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Is it all about awareness? The normalization of coastal risk

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Is it all about awareness? The normalization of coastal risk

Coastal risk is already high in several parts of the world and is expected to be amplified by climate change, which makes it necessary to outline effective risk management strategies. Risk managers assume that increasing awareness of coastal risk is the key to public support and endorsement of risk management strategies —an assumption that underlies a common worldview on the public understanding of science, which has been named *the deficit model*. We argue that the effects of awareness are not as straightforward. In particular, awareness of coastal hazards might not lead to more technically-accurate risk perceptions. Based on research on risk perception normalization, we explored the hypothesis that coastal risk awareness reduces coastal risk perception —in particular the perceived likelihood of occurrence of coastal hazards— through its effect on reliance on protective measures to prevent risk. Individuals can rely on protective measures, even when those are not effective, as a positive illusion to reduce risk perception. This effect might be stronger for higher-probability hazards and for permanent residents of costal zones. Data from 410 individuals living in coastal zones corroborated most of our expectations. Global results demonstrated a risk normalization effect mediated by reliance on current measures. Additional analyses made clear that this effect occurred in 2 of the 5 high-probability hazards (flood and storm), and not in the low-probability hazard (tsunami). Normalization might be more likely among high-probability hazards which entail catastrophic and immediate impacts. This effect was also found among permanent residents, but not among temporary residents. Results imply that coastal risk management might benefit from a) taking risk perception normalization effects into account, b) tailoring strategies for permanent and temporary residents, and c) promoting a higher public engagement, which would facilitate a more adaptive and effective coping with coastal risk than the use of positive illusions.

Keywords: risk awareness; risk perception normalization; positive illusions; coastal zones; deficit model.

1. **Introduction**

The need to develop coastal risk management has been increasing over the last years. Not only has the amount of people living in coastal zones been increasing, but coastal risk is also expected to increase, as a result of climate change. Climate models of the Intergovernmental Panel on Climate Change predict a global sea level rise that will amplify coastal risk, indicating that it is urgent to adapt (Wong et al. 2014).

Individuals living in coastal zones are expected to play an important part in risk management. It is often suggested that increasing the awareness of coastal risk is the key to public support and endorsement of coastal risk management strategies (e.g., IOC 2009). “Awareness” usually refers to having information and knowing about coastal risk. It appears that it is naturally assumed that an inaccurate coastal risk perception is the result of a lack of awareness of coastal risk and that, as such, more accurate risk perceptions could be promoted by awareness-raising campaigns. This assumption underlies a common worldview regarding the public understanding of science that has been called *the deficit model* (e.g., Wynne 1982; Gregory and Miller 1998). The deficit model encompasses the approaches to science communication that are based on the belief that lay individuals are critical, sceptical, or not interested in science, because they do not have enough information or are misinformed. Within these deficit model approaches, the proposed solution to increasing public interest and support is to provide more information, in order to establish a proper awareness of the themes that are being discussed. Research has shown that the crux of these issues is often beyond information or awareness (e.g., Miller 2001). Nevertheless, deficit model approaches tend to persist, possibly due to their appealing simplicity. Adopting the deficit model has implications in risk management. Initiatives among local individuals, in particular, are usually

limited to the promotion of risk awareness, using top-down types of communication that leave no room for high public engagement (see Rowe and Frewer 2000).

Risk awareness is an important factor in risk management. There is ample evidence that when individuals are provided information on risk, or when they acquire information by themselves, it influences risk-related perceptions and motivates protective behaviour (e.g., Floyd, Prentice-Dunn, and Rogers 2000; Kellens, Zaalberg, and De Maeyer 2012; Neuwirth, Dunwoody, and Griffin 2000). However, risk awareness does not necessarily relate to perceptions that endorse risk management strategies. The continued awareness of an uncontrollable risk, as is the case of coastal risk, might paradoxically normalize risk perception.

1.1 The normalization of coastal risk perception

Literature on risk perception underlines that when individuals are living in high-risk situations they develop strategies to minimize risk perception, as a way to psychologically cope with the threat (Lima 2004; Lima, Barnett, and Vala 2005; Halpern-Felsher et al. 2001; Lindell and Earle 1983; MacGregor et al. 1994). Dealing with risk is related to becoming familiarized with that risk. For instance, Lima (2004) showed that individuals who lived near an incinerator gradually reduced the perceived risk associated with it. This effect has often been found among individuals who live with risk, and can be designated as risk perception normalization (e.g., Lima, Barnett, and Vala 2005; Mileti and O'Brien 1992; Parkhill et al 2010; Silva and Lima 1997; van der Pligt 1992; van der Pligt, Eiser and Spears 1986). Risk perception normalization is particularly likely to happen when individuals voluntarily expose themselves to risk (Twigger-Ross and Breakwell 1999), which is relevant to the case of coastal risk. Coastal populations tend to have both an affective and an economic relation with the sea

(Martins, Betâmio de Almeida, and Pinho 2009; Pinho 2012; Schmidt et al. 2014), and such relations may motivate them to keep living, voluntarily, with coastal risk, thus contributing to risk normalization.

Risk perception normalization has been mostly explained in terms of psychological responses that result from extended contact (with risk) and risk awareness (Lima 2004; Lima, Barnett, and Vala 2005; Richardson, Sorenson, and Soderstrom 1987). Coastal risk might be especially prone to normalization. Individuals living in coastal zones are likely to have an extended contact with — and be aware of — coastal risk, as a result of their experience by the coast, or based on information derived from the media or other sources of information. Indeed, research shows that most individuals living in coastal zones have adequate knowledge of coastal risk (Kellens et al. 2011; Delicado et al. 2014; Schmidt et al. 2014). In addition, there is some evidence that points toward risk perception normalization. Kellens et al. (2011) found that inhabitants who lived in areas of higher coastal risk did not have higher risk perceptions, when compared to inhabitants of areas of lower risk. However, tourists who overnighted in areas of higher coastal risk did have a higher risk perception, when compared to individuals from areas of lower risk. As the researchers suggest, this result might be explained by a certain habituation to risk on behalf of these inhabitants, but not of tourists, although more research is necessary to clarify this issue.

1.1.1 The perception of control and positive illusions

Individuals can gain control over environmental threats, such as coastal risk, using either primary or secondary control strategies. Sometimes, an individual can act and directly minimize the threat. For instance, individuals who fear the health risks posed by the consumption of red meat can stop eating it. This direct type of control is designated as primary control (Rothbaum, Weisz, and Snyder1982). However, some other times,

individuals cannot act directly over a threat. Coastal risk poses this type of uncontrollable event. It is not possible for individuals to control the occurrence of erosion or flooding. In these situations, individuals may only minimize risk perception by using secondary control type strategies, such as trusting others (the authorities, God) to act in order to promote their protection (Rothbaum, Weisz, and Snyder1982). The process of risk perception normalization has been explained through the use of secondary control strategies, particularly through the development of positive illusions (e.g., Lima 2004; Silva and Lima 1997). Positive illusions are coping strategies that individuals use to deal with risk and gain control over environmental risks. Social psychologists have long demonstrated that certain illusions can play an adaptive role in the mental health and well-being of individuals (see Taylor and Brown 1988). For instance, realistic perceptions of the level of control are more characteristic in individuals in a depressive affective state than in individuals in a non-depressed affective state (Alloy, Abramson, and Viscusi 1981).

Research suggests that populations in coastal zones are aware of their exposure, and recognize that adaptation to coastal risk will, in due time, be required. Nonetheless, they wish to maintain their current levels of coastal protection, and preserve local societies (Schmidt et al. 2014). If individuals want to continue living in risky coastal zones, one way to psychologically cope with risk is by using positive illusions. Relying on the ability of current mitigation measures to control the occurrence of coastal hazards might constitute this type of positive illusion.

1.2 Study context

This study tests if coastal risk awareness leads to coastal risk normalization, due to reliance on current measures, based on a dataset (Pinho 2012) on the coastal risk perception of the inhabitants of six coastal locations in the Aveiro region, in Portugal:

Praia de Esmoriz, Praia de Cortegaça, Furadouro, Praia da Barra, Costa Nova do Prado, and Praia da Vagueira (see Figure 1). Following global demographic mobility to coastal areas in the last decades, there has been a significant increase of population in these study areas. This increase is much higher than the national average, and this population is mostly comprised of young, working people (Pinho 2012). It is naturally related to an expansion and densification of urbanized seafronts, to which tourism has also contributed as a significant percentage of the population is comprised of temporary residents (Pinho 2012).

[Figure 1 near here]

The study area is characterized by pronounced rates of erosion and coastline retreat, sediment accumulation in river mouths, as well as a high risk of flood, which puts the population and their properties at risk (Martins, Betâmio de Almeida and Pinho 2009). There have been several threatening episodes in the past, and more can be expected for the future. As in many coastal zones, climate change is expected to amplify erosion, coastline retreat, flood levels and flood areas, sea influence on estuaries and lagoons, and to change the tide regime and sedimentary balance (Santos, Forbes and Moita 2002; Dias and Alves 2013).

So far, coastal risk management has been based on protective responses, mostly via hard structural coastal engineering — in particular, groynes and shore-parallel seawalls —, combined with a few soft structural measures in beaches and dunes. These measures do not appear to be sufficient or effective enough to prevent coastal risk. Between 2001 and 2011, around 60 coastal risk-related impacts in the study area were reported and covered in the media (Pereira and Coelho 2011). Coastal defence structures are also in frequent need of both emergency and maintenance interventions. Indeed, most funding available for costal management has been used in emergency

interventions (Pinho 2012). Between 1958 and 2010 there were 75 interventions in groynes, 61 interventions in seawalls, 10 interventions in sand dunes, and 5 interventions of various types, such as beach renourishment (Pereira and Coelho 2011). Furthermore, coastal engineering structures appear to increase the occurrence of erosion in nearby locations (Veloso Gomes 2007).

1.2.1 Hypotheses

The study hypotheses were based on risk perception normalization research, and on how positive illusions account for normalization. We expected coastal risk awareness to reduce coastal risk perception, in particular the perceived likelihood of occurrence of coastal hazards, through its effect on reliance on current protective measures to prevent coastal risk. Despite the limited effectiveness of current protective measures, which has been evidenced by the frequent occurrence of coastal risk-related impacts, individuals might apply psychological efforts to rely on them, in order to minimize risk perception. The implementation and maintenance of shore-parallel seawalls and groynes, or beach renourishment, might lead individuals to believe that they are more protected against the different types of hazards that have their origin in the sea. As noticed by Kellens et al. (2011), coastal defence investments, along with technological advances, may have given the public a false sense of security. We would add that it can constitute a form of secondary control over the threat.

The normalization effect was expected to be stronger when coastal risk was higher, in terms of the likelihood that a hazard has of occurring. Hazards with a higher likelihood of occurrence happened frequently in the past and were probably noticed by local individuals. As such, individuals should be more aware and have a greater need to reduce their threat. In addition, we anticipated that the type of residence could influence the effects of risk perception normalization. Permanent residents might personally

witness and recall more risk-related events than temporary residents and, therefore, have a greater need to rely on current measures to normalize risk perception. Type of residence is a relevant factor for the present case-study and for coastal risk management in general, because the number of temporary residents in coastal zones is usually high. In accordance with coastal risk management guidelines, it is advisable to distinguish between permanent and temporary residents (e.g., IOC 2009).

We posed the following hypotheses:

- Hypothesis 1 (H1): coastal risk awareness will be associated with a reduction in coastal risk perception through reliance on current protective measures;
- Hypothesis 2 (H2): the correlations in H1 will be stronger for coastal hazards with a higher probability of occurrence, in comparison with coastal hazards with a lower probability;
- Hypothesis 3 (H3): the correlations in H1 will be stronger for permanent residents, in comparison with temporary residents.

2. Method

2.1 Participants and study areas

The targets of the survey were the dwelling owners and tenants (or their spouses) of the houses located in the areas classified as high risk in Praia de Esmoriz, Praia de Cortegaça, Furadouro, Praia da Barra, Costa Nova do Prado, and Praia da Vagueira (N = 4649 houses; see Pinho 2012). These individuals were approached in their houses in 2006, during summer season. Three attempts were made to establish contact and ask individuals to respond to the survey. Contact was established in 11.21% of the houses and 8.82% of the individuals agreed to respond. The response rate of the individuals who were contacted was 78.69%. In concrete, 410 individuals responded to the survey:

15.10% from Praia de Esmoriz, 9.30% from Praia de Cortegaça, 36.60% from Furadouro, 11.50% from Praia da Barra, 12.70% from Costa Nova do Prado, and 14.90% from Praia da Vagueira. Most individuals were female (59.80%), were more than 65 years old (53.40%), had medium education levels (34.10%), were permanent residents (56.10%), and had an income below 500 Euros (9.30%). The large majority of individuals (80.70%) did not answer the income question, therefore this data was not further analysed.

2.1.1 Coastal hazards: erosion, coastline retreat, flood, overtopping, storm, and tsunami

The case-study areas have a higher probability of occurrence of erosion, coastline retreat, flood, overtopping, and storm, than of tsunami. The areas have been classified as having a high risk of erosion and flood, as well as being afflicted by the related hazards of coastline retreat and overtopping (CEHIDRO/INAG 1998; Pereira and Coelho 2013; Dias and Alves 2013). These areas are also among the most severely hit by storms in Portugal (Dias, Ferreira and Pereira 1994). Wave records between 1981 and 2003 show that 8.6% of the total records illustrate storms (Coelho 2005) and, according to European hazard maps, the probability of occurrence of a storm surge is medium/high (Schmidt-Thomé and Kallio 2006). Regarding tsunami, its probability of occurrence in the case-study areas is very low. The areas are not in close vicinity to tectonically active zones that have already experienced tsunami run-ups from earthquakes, volcanoes and/or resulting (submarine) landslides (Schmidt-Thomé and Kallio 2006).

2.2 Procedure and measures

The questionnaire was administered face to face at the houses of the individuals as part of a major study aiming to illustrate people's knowledge and risk perceptions on coastal

zone management and planning (see Pinho 2012). Data for coastal risk awareness, reliance on the sufficiency of current measures, and coastal risk perception was collected, among other information.

Coastal risk awareness. Individuals were asked to respond *yes* or *no* to the following question: *Nowadays, do you consider yourself informed about the problems of coastal area protection and aware of the risk that coastal zone populations are exposed to?* In addition, individuals were asked to indicate if the following were sources of their risk awareness (*yes* or *no*): (1) *life-acquired knowledge*, (2) *television*, (3) *newspapers*, (4) *the internet*, (5) *awareness-raising campaigns*, (6) *public participation events*, (7) *friends/neighbours*, (8) *formal education.*

Reliance on the sufficiency of current measures to prevent coastal risk. Individuals were asked to respond *yes* or *no* to the following question: *Do you consider that the measures necessary to prevent the impacts of possible hazards have been implemented?* Individuals were further asked to indicate up to three of the measures that they considered to be sufficient: (1) *prohibition of construction by the sea*, (2) *relocation of buildings at risk*, (3) *permitting only non-structural and movable occupancy by the sea*, (4) *protection and restoration of the dunes*, (5) *beach renourishment*, (6) *prohibition of sand extraction*, (7) *monitoring/redefinition of the shoreline*, (8) *implementation of coastal engineering structures*, (9) *increase/restructuring of coastal engineering structures*, (10) *removal of coastal engineering structures*, (11) *awareness-raising campaigns*, (12) *inspection*, (13) *monitoring*, (14) *research*.

Coastal risk perception. Individuals were asked about the probability of occurrence of the following hazards: (1) *erosion*, (2) *coastline retreat*, (3) *flood*, (4) *storm*, (5) *overtopping*, and (6) *tsunami*. A 4- point scale was used, ranging between 4 –

most likely, 3 – *likely*, 2 – *not likely*, and 1 – *impossible*. Means and standard deviations for each event and impact are presented in Table 1. The 6 items were highly related and were averaged into a composite measure: the coastal risk perception scale. This measure reflected the average probability of occurrence of these hazards, with an adequate level of internal consistency reliability (Cronbach's $\alpha = .71$; Nunnally and Bernstein 1994).

[Table 1 near here]

Recall of coastal risk-related events. This measure was analysed for exploratory purposes. Individuals were asked to respond *yes* or *no* to the following question: *Do you know any coastal risk-related event that occurred in this area.*

3. Results and Discussion

The majority of individuals reported that they were aware of coastal risk (82.00%) and that they recalled episodes of costal hazard (56.60%). Most individuals reported that their sources of awareness were *life-acquired knowledge* (62.00%) and *television* (45.90%), and a considerable number referred *newspapers* (28.30%). Relatively few referred *friends/neighbours* (7.80%), *the internet* (6.10%) and *formal education* (4.60%), and very few referred *awareness-raising campaigns* (1.50%) or *public participation events* (0.20%). Awareness of coastal risk was our dependent variable, therefore we analysed if it varied in function of socioeconomic variables. Data analyses demonstrated that awareness of coastal risk was not associated with gender, χ^2 $(1, N = 410) = 3.15$, $p > .050$, or age, χ^2 $(3, N = 410) = 1.59$, $p > .050$. It was, however, associated with literacy. While among individuals with higher levels of literacy almost everyone (94%) was aware of costal risks, among those with lower literacy this percentage significantly dropped to 72%, χ^2 $(3, N = 410) = 15.33$, $p < .001$, Cramér's $V = .193$.

The majority of individuals reported that they rely on the sufficiency of current protective measures (57.30%). The measure that most respondents considered to be sufficient was the *implementation of coastal engineering structures* (53.80%), as expected. A considerable number of respondents also indicated *protection and restoration of the dunes* (23.09%), and *prohibition of construction by the sea* (10.05%). Despite the frequent interventions that take place in the study areas, only a few participants indicated *increase/restructuring of coastal engineering structures* (5.70%), which suggests that few individuals believed that changes had to be made in current coastal engineering structures. Very few considered *inspection* (1.63%), *prohibition of sand extraction* (1.09%), *monitoring/redefinition of the shoreline* (1.09%), *awareness-raising campaigns* (1.09%), *beach renourishment* (0.82%), *monitoring* (0.82%), and *research* (0.27%). No participant referred *relocation of buildings at risk*, *permitting only non-structural and movable occupancy by the sea*, or *removal of coastal engineering structures*.

The mean value of the coastal risk perception was 2.72 (*SD* = 0.54), indicating that the mean perceived probability of coastal risk was between *less likely* and *likely*.

3.1 Coastal risk perception normalization

We followed Baron and Kenny's (1986) general steps for mediation analysis, in order to calculate the effect of coastal risk awareness on risk perception mediated by reliance on current measures. The mediator (reliance on current measures) was a dichotomous variable. Therefore, we used both linear and logistic regression methods and we opted for reporting the unstandardized coefficients (*B*) of all analyses. To test for the significance of the mediation effects, we used the Sobel test, which has proved to be adequate for large samples (MacKinnon et al. 2002).

H1 was corroborated. The relationship between coastal risk awareness and risk perception was negative and mediated by reliance on current measures. As Figure 2(a) shows, individuals who are aware of coastal risk were significantly more likely to rely on current measures to prevent coastal risk, and reliance on current measures was significantly related to lower risk perception of coastal risk. The coefficients for the total effect (effect of coastal risk awareness on coastal risk perception) and direct effect (effect of coastal risk awareness on coastal risk perception, controlling for reliance on current measures to prevent coastal risk) demonstrated a decrease in the size of the coefficient, as expected. The direct effect was smaller than the total effect and non-significant, indicating that there might be a total mediation effect. The mediation effect was significant (z = -2.74, p = .006).

[Figure 2(a) near here]

3.1.1 Probability of hazard occurrence

We expected coastal risk awareness to reduce coastal risk perception through its effect on reliance on current measures, particularly for hazards with a higher probability of occurrence (erosion, flood, coastline retreat, overtopping, and storm), when compared to hazards with a lower probability of occurrence (tsunami). To test it, we reran separate mediation analyses for the hazards aggregated in the coastal risk perception scale. A summary of simple mediating analyses is presented in Table 2. Coefficients between coastal risk awareness and reliance on current measures to prevent coastal risk are not presented in Table 2, because the value is the same across coastal hazards (B = 1.03**).

[Table 2 near here]

H2 was only partially corroborated. As expected, we found significant mediation effects for all hazards, with the exception of tsunami, which was the only hazard with a

low probability of occurrence. However, among the hazards with a high probability of occurrence, although all mediation effects were significant, the total effects diverged, and there was a case of inconsistent mediation. Total effects were stronger for flood and storm, and smaller and non-significant for erosion and overtopping. Statistically, it is understandable that all mediation effects emerged as significant, because the test for mediation effect has relatively more power than the test for total effect. As described by Kenny and Judd (2014), it is possible and quite common to find mediation but no statistical evidence that the causal variable is related to the outcome. Theoretically, results indicate that coastal risk normalization, as a result of reliance on current measures to prevent coastal risk, is more likely to occur among higher-probability hazards that might be catastrophic and have immediate consequences (flood and storm) than among higher-probability hazards that are common and have cumulative consequences in time (erosion and overtopping).

The hazard of coastline retreat is more complex and appears to illustrate a case of inconsistent mediation (see MacKinnon, Krull, and Lockwood 2000; MacKinnon, Fairchild, and Fritz 2007). Although individuals who are aware of coastal risk were significantly more likely to rely on current measures, and reliance on current measures was significantly related to lower risk perception of coastline retreat, the relationship between coastal risk awareness and risk perception of coastline retreat was positive, not negative. Furthermore, the direct effect of coastal risk awareness on coastal risk perception was larger than the total effect, as is typical of inconsistent mediation. Inconsistent mediation suggests there are probably other variables that are related to coastal risk awareness, which have stronger and opposing effects in terms of reliance on current measures, and which, therefore, increase the perception of coastline retreat. Such variables might have to do with the specific nature of this retreat. Coastline retreat

has been quite large in these study areas, reaching an average of 10 m/year (CEHIDRO/INAG 1998). The cumulative changes in coastline retreat are concrete and evident, and individuals would probably need to engage in a high psychological effort in terms of their reliance on current measures, in order to minimize their awareness of occurring coastline retreat.

Regarding tsunami, we found no significant mediation effect, and awareness of coastal risk did not significantly relate to a lower risk perception of tsunami. Curiously, reliance on current measures was positively related to risk perception of tsunami: individuals who relied on current measures perceived a higher probability of occurrence of tsunami. This result is unexpected. Tsunami had a very low probability of occurrence, but its consequences might be catastrophic and, therefore, local individuals might need to deal with them, even if to a lower extent than when compared to higher-probability hazards. Indeed, current protection measures were not suited for tsunami. Nonetheless, individuals could heuristically perceive that current measures, in particular coastal engineering structures, could create a barrier for tsunami, as they appear to believe they did for storms. As such, we would expect to find a negative relation, of a smaller size or even non-significant, but not a positive relation. When analysing tsunami and other hazards together, results appear to illustrate that reliance on current measures regressed both high and low-probability hazards to a risk perception norm, to an extent where reliance is negatively related to high-probability hazards and positively related to a low-probability hazard. Theoretically, this is an interesting possibility to explore. Nonetheless, we believe that in this case there might be a more simple explanation. Results might indicate that reliance on current measures acted as a confounding variable, regarding the risk of tsunami, as we will discuss further ahead.

3.1.2 Type of residence

To analyse the effects of the type of residence, we reran separate analyses for permanent and temporary residents. Based on the previous results, we computed a new risk perception scale, which combined the hazards whose effects were clear (flood and storm; Cronbach's $\alpha = .67$).

H3 was supported. The mediation model was significant for permanent residents but not for temporary residents (see Figure 2(b). Among permanent residents, individuals who were aware of coastal risk were significantly more likely to rely on current measures to prevent coastal risk, and reliance on current measures was significantly related to lower risk perception. The direct effect of coastal risk awareness on coastal risk perception was smaller than the total effect, and the mediation effect was significant ($z = -2.08$, $p = .037$). Among temporary residents, we found no risk perception normalization. In addition, individuals who were aware of coastal risk were not significantly more likely to rely on current measures to prevent coastal risk, and reliance on current measures was not significantly related to lower risk perception.

[Figure 2(b) near here]

To better understand the differences between permanent and temporary residents, we explored whether there were differences in awareness of coastal risk. We found no differences in awareness, $\chi^2 (1, N = 410) = 1.35$, $p > .050$, but found differences between the sources of awareness. Permanent residents reported more often that the source of their awareness was life-acquired knowledge ($\chi^2 (1, N = 336) = 6.07$, $p = .016$, $\phi = -.134$), whereas temporary residents reported relatively more often that the source of their awareness was television ($\chi^2 (1, N = 336) = 5.26$, $p = .027$, $\phi = .125$) and newspapers ($\chi^2 (1, N = 336) = 9.22$, $p = .003$, $\phi = .166$). Not surprisingly, this suggests that coastal risk awareness based on life-acquired knowledge induces a larger amount of coastal risk perception normalization, mediated by reliance on current measures, than

awareness based on television and newspapers. A greater level of contact and personal experience with coastal risk-related events should result from awareness based on life-acquired knowledge than from awareness based television and newspapers, thereby setting a more solid context for the occurrence of coastal risk normalization mediated by reliance on current measures among permanent residents.

For exploratory purposes, we further analysed whether there were differences in the recall of coastal risk-related events between permanent and temporary residents but no differences were found, χ^2 (1, N = 328) = 0.33, $p > .050$. However, differences emerged when we run separate mediation analyses for permanent and temporary residents who recalled and who did not recall coastal risk-related events. The mediation effect of reliance on current measures on costal risk normalization only emerged for permanent residents who recalled particular costal risk-related events. The effect was marginally significant for permanent residents who recalled (z = -1.75, p = .080), but non-significant for permanent residents who did not recall (z = -1.23, p = .219), non-significant for temporary residents who recalled (z = -1.37, p = .169), and non-significant for temporary residents who did not recall (z = -0.03, p = .978). The effect found for permanent residents who recalled is only marginally significant, maybe because the analyses had relatively less statistical power, as smaller size sub-samples were used. Nonetheless, results suggest that living permanently in a high risk zone, combined with recalling coastal risk-related events, might lead to a greater need to rely on current measures to normalize coastal risk perception, as could be expected from research on positive illusions.

We also analysed if there were socioeconomic differences between permanent and temporary residents. Data analyses showed no differences as a function of gender, χ^2 (1, N = 410) = 1.27, $p > .050$. There were, however, differences as a function of age and

literacy. The majority of individuals younger than 44 years old were permanent residents (73.30%), but the age difference significantly dropped when we consider individuals older than 65 years old (48.40%), χ^2 (3, N = 410) = 14.81, p = .002, Cramér's V =.190. Also, the majority of individuals with higher levels of literacy (66.70%) were temporary residents, whereas the majority of individuals with lower literacy (82.40%) were permanent residents, χ^2 (3, N = 410) = 33.74, p < .001, Cramér's V =.287. The existence of these differences indicates that more research is needed, in order to clarify the differences between permanent and temporary residents, as well as the relation between risk normalization and socioeconomic variables.

Results are in line with the need to distinguish between permanent and temporary residents, and to tailor adequate coastal risk management strategies. Permanent residents appear to be more vulnerable to risk normalization, particularly those who recall coastal risk-related events. Temporary residents appear to have less life-acquired knowledge and, therefore, less personal experience in dealing with coastal hazards. It may also be worth considering socioeconomic differences between permanent residents and temporary residents, to better tailor coastal risk management strategies.

4. Conclusions

According to deficit model approaches, awareness of coastal hazards should lead to more technically-accurate risk perceptions. However, our research shows that awareness of high-probability coastal hazards can, on the contrary, lead to a lower risk perception, particularly when coastal hazards might be catastrophic, and when individuals are permanent residents of costal zones. Risk awareness was related to a lower, more psychologically-adapted, risk perception, and not to a higher, more technically-accurate, risk perception. This risk normalization effect was mediated by reliance on current

measures to prevent coastal risk. Relying on the sufficiency of current measures was a positive illusion that was functional in lowering coastal risk perception, even in the face of frequent coastal events, impacts, and emergency interventions that contradicted the sufficiency of current measures. Maintaining this positive illusion might justify inaction towards current coastal risk, and reduce adaptation to climate change.

4.1 The role of risk awareness in coastal risk management

Risk awareness plays an important role in coastal risk management. Individuals must be aware in order to be able to evaluate risk, to make informed decisions, and to take protective measures. However, coastal risk management among local individuals should not be all about awareness. First of all, because individuals that live by the coast probably already have some type of awareness. We found that the vast majority of individuals living in coastal zones was aware of coastal risk. This is only natural because coastal populations are the ones who deal most directly with this physical space, and also because they are the ones who have a better knowledge of the processes/phenomena that occur there (Martins, Betâmio de Almeida, and Pinho 2009). The knowledge of local individuals may not be technical, but that does not necessarily mean that it is incorrect. There is evidence that local individuals accurately understand coastal risk and coastal changes (Kellens et al. 2011; Schmidt et al. 2014). Fishermen, in particular, have specific and profound knowledge about the coast, which, if integrated in coastal planning, could probably improve the quality of decision-making (Delicado et al. 2012).

Secondly, it should not be all about awareness, because the effects of awareness are not as straightforward as assumed by deficit model approaches. As we have shown, individuals that are more aware of high-probability coastal hazards with catastrophic

consequences actually have a lower risk perception. Therefore, providing individuals with information on coastal risk might lead to risk perception normalization, in order to psychologically cope with hazards. This might be particularly true if risk awareness campaigns are narrowed down to fear appeals, and if there is no involvement of the public in a discussion about the effectiveness, feasibility, or ease with which particular strategies might avert coastal hazards. Research on fear appeals and persuasion suggests that a fear appeal message might only be successful in motivating people to engage in protective strategies if it successfully increases people's confidence that they are capable of engaging in these strategies, and if these strategies are an effective means of avoiding the threat (e.g., Witte et al. 1996; Maloney, Lapinski, and Witte 2011). Coastal risk awareness campaigns that are limited to providing risk information (which is likely to arouse fear) and that do not involve the public might end up increasing threat perception without increasing individuals' perceived efficacy in dealing with it. This will create the need for the use of positive illusions, instead of motivating people to actually engage in protective strategies. This type of campaign might be quite common. As Rowe and Frewer (2000) pointed out, deficit model approaches tend to limit risk management to providing risk information using top-down forms of communication that leave no room for public involvement.

4.1.1 Higher public engagement as a way to bypass positive illusions

It is not all about awareness, but it may be about public engagement. Public engagement is fundamental because it assures democratic legitimacy, as individuals have the right to be involved in coastal risk management decisions that affect their lives. Furthermore, public engagement might help individuals to cope with coastal hazards in a more adaptive way than through the use of positive illusions. As we will argue below, both the process and the contents of public engagement might contribute to bypassing

positive illusions, so that individuals can adopt further protective strategies to prevent costal risk.

Research on the psychosocial impacts of environmental changes suggests that processes of high public engagement might facilitate coping with environmental threats, to the extent that they reduce threat-related anxiety (Luís, Neves, and Palma-Oliveira, forthcoming). Public engagement practices that get individuals more involved in decision-making processes might enhance individuals' perception of predictability and control over the environmental issues that are being discussed. Such practices facilitate coping because events tend to be considered less threatening the more controllable and predictable the individuals perceive them to be. By being able to participate in decision-making, individuals might realize that environmental threats can be controlled and predicted. Therefore, the need to rely on positive illusions to cope with coastal risk is expected to diminish.

Higher public engagement can also make room for the discussion of crucial contents, such as the effectiveness of different strategies in deterring coastal risk, and the ability that risk managers or individuals have to implement those strategies. This discussion is expected to increase individuals' perceived efficacy in dealing with coastal risk, thereby motivating them to endorse the protective strategies that originated from their engagement process. Individuals would no longer need to rely on positive illusions to cope with coastal risk. At the same time, public engagement might also allow local knowledge to be taken into account, which would most likely improve coastal risk management.

We thus suggest that higher public engagement might strengthen the capacity that local individuals have to deal with coastal risk more efficiently. Public engagement could be a promising avenue for future studies.

4.2 Study limitations

Some methodological limitations of the current study must be acknowledged. The study was correlational. As such, conclusions do not allow for the same level of internal validity as conclusions drawn from experimental studies, particularly regarding the establishment of causal relations between variables. Nonetheless, the relations between variables that emerged in this study are firmly sustained by a substantial body of research in risk perception (e.g., Lima 2004; Lima, Barnett, and Vala 2005; Halpern-Felsher et al. 2001).

Also, the measures of awareness of coastal risk and reliance on current measures, as well as the measure of recall of coastal risk-related events, were dichotomous. Dichotomous variables capture extreme responses well (e.g., very low and very high awareness), but not medium responses (e.g., partial awareness), and do not allow for finer statistical analyses of variations in the levels of the variables. Even so, risk normalization emerged as mediated by reliance on current protective measures, which suggests that this effect can be quite pervasive. Future studies could benefit from distinguishing between awareness levels, and understanding how personal experience and recall of coastal risk-related events can interact with reliance on current measures in order to influence risk perception.

Another limitation of this study is that the measures of awareness of coastal risk and reliance on current measures focused on coastal risk in general, whereas the risk perception measure listed specific hazards. This difference could provide an alternative explanation of the study results. Results might have stemmed from individuals misunderstanding the risks included in the awareness and reliance questions. In particular, this might have happened for tsunami which was a very low-probability hazard that most likely was not highly accessible in individuals' memory. Therefore,

respondents might not have considered tsunami as a hazard against which current measures should protect. We believe, however, that this limitation does not apply to high-probability hazards, which were frequent in the case-study areas and, as such, should be highly accessible in memory.

Despite these limitations, this study provides relevant insights on the relation between awareness of coastal risk and coastal risk perception, pointing out that awareness of high-probability catastrophic hazards might lead to the normalization of risk perception, as a result of reliance on current measures. Results suggest that coastal risk management might benefit from taking risk perception normalization effects into account, from tailoring strategies for permanent and temporary residents, and from promoting a higher public engagement, to facilitate a more adaptive and effective coping process.

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Table 1

Descriptive statistics for coastal risk perception (N = 410).

Variable	*M*	*SD*
Erosion	3.04	0.82
Coastline retreat	3.43	0.75
Flood	2.42	0.82
Overtopping	3.00	0.84
Storm	2.30	0.70
Tsunami	1.82	0.63
Risk perception scale	2.72	0.54

Table 2

Summary of mediating analyses between coastal risk awareness (IV) and the risk perception of hazards (DV), as mediated by reliance on current measures (M).

Variable	M → DV	IV →DV (total effect)	IV→ DV, controlling for M (direct effect)	Sobel test (*z*)
Erosion	- 0.57***	- 0.08	- 0.04	-2.96**
Coastline retreat	- 0.30***	0.18	0.25*	-2.43*
Flood	- 0.28**	- 0.27*	- 0.21	-2.20*
Overtopping	- 0.34***	- 0.02	0.05	-2.40*
Storm	- 0.28**	- 0.29**	- 0.22*	-.2.41*
Tsunami	0.18*	- 0.05	- 0.10	1.89

Note: * $p < .05$, ** $p < .010$, *** $p < .001$.

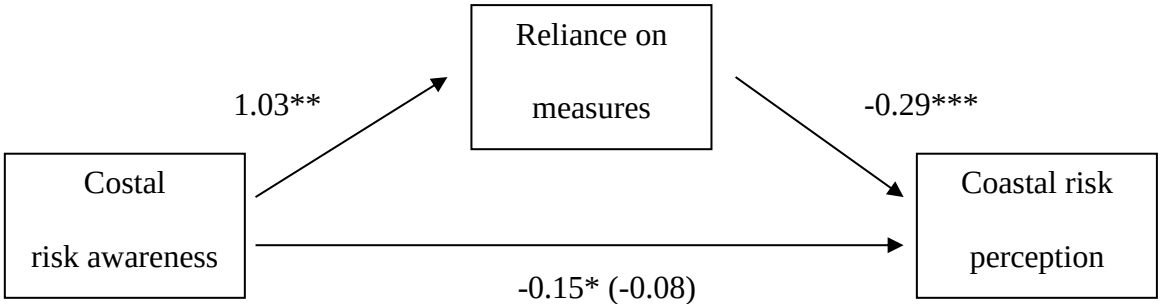

Figure 2(a). Unstandardized regression coefficients (*B*) for the relationship between coastal risk awareness and risk perception, as mediated by reliance on current protective measures. The unstandardized regression coefficient for coastal risk awareness and risk perception controlling for reliance on current measures is shown in parenthesis.

* $p < .05$, ** $p < .010$, *** $p <. 001$.

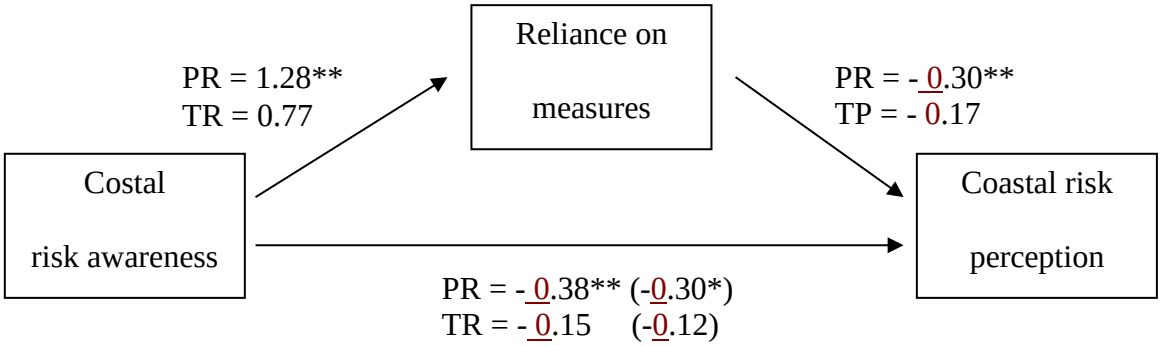

Figure 2(b). Unstandardized regression coefficients (*B*) for the relationship between coastal risk awareness and risk perception of catastrophic hazards (flood and storm), as mediated by reliance on current protective measures, for permanent residents (PR; *n* = 230) and temporary residents (TR; *n* = 180). The unstandardized regression coefficients for coastal risk awareness and risk perception controlling for reliance on current measures are shown in parenthesis. * $p < .05$, ** $p < .010$.