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**A pilot randomised controlled trial comparing the effectiveness of the MaTerre180' participatory tool including a serious game versus an intervention including carbon footprint awareness-raising on behaviours among academia members in France**

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A randomised pilot study to evaluate the effect on low-carbon behaviours in the academic sector

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1

2 **A pilot randomised controlled trial comparing the effectiveness of the MaTerre180'**  
3 **participatory tool including a serious game versus an intervention including carbon**  
4 **footprint awareness-raising on low-carbon behaviours among academia members in**

5 **France**

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24 to the sharing of this preprint on *PsyArxiv*.  
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26 Abstract

27 **Background.** Activities embedded in academic culture (international conferences,  
28 field missions) are an important source of greenhouse gas emissions. For this reason,  
29 collective efforts still need to be strengthened to lower the carbon footprint of the academic  
30 sector. Serious games are often used to promote ecological transition. Nevertheless, most  
31 evaluations of their effects either uses qualitative methods or focuses on changes in  
32 knowledge and not on behaviour. The main objectives of this study are to 1) Evaluate the  
33 feasibility of a control and an experimental behaviour change intervention and, 2) Evaluate  
34 the fidelity (the extent to which the implementation of the study corresponds to the original  
35 design) of both interventions.

36 **Methods.** People employed by a French research organisation (N=30) will be  
37 randomised to one of the two arms. The experimental arm consists in a 1-hour group  
38 discussion for raising awareness about climate change, carrying out a carbon footprint  
39 assessment and participating to a serious game called “Ma terre en 180 minutes.” The control  
40 arm consists of the same intervention (1h discussion + carbon footprint assessment) but  
41 without participating to the serious game.

42 On two occasions over one month, participants will be asked to fill in online  
43 surveys about their behaviours, psychological constructs related to behaviour change,  
44 sociodemographic and institutional information. For every session of intervention, the  
45 facilitators will assess task completion, perceived complexity of the tasks, percentage of  
46 completion of online questionnaires, duration of each session and perceived responsiveness of  
47 participants. Descriptive statistics will be done to analyse percentages and averages of the  
48 different outcomes.

49 **Discussion.** Ma-terre EVAL pilot study is a 1-month and a half pilot randomised  
50 controlled trial aiming to evaluate the feasibility and the fidelity of a 24-month randomised

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51 controlled trial aiming to change academic behaviours such as professional mobility by air,  
52 daily commuting and digital and material purchases.

53 **Keywords:** serious game, carbon footprint, psychology, professional mobility, commuting,  
54 behaviour change, RCT, human geography, air travel

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**A pilot randomised controlled trial comparing the effectiveness of the MaTerre180' participatory tool including a serious game versus an intervention including carbon footprint awareness-raising on low-carbon behaviours among academia members in France**

## **1. Background**

Reducing greenhouse gas emissions to successfully mitigate climate change is a great challenge of the 21st century. From demand-side perspective, an important percentage of greenhouse gases (72%) are related to household or “lifestyle” consumption such as housing, mobility and daily diet (Hertwich & Peters, 2009). For this reason, citizens and communities are encouraged to change their behaviours and practices to mitigate climate change not only in their individual spheres but also in their professional and collective spheres (Whitmarsh et al., 2021). If humanity wants to limit global warming to 1.5° (or 2°), a set of coordinated actions between citizens, investors, consumers, role models and professionals is needed (IPCC, 2022).

Academia members, which include scholars, technical and administrative staff working in universities and research centres, are not exempt from contributing to greenhouse gas emissions and inequalities through certain behaviours. One common practice is attending in-person scientific conferences and field missions, which have been identified as significant sources of emissions (Leochico et al., 2021). Related to the Covid-19 lockdowns, many recent studies focused on conference habits in the academic sector. For example, (van Ewijk & Hoekman, 2021) compared the impact of three in-person conferences in the United States, Korea and England, and estimated that each academic attending to one of these three conferences produced between 1.3 and 1.8 tons of CO<sub>2</sub>e.

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79 Moreover, research indicates that certain groups within academia face additional  
80 disadvantages in accessing in-person conferences. Women, individuals with household  
81 responsibilities, those requiring visa applications, scientists working in the Global South and  
82 early-career researchers are among those disproportionately affected (Cohen et al., 2020;  
83 Glover et al., 2017; Kreil, 2021a; Whitmarsh et al., 2020; Wynes et al., 2019).

84 Criticism has been raised both within and outside academia regarding the high  
85 emissions associated with such behaviours (Goodwin, 2020; Köhler et al., 2022), which can  
86 undermine the credibility of academics' recommendations on climate change (Attari et al.,  
87 2016). Nonetheless, attending in-person scientific conferences continues to be strongly  
88 encouraged and often linked to academic excellence (Berné et al., 2022; Glover et al., 2017;  
89 Kreil, 2021a; Le Quéré et al., 2015; Storme et al., 2013).

### 90 **1.1 Strategies for changing Academia's practices and behaviours: *hard* and *soft*** 91 **levers**

92 Increasingly, universities and research centres (National Centre for Scientific  
93 Research, CNRS, 2022; EHT Zurich, Kreil, 2021b), communities of actors from the academia  
94 (Ma Terre en 180 minutes community, Gratiot et al., 2023; Labo1point5 community,  
95 Labo1point5, 2021) and international conference organisers (Warner et al., 2022) are  
96 committing to proposing strategies to reduce the carbon footprint of the academic world.

97 In this study protocol, strategies will be categorised in *Hard* levers and *Soft* levers  
98 (Bamberg et al., 2011; Javaid et al., 2020; Teran-Escobar et al., 2022). *Hard* levers aim to  
99 change the economic and geographical contexts of individuals to encourage or discourage  
100 them from adopting a practice. In general, *hard* levers seek to build enabling environments for  
101 the adoption of behaviours (Michie et al., 2011). In recent years, in the Academic context,  
102 *hard* levers as economic (dis)incentives (e.g., carbon tax on air travel, Barron et al., 2020),  
103 limiting air travel by applying individual or collective quotas (Locean-Climactions et al.,

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2020; Pellarin et al., 2023), replacing air travel by videoconference (Glover et al., 2017),  
prohibiting air travel (e.g., for domestic air travel or for easily achievable travel by train) and  
making it more complicate (e.g., longer procedures) to purchase airline tickets (Hoolohan et  
al., 2021) have only started to be implemented.

*Soft* levers or behavioural interventions aim to change the psychological factors  
associated with behaviours, such as the intention to reduce air travel for professional mobility  
and subjective norms (the feeling of social pressure to adopt a practice deemed acceptable or  
expected by others). In general, *soft* levers seek to influence attitudes, motivations and reasons  
for adopting a practice (Araújo-Soares et al., 2019). In the field of behaviour change  
literature, these levers are referred to as behaviour change techniques (Michie et al., 2013).  
Some examples of behaviour change techniques in the field of academic behaviours are the  
creation of tools to inform about the emissions of air travel (Hoolohan et al., 2021), relaying  
detailed documents about how to travel in a train or engaging in eco-friendly actions during  
conferences (e.g., Warner et al., 2022), informing about the social and environmental impacts  
of air travelling (Whitmarsh et al., 2020), developing and promoting the use of collaborative  
workshops and serious games to raise awareness and discuss transition pathways (Gratiot et  
al., 2023). Indeed, serious games are becoming increasingly widespread to promote pro-  
environmental behaviours and climate change adaptation behaviours (for reviews, read  
Fernández Galeote et al., 2021; Fernández Galeote & Hamari, 2021; Flood et al., 2018).  
Although the use of serious games can influence the perception of climate change issues,  
stimulate cognitive engagement and even increase the intention of adopting new behaviours  
(Fernández Galeote et al., 2021; Fernández Galeote & Hamari, 2021), most of them present  
similar limitations (Fernández Galeote et al., 2021). First, most studies examine and evaluate  
the gains in knowledge and participants' engagement without measuring any actual  
behavioural changes. Second, they often lack of rigorous methodologies including controlled



A randomised pilot study to evaluate the effect on low-carbon behaviours in the academic sector designs (i.e., comparing the effects of an experimental group containing a serious game versus a control group containing other content or no content at all) and longitudinal designs (i.e., studies following the participants' behaviours and knowledge over weeks or months). Third, to our knowledge, there is a lack of studies taking into account the socio-spatial context of the individuals who participate in serious games (their age, their socio-economic status, the characteristics of their living areas). Ma Terre-EVAL study aims to address all the aforementioned limitations.

## 1.2 Ma Terre-EVAL pilot study

Ma Terre-EVAL is a study carried out by a consortium of researchers in social psychology, human geography and climate science aiming to better understand the motivations and obstacles to adopt ecological transitions paths in Academia. For this purpose, Ma Terre-EVAL combines concepts and knowledge in climate science, gaming and simulation, human geography and behavioural sciences to evaluate the effects of a serious game on three academic practices: professional mobility by air, daily commuting by car and digital and material purchases. Moreover, the motivations towards changing behaviours and the socio-economic and institutional contexts will also be assessed. Ma Terre-EVAL will rely on rigorous methodologies such as a randomised controlled study comparing an experimental arm versus a control arm, a longitudinal follow-up of 6 weeks spread over 24 months and a large-scale study with 1000 participants. More precisely, the sample size was estimated by using *a priori* sample calculation in G\*Power 3.1.9.4 (Erdfelder et al., 2009; Faul et al., 2007) by considering that implementing *soft* levers in our second dependent variable (because no study has investigated the effects of *soft* levers on air travel) reduces 7% of daily travel by car ( $g = 0.16$ ,  $Z = 6.419$ ,  $p < .001$ , 95 % CI [0.113, 0.213], (Semenescu et al., 2020) and considering a significance level of 0.05 and a statistical power of 80%. The behaviours of Academia's actors will be assessed through detailed online surveys (e.g., questionnaires about

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154 the numbers of academic travels, distances travelled and questionnaires assessing intentions,  
155 habits, subjective norms and socio-economic and institutional contexts).

156 The main objective of this pilot study will be to evaluate the feasibility and the fidelity  
157 of Ma Terre-EVAL study through a shorter version (a follow-up of two weeks over one  
158 month and a half) with a small number of participants. In this study, the feasibility will be  
159 understood as the extent to which the different elements of the intervention and evaluation are  
160 feasible for the implementation team (Whitehead et al., 2014) and the fidelity will be  
161 understood as the extent to which all the elements of the intervention are accurately  
162 implemented and without modifying the behaviour change techniques and contents  
163 (Bartholomew et al., 2016). For evaluating the feasibility and the fidelity of this study, a 1-  
164 month and a half pilot randomised controlled trial, parallel groups, two arms, exploratory trial  
165 with a 1:1 allocation ratio will be implemented. More precisely, the objectives of the study are  
166 twofold:

- 167 a) Evaluate the feasibility of the different elements of the interventions (completion  
168 or non-completion of planned tasks, assessment of task complexity, participation  
169 rates in intervention sessions) and the evaluation (completion rate of online  
170 questionnaires and quality of the responses) proposed in Ma Terre-EVAL study.  
171 b) Evaluate the fidelity of the behavioural interventions provided to the experimental  
172 and control arms (the extent to which all the different elements of the interventions  
173 and evaluation are feasible for the team implementing the study).

## 174 2. Methods

175 The Figure 1 shows the SPIRIT schedule of the present study. All the details related to  
176 the tools used for the assessments are presented in Table 1.

	STUDY PERIOD					
	Enrolment	Allocation	Post-allocation		Close-out	
TIMEPOINT	$-S_1$	0	$S_0$	$SI_1$	$SI_2$	$S_1$

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<b>ENROLMENT:</b>						
<b>Eligibility screen</b>	X					
<b>Informed consent</b>	X					
<b>Allocation</b>		X				
<b>INTERVENTIONS:</b>						
<b><i>Intervention A/Experimental Arm</i></b>				X	X	
<b><i>Intervention B/Control Arm</i></b>				X		
<b>ASSESSMENTS:</b>						
<b><i>Feasibility of the intervention and adherence</i></b> <i>Task completion, Perceived complexity of tasks, Participation in sessions</i>				X	X	
<b><i>Feasibility of the evaluation</i></b> <i>Completion rate of online surveys, Quality of responses</i>			X			X
<b><i>Fidelity of the intervention</i></b> <i>Exposure to the intervention, Perceived responsiveness of participants</i>				X	X	
<b><i>Academic's behaviours</i></b> <i>Number of professional trips by air, Percentage of home-work trips made by car or other modes, Frequency of purchasing of equipment, Use of alternatives to air travel</i>				X		
<b><i>Psychological constructs</i></b> <i>Intention towards changing behaviours, Knowledge about climate change Beliefs about the consequences of behaviour on the climate, Self-efficacy, Beliefs about negative consequences of reducing air travel, Attitude, Environmental attitudes, Ecological identity, habits, Compensatory beliefs, Self-control resources, Descriptive and subjective norms</i>			X			X
<b><i>Sociodemographic and institutional information</i></b> <i>Gender, age, number of children, self-reported distance between home and work, perceived accessibility by train or alternative transport modes, income level, Career status, employer,</i>						

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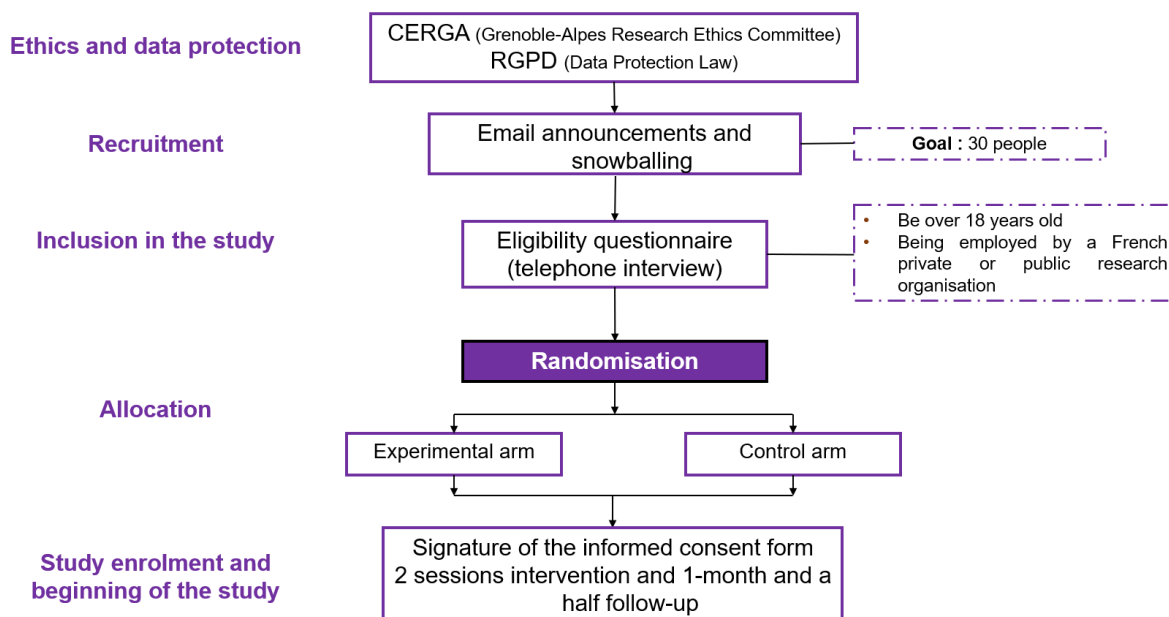


177 Figure 1. SPIRIT schedule of the present study.

178 Note. S = Session (Survey to be fill up), SI = Session if intervention.

179 **2.1 Ethics and data protection**

180 The Figure 2 shows the procedure of ethics, data protection, recruitment, inclusion in  
 181 the study, allocation, study enrolment and beginning of the study. First, the main researchers  
 182 of this study contacted the Data Protection officer to establish a detailed planned of data  
 183 collection and data protection. Then, a detailed document containing the data collection, data  
 184 analysis and data protection were submitted to the Grenoble Alpes Research Ethics  
 185 Committee (CERGA). Ma Terre-EVAL pilot study received the ethic’s approval in May 2023  
 186 (File CERGA-Avis-2023-11).



187  
 188 Figure 2. Procedure of the Ma Terre-EVAL pilot study since the ethics and data protection  
 189 procedures to the study enrolment and beginning of the study.

190 **2.2 Participants**

191 **2.2.1 Study Setting**

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192 This study will be restricted to individuals being employed by a French private or  
193 public research organisation. In France, 462k<sup>1</sup> of people work full time for a French private or  
194 public research organisation (Ministère de l'Enseignement supérieur et de la Recherche,  
195 2020). According to a recent survey involving more than 6000 people working in public  
196 research centres (Labo1point5, 2021), between 25% and 35% of the respondents have  
197 travelled by air for professional reasons between 2017 and 2019. The principal motives of  
198 professional air mobility were conferences, meetings, workshops and research visits.  
199 According to this same survey, 24% of the respondents commute by car to go to work.

### 200 **2.2.2 Eligibility criteria**

201 To take part in Ma Terre-EVAL pilot study, participants will need to meet the following  
202 criteria:

- 203 • Being over 18 years old
- 204 • Being employed by a French public or private research organisation.

## 205 **2.3 Participant timeline**

### 206 **2.3.1 Recruitment, allocation, and blinding**

207 The participants will be recruited through announcements by e-mail sent by the study  
208 partners (CNRS, IRD, Univ. Grenoble-Alpes) and “snowball”. The study partners (CNRS,  
209 IRD, Univ. Grenoble-Alpes) will relay announcements describing the study and the steps to  
210 follow to participate.

211 The people volunteering to participate in Ma Terre-EVAL pilot study will send an  
212 email to the field manager who will call them back to explain the study procedure and  
213 verify the eligibility criteria.

214 Participants accepting to participate will be randomly allocated to the experimental or  
215 control arm. For this purpose, previously to the enrolment, the scientific team will create a

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<sup>1</sup> In total 649 1000 people work partial or full time for R&D representing 462K full-time works.

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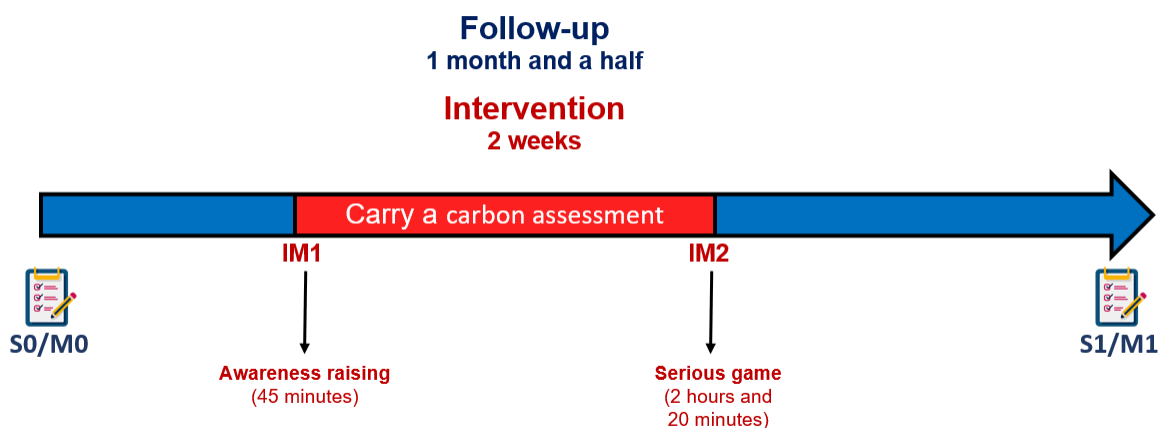
216 randomisation list by blocks of ten (i.e., in this randomisation list by blocks of ten, here are  
217 five possibilities to be in the experimental arm and five possibilities to be in the control arm).


218 Concerning the blinding, the implementation team (the facilitators in charge of leading  
219 the intervention sessions) will not be aware of the arm allocation at the beginning of the study  
220 (S<sub>0</sub>), but blinding will be impossible afterward because the facilitators deliver different  
221 contents to each arm through online meetings with the participants. The research team might  
222 be aware of the group allocation at the moment of analysing the data of the pilot study  
223 because of the missing data (because the control arm will have no information about the  
224 second intervention meeting). Nevertheless, the lack of blinding will not be a problem,  
225 because the objective of this study is not to determine the effects of the intervention but the  
226 feasibility and the fidelity of the intervention and the evaluation.

### 227 **2.3.2 Timeline of the Study**

228 Participants enrolled in this study will have a first 45-minutes online meeting with a  
229 member of the implementation team (“Session 0” or S<sub>0</sub>, see Figure 3). At the beginning of this  
230 meeting, the participant will read and electronically sign and send by mail the consent form (cf.  
231 Supplementary materials). Then, he or she will fill in a questionnaire to report on his or her  
232 professional mobility, home-to-work mobility and professional electronic purchases,  
233 psychological constructs and socio-economic and institutional information (see Table 1 for all  
234 the details about the tools and surveys).

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235  
236 *Figure 3.* Calendar of Ma Terre-EVAL pilot study and the measurements. S = Session (Survey  
237 to be fill up), M = Month, IM1 = Intervention meeting with experimental and control arm. IM2  
238 = Intervention meeting only with experimental arm.  = Online survey.

239 Approximately two weeks after this session, participants of both experimental and  
240 control arm will have the first intervention meeting (IM<sub>1</sub>) with another four participants of their  
241 same arm and a facilitator (1 hour). During this meeting, the participants will have a discussion  
242 aiming to raise awareness between academic behaviours and environmental issues (all the  
243 details of this session will be described in the section 2.4). At the end of this meeting,  
244 participants of both arms will be asked to evaluate their carbon footprint through the Micmac  
245 app (<https://avenirclimatique.org/micmac/simulationCarbone.php>) and send it to the  
246 implementation team.

247 Approximately two weeks after this first intervention meeting, only the participants of  
248 the experimental arm will be contacted to carry out a second intervention meeting (IM<sub>2</sub>) with  
249 four participants of their same arm and a facilitator (2 hours and 20 minutes). During this  
250 meeting, the participants will participate to the serious game “Ma Terre en 180 minutes” aiming  
251 to discuss the possible transition pathways to diminish carbon emissions while playing the role  
252 of fictional research laboratory team members (all the details of this session will be described  
253 in the section 2.4). During and after each of the meetings (IM<sub>1</sub> and IM<sub>2</sub>) the facilitators will

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254 complete a checklist and answer questions about the sessions (see Table 1 and supplementary  
255 materials).

256 Two weeks after the experimental arm's intervention meeting session (IM2) and one  
257 month after the control arm's intervention meeting session (IM2), the participants will receive  
258 a link to complete a 15-minutes online survey ("Session 1" or "S<sub>1</sub>").

### 259 **2.3.3 Retention of participants**

260 To limit the attrition risk, we will send a newsletter one month after the start of the study  
261 to inform about the laboratories involved in the study and a short presentation of the  
262 research and field team.

### 263 **2.3.4 Power Analysis and Sample Size**

264 Because our data analysis will be descriptive as a part of the feasibility study, we  
265 consider that a power analysis is not necessary (Whitehead et al., 2014). Considering time and  
266 resources constraints, we decided to recruit thirty participants ( $N = 30$ ) that will be  
267 randomised in the experimental or control arm.

268

## 269 **2.4 Intervention**

270 Eligible participants will be randomised in equal proportion to the experimental arm or to  
271 the control arm. The intervention for the experimental arm will last for two weeks (including  
272 two intervention meetings and a carbon assessment) as the one for the control arm (including  
273 only one intervention meeting and a carbon assessment of the one month and a half study  
274 period) (Figure 3). The detailed content of the interventions for experimental and control arms  
275 will be described in the next subsections (see Table 2 for a summary).

### 276 **2.4.1 Experimental Arm**

277 The intervention (Intervention A) to be carried out by this arm consists of an  
278 awareness-raising session (one hour in a group of five people with a facilitator), the



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279 completion of a carbon footprint assessment and a “Ma Terre en 180 minutes” game session  
280 (2 hours 20 minutes in a group of five people with a facilitator).

281 During the first online 1-hour meeting (Intervention meeting 1, IM<sub>1</sub>), the facilitator  
282 and the group of five participants will discuss about the energy consumption and the basic  
283 human’s needs, planetary limits, climate issues, current carbon footprint of a random French  
284 person and target carbon footprint according to the Paris Agreement, the link between  
285 activities in an academic life and carbon footprint, the distribution of the carbon footprint of  
286 some laboratories and the initiatives to diminish it. At the end of the meeting, they will  
287 collectively make an astonishment report using virtual Post-its. The behavioural change  
288 techniques (Michie et al., 2013) that were targeted by these activities are “5.2 Saliency of  
289 consequences”, “5.3 Information about social and environmental consequences”, “6.3  
290 Information about others’ approval” and “4.1 Instruction on how to perform the behaviour”.

291 After the first meeting of the intervention, the study participants are encouraged to  
292 carry out an online carbon footprint assessment by using a free tool:

293 <https://avenirclimatique.org/micmac/simulationCarbone.php>. This takes between ten and  
294 fifteen minutes and requires precise information about the household energy consumption.  
295 The behavioural change technique (Michie et al., 2013) that was targeted by this activity is  
296 “2.2 Self-monitoring of behaviour”.

297 During the second online 2 hour and 20 minutes meeting (Intervention meeting 2,  
298 IM<sub>2</sub>), the group of five participants play the serious game “Ma terre en 180 minutes” (see  
299 Figure 4 to see an example of a game table or <http://51.178.55.78/MT180/mt180.htm>) under  
300 the gaze of the facilitator who answers questions and paces the game steps. During the game  
301 session, each player takes on the role of two characters from a research team and begins a free  
302 negotiation followed by a guided negotiation aiming at a 50% reduction of the research  
303 laboratory carbon footprint. In addition, after the end of the game, the facilitator leads a

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304 debriefing session with the participants. The behavioural change techniques (Michie et al.,  
 305 2013) that was targeted by the serious game and its debriefing are “6.2 Social comparison”,  
 306 “5.2 Saliency des consequences”, “13.2 Framing/reframing”, “6.1 Demonstration of the  
 307 behaviour”, “4.1 Instruction about how to perform a behavior”, “12.2 Restructuring the social  
 308 environment”. Moreover, the detailed content of the intervention is available on  
 309 Supplementary materials.



310

311 *Figure 4.* Example of a game board from the serious game “Ma terre en 180 minutes”.

312 The tokens show the different sources of carbon footprint of each fictional character (e.g.,  
 313 travel for conferences or field missions, commuting). The bigger tokens indicate bigger  
 314 carbon footprints.

#### 315 2.4.2 Control Arm

316 The intervention (Intervention B) to be carried out by this arm consists of an  
 317 awareness-raising session (one hour in a group of five people with a facilitator) and the  
 318 completion of a carbon footprint assessment.

319 During the first online 1-hour meeting (Intervention meeting 1, IM<sub>1</sub>), the facilitator  
 320 and the group of five participants will discuss about the energy consumption and the basic  
 321 human’s needs, planetary limits, climate issues, current carbon footprint of a random French

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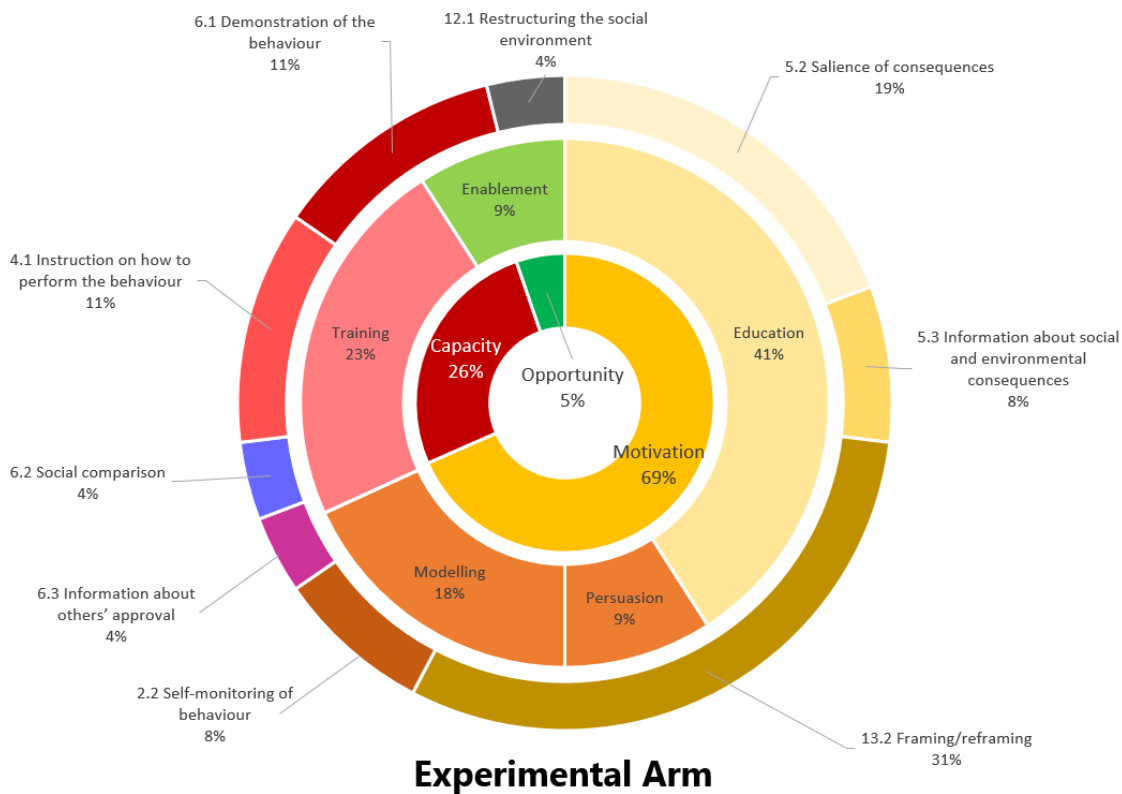
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327 consequences”, “5.3 Information about social and environmental consequences”, “6.3  
328 Information about others’ approval” and “4.1 Instruction on how to perform the behaviour”.

329 After the first meeting of the intervention, the study participants are encouraged to  
330 carry out an online carbon footprint assessment by using a free tool:

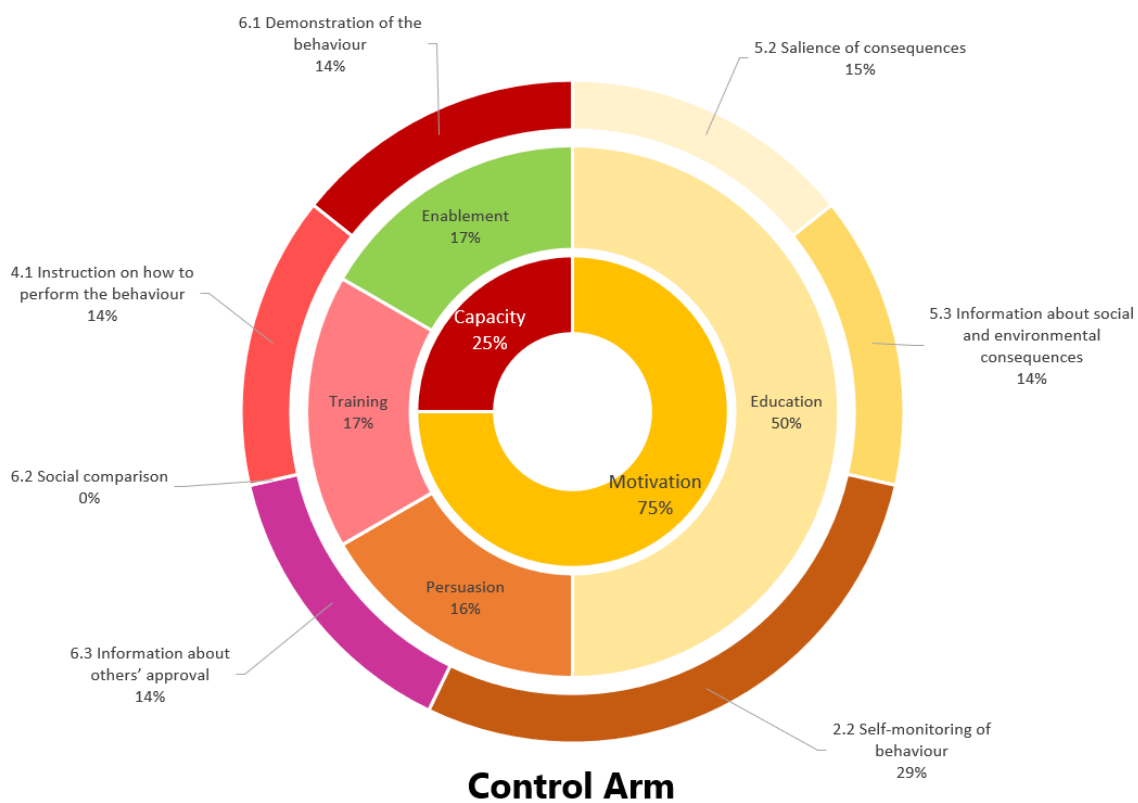
331 <https://avenirclimatique.org/micmac/simulationCarbone.php>. This takes between ten and  
332 fifteen minutes and requires precise information about the household energy consumption.  
333 The behavioural change technique (Michie et al., 2013) that was targeted by this activity is  
334 “2.2 Self-monitoring of behaviour”. The control group does not participate in the serious  
335 game “Ma Terre en 180 minutes”.

336 The figure 5 compares the targeted sources of behaviour (i.e., motivation, opportunity  
337 or capability according to (Michie et al., 2013), the intervention functions (i.e., education,  
338 persuasion, incentivisation, coercion, training, enablement, modelling, environmental  
339 restructuring and restriction according to (Michie et al., 2013)) and the behaviour change  
340 techniques (Michie et al., 2013) mobilised in the Experimental and Control arms.

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343 *Figure 5.* Sources of behaviour targeted by the interventions (in the centre of the circle),  
344 intervention functions (in the intermediary part) and behaviour change techniques (in the  
345 exterior part).

### 346 **2.4.3 Adherence**

347 To measure the adherence to each intervention arm, the facilitator will take notes  
348 about the duration of each intervention meeting and of every situation that could disrupt the  
349 planned elements of the intervention (e.g., participants not sending their carbon footprints,  
350 participants lacking an intervention meeting).

## 351 **2.5 Outcomes and data collection**

### 352 **2.5.1 Primary outcomes and data collection methods**

353 The main outcomes of Ma Terre-EVAL pilot will be the feasibility of the intervention,  
354 the feasibility of the evaluation of behavioural changes and the fidelity of the intervention.

355 The intervention's feasibility will be operationalised in three variables: 1) Task  
356 completion (a checklist of all activities that need to be carried out during the intervention  
357 sessions), 2) Complexity of the intervention tasks (a scale of 1 to 3, from easy to difficult) and  
358 3) Percentage of participation in the meetings (percentage of people absent or present at the  
359 intervention meetings). All of this information will be collected through paper questionnaire.

360 The feasibility of the evaluation of behavioural change will be operationalised in two  
361 variables: 1) Completion rate of the online questionnaires (average of the completion of each  
362 questionnaire) and 2) Quality of the answers (considering the duration of each questionnaire).  
363 More precisely, the quality of the answers will allow us to detect participants who potentially  
364 do not take the task seriously enough (i.e., with unrealistic short time on certain tasks) by  
365 calculating the Median Absolute Deviation (Leys et al., 2013) to detect outliers on the time  
366 spent on the page showing the article and will exclude participants with a Median Absolute

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367 Deviation superior to 3. Both of these outcomes will be calculated by the scientific team by  
368 downloading the online surveys completed by the participants of the study.

369 Finally, the fidelity of the intervention will be operationalised in two variables: 1)  
370 Exposure to the intervention (average time of each session) and, 2) Responsiveness of the  
371 participants (via a scale of 1 to 7 from not at all responsive to very responsive, this question  
372 will be asked to each facilitator). All of this information will be collected through  
373 paper forms. All the details of the variables, tools and measurement times can be found in  
374 Table 1.

### 375 **2.5.2 Secondary outcomes and data collection methods**

376 Secondary outcomes of Ma Terre-EVAL pilot will include the following variables  
377 related to Academia's behaviours: Number of professional trips by air, percentage of home-to-  
378 work trips made by car, by active and sustainable mobility, frequency of numerical equipment  
379 purchase, intention towards changing professional trips made by car, reducing home-to-work  
380 trips made by car and frequency of numerical equipment purchase equipment (Godin, 2012)  
381 and the use of alternatives to air travel through online surveys implemented on the platform  
382 Sphinx iQ2 v 7.3.1.0. Moreover, we will collect psychological constructs such as knowledge  
383 about climate change (measured through a multiple-choice questionnaire), beliefs about the  
384 consequences of behaviour on the climate (Whitmarsh et al., 2020), self-efficacy of choosing  
385 an alternative to air travel (Godin, 2012), self-efficacy of choosing an alternative to car travel  
386 (Godin, 2012), self-efficacy of making sustainable purchases (Godin, 2012), beliefs about  
387 negative consequences of reducing air travel (Labo1point5, 2021), attitudes towards  
388 alternatives to air travel (Godin, 2012), attitudes towards alternatives to car travel (Godin,  
389 2012), environmental attitudes (Schleyer-Lindenmann et al., 2016), ecological identity (Lalot  
390 et al., 2019), professional travel habits by air (Gardner et al., 2012), commuting habits by car  
391 (Gardner et al., 2012), compensatory beliefs (Whitmarsh et al., 2020), perceived self-control

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resources (Ryan & Frederick, 1997), descriptive and subjective norms (Godin, 2012) through  
online surveys. Finally, socio-demographic and institutional information such as gender, age,  
number of children, self-reported distance between home and work, perceived accessibility by  
train or alternative transport modes, income levels, career status, employer characteristics,  
perceived academic recognition and, funding for professional mobility. All the details of the  
variables, tools and measurement times can be found in table 1.

## **2.6 Data management and statistical methods**

### **2.6.1 Data quality, management, storage, access and confidentiality**

In order to monitor the quality of the data, one member of the scientific team will  
check the documents filled in by the facilitators (i.e., the documents evaluating the feasibility  
and the fidelity) and the presence of missing data in these documents after the end of each  
intervention meeting. This data will be immediately transferred to an Excel table.  
Furthermore, data from online surveys will be downloaded at the end of each session of  
measurement.

The data will be stored in two blocks:

Block 1 will contain the contact file including name and email of the participants for  
sending the surveys and setting the intervention meetings. Moreover, this block will contain  
the correspondence table between the participants' identifier and their name. This block will  
be encrypted and it will only be accessible by the scientific coordinator and the field  
coordinator.

Block 2 will contain all the collected data from the paper forms and the online  
surveys. The data will be anonymised (only containing the participant's identifier).

Both of the blocks will be locally stored on the secured data centre of the university  
Grenoble-Alpes with access restricted only to Ma Terre-EVAL pilot team.

### **2.6.2 Data monitoring, harms and auditing**

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417 No data monitoring committee has been conformed for this study because the  
418 researchers have no strong suspicion that any of the interventions can potentially harm the  
419 participants. The coordinator of the implementation team and the coordinator of the scientific  
420 team will meet once every two weeks to audit the trial conduct.

### 421 **2.6.3 Ancillary and post-trial care**

422 No ancillary and post-trial care will be provided.

### 423 **2.6.4 Trial registration**

424 Because of the non-clinical character of this research study, we have submitted a  
425 registration in <https://www.protocols.io/> with the registration number YXMVM24JBG3P.

### 426 **2.6.5 Statistical methods**

#### 427 **2.6.5.1 Analysis of the feasibility of the intervention and adherence**

428 Concerning the Task completion, we will identify the tasks that were not completed  
429 (i.e., for each group of participants and for each meeting) and we will calculate the percentage  
430 of completion of each task (e.g., the discussion about planetary limits was completed in 100%  
431 of IM<sub>1</sub> for experimental and control arms). Concerning the perceived complexity of tasks, we  
432 will calculate the average complexity of each task (from 1 to 3) and look at all the comments  
433 noted by the facilitators. Concerning the adherence, a participation/absence rate will be done  
434 per each intervention meeting.

#### 435 **2.6.5.2 Analysis of the feasibility of evaluation**

436 Concerning the Completion rate of online surveys, we will calculate the percentage of  
437 completion of online questionnaires during the first session of measurement (S<sub>0</sub>) and the  
438 second session of measurement (S<sub>1</sub>). Concerning the quality of the responses, we will  
439 calculate the Median Absolute Deviation (Leys et al., 2013) to detect outliers that spent too  
440 few or too much time to complete the surveys (participants with a Median Absolute Deviation  
441 > 3).



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### 442 **2.6.5.3 Analysis of the fidelity of the intervention**

443 Concerning the exposure to the intervention, we will calculate the average duration of  
444 each intervention meeting. Concerning the perceived responsiveness of participants, we will  
445 calculate the average of perceived responsiveness per each intervention meeting.

## 446 **3. Discussion**

447 Ma-terre EVAL pilot study is a 1-month and a half pilot randomised controlled trial  
448 designed to evaluate the feasibility and the fidelity of a 24-month randomised controlled trial  
449 aiming to change academic behaviours such as professional mobility by air, daily commuting  
450 and digital and material purchases. Ma-terre EVAL pilot study will include a two-arm  
451 intervention of 2-weeks: an experimental arm that includes an awareness-raising group  
452 discussion, an online carbon footprint assessment and a group session of the serious game “Ma  
453 Terre en 180 minutes” (Gratiot et al., 2023); and a control arm which includes only the  
454 awareness-raising group discussion and the online carbon footprint assessment. We believe that  
455 because the control arm targets mainly raising awareness about climate change and professional  
456 behaviours (through the group discussion and the carbon footprint assessment) and  
457 consequently it will target sources of behaviour such as capacity and motivation (by using  
458 behavioural techniques such as 2.2 self-monitoring of behaviour, 5.3 information about social  
459 and environmental consequences, 5.2 salience of consequences according to (Michie et al.,  
460 2013)). Furthermore, the experimental arm will additionally aim the co-construction of  
461 ecological transition paths in Academia (through the serious game) and potentially will lead to  
462 capacity and opportunity building (by using additional behavioural techniques such as 13.2  
463 framing/reframing, 12.1 restructuring the social environment and 6.2 social comparison  
464 according to (Michie et al., 2013) ).

465 Moreover, the evaluation of the effects of Ma Terre-EVAL pilot study includes two  
466 sessions of online surveys to measure the participants’ behaviours (number of professional trips

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467 by air, percentage of home-to-work trips made by car and by active and sustainable mobility,  
468 frequency of purchasing of equipment), the intention towards changing professional trips made  
469 by car, reducing home-to-work trips made by car and frequency of purchasing of equipment,  
470 psychological mechanisms related to changing behaviours (attitudes, subjective norms, self-  
471 efficacy, ecological identity, habits) and socio-demographic and institutional information (e.g.,  
472 gender, age, income levels, career status, perceived academic recognition).

473 Because of the complexity of the interventions proposed to the experimental and control  
474 arms and the complexity of the evaluation of the behavioural changes, this pilot randomised  
475 controlled trial aims to evaluate the feasibility (the extent to which all the different elements of  
476 the interventions and evaluation are feasible for the team implementing the study) of the  
477 intervention and the evaluation of the fidelity (the extent to which all the elements of the  
478 intervention are accurately implemented and without modifying the behaviour change  
479 techniques and contents). Indeed, several authors (Bartholomew et al., 2016; Freedland, 2020;  
480 Hankonen & Hardeman, 2020) have indicated that every large-scale study should be pre-tested  
481 with small groups of participants to identify elements that could be adapted to ensure better  
482 feasibility and fidelity.

#### 483 **4. List of Abbreviations**

484 No abbreviation has been used in this paper.

#### 485 **5. Acknowledgements**

486 The authors thank the IRD (Institut for Research and Developpement).

#### 487 **6. Composition, roles, and responsibilities in the project**

488 IR and NB are the scientific coordinators of the project. NG, NC, GP and BH created the  
489 content of the experimental and control interventions. CT-E has developed the details of the  
490 protocol of the study. All authors contributed to the study design and data collection, and  
491 approved the final version of this study.

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## 492 **7. Protocol version and protocol amendments**

493 This version of the protocol (1.0) is dated 1 May 2023. Any changes in the protocol  
494 will be communicated and shared on [https://www.protocols.io/view/my-earth-eval-pilot-](https://www.protocols.io/view/my-earth-eval-pilot-yxmvm24jbg3p/v1)  
495 [yxmvm24jbg3p/v1](https://www.protocols.io/view/my-earth-eval-pilot-yxmvm24jbg3p/v1) with the DOI: 10.17504/protocols.io.yxmvm24jbg3p/v1.

## 496 **8. Dissemination policy**

497 The results of the study will be published in scientific journals and open science platforms  
498 (e.g., OSF). In addition, the results of the study will be described in a user-friendly style to be  
499 sent to the participants and partners of the study.

## 500 **9. Authors' contributions**

501 CT-E drafted the manuscript under the supervision of IR. All the authors critically appraised  
502 the manuscript, worked on its content, and approved the final version for submission.

## 503 **10. Funding**

504 No funding will be received for carrying out this study.

## 505 **11. Availability of data and material**

506 The anonymised dataset and the analyse codes will be available after the end of the  
507 data analysis in the open science framework:

508 [https://osf.io/chpfk/?view\\_only=0ba1ecd434ce427fb115a447cf36c2c1](https://osf.io/chpfk/?view_only=0ba1ecd434ce427fb115a447cf36c2c1) with the DOI  
509 <https://doi.org/10.17605/OSF.IO/CHPFK>

## 510 **12. Declarations**

### 511 **12.1 Ethics approval and consent to participate**

512 Ma Terre-EVAL was approved by Grenoble-Alpes Ethics Committee (File CERGA-  
513 Avis-2023-11) in May 2023. Moreover, each participant will read and sign a detailed informed  
514 consent form (cf. Supplementary materials) before starting the study only if he/she agrees to  
515 participate in the study.

### 516 **12.2 Consent for publication**

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517 Not applicable

### 518 **12.3 Competing interests**

519 The authors declare no potential competing interests.

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## Tables

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Table 1. Summary of the variables, tools and time measurements.

Outcomes	Tool	S <sub>0</sub>	SI <sub>1</sub>	SI <sub>2</sub>	S <sub>1</sub>
<b>Main outcomes of the study</b>					
<b>Feasibility of the intervention and adherence</b>					
Task completion	Cheklist of tasks to complete		✓ <sup>a</sup>	✓ <sup>a</sup>	
Perceived complexity of tasks	Scale of 1 to 3 (easy to difficult)		✓ <sup>a</sup>	✓ <sup>a</sup>	
Participation in sessions	Rate of participation/absence in sessions		✓ <sup>a</sup>	✓ <sup>a</sup>	
<b>Feasibility of the evaluation</b>					
Completion rate of online surveys	Percentage of completion of online questionnaires	✓ <sup>b</sup>			✓ <sup>b</sup>
Quality of responses	Duration of each questionnaire (too short or too long times considered low quality)	✓ <sup>b</sup>			✓ <sup>b</sup>
<b>Fidelity of the intervention</b>					
Exposure to the intervention	Duration of each session		✓ <sup>a</sup>	✓ <sup>a</sup>	
Perceived responsiveness of participants	Scale of 1 to 7 (not at all responsive to very responsive)		✓ <sup>a</sup>	✓ <sup>a</sup>	
<b>Secondary outcomes</b>					
<b>Academic's behaviours</b>					
Number of professional trips by air	Survey	✓			

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Percentage of home-work trips made by car et by active and sustainable mobility	Survey	✓	
Frequency of purchasing of equipment	Survey	✓	
Intention towards changing professional trips made by car, reducing home-work trips made by car and frequency of purchasing of equipement	Adapted survey (Godin, 2012)	✓	✓
Use of alternatives to air travel	Survey	✓	
<b>Psychological constructs</b>			
Knowledge about climate change	Multiple choice questionnaire	✓	✓
Beliefs about the consequences of behaviour on the climate	Adapted survey (Whitmarsh et al., 2020)	✓	✓
Self-efficacy of choosing an alternative to air travel	Adapted survey (Godin, 2012)	✓	✓
Self-efficacy of choosing an alternative to car travel	Adapted survey (Godin, 2012)	✓	✓
Self-efficacy of making sustainable purchases	Adapted survey (Godin, 2012)	✓	✓
Beliefs about negative consequences of reducing air travel	Adapted survey (Labo 1point5, 2021)	✓	✓
Attitudes towards alternatives to air travel	Adapted survey (Godin, 2012)	✓	✓
Attitudes towards alternatives to car travel	Adapted survey (Godin, 2012)	✓	✓

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Environmental attitudes	Environmental attitudes scale (Schleyer-Lindenmann et al., 2016)	✓	✓
Ecological identity	Green identity scale (Lalot et al., 2019)	✓	
Business travel habits by air	Adapted habits scale (Gardner et al., 2012)	✓	
Commuting habits by car	Adapted habits scale (Gardner et al., 2012)	✓	
Compensatory beliefs	Survey (Whitmarsh et al., 2020)	✓	✓
Self-control resources	Subjective vitality scale (Ryan & Frederick, 1997)	✓	✓
Descriptive and subjective norms	Adapted survey (Godin, 2012)	✓	✓
<hr/>			
Sociodemographic and institutional information			
Socio-demographic questionnaire (Gender, age, number of children, self-reported distance between home and work, perceived accessibility by train or alternative transport modes, income level)	Survey	✓	
Socio-demographic follow-up questionnaire (number of children, self-reported distance between home and work, perceived accessibility by train or alternative transport modes, income level)	Survey		✓
Employment questionnaire	Survey	✓	

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(Career status, employer characteristics, academic recognition, funding for professional mobility)

Employment follow-up questionnaire (career status, employer characteristics, academic recognition, funding for professional mobility)

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Survey



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708 **Note.** By default, the outcomes will be measured by using an online survey. S = Session (Survey to be fill up), SI = Session if intervention, R=

709 Recruitment and enrolment periods. <sup>a</sup> indicates that the outcome was measured by a questionnaire by paper, <sup>b</sup> indicates that the outcome was

710 calculated by a member of the research team based on other data.

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711 Table 2. Summary of the elements of the experimental and the control arms.

<b>Element</b>	<b>Experimental arm</b>	<b>Control arm</b>
First group appointment with a facilitator	Group discussion about topics related to planetary limits, climate change, distribution of the carbon footprint of some research laboratories and initiatives to decrease the Academia's carbon footprint.	Group discussion about topics related to planetary limits, climate change, distribution of the carbon footprint of some research laboratories and initiatives to decrease the Academia's carbon footprint.
Conducting an individual carbon assessment	Online individual carbon assessment related to food, mobility and energy consumption.	Online individual carbon assessment related to food, mobility and energy consumption.
Second group appointment with a facilitator	Group session of the serious game "Ma terre en 180 minutes". During the serious game, each participant takes on the role of two fictional characters from a research laboratory whose mission is to reduce the laboratory's carbon footprint by 50%.	

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