 10 for each item).

5. Perceptions relative to relocation policies (score from 1 to 10 for each item)

The beaches are part of our natural heritage and must be preserved for generations to come. It is useless to seek to anticipate; it is better to leave to do and adapt as and when. It is useless to protect the beaches because early or later they will be submerged/flooded. Relocation offer the opportunity to rethink the city. Willingness to pay more taxes to fund the policy of relocation (selected question to measure the differences).

6. Perceptions and feelings raised using differentiated communication visuals

Presentation of one of the two VISUAL to respondents

Feeling raised by the message of the visual (proposed items were feeling of fatalism, it is catastrophic, fear of human or material losses, scepticism, it is an exceptional situation which does not account for the reality, the elected officials are responsible because they urbanized too much in risk areas, the owners have not been vigilant enough at the time of purchase, I feel more convinced of the interest of the relocation of the most exposed houses) (1 choice).

Three questions were already asked to evaluate the rating gap as a proxy for the impact of the messageAcceptability of relocation for the most exposed houses? (score from 1 to 10)

Feeling that it is courageous for an elected official to embark on a relocation policy (score from 1 to 10)

Willingness to pay more taxes to fund relocation policy (score from 1 to 10)

Experienced emotion after the visual was presented to respondents (6 positive items and 6 negative items). Judgement on the effectiveness of the visual to motivate citizens for a relocation policy (4-point Likert scale).

7. Measuring environmental awareness (8 items selected among the NEP framework (Dunlap et al. 2000) (6-item Likert scale)

Human beings have the right to change the natural environment according to their needs. When humans try to change the course of nature, this often produces disastrous consequences. The so-called ecological crisis that is threatening the human race has been greatly exaggerated; humans have been created to govern nature. If things continue at the current rate, we will soon experience a major ecological disaster. The balance of nature is very sensitive and easily disturbed.

8. Sociodemographic profile

Gender, age, childhood in a coastal town, marital status, ownership, number of years of residence in the house, socio-professional category, level of education, affiliation and donations to environmental associations and professional activity linked to the survey concerns.

Appendix 2

Table 7 Selection of predictors to be added in our models with respect to their values of AIC and L-ratio

	AIC	L-ratio	*p*
Relocation acceptability			
Time	6198.5	10.23	.001
Gender	6197.3	11.42	<.001
Efficiency information	6192.9	15.78	<.001
Skill institution	6193.8	14.89	<.001
Submersion beach	6194.5	14.16	<.001
Donation environment	6195.6	13.05	<.001
Courage mayor			
Time	5977.9	6.71	.01
Age	5968.8	15.87	<.001
Efficiency information	5973.9	10.68	.001
Skill institution	5966.7	17.88	<.001
Submersion beach	5973.1	11.57	<.001
Donation environment	5961.8	22.86	<.001
Tax relocation			
Sea influence	6371	4.58	.03
Efficiency information	6343.2	32.37	<.001
Skill institution	6345.1	30.45	<.001
Donation environment	6361.9	13.65	<.001
Graduation	6371.3	4.26	.04
Child littoral	6309.8	4.48	.03

Appendix 3

Table 8 Mixed-effects models

Parameter values from the mixed-effects models that best adjusted the data for "Acceptreloc" (M_{2A})		Fixed effects				Random effect (intercept)	
		B	SE	CR	*p* value	Variance	SD
Acceptreloc (M_{2A})	*Acceptability relocation*	–	–	–	–	1.71	1.31
Time	*Time*	−.21	.07	−3.21	.001	–	–
Gender	*Gender*	−.36	.12	−3.11	.002	–	–
Efficiencyinfo	Effectiveness of measures	.10	.30	3.36	.001	–	–
Skillinstitution	*Skill of institutions*	.09	.04	2.33	.02	–	–
Subbeach	*Inexorable beach submersion*	−.08	.03	−3.04	.002	–	–
Donationenv	*Donation for environment*	.45	.13	3.45	<.001	–	–
Parameter values from the mixed-effects models that best adjusted the data for "Couragemayor" (M_{2C})		Fixed effects				Random effect (intercept)	
		B	SE	CR	*p* value	Variance	SD
Couragemayor (M_{2C})	Courage mayor for relocation	–	–	–	–	1.70	1.31
Time	*Time*	−.15	.06	−2.60	.01	–	–
Age	*Age*	.01	.004	4.13	<.001	–	–
Efficiencyinfo	Effectiveness of measures	.07	.03	2.33	.02	–	–
Skillinstitution	*Skill of institutions*	.12	.03	3.30	.001	–	–
Subbeach	*Inexorable beach submersion*	−.07	.02	−2.97	.003	–	–
Donationenv	*Donation for environment*	.58	.13	4.55	<.001	–	–
Parameter values from the mixed-effects models that best adjusted the data for "Taxreloc" (M_{2t})		Fixed effects				Random effect (intercept)	
		B	SE	CR	*p* value	Variance	SD
Taxreloc (M_{2t})	Will to pay due taxes to relocate	–	–	–	–	3.7	1.92
Seainfluence	Sea influence on choice of housing	.03	.02	1.57	.11	–	–
Efficiencyinfo	Effectiveness of measures	.17	.04	4.38	<.001	–	–
Skillinstitution	*Skill of institutions*	.20	.05	4.17	<.001	–	–
Donationenv	*Donation for environment*	.61	.17	3.56	<.001	–	–
Graduation	*Graduation*	.36	.15	2.36	.02	–	–
Chillit	Childhood in littoral zone	−.31	.15	−2.11	.03	–	–

Note: *B* = unstandardized regression coefficient, *SE* standard errors, *CR* critical ratios, *SD* standard deviation

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