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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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26

27

Abstract

28

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

41

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

44

45

46 Coastal areas are highly attractive territories. In France, demographic density along the
47 coast is twice as high as that observed elsewhere (272 inhabitants / km² vs. 118) (Le Délézir,
48 2008). This can be explained partly by economic factors such as the competitive advantage
49 for employers of easy access to maritime transport (Miossec, 2001). The attraction of blue
50 environments can also be explained psychologically, in terms of quality of life, as
51 demonstrated by the positive effects of living by the coast upon wellbeing and health (White,
52 2013).

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

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

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

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

87

88 *Historical context: the industrial past in Marseille*

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

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

106 The other chemical residue that has more recently stirred the local public opinion is the
107 local environmental destiny of 'red mud'. Red mud results from the production of alumina - a
108 material used in aluminium smelting, advanced ceramics and other chemical processes. The
109 Barcelona Convention¹ halted this type of production in the Mediterranean basin as of 2016;
110 however, the existing alumina factory obtained an exemption, also enabling disposal of only
111 processed aqueous remainders in the Mediterranean Sea. This exemption was locally highly
112 contested (Reig, Belbachir & Massenot, 2016) motivating opposition even by the
113 Environment Minister at the time (see Barraqué, 2017). In this way, since 2016 red mud must
114 be dewatered and the liquid part processed before disposal to reduce volume and metal
115 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)

116 sea can no longer receive them new alternatives must be found for sub-products disposal (e.g.
117 the Mange Garri disposal site in Bouc Bel Air) or, ideally, recycling².

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

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

137

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

138 *Place attachment*

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

151 The problem arises when these cherished and resourceful places are seen to represent a
152 threat (Breakwell, 2001). When this happens, an inverse relationship is often observed
153 between place attachment and risk perception (Bonaiuto, Breakwell, & Can, 1996; Breakwell,
154 2001; Uzzell, 2000). For example, Bonaiuto et al. (1996) described how residents in the UK
155 who felt more attached to their local environment (town and nation) perceived their local
156 beaches as less polluted than those in other towns and nations – irrespective of official EU
157 rankings for beach pollution. This inverse relationship between place attachment and risk
158 perception was then demonstrated by Uzzell (2000) through a cross-cultural study (Australia,
159 England, Ireland and Slovakia) where local “environmental quality” was compared to
160 increasingly more global environmental scales - me, town, country, continent and the world.
161 An inverse effect was consistently found between risk perceived at local vs. global scales:
162 environmental quality is perceived as worse the farther away the geographic unit is from the

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

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

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

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

187 *Trust in institutions*

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

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

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

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

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

224

225 *The present study*

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

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

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

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

- 245 1. the more greatly attached participants will perceive the local Marseille environment as
246 *less polluted* in relation to other places in France or Europe (cf. Luís et al., 2016;
247 Uzzell, 2000).
- 248 2. Moreover, more greatly attached participants will more strongly oppose the red mud
249 recycling. This expectation is based on the timeframe with which public opinion reacts
250 to new technologies or projects: rejected by the local population at the moment of the
251 initial announcements and concertation efforts, these projects and technologies
252 become progressively familiarized to be finally met with lower concerns locally in
253 relation to communities situated farther away (Lima, 2004; Lima et al., 2005).
- 254 3. Based on how institutional trust was found to assure individuals of the competence of
255 societal institutions to manage hazards on citizen's behalf (Siegrist & Cvetkovich,
256 2000), we expect participants displaying *higher* levels of institutional trust to perceive
257 *less* risk in the mud recycling and lead depollution project.

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

260 **Method**

261 *Procedure and participants*

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

273 The sample was made up of 61.3% of women and 32.5% of men. Participants were
274 29.4 years old on average (16 – 83, $SD = 13.9$). Most participants said they had attained either
275 secondary school level studies (43.6%) or a university degree (29.4%).

276 *Variables*

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

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

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

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

291 Trust. Items addressing trust in either scientific (Achterberg, de Koster, & Van der
 292 Waal, 2015) or a diverse set of other involved institutions including e.g. the media (Ren et
 293 al., 2016) were proposed (see Table 1). Participants were asked for example how much they
 294 trusted “scientists involved in this project” or “private organisations involved in the project”
 295 (5-point scale from 1 – *no trust at all* to 5 – *trust completely*). These data were then submitted
 296 to an exploratory factor analysis. Varimax rotation revealed two factors corresponding to (1)
 297 trust in science ($\alpha = .80$) and (2) trust in the societal institutions ($\alpha = .70$). These two factors
 298 together accounted for 68.5% of the total variance (KMO = .63; Bartlett’s test of sphericity:
 299 $\chi(15) = 315$, $p < .001$). The two factors were averaged in two trust items – ‘trust in science’
 300 and ‘trust in societal institutions’ which are not correlated, further demonstrating their
 301 independence ($r = .13$, $p = .08$).

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

I trust:	Factor loadings	
	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

303

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

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

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

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

324 *Data analysis*

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

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

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

340

341 **Results**

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

345 47% of the local inhabitants in the sample had already heard of the red mud issue near
346 Marseille. Among these participants, 17.4% affirmed they had heard of this specific red mud
347 recycling project. Then all participants – irrespective of previous knowledge – received a
348 standardized explanation about the red mud issue and of the depollution project and estimated
349 their approval: 53.4% of participants were either strongly or moderately in favour of the

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

352 Previous knowledge about the red mud issue in the region was especially high among
353 people who identified as ‘environmentalists’. This analysis was done by splitting the sample
354 between participants whose responses were one standard deviation above and below the mean
355 environmental identity. The groups used in this analysis are labelled as having strong ($M =$
356 4.36 , $SD = .42$) or weak ($M = 2.65$, $SD = .76$) environmental identity. Results show that
357 55.8% of the participants with a *strong* environmental identity had heard of the red mud issue
358 in Marseille compared with 35.8% among those with a weak environmental identity ($\chi^2(1) =$
359 7.3 , $p = .007$; Cramer’s $V = .19$, $p < .007$). These results suggest that groups more concerned
360 with the environment are also better informed about or more attentive to the historical red
361 mud issue in the region.

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

369

370 Table 2. *Correlations between the place attachment, environmental identity, trust and*
 371 *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	-	1.00		
									.29**			
10. Perceived risk for others	1	-.06	.14	-	-.01	.05	-.03	-.08	-	.88***	1.00	
				.17*					-	.28**		
11. Perceived risk for the environment	1	.12	-.06	.07	-.02	.08	.01	-	.14	.01	.07	1.00
								.27**				

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

373

374 *Place attachment*

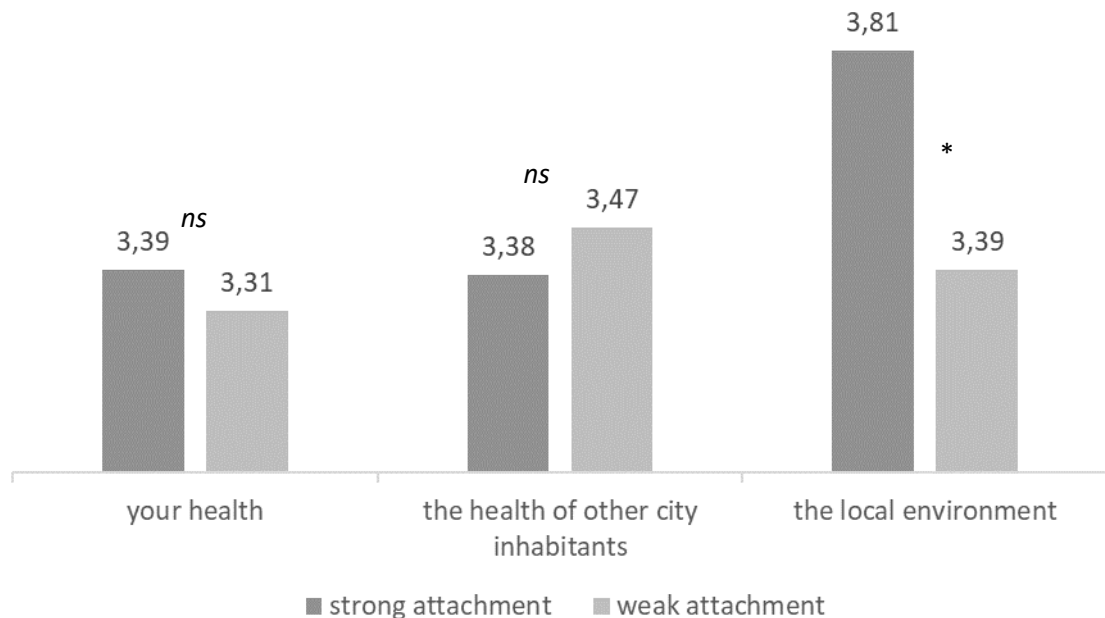
375 Given the strong emotional bonds experienced by people who are highly attached to
 376 their environment, we compared how people who express a high (vs. low) attachment to
 377 Marseille perceive the pollution problem in the region; and how risky they considered the
 378 depollution proposal to be.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

382 A first comparison was performed to analyse how these two groups perceive the
 383 pollution (1) in Marseille in relation to the rest of France; and (2) in France in relation to other
 384 countries. Consistent with the environmental hyperopia phenomenon, participants who are
 385 more attached to Marseille tend to perceive the city as *less* polluted ($M = 3.8$, $SD = .09$) than
 386 do participants who are less attached, a marginally significant result ($M = 4.1$, $SD = .09$;
 387 $t(183) = 1.9$, $p = .056$, Cohen's $d = 3.33$). No differences between the two attachment groups

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

390 Place attachment also influenced the degree to which participants perceived the project
 391 as risky. As presented in Figure 1, respondents were asked about the threat posed by the
 392 project in relation to their own health, to the health of the other city inhabitants and to the
 393 local environment. More and less attached participants perceived similar levels of threat to
 394 their own health and the health of the city inhabitants (Figure 1). The more attached
 395 participants however perceived the project as significantly more dangerous to the local
 396 environment as compared to less attached participants ($t(179) = 2.75, p = .006$, Cohen's $d =$
 397 $.4$).

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



401

402

403

404 *Explaining risk perception*

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

413 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	-1.830†	-.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 †	-.069	.443
	Place attachment				.012	.144	-.213	.238
	Ecological identity				.128	1.522	-.040	.320

414

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

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

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

429

430 **Discussion**

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

439 Results show that despite the historicity and mediatization of the red mud issue since
440 2014, less than half of the participants had heard about it. After being informed about the
441 depollution project, 54% of participants evaluated it positively.

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

451 Finally, we modelled the perception of risks vs. benefits associated with the project.
452 After controlling for demographic variables, only trust was seen to explain perceived risk-
453 benefit and, more specifically, trust in societal institutions. This result means that the more
454 participants trusted media, non-scientific institutions and private organisations involved in the
455 red mud recycling project, the more they attributed benefits to this project. Trust in science
456 was not related to the perceived risk-benefit of the project. On the other hand the positive
457 effect of trust in societal institutions upon evaluation of the project as beneficial (vs. risky)
458 makes sense in terms of risk perception heuristics. The absence of an effect of 'trust in
459 science' suggests a low variance yielding an apparent ceiling effect ($M = 3.85$, $SD = .78$) of
460 this variable in comparison to 'trust in societal institutions' ($M = 2.57$, $SD = .84$; $t(187) =$
461 17.29 , $p < .001$).

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

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

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

477 Our results demonstrated that variables such as trust in societal institutions and place
478 attachment impact, as expected, the evaluation of how polluted the local environment is. We
479 have also shown that just over half of our study participants (54%) would be favourable to the
480 implementation of such a depollution project. This slight majority agreement must be taken
481 with caution since this depollution project, recycling industrial residues to neutralize other
482 legacy pollution, has not yet been scrutinized by the public. If in the future the depollution
483 project is officially announced, with its attendant environmental impact consultations, our
484 preliminary results may help to analyse the basis on which local people and organisations may
485 evaluate the proposal. The identity of the institutions (scientific or other) that make the
486 announcement and carry the project may shape whether highly attached, environmentally
487 aware residents welcome the project or on the contrary echo the resistance identified in the
488 60's when pipelines first starting to dump red mud in the Mediterranean Sea (Loison & Pezet,
489 2006).

490

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