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Industrial risks by the coast: How people-place bonds impact acceptance of a red mud recycling project

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Abstract

Industries sometimes leaves invisible yet dangerous chemical memories of their activities. Because these compounds are invisible, people rely on heuristics informed in part by people-place relations to make a risk judgement. The Marseille region of France provides an interesting case to analyse how local risks are judged in relation to people-place variables. The perceived risks of a depollution project where "red mud" (an industrial residue) is used to neutralize lead-contaminated soil are analysed in relation to (1) place attachment; and (2) trust in several types of organisation. Results show that participants with stronger local attachment perceive their local environment as less polluted and consider the project as a greater threat. Furthermore, risks vs. benefits associated with the project are significantly explained by age (associated with perceived risk) and trust in societal organisations (associated with perceived benefits). Discussion considers how the diversity of local publics could lead to widely different reactions to the depollution project across the city's social tissue.

Keywords: red mud; risk perception; place attachment; institutional trust; industrial pollution, Marseille.

Coastal areas are highly attractive territories. In France, demographic density along the coast is twice as high as that observed elsewhere (272 inhabitants / km2 vs. 118) (Le Délézir, 2008). This can be explained partly by economic factors such as the competitive advantage for employers of easy access to maritime transport (Miossec, 2001). The attraction of blue environments can also be explained psychologically, in terms of quality of life, as demonstrated by the positive effects of living by the coast upon wellbeing and health (White, 2013).

Demographic pressure along the coasts as well as sometimes irreconcilable land uses or logics of occupation make coastal areas into "zones of tension" (Robert & Melin, 2016; Gomez & Picarzo, 2006). Different temporalities of land use too produce tensions, between e.g. the present-day urbanization of the coastal environments and the past industrial activities that have left significant chemical traces of their presence in Marseille, over the course of the last century (Mioche, 2011). Despite important advances in the reconditioning of previously polluted areas for urbanization, the necessary excavation and removal of soil is sometimes made difficult or impossible by present-day land use, such as when private buildings exist on the polluted land (e.g. Jadach-Sepiolo, Muszyńska-Jeleszyńska, & Spadlo, 2016). These difficulties force some local communities to manage polluted sites by integrating them into the present-day environment. This has been achieved in Marseille though the creation of a national parc integrating parts of these previously polluted sites (Claeys, Hérat, Barthélémy, & Deldrève, 2017).

The city of Marseille provides a good example of land uses from different times in conflict. In the early XIXth century waste from the booming local chemical industry was disposed of far from the city centre and away from the public eye (Barthélémy, 2016). Today Marseille has grown to be France's second most populated city (behind Paris) and developed to a point where the urban sprawl has reached these polluted places (Desrousseaux, 2017).

The invisibility and cumulated effects of chemical pollutants means that the perception that one is exposed, and the extent of this exposure is based on locally crafted logics, which are part of people-place bonds (Dixon & Durrheim, 2000). This singular context of coastal pollution presents an opportunity to analyse how industrial pollution risks are perceived and how they concern inhabitants who might be more or less attached to a place (e.g. Wakefield, Elliott, Cole, & Eyles, 2001). This article presents a study where the perceived risks associated with a depollution project are examined. More precisely we inquire how place attachment (e.g. Bonaiuto, Alves, De Dominicis, & Petruccelli, 2016) and trust in organisations (e.g. Engdahl & Lidskog, 2014) explain the different reactions to a possible depollution project.

In the following sections we start by reviewing the historical context of the industrial pollution in the region, the issue of "red mud" (an alkaline industrial residue) and how this particular residue could be applied to depollute other affected soils. Then, we present our analytical framework guiding our survey study, and finally show how the variables associated with people-environment relations (place attachment and trust) can explain the risks people associate with the red mud depollution proposal.

Historical context: the industrial past in Marseille

Metal manufacturing and trade expanded significantly during the industrialisation of the Marseille region. In the early XIXth century the region grew with development of the steel industry (Daumalin & Raveux, 2001) and the important connections between the port of Marseille and other regions supplying raw materials. Among the activities that took root in the region at that time, the lead and the alumina (aluminum oxide) industry were of paramount importance (Daviet, 2000).

The lead industries mainly worked with two smaller ports near Marseille - Les Goudes and Escalette (Desrousseaux, 2017). Placed at a convenient distance from the city centre, they successfully harboured lead industries enjoying easy access to both the main Marseille port and the Mediterranean Sea used as a dumping ground. The soil around these places today is still contaminated by heavy metals including lead (Testiati, 2012). Importantly, the toxicity associated with these metals is dependent upon the acidity of the soil - the more acidic it is, the greater the toxicity of the metals for living organisms (Peijnenburg & Jager, 2003; Smolders et al., 2009). The local authorities assessed the threat of this site to the local population in 2005, resulting in restrictions of access to the area. The population was informed through billboards in the region (Desrousseaux, 2017) although local inhabitants systematically removed them.

The other chemical residue that has more recently stirred the local public opinion is the local environmental destiny of ‘red mud’. Red mud results from the production of alumina - a material used in aluminium smelting, advanced ceramics and other chemical processes. The Barcelona Convention[1] halted this type of production in the Mediterranean basin as of 2016; however, the existing alumina factory obtained an exemption, also enabling disposal of only processed aqueous remainders in the Mediterranean Sea. This exemption was locally highly contested (Reig, Belbachir & Massenot, 2016) motivating opposition even by the Environment Minister at the time (see Barraqué, 2017). In this way, since 2016 red mud must be dewatered and the liquid part processed before disposal to reduce volume and metal content, in order to decrease environmental burden. Regarding the solid residues, because the

[1] Barcelona Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (http://ec.europa.eu/environment/marine/international-cooperation/regional-sea-conventions/barcelona-convention/index_en.htm)

sea can no longer receive them new alternatives must be found for sub-products disposal (e.g. the Mange Garri disposal site in Bouc Bel Air) or, ideally, recycling[2].

Therefore, this article presents the analysis of the public's response to use the alkaline 'red mud' residues, to *neutralize* the acid pH of the lead-contaminated soils around Marseille. Application of red mud residues on lead-polluted soils would recycle waste that would otherwise be disposed of on land, using it to neutralise the acidity of lead-contaminated soils around Marseille. This pH neutralisation would reduce the bioavailability and the toxicity of metals and metalloids present in the soil of these regions (Merdy et al., 2017). This depollution proposal would present an interesting synergy in sustainable waste management. Still, considering the public controversies it could raise, we decided to analyse the public's reaction to the project. Therefore a direct 'treatment' of the Escalette site was excluded: the robustness and long-term efficiency of the red mud recycling process was to be tested *ex situ* using some contaminated soil and slag excavated from the Escalette area.

The idea that pollutants could be used to neutralize other pollutants might seem counter-intuitive. Moreover, in a context where the industrial memory also witnesses struggles over power and the right to pollute (Loison & Pezet, 2006), it is important to analyse the extent to which the local populations in Marseille (1) are aware of the environmental situation surrounding them in general, and about the red mud, in particular; and (2) perceive the risks vs. benefits associated with this red mud recycling project. In the following section we will present two variables hypothesised to influence the perception of this project: place attachment and institutional trust.

[2] Local decree creating an expert committee to monitor the changes Alteo (the emitting industry) made to comply with regulations: http://www.calanques-parcnational.fr/sites/calanques-parcnational.fr/files/atoms/files/20160331_ap_creation_csirm.pdf

Place attachment

Place attachment corresponds to the complex affective bonds individuals and groups progressively build with the place where they live, visit or with which they are familiar (Devine-Wright, 2009). People-environment bonds can be understood in a variety of ways (Patterson & Williams, 2006) or differently depicted according to whether research aims are predominantly qualitative or psychometric (Lewicka, 2011). In our study we favoured a conceptualization of place attachment as an emotional bond that drives an individual to preserve an association with a given place (Hidalgo & Hernández, 2001). "It is the propensity of human beings and other animals to seek out the place where they were born or find a place in which they feel comfortable and secure" (Hidalgo & Hernández, 2001, p. 274). These bonds may often be more significant with towns or cities than with nations: "compared to countries which may change their territories and frontiers, cities are stable and continuous through time" (Lewicka, 2011, p. 212).

The problem arises when these cherished and resourceful places are seen to represent a threat (Breakwell, 2001). When this happens, an inverse relationship is often observed between place attachment and risk perception (Bonaiuto, Breakwell, & Can, 1996; Breakwell, 2001; Uzzell, 2000). For example, Bonaiuto et al. (1996) described how residents in the UK who felt more attached to their local environment (town and nation) perceived their local beaches as less polluted than those in other towns and nations – irrespective of official EU rankings for beach pollution. This inverse relationship between place attachment and risk perception was then demonstrated by Uzzell (2000) through a cross-cultural study (Australia, England, Ireland and Slovakia) where local "environmental quality" was compared to increasingly more global environmental scales - me, town, country, continent and the world. An inverse effect was consistently found between risk perceived at local vs. global scales: environmental quality is perceived as worse the farther away the geographic unit is from the

perceiver, an effect Uzzell (2000) calls environmental hyperopia. This trend to perceive local risks as smaller is interpreted by Breakwell (2001) as an adaptative effort in the face of an identity-based threat to local people's continuity, distinctiveness, self-efficacy or self-esteem. In this sense, local communities are more willing to share representations that contribute to individuals' identity protection (Breakwell, 2001). In some cases this propensity can be a dangerous 'illusion' observed among people who are attached to their environment and downplay the risks it represents, as seen in regard e.g. to flood risks in Italy (Bonaiuto, 2011) or in France (Michel-Guillou & Meur-Ferec, 2017), or to seismic risks (Lima, 2003) or coastal risks (Luís et al., 2016) in Portugal. These latter Portuguese studies illustrate how individuals living in areas highly prone to natural risks tend to 'naturalise' these risks to cope with the risks (Bertoldo et al., 2021; Luís et al., 2016).

However, a positive or direct relation between place attachment and risk perception has also been found (Bonaiuto et al., 2016), i.e. the more people are attached, the greater exposure to risk they perceive. For example, attachment to a precise tsunami-prone coast was described as an important predictor of the intention to evacuate (Ariccio et al., 2020).

Bernardo (2013) provides a convincing description of how locally attached participants perceive familiar and less dangerous risks as 'more likely'; while rare and potentially catastrophic risks are seen as 'less likely'. This study shows that people adapt the likelihood an event to how catastrophic it is, and therefore illustrates how people-place bonds can protect self-esteem from perceived threats (Breakwell, 2001).

Systematic literature reviews have underlined the pivotal role played by risk perception – and indirectly by place attachment as we have presented above – and by institutional trust as predictors of risk preparedness (Wachinger et al., 2013). The following section presents a review of how institutional trust impacts risk management.

Trust in institutions

In the past, a part of community tradition was knowledge of local risks and a set of risk prevention or mitigation practices. Beck (1992) suggests, however, that modern technologies expose communities to risks that transcend any attempt they may make to protect themselves. People can cope with this lack of knowledge by relying on 'social trust' to reduce the complexity of the issues they are faced with (Earle & Cvetkovich, 1995; Siegrist & Cvetkovich, 2000). Trust can be understood in this sense as a psychological state comprising "the intention to accept vulnerability based upon positive expectations of the intentions or behaviours of another" (Rousseau, Sitkin, Burt & Camarer, 1998, p. 395). Thus, community recognition of risk exposure and trust in responsible institutions to manage risks on their behalf is another – relational – characteristic typical of what Beck (1992) has called "risk societies".

This relational definition of trust supposes individuals (1) are *aware* a risk exists and (2) *how* do people trust institutions in charge of managing these risks (Siegrist, 2021). In situations for example where the perception of risk exposure is minimal, communities express less the need to trust in institutions in relation to other situations where risk exposure is perceived as high (Bertoldo et al., 2020).

In relation to the second point, trust in the risk management capacities of institutions and public bodies often makes the implicit or explicit distinction between performance aspects (i.e., confidence) and values (i.e., social trust) (Siegrist, 2021). In other words, we can trust institutions in different ways and for different things. In regard particularly to risk management, trust can imply different things if we mean it in a 'calculative' or 'relational' sense (Earle, 2010; Rousseau et al., 1998). Calculative trust involves the recognition that the trusted institution is sufficiently *knowledgeable* about the risk it is supposed to manage and is *able* to manage it (Engdahl & Lidskog, 2014). In this perspective the trustee would mainly be

judged on his or her competence (Fiske et al., 2002) or resources to manage a risk. Given the rational basis of calculative trust, it has been shown to be more influenced by detailed information and past events (Luhmann, 1979) than by emotion-based heuristics.

Such heuristics for their part are the basis of trust grown from the quality of previous experiences with the institution: relational trust (Engdahl & Lidskog, 2014). Trust is here regarded as "a modality of action that is relational, emotional, asymmetrical, and anticipatory" (p. 713). Here the individual extends these emotion-based heuristic judgements to other institutions perceived to be more or less socially close and to their respective reputation. Considering the empirical nature of relational trust in comparison to calculative trust, relational trust can be considered as being "broadly based, primarily concerned with intentions, and *resilient*; calculative trust, based on specific behaviours, is *fragile*" (Engdahl & Lidskog, 2014, p. 542, emphasis added).

The present study

Coastal areas are attractive spaces for broadly divergent types of activities – touristic or industrial. Present tensions can be exacerbated by past industrial activities which have left significant "chemical memories" in an environment that today harbours people who have no other choice but to deal with their exposition to heavy metals. This questionnaire study interrogates people-place relations in the context of a risky depollution project in Marseille: the use of red mud waste to treat or neutralize lead-contaminated areas (Merdy et al., 2017).

More specifically we inquire how place attachment (Bonaiuto et al., 2016) and trust in institutions (Engdahl & Lidskog, 2014) explain the acceptance or rejection of a red mud recycling and lead-depollution project. Taking the perception of exposure as a condition for the expression of trust (Bertoldo et al., 2020; Siegrist, 2021), we start by asking participants about (1) their knowledge of the red mud residue disposal in the Mediterranean sea, near

Marseille. Participants who were not aware of the issue were informed about the history of the red mud disposal in the disposal site and in the Sea. After that, a summary of the red mud recycling and lead depollution project was presented, which was not known by the public at the time of the study. Then, we asked participants to (2) position themselves in relation to the depollution project and (3) evaluate the risks and benefits associated with the project described. Finally, participants were also questioned about their (4) attachment to the city of Marseille and (5) how much they trusted different institutions.

Based on the literature reviewed above, we make three main hypotheses:

1. the more greatly attached participants will perceive the local Marseille environment as *less polluted* in relation to other places in France or Europe (cf. Luís et al., 2016; Uzzell, 2000).

2. Moreover, more greatly attached participants will more strongly oppose the red mud recycling. This expectation is based on the timeframe with which public opinion reacts to new technologies or projects: rejected by the local population at the moment of the initial announcements and concertation efforts, these projects and technologies become progressively familiarized to be finally met with lower concerns locally in relation to communities situated farther away (Lima, 2004; Lima et al., 2005).

3. Based on how institutional trust was found to assure individuals of the competence of societal institutions to manage hazards on citizen's behalf (Siegrist & Cvetkovich, 2000), we expect participants displaying *higher* levels of institutional trust to perceive *less* risk in the mud recycling and lead depollution project.

Further details about each of these variables and the study procedure are presented below.

Method

Procedure and participants

One-hundred-and-ninety-one Marseille inhabitants responded to a questionnaire in a public setting (train station and public transportation to or from Marseille). Before responding to the questionnaire, participants were asked if they were inhabitants or not. All participants informed their zip code. People living near the lead contaminated areas were especially targeted by the research team, who were present in these neighbourhoods to find participants to whom the lead contamination is more concerning. Considering these areas to be significantly less densely populated in relation to the city centre, and despite the effort to include these participants, only 9 participants (4.71%) of the sample live in lead contaminated areas. Still, we can extend the concerns about lead contamination to the whole sample because the areas surrounding the lead contaminated sites are part of the urban tissue, and highly visited during the summer season.

The sample was made up of 61.3% of women and 32.5% of men. Participants were 29.4 years old on average (16 – 83, *SD* = 13.9). Most participants said they had attained either secondary school level studies (43.6%) or a university degree (29.4%).

Variables

Place attachment. This variable was measured through a combination of two place attachment scales (Bonaiuto et al., 1996; Hidalgo & Hernandez, 2002). Example: “do you feel proud of living in this town?” (5-point scale from 1 – *not at all* to 5 – *very much*). The eight items were averaged to a single place attachment indicator (*a* = .84).

Pollution perception. This variable was inspired in the work of Bonaiuto et al. (1996) and Uzzell (2000) which demonstrated that individuals tend to downplay environmental issues of places they are close or attached to. We therefore asked through two single items “On average, would you consider natural and public spaces as polluted in Marseille in relation

to other cities?" and "On average, would you consider natural and public spaces as polluted in France in relation to other countries?" (5-point scale from 1 – *not at all* to 5 – *very much*).

Environmental identity. This variable was measured using two items (Bertoldo & Castro, 2016). Participants were asked to rate the extent to which they agreed that: "I think of myself as someone with ecological concerns" and "I think of myself as someone committed to environmental causes". The two items (Sperman-Brown coefficient = .827).

Trust. Items addressing trust in either scientific (Achterberg, de Koster, & Van der Waal, 2015) or a diverse set of other involved institutions including e.g. the media (Ren et al., 2016) were proposed (see Table 1). Participants were asked for example how much they trusted "scientists involved in this project" or "private organisations involved in the project" (5-point scale from 1 – *no trust at all* to 5 – *trust completely*). These data were then submitted to an exploratory factor analysis. Varimax rotation revealed two factors corresponding to (1) trust in science (a = .80) and (2) trust in the societal institutions (a = .70). These two factors together accounted for 68.5% of the total variance (KMO = .63; Bartlett's test of sphericity: $\chi(15) = 315$, $p < .001$). The two factors were averaged in two trust items – 'trust in science' and 'trust in societal institutions' which are not correlated, further demonstrating their independence (r = .13, p = .08).

Table 1. *Factor loadings of items addressing trust in science and social institutions*.

	Factor loadings	
I trust:	Trust in science	Trust in societal institutions
Science	**,670**	-,514
Scientists involved in this project	**,718**	-,493
Scientific information about this project	**,813**	-,255
Private organisations involved in this project	,476	**,700**
Institutions involved in this project	,604	**,639**
Media information about this project	,336	**,554**

Knowledge of the 'red mud issue' and knowledge of the red mud recycling project. These questions aimed at controlling if participants knew about (1) the historical red mud issue and (2) the red mud recycling and lead decontamination project. In any case, at this moment the researcher briefly explained through a standardized message the historical red mud issue and the possibility of using this residue to decontaminate the Escalette site. Both questions were answered with (1) *yes* and (2) *no*.

Position in relation to the project. Participants expressed their support or opposition to the red mud recycling project through the following question "How would you position yourself in relation to this red mud recycling project in Marseille?" (5-point scale from 1 – *strongly against* to 5 – *strongly favourable*).

Risk perception. Risks associated with the depollution project were measured through 3 items: risk to participants' own health, risk to the health of other city dwellers and risk to the local environment (5-point scale from 1 – *not risky* to 5 – *very risky*).

Risk vs. benefit. Using one of the simplest ways to measure risk perception (e.g. Bertoldo et al., 2016), participants were asked to compare the risks and benefits they perceive to be associated with the presented project. This 5-point Likert scale opposed the statement (1) "the *risks* associated with this project largely outweigh the *benefits*" to (5) "the *benefits* associated with this project largely outweigh the *risks*". The middle value (3) corresponded to the statement "the *risks* and *advantages* associated with this project are equivalent". Lower values convey greater risk perception while higher values indicate greater benefit perception.

Data analysis

All the questionnaire data was entered in an SPSS database. Here all the descriptive and inferential statistics were performed. We used chi square analysis in our two questions

which a had binary (yes-no) response modality – 'knowledge of the red mud issue' and 'knowledge of the project'.

All the other variables had scales as response modalities. For these variables we started with the correlations (Table 2) between all the scales. Then we opted for different analytical approaches for our different hypothesis: either variance analysis (Anova) or regression analysis. Variance analysis were used to compare how the state of the environment, and the risk presented by the project are seen by people who are more (or less) attached to the region. A variance approach for the analysis of these variables to facilitate the readability of our results in relation to the existence (or not) of an optimism bias as described in the place attachment literature. Finally, a regression analysis was performed on the perceived risk associated with the red mud recycling project. This analysis aimed at identifying from our model which are the variables that contribute (and how much) to the perceived risk vs. benefit attributed to the red mud recycling and lead depollution project.

Results

Overall knowledge of the red mud issue and knowledge of the red mud recycling project will be analysed first, followed by the psychosocial variables. Then we will present an analysis of how psychosocial variables influence risk perception.

47% of the local inhabitants in the sample had already heard of the red mud issue near Marseille. Among these participants, 17.4% affirmed they had heard of this specific red mud recycling project. Then all participants – irrespective of previous knowledge – received a standardized explanation about the red mud issue and of the depollution project and estimated their approval: 53.4% of participants were either strongly or moderately in favour of the

depollution project (*M* = 3.98; *SD* = 1.08). Project approval was not associated with place attachment (see Table 2).

Previous knowledge about the red mud issue in the region was especially high among people who identified as 'environmentalists'. This analysis was done by splitting the sample between participants whose responses were one standard deviation above and below the mean environmental identity. The groups used in this analysis are labelled as having strong (*M* = 4.36, *SD* = .42) or weak (*M* = 2.65, *SD* = .76) environmental identity. Results show that 55.8% of the participants with a *strong* environmental identity had heard of the red mud issue in Marseille compared with 35.8% among those with a weak environmental identity ($\chi^2(1)$ = 7.3, *p* = .007; Cramer's V = -.19, p < .007). These results suggest that groups more concerned with the environment are also better informed about or more attentive to the historical red mud issue in the region.

Table 2 presents the proposed psychosocial variables and their correlations. These results show that a positive correlation is observed between (1) environmental identity and place attachment; and (2) environmental identity and trust in societal institutions. While the first correlation can easily be interpreted as a heightened sense of place, the second is less clear. This could possibly suggest that participants identify more with the environment also feel a greater need to trust the various institutions dealing with the red mud issue in the region.

Table 2. *Correlations between the place attachment, environmental identity, trust and risk perception scales.*

	N of items	1	2	3	4	5	6	7	8	9	10	11
1. Place attachment	8	1.00										
2. Environmental identity	2	*.19***	*1.00*									
3. Trust (science)	3	.07	*-.01*	1.00								
4. Trust (societal institutions)	3	.03	*.21***	.13	1.00							
5. Pollution perception (Marseille vs. other cities in France)		-.14*	*-.01*	.04	.01	1.00						
6. Pollution perception (France vs. other countries)		.06	*-.03*	.13	.01	.23**	1.00					
7. Project perceived risk vs. benefit	1	.01	.08	-.04	.14	1.00	-.04	1.00				
8. Position in relation to the project		.04	-.06	.17	.07	.10	.29**	.09	1.00			
9. Perceived risk for oneself	1	-.00	.18*	-.12	-.01	-.02	.02	-.03	-.29**	1.00		
10. Perceived risk for others	1	-.06	.14	-.17*	-.01	.05	-.03	-.08	-.28**	.88***	1.00	
11. Perceived risk for the environment	1	*.12*	-.06	.07	-.02	.08	.01	-.27**	.14	.01	.07	1.00

* $p < .05$; ** $p < .01$; *** $p < .001$

Place attachment

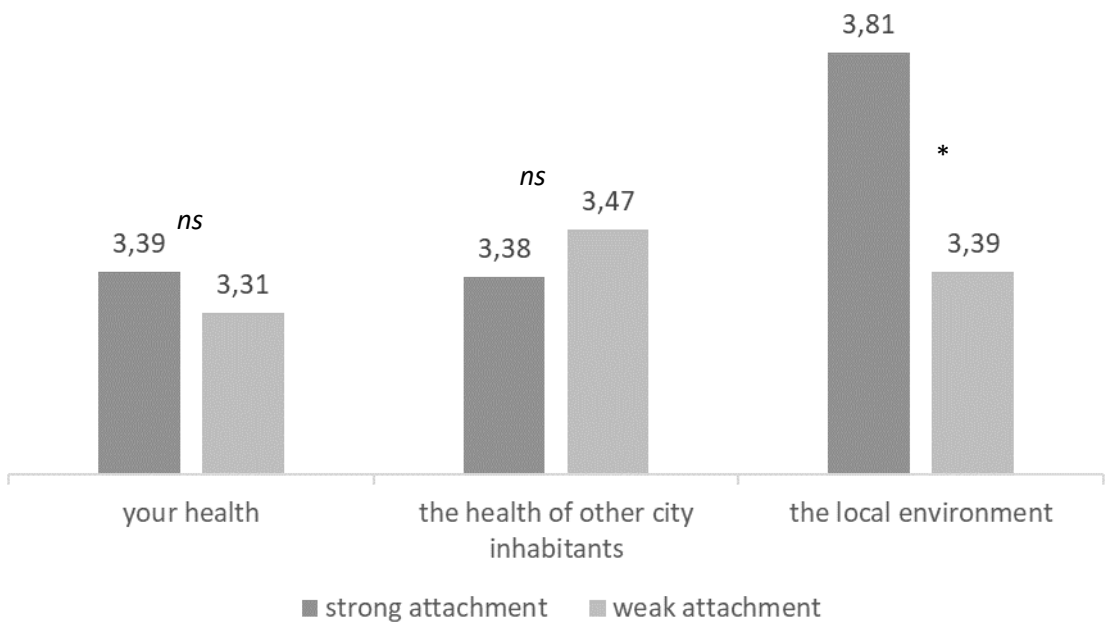
Given the strong emotional bonds experienced by people who are highly attached to their environment, we compared how people who express a high (vs. low) attachment to Marseille perceive the pollution problem in the region; and how risky they considered the depollution proposal to be. This comparison was done by splitting the sample between participants whose responses were one standard deviation above and below the mean place attachment. Hence these groups are identified as high (M = 3.9, SD = .05) and low attachment (M = 2.5, SD = .05).

A first comparison was performed to analyse how these two groups perceive the pollution (1) in Marseille in relation to the rest of France; and (2) in France in relation to other countries. Consistent with the environmental hyperopia phenomenon, participants who are more attached to Marseille tend to perceive the city as *less* polluted (M = 3.8, SD = .09) than do participants who are less attached, a marginally significant result (M = 4.1, SD = .09; $t(183) = 1.9$, $p = .056$, Cohen's $d = 3.33$). No differences between the two attachment groups

were found in relation to how they evaluate pollution in France in relation to other countries ($t(184) = -.43$, $p = .635$).

Place attachment also influenced the degree to which participants perceived the project as risky. As presented in Figure 1, respondents were asked about the threat posed by the project in relation to their own health, to the health of the other city inhabitants and to the local environment. More and less attached participants perceived similar levels of threat to their own health and the health of the city inhabitants (Figure 1). The more attached participants however perceived the project as significantly more dangerous to the local environment as compared to less attached participants ($t(179) = 2.75$, $p = .006$, Cohen's $d = .4$).

Figure 1: Perceived threat of the recycling red mud project to the respondents' own health, the health of other city's inhabitants and to the local environment in function of place attachment (strong vs. weak).



Explaining risk perception

Finally, the perception of risks vs. benefits associated with the project was entered in a regression analysis where it was modelled by the following variables: trust in science, trust in societal institutions, place attachment and environmental identity. This regression model also controlled for the variance of demographic variables (age, gender and education). The regression analysis contained three blocks of predictors: the first including demographic variables; the second assessing trust in science and trust in societal institutions; and finally, the third with environmental variables (place attachment and environmental identity). Results are presented in Table 3.

Table 3. *Regression analysis of the risk vs. benefit attributed to the red mud recycling project*.

Bloc	Predictors	*Adj. R^2*	*F*	*df*	β	*t*	LL	UL
1	Age	.068	4.5**	3,144	-.196	-2.351*	-.034	-.003
	Education				-.105	-1.264	-.198	.044
	Gender (woman)				-.148	-1.830ŧ	-.764	.030
2	Age	.085	3.67**	5,144	-.192	-2.329*	-.330	-.003
	Education				-.090	-1.053	-.192	.059
	Gender (woman)				-.161	-2.003*	-.794	-.005
	Trust in science				-.054	-.641	-.359	-.183
	Trust in private organisations				.172	2.123*	.017	.473
3	Age	.089	2.99**	7,144	-.198	-2.401*	-.035	-.004
	Education				-.094	-1.092	-.197	.062
	Gender (woman)				-.160	-1.990*	-.770	-.021
	Trust in science				-.036	-.418	-.354	.278
	Trust in societal institutions				.145	1.751 ŧ	-.069	.443
	Place attachment				.012	.144	-.213	.238
	Ecological identity				.128	1.522	-.040	.320

The first block controlling for demographic variables shows that age (β = -.196) and gender (β = -.148) explains the risk vs. benefits perceived in this red mud recycling project. The negative association between age and risk-benefit perception indicates that the older

participants are, the more likely they are to associate risk rather than benefits with this project. The negative relation with gender (dummy variable for women) suggests that women tend to attribute more risks than benefits to this project.

Trust in science and trust in societal institutions were then added in the second block of predictive variables. Trust in science does not significantly contribute to explain the risk associated with the project (β = -.054) but trust in societal institutions does (β = .172). It is positively associated with risk-benefit perception, meaning that the more people trust societal institutions, the more they attribute benefits rather than risks to this red mud recycling project. The addition of the environmental variables (place attachment and environmental identification) in the third block does not contribute further to explain the perceived risks or benefits associated with this project.

Discussion

The relative invisibility of industrial pollutants in e.g. soils means that the perception that one is exposed might depend on other variables describing people-place bonds, like place attachment or environmental identity. Thus, we explored how people-place bonds to the city of Marseille could predict local response to a potentially polemical depollution project. More precisely we have analysed two hypotheses: (1) participants more attached to Marseille would perceive lower levels of pollution (Uzzell, 2000; Bonaiuto et al., 1996, 2016) (2) would more strongly oppose the depollution project; and finally (3) participants displaying higher levels of trust would perceive lower risks in the depollution project (Siegrist & Cvetkovich, 2000).

Results show that despite the historicity and mediatisation of the red mud issue since 2014, less than half of the participants had heard about it. After being informed about the depollution project, 54% of participants evaluated it positively.

People-place variables played influenced how polluted the local environment is perceived to be, in the sense of the proposed hypotheses: participants who are more attached to the city of Marseille regard its surrounding environment as less polluted compared to people who are not attached. Moreover, attached participants regard the depollution project as riskier to the local environment than less attached participants. No differences were found between these populations for perceived risks to respondents' own health and the health of the community. This study provides additional evidence of the negative relations found between place attachment and risk perception (Bonaiuto et al., 1996, 2016) demonstrating how people-place bonds contribute to a person's sense of familiarity and security.

Finally, we modelled the perception of risks vs. benefits associated with the project. After controlling for demographic variables, only trust was seen to explain perceived risk-benefit and, more specifically, trust in societal institutions. This result means that the more participants trusted media, non-scientific institutions and private organisations involved in the red mud recycling project, the more they attributed benefits to this project. Trust in science was not related to the perceived risk-benefit of the project. On the other hand the positive effect of trust in societal institutions upon evaluation of the project as beneficial (vs. risky) makes sense in terms of risk perception heuristics. The absence of an effect of 'trust in science' suggests a low variance yielding an apparent ceiling effect (M = 3.85, SD = .78) of this variable in comparison to 'trust in societal institutions' (M = 2.57, SD = .84; $t(187)$ = 17.29, $p < .001$).

The Marseille region has seen significant social movements around how the red mud issue has been handled locally, as well as the local management of areas polluted by lead (Desrousseaux, 2017). Analyses describing the people-place dynamics in the Marseille region have been greatly supported by an interdisciplinary dispositive of applied environmental sciences (e.g. Observatoire Homme Milieux – Bassin Minier de Provence). Still, analyses of

how people-place dynamics affect the local handling of industrial risks have been infrequent (but see Claeys, et al., 2017). Our study offers an initial approach to grasping the psychosocial background to local tensions arising from conflicts over land use.

Among the limitations of this study, we acknowledge the sample could have included people more people living in the vicinity of the lead-contaminated areas. These places are already less densely populated what rendered data collection there especially difficult. Another limitation is the exclusive use of questionnaires: a more profound understanding of how place attachment and trust in institutions shape people-place bounds would be gained by analysing argumentation, through e.g. media analysis, focus group and individual interviews, and or *in situ* observations.

Our results demonstrated that variables such as trust in societal institutions and place attachment impact, as expected, the evaluation of how polluted the local environment is. We have also shown that just over half of our study participants (54%) would be favourable to the implementation of such a depollution project. This slight majority agreement must be taken with caution since this depollution project, recycling industrial residues to neutralize other legacy pollution, has not yet been scrutinized by the public. If in the future the depollution project is officially announced, with its attendant environmental impact consultations, our preliminary results may help to analyse the basis on which local people and organisations may evaluate the proposal. The identity of the institutions (scientific or other) that make the announcement and carry the project may shape whether highly attached, environmentally aware residents welcome the project or on the contrary echo the resistance identified in the 60’s when pipelines first starting to dump red mud in the Mediterranean Sea (Loison & Pezet, 2006).

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