

1 **Exploring the Potential of Using a Text-Based Game to Inform Simulation Models of**
2 **Risky Migration Decisions**

3
4 Ariana Modirrousta-Galian¹, Toby Prike², Philip A. Higham¹,
5 Martin Hinsch³, Sarah Nurse¹, Souhila Belabbas¹, Jakub Bijak¹

6 ¹University of Southampton, Southampton, UK

7 ²University of Western Australia, Perth, Australia

8 ³University of Glasgow, Glasgow, Scotland

9
10 **Author Note**

11 Ariana Modirrousta-Galian  <https://orcid.org/0000-0003-2925-2976>

12 Toby Prike  <https://orcid.org/0000-0001-7602-4947>

13 Philip A. Higham  <https://orcid.org/0000-0001-6087-7224>

14 Martin Hinsch  <https://orcid.org/0000-0002-7059-7266>

15 Sarah Nurse  <https://orcid.org/0000-0001-9915-7742>

16 Souhila Belabbas  <https://orcid.org/0000-0003-2628-0592>

17 Jakub Bijak  <https://orcid.org/0000-0002-2563-5040>

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27 Correspondence concerning this article should be addressed to Ariana Modirrousta-
28 Galian, Centre for Perception and Cognition, School of Psychology, University of
29 Southampton, University Road, Highfield, Southampton, SO17 1BJ, United Kingdom. Email:
30 amg1g17@soton.ac.uk

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32

33 **Abstract**

34 **Background**

35 In this paper, we explore the potential of games to collect empirical data for informing agent-
36 based simulation models of migration. To examine the usefulness of game-based
37 approaches, we conducted a simple, yet carefully designed psychological experiment.

38 **Methods**

39 In a preregistered study, we used a novel, immersive experimental setting to investigate the
40 risky migration decisions made by migrants and non-migrants. Participants (284 migrants
41 and 284 non-migrants) played a choice-based interactive fiction game—a fully text-based
42 game where players progress by selecting from a list of possible actions—that involved
43 making three risky migration decisions. In one condition, participants were shown a non-
44 linear progress bar and explicit acknowledgements of the choices they made to promote
45 perceived agency: the feeling that one's actions have a non-trivial impact on the game. In
46 the other condition, the progress bar was linear, and the explicit acknowledgements were
47 omitted.

48 **Results**

49 Our experimental manipulation was successful; participants in the former condition self-
50 reported higher perceived agency than participants in the latter condition, as did migrants
51 compared to non-migrants. Nevertheless, condition and migrant status did not meaningfully
52 affect the risky migration decisions participants made in the game.

53 **Conclusion**

54 These findings indicate that the results of generic studies on risky migration decisions
55 conducted on non-migrants can potentially inform simulation models of migration. However,
56 these findings were obtained from a single experiment, and thus warrant replication and
57 further research before definitive conclusions can be drawn. Furthermore, a simple text-
58 based game may be too superficial to allow deep insights into the idiosyncrasies of migration
59 decision-making. This suggests a possible trade-off between clear interpretability of the

60 results and the usefulness for informing simulation models of complex social processes,
61 such as migration.

62 *Keywords:* migration, decision-making, risk-taking, text-based game, simulation
63 models, perceived agency

64

65

66 **Background**

67 Highly complex and dynamic social processes, such as migration, require analytical
68 tools that can make meaningful statements about their underlying mechanisms. Simulation
69 models, such as agent-based models, offer an appealing possibility for designing and
70 analyzing such processes *in silico*, provided the models reflect the broader social reality and
71 the way that the modelled individuals—agents—make decisions and interact with one
72 another. However, the information needed to inform such models is typically so specific to
73 the individual model and research questions that generic survey or experimental data are
74 inappropriate, and therefore more bespoke approaches and data collection may be
75 required.

76 In this paper, we explore the potential of using simple text-based games to inform the
77 parameters and specification of an agent-based simulation model of migrant journeys (Bijak
78 et al. 2021). The main motivation behind using games in this context is to obtain results that
79 are as psychologically realistic as possible, while enabling their rigorous analysis through
80 proper experimental control. To gain insights into the usefulness of game-based approaches
81 for such purposes, we conducted a simple, yet carefully designed psychological experiment,
82 focused on risk preferences in the context of risky migration decisions. In this paper, we start
83 by presenting the background that motivated our intervention and methodological choices,
84 which are discussed in more detail immediately after. Next, we report the results before
85 finishing with a critical discussion, focused on the trade-offs between the simplicity of the
86 proposed approach and the insights that can be gained for modelling purposes.

87 **Migration Research**

88 Experimental research has been largely neglected in migration studies, with a few
89 notable exceptions (e.g., Baláz & Williams, 2015). This is likely due to the common criticism
90 that experimental conditions cannot accurately replicate and thus measure real-world social
91 phenomena, especially those as complex as human migration. Indeed, due to its countless
92 factors, dynamics, and their intricate interactions, human migration has been considered
93 impossible to fully measure or understand (International Organization for Migration, 2018).

94 However, de Haas (2021) criticized what he labelled the “‘migration is too complex’ fallacy”
95 (p. 3), pointing out that the notion of complexity highlights that experiences such as human
96 migration are multi-faceted, but does not imply they are devoid of patterns or structure. In
97 line with this argument, experimental research aims to abstract and reproduce facets of real-
98 world phenomena to identify their patterns and consequently establish causal relationships
99 (Kihlstrom, 2021; Orne, 1961). Therefore, provided experimental findings are understood
100 within context, using experimental methods to clarify and predict certain aspects of our
101 reality is not only justified, but often necessary to make sense of the world around us.

102 Nevertheless, perfect reproduction of social contexts in artificial settings is currently
103 impossible. Accordingly, despite causal relationships being possible to establish through
104 experimental control, questions remain over the extent to which these relationships can be
105 generalized to real-world settings (i.e., ecological validity; Andrade, 2018). To that end, other
106 methods, such as ethnographic research, are largely considered more ecologically valid
107 than experimental methods. Ethnography refers to the study of social interactions,
108 behaviors, and group perceptions through qualitative research methods, such as interviews
109 and participant observation (Falzon, 2015; Shah, 2017). In a recent example related to
110 migration decisions, Belabbas et al. (2022) conducted qualitative interviews with Syrian and
111 Afghan refugees to determine what factors were relevant in shaping their journeys to
112 Europe. Although such ethnographic research provides rich, contextually detailed data, it
113 does not provide the experimental control or quantitative data that are often needed to
114 explain and predict specific aspects of real-world phenomena.

115 In summary, there is a clear trade-off between ecological validity and experimental
116 control in social science research. In fact, Kothgassner and Felnhofer (2020) referred to this
117 problematic trade-off as a “Gordian Knot” (p. 216), highlighting its ongoing relevance. It has
118 long been noted that immersive games can decrease the extent of this trade-off (Kozlov &
119 Johansen, 2010; Lin-Greenberg et al., 2021), as they allow researchers to create more
120 realistic environments and at the same time control and manipulate variables to determine
121 their individual impacts and thus establish cause-and-effect relationships. With the

122 exponential advancement of technology, it is possible that the compromise between
123 ecological validity and experimental control will one day disappear, but this is not yet the
124 case. In this paper, we explore the possibility of using games to cut, or at least loosen, this
125 Gordian Knot in the context of risky migration decisions.

126 **Immersion and Player Agency**

127 Murray (1997) defined virtual reality as a stirring narrative in any medium, such as a
128 game. McMahan (2003) adopted this definition and proposed three requirements for making
129 virtual realities and games immersive, offering players the feeling of being inside a virtual
130 world: (a) the user's expectations of the game must match the game's mechanics closely;
131 (b) the game's mechanics must be consistent even if they do not match those of real life;
132 and (c) the user's actions must have a non-trivial impact on the game. The *game mechanics*
133 here refer to the rules that simulate the virtual world inside a game (Mizutani et al., 2021).

134 Since all three requirements are needed to attain immersion, failing to achieve one
135 should theoretically lead to a complete or at least partial loss of immersion. When using
136 games in experimental research, the first two requirements will likely be achieved by default.
137 This is due to the standard procedure for conducting experiments and the typical design of
138 games used in this setting. Firstly, clear instructions are usually given to participants before
139 they take part in an experiment. Therefore, if an experiment involves a game, participants
140 will likely be given information on how to play it beforehand, so their expectations should
141 match the game's mechanics. Secondly, most of the time, games created for experimental
142 research are simple by design since their purpose is to investigate a limited number of
143 outcome variables, so their mechanics are inherently consistent. Consequently, to
144 manipulate immersion in games used for experimental research, we must typically focus on
145 the final requirement, which refers to a concept commonly known as *player agency*—the
146 ability for a player's actions to have a non-trivial impact on the game.

147 We are not the first to use player agency as an indicator of immersion. Indeed,
148 immersion is considered an umbrella construct that consists of different sub-dimensions
149 (Wagner & Liu, 2021), and previous studies have regarded player agency as a sub-

150 dimension of immersion (Denisova & Cairns, 2015; Guo & Lo, 2023; Qin et al., 2009). To
151 ensure player agency, multiple story arcs and decision trees are often designed and created.
152 However, it is also possible to make users feel as if their actions have a non-trivial impact on
153 the game even when they do not. Fendt et al. (2012) created two versions of the same text-
154 based interactive story to compare the effects of simulated player agency and real player
155 agency. Since Murray (1997) defined player agency as the power to take meaningful action
156 and see the results of our decisions, Fendt et al. simulated agency by presenting players
157 with explicit acknowledgements of their decisions. In contrast, real agency was created by
158 generating different outcomes depending on the player's decisions. Results showed that
159 participants reported similar feelings of agency regardless of whether it was real or
160 simulated.

161 **The Present Study**

162 The present study's research question was the following: Does immersion narrow the
163 gap between migrants and non-migrants in the context of risky migration decisions?
164 Comparability of migration decisions among migrants and non-migrants is desirable
165 considering the limited number of migrants on online data collection platforms, as well as the
166 potential ethical issues associated with asking migrants to relive their potentially traumatic
167 migration decisions. To address our research question, we created a choice-based
168 interactive fiction game, namely, a fully text-based game where players progress by
169 selecting from a list of possible actions (Hausknecht et al., 2020). Our game shows
170 similarities to interactive digital narratives and interactive storytelling. However, definitions
171 for both of these terms emphasize the need for different paths to be available in the story,
172 demanding player agency (Bostan & Marsh, 2012; Koenitz et al., 2018). Considering that our
173 game does not ensure player agency, but rather only simulates it, we decided not to define it
174 with these terms.

175 In our game, participants, who included both migrants (broadly defined in our study
176 as individuals who migrated to a new country before and were old enough to remember their
177 migration journey) and non-migrants, made three risky migration decisions embedded within

178 the context of a migrant journey to advance through a story. Consistent with commonly used
179 measures of risk-taking (e.g., the Columbia Card Task and the Balloon Analogue Risk Task;
180 Figner et al., 2009; Lejuez et al., 2002), these decisions involved a binary trade-off between
181 a greater reward that involved risk and a smaller reward that involved no risk. A prototype
182 game was created for similar purposes in Bijak et al. (2023), but its complex design
183 introduced several confounds that made the results difficult to interpret. Therefore, we
184 simplified the design in our study. Specifically, participants took part in one of two conditions:
185 *agency* or *no-agency*. In the agency condition, our game promoted perceived agency by
186 showing participants explicit acknowledgements of the choices they made and having a non-
187 linear progress bar. In the no-agency condition, our game did not promote perceived agency
188 by omitting these acknowledgements and having a linear progress bar. We hypothesized
189 that the risky migration decisions of migrants and non-migrants would be more similar in the
190 agency condition than in the no-agency condition.

191 **Methods**

192 **Transparency and Openness**

193 All data, analytic code, and materials needed to replicate this study are available on
194 OSF (<https://osf.io/7a4vr/>). This study was preregistered (<https://aspredicted.org/sn4v5.pdf>).
195 We obtained ethical approval to conduct this study from the University of Southampton
196 Faculty of Environmental and Life Sciences Ethics Committee (approval no. 68015.A1).

197 **Participants**

198 ***Pilot Study***

199 For the pilot, we recruited 285 participants from Prolific (<https://www.prolific.com/>) for
200 the pre-screener, which assessed participants' suitability for the study. A total of 60
201 participants reported having migrated to a new country before, but four of these reported not
202 remembering their migration journey. These four participants were excluded, and the
203 remaining 56 that reported remembering their migration journey were included as migrants
204 (~20% of the sample). We then selected a matched sample (based on age, gender, highest
205 level of education, marital status, and annual household income) of 56 non-migrants from

206 the remaining 225 participants. We matched the migrant and non-migrant samples based on
207 these demographic variables to control for their potential effects on the dependent variables
208 (see the Experimental Design section). These 112 participants (56 migrants and 56 non-
209 migrants) were invited to take part in our experiment, but only 92 complied (~18% attrition
210 rate). Specifically, 25 migrants and 23 non-migrants participated in the agency condition,
211 and 17 migrants and 27 non-migrants participated in the no-agency condition. For further
212 sampling and demographic details, see Method Supplement S1.

213 The sample size for the experiment in the pilot study was intended to be ~20% of the
214 sample size for the experiment in the main study. The sample size for the pre-screener was
215 not specified in advance. Instead, we simply stopped data collection once we had recruited
216 56 migrants. After the pilot, two minor formatting changes were made, neither of which
217 impacted the main body of the experiment. For further details on these minor formatting
218 changes, see Method Supplement S1.

219 **Main Study**

220 Subsequently, for the main study, we recruited 1,850 participants from Prolific for the
221 pre-screener. A total of 385 participants reported having migrated to a new country before,
222 but 21 of these reported not remembering their migration journey. These 21 participants
223 were excluded, and the remaining 364 that reported remembering their migration journey
224 were included as migrants. We then selected a matched sample (based on age, gender,
225 highest level of education, marital status, and annual household income) of 364 non-
226 migrants from the remaining 1,465 participants. These 728 participants (364 migrants and
227 364 non-migrants) were invited to take part in our experiment, but we stopped data
228 collection once we reached our preregistered sample size (284 migrants and 284 non-
229 migrants). For further sampling and demographic details, see Method Supplement S1.

230 The sample size for the main study was based on an a priori power analysis in
231 G*Power 3.1 that indicated 566 participants were required to detect a small-to-medium effect
232 with a mixed factorial ANOVA ($n \approx 566$, $f = .15$, $1-\beta = .90$, $\alpha = .05$). We increased the
233 sample size to $n = 568$ so that an equal number of migrants and non-migrants could take

234 part in each of the two conditions. The sample size for the main study's pre-screener was
235 based on: (a) the planned sample size for the experiment; (b) the attrition rate between the
236 pre-screener and the experiment, which our pilot study found to be ~18%; and (c) the
237 percentage of Prolific participants that reported having migrated to a new country before and
238 remembering their migration journey, which our pilot study found to be ~20%. Despite the
239 pilot study being almost identical to the main study, we did not combine their data. This is
240 because the migrants and non-migrants were demographically matched within, but not
241 across, the pilot study and the main study. Therefore, combining their data results in a
242 demographically unmatched sample of migrants and non-migrants, which could account for
243 any differences between the two groups.

244 **Experimental Design**

245 A 2x2x3 mixed factorial experimental design was used. The between-subjects
246 independent variables were the condition that participants took part in (agency or no-
247 agency) and participants' migrant status (migrant or non-migrant). The within-subjects
248 independent variable was the risky migration decisions in the game (first, second, or third).
249 The dependent variables were participants' responses to the risky migration decisions and
250 their self-reported perceived agency. Age and gender were measured as demographic
251 variables.

252 **Choice-Based Interactive Fiction Game**

253 We created the choice-based interactive fiction game on Qualtrics
254 (<https://www.qualtrics.com/>). Despite not being game design software, Qualtrics allows for
255 the implementation of HTML, CSS, and JavaScript, which are commonly used to create text-
256 based games. Our game included a prologue, three risky migration decisions, and an
257 epilogue. The prologue involved a trivial decision that did not provide a measure of the
258 dependent variable. Each of the following three risky migration decisions involved a binary
259 trade-off between a greater reward that involved risk and a smaller reward that involved no
260 risk, and they were all embedded within the context of a migrant journey. For example, the
261 first risky migration decision involved taking a shorter but more treacherous route or taking a

262 longer but safer route (all the risky migration decisions are available on OSF:
263 <https://osf.io/7a4vr/>). To make the decisions as realistic as possible, we drew inspiration
264 from both first-hand and second-hand accounts of migrant journeys. These were obtained
265 from the website Telling the Real Story (<https://www.tellingtherealstory.org/en/>) and from
266 YouTube videos published by various news channels (e.g., BBC News and Sky news). The
267 epilogue did not involve any decisions.

268 The development of our game followed an iterative process (Bannon, 1995;
269 Raghothama & Meijer, 2018). Each version of the game was shared among the authors and
270 sent to personal contacts that included migrants and non-migrants. The game was then
271 updated accordingly and once again sent out for feedback. This was done until no further
272 improvements were suggested.

273 Two versions of the game were made, one for the agency condition and one for the
274 no-agency condition. There were two differences between the two versions of the game.
275 First, at the beginning of each decision, participants in the agency condition, but not in the
276 no-agency condition, were shown an explicit acknowledgment of the choice they made in the
277 preceding decision. This acknowledgement was one or two sentences long and did not
278 provide any additional useful information. The trivial decision in the prologue was used to
279 show (or not show) an explicit acknowledgement of this choice in the following risky
280 migration decision, and thus vary the perceived agency between conditions from the first
281 decision. Second, the progress bar in the agency condition displayed two different branches
282 at each decision, one of which was subsequently filled in, indicating the choice the
283 participant made. This created the illusion that different choices led to different outcomes. In
284 contrast, the progress bar in the no-agency condition was linear.

285 **Procedure**

286 Device restrictions were applied on Prolific, which suggested that participants access
287 the experiment through a computer. Since this was a remote online study, participants could
288 use any web browser and computer of their choosing. To navigate through the experiment, a
289 mouse (or touchpad) and keyboard were necessary.

290 Participants were first recruited for the pre-screener. Before starting, they were
291 shown a combined information sheet and consent form. After reading the form and providing
292 informed consent by clicking a button at the bottom of the web page, participants were
293 asked to provide their Prolific IDs. They were then asked for their age, gender, highest level
294 of education, marital status, annual household income, whether they had ever migrated to a
295 new country before, and, if they replied yes to the preceding question, whether they were old
296 enough to remember their migration journey. For the response options of each demographic
297 question, see Method Supplement S1. Participants were then debriefed and redirected back
298 to the Prolific website. The pre-screener took approximately 2 min to complete.

299 Participants that passed the pre-screener were then invited to take part in the
300 experiment. Before starting, the procedure was identical to that of the pre-screener. That is,
301 the same combined information sheet and consent form was used, and participants
302 indicated they read the form, gave informed consent, and provided their Prolific IDs in the
303 same way. They then took part in the agency condition or the no-agency condition. In both
304 conditions, participants navigated through a choice-based interactive fiction game. However,
305 the game promoted perceived agency in the agency condition, but not in the no-agency
306 condition.

307 After completing the game, participants were asked to indicate the extent to which
308 they felt as though their actions were meaningful within the context of the story, and to what
309 extent they felt as though they were able to see the consequences of their decisions, both
310 on a scale of 0–100 (adapted from Fendt et al., 2012). Finally, they were asked for their age,
311 gender, whether they had ever migrated to a new country before, and, if they replied yes to
312 the preceding question, whether they were old enough to remember their migration journey.
313 For the response options of each demographic question, see Method Supplement S1.
314 Participants were then debriefed and redirected back to the Prolific website. Both conditions
315 took approximately 10 min to complete, but since progression was entirely self-paced,
316 completion times varied between participants.

317

Results

318 **Risky Migration Decisions**

319 We coded participants' responses into binary variables, with 0 indicating the choice
320 of a non-risky option and 1 indicating the choice of a risky option. A 2 (condition) ×2 (migrant
321 status) ×3 (decision) mixed factorial ANOVA was conducted on participants' responses. The
322 same ANOVA was repeated twice, once with age added as a factor and once with gender
323 added separately. The results from these three ANOVAs are shown in Table 1. Post-hoc
324 Tukey tests based on estimated marginal means were then conducted for the main effect of
325 decision across all three ANOVAs, since it was significant with a $BF_{10} > 3$. BF_{10} = Bayes
326 factor that quantifies the empirical evidence in favour of the alternative hypothesis. When a
327 Bayes factor is between one-third and three, it is considered evidentially weak or anecdotal,
328 and thus researchers typically conclude that a significant effect is absent (Giolla & Ly, 2019).
329 Conversely, when a Bayes factor is greater than three, researchers typically conclude that a
330 significant effect is present. The results from these three post-hoc Tukey tests are shown in
331 Table 2. In the ANOVA with gender added as a factor, the main effects of condition and
332 gender as well as the interaction between migrant status, gender, and decision were
333 significant, but with a $BF_{10} < 3$. Therefore, post-hoc independent samples *t*-tests based on
334 estimated marginal means were conducted for the two main effects (see Table S1), and their
335 interaction is visualized in Figure S1. Overall, these results suggest that migrants did not
336 significantly differ from non-migrants in their risky migration decisions, and that the condition
337 participants took part in (agency or no-agency) did not meaningfully impact their risky
338 migration decisions.

339

340

341 **Table 1**342 *Mixed Factorial ANOVAs*

ANOVA	<i>df</i>	<i>F</i>	<i>p</i>	η^2_G	<i>BF</i> ₁₀
ANOVA 1					
condition	1, 564	3.71	.055	.002	0.30
migrant	1, 564	0.09	.771	< .001	0.06
condition:migrant	1, 564	0.09	.771	< .001	0.08
decision	1.88, 1062.53	62.09	< .001	.067	6.69×10²⁴
condition:decision	1.88, 1062.53	0.01	.987	< .001	0.01
migrant:decision	1.88, 1062.53	1.22	.293	.001	0.04
condition:migrant:decision	1.88, 1062.53	0.28	.741	< .001	0.03
ANOVA 2					
condition	1, 544	2.20	.139	.001	0.37
migrant	1, 544	1.63	.203	< .001	0.09
age	5, 544	1.53	.178	.005	0.01
condition:migrant	1, 544	1.76	.185	.001	0.14
condition:age	5, 544	0.54	.744	.002	0.01
migrant:age	5, 544	0.80	.549	.002	0.00
condition:migrant:age	5, 544	1.40	.221	.004	0.06
decision	1.88, 1021.92	19.19	< .001	.022	1.90×10¹²
condition:decision	1.88, 1021.92	0.05	.948	< .001	0.01
migrant:decision	1.88, 1021.92	0.85	.421	< .001	0.04
age:decision	9.39, 1021.92	0.59	.812	.003	0.00
condition:migrant:decision	1.88, 1021.92	0.05	.938	< .001	0.03
condition:age:decision	9.39, 1021.92	1.33	.213	.008	0.06
migrant:age:decision	9.39, 1021.92	0.43	.924	.003	0.00
condition:migrant:age:decision	9.39, 1021.92	1.05	.395	.006	0.07
ANOVA 3					
condition	1, 555	4.27	.039	.003	0.44
migrant	1, 555	0.07	.787	< .001	0.07
gender	1, 555	3.96	.047	.002	0.46
condition:migrant	1, 555	0.10	.754	< .001	0.11
condition:gender	1, 555	1.00	.317	< .001	0.16
migrant:gender	1, 555	0.74	.390	< .001	0.15
condition:migrant:gender	1, 555	0.08	.781	< .001	0.16
decision	1.88, 1042.70	61.21	< .001	.067	4.15×10²⁴
condition:decision	1.88, 1042.70	0.00	> .999	< .001	0.02
migrant:decision	1.88, 1042.70	1.36	.256	.002	0.03
gender:decision	1.88, 1042.70	0.27	.746	< .001	0.02
condition:migrant:decision	1.88, 1042.70	0.32	.715	< .001	0.04
condition:gender:decision	1.88, 1042.70	0.93	.391	.001	0.09
migrant:gender:decision	1.88, 1042.70	3.71	.027	.004	1.09
condition:migrant:gender:decision	1.88, 1042.70	0.90	.403	.001	0.13

343 *Note.* Rows containing a significant effect are presented in bold. Rows containing a significant effect344 with a *BF*₁₀ > 3 are presented in bold and underlined. ANOVA 1: dependent variable = participants'

345 responses (0 [non-risky] or 1 [risky]); factors = condition (agency or no-agency), migrant status

346 (migrants or non-migrants), and decision (first, second, or third). ANOVA 2: same as ANOVA 1 but

347 with age (18–24, 25–34, 35–44, 45–54, 55–64, or 65 or over) added as a factor. ANOVA 3: same as

348 ANOVA 1 but with gender (male or female) added as a factor.

349

350

351 **Table 2**352 *Post Hoc Tukey Tests*

Post hoc Tukey test	M_1	M_2	df	t	p	d	BF_{10}
Post hoc Tukey tests							
ANOVA 1							
decision 1 - decision 2	.17	.39	564	-8.46	< .001	-0.63	> 1,000
decision 1 - decision 3	.17	.14	564	1.09	.519	0.07	0.01
decision 2 - decision 3	.39	.14	564	9.73	< .001	0.69	> 1,000
Post hoc Tukey tests							
ANOVA 2							
decision 1 - decision 2	.16	.36	544	-4.71	< .001	-0.56	204.23
decision 1 - decision 3	.16	.14	544	0.57	.838	0.05	0.01
decision 2 - decision 3	.36	.14	544	5.40	< .001	0.62	56.78
Post hoc Tukey tests							
ANOVA 3							
decision 1 - decision 2	.17	.39	555	-8.44	< .001	-0.62	0.20
decision 1 - decision 3	.17	.15	555	1.02	.567	0.06	0.01
decision 2 - decision 3	.39	.15	555	9.60	< .001	0.68	0.65

353 *Note.* Rows containing a significant effect are presented in bold. Rows containing a significant effect

354 with a $BF_{10} > 3$ are presented in bold and underlined. All post-hoc Tukey tests were based on

355 estimated marginal means. ANOVA 1: dependent variable = participants' responses (0 [non-risky] or

356 1 [risky]); factors = condition (agency or no-agency), migrant status (migrants or non-migrants), and

357 decision (first, second, or third). ANOVA 2: same as ANOVA 1 but with age (18–24, 25–34, 35–44,

358 45–54, 55–64, or 65 or over) added as a factor. ANOVA 3: same as ANOVA 1 but with gender (male

359 or female) added as a factor. The results from post hoc Tukey test 3 may be misleading due to the

360 significant interaction between migrant status, gender, and decision in ANOVA 3. Post-hoc Tukey

361 tests 1, 2, and 3 tested the pairwise comparisons between each decision (first, second, and third)

362 from ANOVAs 1, 2, and 3, respectively.

363

364 **Perceived Agency**

365 We summed participants' ratings for the two perceived agency questions to create a

366 composite measure of perceived agency ranging from 0–200. A Welch's independent

367 samples t -test showed that perceived agency was significantly higher in the agency

368 condition ($M = 156.41$, $SD = 36.14$) than in the no-agency condition ($M = 146.39$, $SD =$

369 39.92), $t(560.48) = 3.14$, $p = .002$, 95% CI [3.74, 16.29], $d = 0.26$, $BF_{10} = 10.89$. A Welch's

370 independent samples t -test showed that perceived agency was significantly higher for

371 migrants ($M = 155.82$, $SD = 37.97$) than non-migrants ($M = 146.99$, $SD = 38.32$), $t(565.95) =$

372 2.76, $p = .006$, 95% CI [2.54, 15.12], $d = 0.23$, $BF_{10} = 3.73$. Overall, these results suggest
373 that participants' perceived agency was significantly higher in the agency condition
374 compared to the no-agency condition, and that migrants' perceived agency was significantly
375 higher than non-migrants' perceived agency.

376 **Discussion**

377 In this preregistered study, we investigated the risky migration decisions (embedded
378 within the context of a migrant journey) of migrants (broadly defined in our study as
379 individuals who migrated to a new country before and were old enough to remember their
380 migration journey) and non-migrants within a novel and immersive experimental setting. We
381 found that migrants did not significantly differ from non-migrants in their risky migration
382 decisions. This refutes a fundamental assumption in our research question, which asks
383 whether immersion narrows the gap between migrants and non-migrants in the context of
384 risky migration decisions, and thus assumes that a gap exists in the first place. We made
385 this assumption because of the received wisdom that migrants are more risk-taking than
386 non-migrants (Baláž & Williams, 2011; Goldbach & Schlüter, 2018; Jaeger et al., 2010;
387 Lübke et al., 2021; but see Ceriani & Verme, 2018; Mironova et al., 2019 for opposite
388 findings for conflict-driven migration). However, most of the previous research investigated
389 risk attitudes through Likert scales that ranged from a complete unwillingness to take risks to
390 a complete willingness to take risks. Although this type of self-report measure has been
391 shown to be a reliable predictor of certain risk behaviors (Dohmen et al., 2011), it is vastly
392 different from the context-rich and migration-specific risky decisions used in our study, which
393 may explain the differing results. Indeed, consistent with the aim of our study, Czaika et al.
394 (2021) discussed the multi-faceted nature of migration decisions and recommended
395 conducting scenario-based studies that experimentally manipulate the decision environment
396 to capture this complexity and thus learn more about migration-specific risk-taking.

397 We also found that the condition participants took part in (agency or no-agency) did
398 not meaningfully impact their risky migration decisions. This result is noteworthy considering
399 that our experimental manipulation worked; participants' perceived agency was significantly

400 higher in the agency condition compared to the no-agency condition. Additionally, migrants'
401 perceived agency was significantly higher than non-migrants' perceived agency, despite
402 their comparable risky migration decisions. Therefore, we can conclude that perceived
403 agency, despite being said to promote immersion and consequently decrease the degree of
404 trade-off between ecological validity and experimental control (Kozlov & Johansen, 2010;
405 Lin-Greenberg et al., 2021; McMahan, 2003), did not affect participants' risky migration
406 decisions in our study. This finding raises an interesting possibility: it might not be necessary
407 to invest the time and effort to promote perceived agency when investigating risky migration
408 decisions in an experimental setting if it does not lead to different results. However, this
409 study is the first to examine the effects of perceived agency and migrant status on migration-
410 specific risk-taking in an immersive, experimental setting, which also raises the possibility
411 that our design is too simplistic (Bijak et al., 2023). Although participants generally reported
412 moderate to high levels of perceived agency in both conditions, perhaps it is necessary to
413 create more realistic games with immersive 3D environments for the effects of perceived
414 agency to emerge.

415 It is worth noting that participants' risk-taking varied significantly between different
416 migration decisions. However, this result was expected, and does not carry any meaningful
417 practical or theoretical insights. Although all decisions involved a binary trade-off between a
418 greater reward that involved risk and a smaller reward that involved no risk, these decisions
419 were placed within rich, idiosyncratic contexts. It is therefore unsurprising that they elicited
420 different levels of risk-taking. Accordingly, the focus of our study was not on differences
421 between participants' decisions on their own, but rather whether these decisions interacted
422 with condition and/or migrant status, which they did not.

423 Notably, age and gender did not meaningfully impact participants' risky migration
424 decisions. This is surprising considering the large body of work on the demography of risk
425 that suggests risk aversion increases with age and that females are more risk averse than
426 males (Donkers et al., 2001; Halek & Eisenhauer, 2001; Hartog et al., 2002). Furthermore,
427 the comparatively small body of work comparing the demography of risk between migrants

428 and non-migrants has also found significant age and gender differences. For example, Baláž
429 and Williams (2011) found significantly greater risk aversion amongst non-migrant women
430 compared to migrant women, whereas Jaeger et al. (2010) found greater risk aversion in
431 migrants compared to non-migrants regardless of both age and gender. Nevertheless, this
432 research assessed willingness to take risks in general rather than willingness to take
433 migration-specific risks, which, as acknowledged by Baláž and Williams (2011), raises
434 questions about causality; although there is likely an association between generic and
435 specific measures of risk-taking, the strength of this association is up for debate. The
436 disparity between our results and those of previous studies highlights this issue as well as
437 the importance of using migration-specific risk measures to gain more nuanced insights into
438 migrant and non-migrant risk-taking.

439 The general concept of validity in the context of games can be described as the
440 degree of correspondence between the game and whatever aspect of reality it attempts to
441 model (Peters et al., 1998). When a game is used as a research tool, it should ideally be
442 designed to make participants behave similarly to how they would in reality. To do this,
443 Peters et al. (1998) suggested that the game should appear realistic to participants,
444 resemble reality, and have high predictive validity (i.e., the extent to which the game can
445 predict what happens in reality). To meet these criteria and therefore increase the validity of
446 a game, Peters et al. recommended: (a) working systematically and participatively to adjust
447 and improve the game; (b) presenting the game to both researchers and future game
448 players (in our study, these were migrants and non-migrants) and asking for their opinion on
449 the degree of correspondence between the game and reality; and (c) testing the game
450 extensively.

451 In our view, the iterative process that we used for the development of our game (see
452 the Choice-Based Interactive Fiction Game section) followed all of Peters et al.'s (1998)
453 criteria. That being said, we could have taken further steps to ensure a high degree of
454 correspondence between our game and reality, such as incorporating a validity
455 questionnaire at the end of our study (van Lankveld et al., 2017). Nevertheless, some

456 perspectives emphasize the notion that the only valid representation of reality is reality itself
457 (Raghothama & Meijer, 2018). This idea is linked to the aforementioned trade-off between
458 ecological validity and experimental control (see the Migration Research section); highly
459 controlled experiments that allow for causality to be established often lack generalizability,
460 and loosely controlled experiments that are generalizable often cannot establish causality
461 (Klabbers, 2009, 2018). Therefore, although games can hold significant explanatory power,
462 they cannot offer comprehensive predictions or explanations of the aspect(s) of reality they
463 attempt to model. This view aligns with the core objective of this paper: to inform the design
464 of future migration experiments with the aim of achieving more accurate (but certainly not
465 perfect) predictions, explanations, and consequently simulation models of migration.

466 **Limitations and Directions for Future Research**

467 Our study has several potential limitations. Firstly, our risky migration decisions were
468 not psychometrically validated. To do this, researchers typically examine the convergent
469 validity between different measures that assess the same construct by examining the extent
470 to which they produce similar results. When doing so, it is recommended to distinguish
471 between general and specific risk-taking measures (Bran & Vaidis, 2020). However, to the
472 best of our knowledge, no other migration-specific risk measures were available at the time
473 of our study.

474 Secondly, as mentioned above, each migration decision in our game was unique in
475 terms of the specific risk, reward, and context it involved. Consequently, one could argue
476 that each migration decision measured participants' risk-taking in that specific setting, and
477 that collapsing risk categories across all questions was inappropriate. Indeed, prior to
478 conducting our study, we considered matching each migration decisions' risk, reward, and
479 setting. However, we decided against it because it would undermine the experiment's
480 ecological validity; a migrant's journey in real-life involves various risky decisions that do not
481 all involve the same information or context (Czaika et al., 2021). Therefore, to holistically
482 measure risk-taking in the context of migration, this variation must be accounted for.

483 Lastly, we determined whether participants were migrants or non-migrants by asking
484 them whether they had ever migrated to a new country before and, if they said yes, whether
485 they were old enough to remember their migration journey. These questions do not allow for
486 distinctions to be made between different types of migrants (e.g., those that migrated within
487 or between countries) or different reasons for migrating (e.g., security, poverty, family, study,
488 or new opportunities). Despite this, our game had participants assume the role of an asylum
489 seeker that made a long, hazardous journey across various countries. Migrants with similar
490 experiences might have been more immersed in our game and thus may have responded
491 differently. Furthermore, if the migrants in our study could not relate to the experiences
492 described in our game, it might have prompted them to adopt a new set of precepts about
493 reality, personal goals, and identity while playing (Bowman & Lieberoth, 2018). Although this
494 can be seen as a consequence of immersion, we consider it undesirable in the context of
495 our study; our aim was for participants to respond as closely as possible to how they would
496 in reality, not to adopt alternate identities that could impact their decision-making. Therefore,
497 information about the type of migrant that was recruited for our study may have been useful
498 since this could have affected their migration-specific risk-taking. However, as noted in The
499 Present Study section, there are potential ethical issues associated with asking migrants to
500 relive their potentially traumatic migration journeys and decisions, which would likely be
501 further exacerbated for asylum seekers.

502 Some additional considerations for future research include how individual differences
503 between migrants and non-migrants (e.g., attitudes toward risk and uncertainty; Czaika et
504 al., 2021) interact with their risky migration decisions in immersive contexts. Furthermore,
505 our game was only in English. Although the participants in our study were all fluent in
506 English, playing the game in their native language might have increased immersion and
507 consequently their propensity for making meaningful decisions.

508 To the best of our knowledge, this study is the first to examine the effects of
509 perceived agency and migrant status on migration-specific risk-taking in an immersive,
510 experimental setting. Our experimental manipulation was successful; participants in the

511 agency condition reported higher feelings of perceived agency than participants in the no-
512 agency condition. Furthermore, migrants reported higher feelings of perceived agency than
513 non-migrants. Despite this, neither condition nor migrant status meaningfully affected risky
514 migration decisions. Nonetheless, additional work is still needed to examine how risk-taking
515 patterns may differ between standard self-report surveys and immersive, context-rich
516 decision-making settings.

517 **Conclusion**

518 In our experiment, participants' perceived agency in a text-based game and migrant
519 status did not affect their risky migration decisions. This suggests that generic studies on
520 risky migration decisions conducted on non-migrants may be enough to inform simulation
521 models of migration, since neither immersive contexts nor specific participant demographics
522 impacted the data required to make agent-based models more psychologically realistic.
523 However, although differences in perceived agency did not translate into differences in our
524 dependent variable of interest—risky migration decisions—they may impact other outcome
525 measures. This is worth exploring considering we found that perceived agency can be easily
526 manipulated through the adaptation of a linear progress bar into a non-linear progress bar,
527 and the addition of explicit acknowledgements of choices made by participants.

528 Our findings also indicate that a text-based game may be too simple and artificial to
529 allow for deep insights into the idiosyncrasies of migration decision-making, and this
530 information might need to be sought elsewhere, for example, in thorough ethnographic
531 studies (see Belabbas et al. 2022). This interpretation is consistent with an earlier
532 suggestion (Bijak et al. 2023) of a trade-off between clear, interpretable experimental results
533 and extensive, data-rich inputs needed to inform simulation models of complex social
534 processes, such as migration. In our case, on the one hand, the straightforward
535 experimental design of our study allowed us to isolate the impacts (or lack thereof) of
536 various factors on human decisions, as reported in this paper. On the other hand, such a
537 manageable and interpretable design was still likely to be too simple to reflect the complex
538 reality being modelled.

539 So, can games help inform the construction and design of agent-based simulation
540 models? In light of our results, the answer depends on the purpose of modelling. If the aim is
541 to include *realistic decision parameters* under various circumstances in the models, then
542 simple games may fail to capture the complex reality, and more complex and realistic games
543 may be difficult to interpret. If, however, the objective of using games is to help understand
544 the mechanisms involved in human decision-making, and create a *plausible design* of an
545 agent-based simulation model, then this avenue may be more promising. This research path
546 is worth pursuing in future studies at the intersection of gaming and simulation modelling.
547

548

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