

Online Research @ Cardiff

This is an Open Access document downloaded from ORCA, Cardiff University's institutional repository: <http://orca.cf.ac.uk/122188/>

This is the author's version of a work that was submitted to / accepted for publication.

Citation for final published version:

Haggar, Paul, Whitmarsh, Lorraine and Skippon, Stephen M. 2019. Habit discontinuity and student travel mode choice. *Transportation Research Part F: Traffic Psychology and Behaviour* 64 , pp. 1-13. 10.1016/j.trf.2019.04.022 file

Publishers page: <https://doi.org/10.1016/j.trf.2019.04.022> <<https://doi.org/10.1016/j.trf.2019.04.022>>

Please note:

Changes made as a result of publishing processes such as copy-editing, formatting and page numbers may not be reflected in this version. For the definitive version of this publication, please refer to the published source. You are advised to consult the publisher's version if you wish to cite this paper.

This version is being made available in accordance with publisher policies. See <http://orca.cf.ac.uk/policies.html> for usage policies. Copyright and moral rights for publications made available in ORCA are retained by the copyright holders.



1 Habit Discontinuity and Student Travel Mode Choice

2 Paul Haggar and Lorraine Whitmarsh

3 Cardiff University, Cardiff, UK

4 Stephen M. Skippon

5 Transport Research Laboratory (TRL), Wokingham, UK

6
7
8 *Author Note.*

9
10 Paul Haggar, School of Psychology, Cardiff University; Lorraine Whitmarsh, School of
11 Psychology, Cardiff University; Stephen M. Skippon, Transport Research Laboratory (TRL),
12 Wokingham, United Kingdom.

13 The Manuscript is based on data from the doctoral thesis of Paul Haggar. Funding: This
14 work was supported by the School of Psychology at Cardiff University, the Wales Doctoral
15 Training Centre [ref: 1231987] and Shell Research limited. Funders were not involved in
16 research design.

17 Correspondence concerning this article can be addressed to Paul Haggar, School of
18 Psychology, Cardiff University, Tower building, 70 Park Place, Cardiff, CF10 3AT,
19 paulhagg@jenkinspoint.com.

20 Abstract

21 Overreliance on motorised travel modes aggravates existing problems of public obesity and
22 global climate change. However, travel mode choices are often habitual, and habits are difficult
23 to break, they are automatic responses to stable-contexts learnt through repetition. One approach
24 is to destabilise the stable-contexts that cue travel habits. Such an opportunity could arise when
25 people move-house, so we predicted that the travel mode choices and habits of university
26 students would change, without a behaviour change intervention, when they moved-house
27 between academic terms. University students ($N = 250$) completed two questionnaires, around
28 5.5 months apart, between new academic years; 153 students moved-house (“movers”). As
29 predicted when movers changed their travel mode choices, their new choices became more
30 automatic and their old choices less automatic. Mover’s travel changes were planned prior to
31 moving-house, however there was insufficient evidence that either changes in the social context
32 or activated values were related to travel changes. We discuss these findings with respect to
33 acquiring habits and the habit discontinuity and self-activation hypotheses (Verplanken, Walker,
34 Davis & Jurasek, 2008) and the advantages of student house-hunting as a 'window of
35 opportunity' for establish new travel habits amongst university students.

36 *Keywords:* Habit discontinuity hypothesis, habits, travel mode choice, university
37 students.

38

39 Choices between walking, cycling, driving or using public transport – travel mode
40 choices – have important consequences. Cumulative motorised travel exacerbates public obesity
41 (McCormack & Virk, 2014) and global climate change (Sims et al., 2014). Physically-active
42 travel (walking and cycling) alleviates these problems (Woodcock et al., 2009; de Nazelle et al.,
43 2011). Travel mode choices are often habitual (Hoffmann, Abraham, White, Ball & Skippon,
44 2017; Lanzini & Kahn, 2017) and habits are difficult patterns of behaviour to change (Jager,
45 2003). One proposal for breaking travel mode choice habits is to take advantage of moments of
46 change or disruption, when habits happen to be at their weakest (Verplanken & Wood, 2006). A
47 candidate for such a moment is when someone moves-house (Verplanken et al., 2008;
48 Verplanken & Roy, 2016). We studied the changing travel mode choices and habits of university
49 students in the UK, predicting that students who moved-house during the study (“movers”)
50 would more often make new travel mode choices and change their travel mode choice habits
51 compared to other students (“non-movers”).

52

53 **Habits and the Habit Discontinuity Hypothesis**

54 There are various concepts of habit (Barandiaran & Di Paolo, 2014), but habits in social
55 psychology can be conceptualised as a type of memory with three specific properties (Kurz,
56 Gardner, Verplanken & Abraham, 2015). (1) Habits are learnt through repetition (Lally, Van
57 Jaarsveld, Potts & Wardle, 2010). (2) Habits are cued (triggered) by *stable-contexts*: physical,
58 temporal and social circumstances that are recurrent and unchanging (Ouellette & Wood, 1998;
59 Verplanken & Aarts, 1999). (3) Perhaps most importantly (Gardner, 2015), cued habits lead to
60 *automatic* behavioural responses – automatic behaviour is fast, efficiently, unconscious and

61 occurs with little thought (Moors, 2016) and, as such, it is difficult to control (Orbell &
62 Verplanken, 2010) and salient information is ignored (Verplanken, Aarts & van Knippenberg,
63 1997. One's sense of identity or personal style is also thought to reflect one's habits (Verplanken
64 & Orbell, 2003). Previous research has identified habits as supporting health-relevant
65 behaviours (e.g. diet, exercise and drug use: see Gardner, 2015) including travel mode choices
66 (Gardner, 2009; Thomas & Walker, 2015). Self-control with self-awareness can be effective in
67 controlling habits (Quinn, Pascoe, Wood & Neal, 2010) until willpower fails and old habits
68 reassert themselves (Neal, Wood & Drolet, 2013).

69 The *habit discontinuity hypothesis* is the hypothesis that if a stable-context is destabilised
70 then the causal links between context-cues and habits are severed, temporarily, provide an
71 opportunity to break old habits altogether (Verplanken et al., 2008) and learn new ones (Walker,
72 Thomas & Verplanken, 2015). It is thought that stable-contexts are destabilised when certain
73 events, “moments of change”, occur (Thompson et al., 2011); these moments of change are often
74 correlated with travel changes (Klößner, 2004; Müggenburg, Busch-Geertsema & Lanzendorf,
75 2015). Some candidates include life-cycle events (Employment: Gillison, Standage &
76 Verplanken, 2014; Parenthood: Schäfer, Jaeger-Erben & Bamberg, 2012; Thomas, Fisher,
77 Whitmarsh, Milfont & Poortinga, 2018) and disruptive events (e.g. road-closure: Fujii, Gärling
78 & Kitamura, 2001; workplace relocation: Walker et al., 2015). Moving-house is also a plausible
79 candidate (e.g. Bamberg, 2006): it involves a new place, and possibly also new people, activities
80 and schedules. Verplanken et al., (2008) hypothesised that moving-house would lead to
81 increased awareness of pro-environmental values amongst commuters and so lead them to reduce
82 their car-use. This was evidenced with a sample of university-commuters: those with strong pro-
83 environmental values drove even less if they had also moved-house recently. This pattern was

84 replicated with a larger, representative sample of the UK population (Thomas, Poortinga &
85 Sautkina, 2016). In a field experiment with householders, Verplanken and Roy (2016) found that
86 an intervention promoting sustainable behaviours was somewhat more effective in increasing
87 sustainable behaviour if participants had also recently moved-house. Importantly, a discontinuity
88 in an old habit is hypothesised to precede behavioural change, which in turn leads to the
89 development of a new habit through behavioural repetition; habit discontinuity precedes habit
90 change (Walker, Thomas & Verplanken, 2015). Understanding subsequent habit changes is
91 important because habits and behaviour are theoretically distinct (Verplanken, 2006) and because
92 of the practical importance of establishing a habit to successfully breaking an old one (Rothman
93 et al., 2015).

94 Previous research has shown that university students can possess strong travel mode
95 choice habits (Gardner, 2009; Thomas & Walker, 2015) that are probably socially-learnt from
96 family, friends and peers (Klößner & Matthies, 2012). A university campus would seem to
97 provide an ideal location within which to encourage positive behaviour changes amongst young
98 people (Plotnikoff et al., 2015; Wilson et al., 2016) and the predictable annual university student
99 house-hunting affords an opportunity to circumvent practical difficulties of studies of the effects
100 of house-moving (Ampt, Stopher & Wundke, 2005). From the habit discontinuity hypothesis,
101 we considered it plausible that students who moved-house would experience a discontinuity in
102 their habits, facilitating changes in travel behaviour that, in turn, would lead to the formation of
103 new travel habits (through repetition) and the loss of old travel habits through forgetting. We
104 asked this two-part primary research question.

105 RQ 1a: ~~To what extent is~~ Is moving to a new house between academic years (predictor,
106 X) associated with change in travel habits (criterion, Y) through changes in travel
107 behaviour (mediator, M)?

108 RQ 1b: ~~To what extent is~~ Is travel mode change, for movers and non-movers, associated
109 with changes in habits for current and previous travel mode use?

110

111 **Motivation and Context**

112 In addition to our primary research question, we considered several motivational and
113 contextual factors that might be involved in habit and travel changes with habit discontinuity.
114 Specifically, we considered the roles of travel planning, value activation and context change.

115 **Planning to change travel mode.** Several studies of moving-house and travel mode
116 change have noted the importance of plans (intentions), before moving-house, to subsequent
117 travel behaviour after moving-house (Bamberg, 2006; Schäfer et al., 2012; Jones & Ogilvie,
118 2012). The motivations for these plans are likely practical, but may also reflect value-motives,
119 such as environmental concern (Dunlap, Van Liere, Mertig & Jones, 2000). Putting planned
120 change into practice is consistent with the idea that habit discontinuity facilitates planned
121 behaviour changes or, theoretically equivalent, that habit limits the effect of prior intentions upon
122 behaviour change (Verplanken & Aarts, 1999: pp. 214-5; Gardner, 2015: pp. 9-10). However,
123 this is less consistent with the idea that habit discontinuity (e.g. with moving-house) coincides
124 with unanticipated motivational changes (Verplanken & Wood, 2006). Therefore, we asked this
125 research question.

126 RQ 2: ~~To what extent is~~ Is moving to a new house (X) associated with changes in travel
127 behaviour (Y) through planning to use a particular type of travel (M)?

128

129 **Value activation.** *Values* are “desirable, transsituational goals, varying in importance,
130 that serve as guiding principles in people’s lives” (Schwartz, et al., 2001: p. 521). The *self-*
131 *activation hypothesis* (Verplanken et al., 2008) is that a moment of change (e.g. moving-house)
132 can lead to value-led behaviour changes if (a) the value is part of an individual’s self-concept (is
133 *self-central*) and (b) the moment of change led to value activation. *Value activation* is thinking
134 about a situation (processing information) from a value-perspective (e.g. thinking about driving
135 as environmentally damaging, or walking as good for my health), rather than, for instance, a
136 pragmatic-perspective (e.g. driving as convenient, walking as cheap) (Schwartz, 1977;
137 Dahlstrand & Biel, 1997). In the context of moments of change, value-activation might occur
138 when values are “implied by the situation or by the information a person is confronted with” or
139 with “self-focused” cognition (Verplanken & Holland, 2002: p. 436). For students, value
140 activation might bridge an apparent gap between value motives and travel behaviour (Shannon et
141 al., 2006; Simons et al., 2014); indeed, UK students, as a demographic group, are generally
142 committed to environmental sustainability (Cotton & Alcock, 2013). Most previous studies have
143 focused upon pro-environmental values as the motivation for changes with habit discontinuity,
144 rather than values in general (Verplanken et al., 2008; Walker et al., 2015; Thomas et al., 2016;
145 Verplanken & Roy, 2016). Therefore, we considered whether different values might be activated
146 at this time. Given this theory of value activation, we anticipated that when students move-
147 house, their values could be activated and (if these values are self-central, as indexed by their
148 strength) then movers with these values will more often change their travel behaviour than
149 movers who do not hold these values. Therefore, we also asked this research question.

150 RQ 3: ~~To what extent is~~ Is moving to a new house (predictor, X) associated with changes
151 in travel behaviour (criterion, Y) only for those with particular values (moderator, W)?

152

153 **Context change.** Previous research has demonstrated that habits are cued within stable
154 contexts: for instance, smoking in public-houses (Orbell & Verplanken, 2010) and eating
155 popcorn in cinemas (Neal, Wood, Wu & Kurlander, 2011). Wood, Tam and Witt (2005), studying
156 the role of stable-contexts in domestic habits as students moved-house, found that exercise
157 behaviour was influenced by similarities in the physical context (similarity of exercise locations)
158 whereas reading newspapers was influenced by similarities in the social context
159 (presence/absence of similar people also reading the newspapers). Aside from Wood et al.
160 (2005), and studies in comparative psychology (e.g. Thraillkill & Bouton, 2014), we could not
161 find any previous research addressing how changing context-cues might weaken or change
162 habits. University life is a learning experience in independent living for young people (Rugg,
163 Ford & Burrows, 2004) and this involves new friendships, social networks and identities (Heath,
164 2004; Easterbrook & Vignoles, 2012), where sharing a house with new people is an important
165 element in this experience (Easterbrook & Vignoles, 2015). Therefore, it is plausible that
166 changes in a student's household reflect these changes in their social context. Indeed, Young
167 people identify the travel of their friends, family and peers as important in their own travel
168 choices (Simons et al., 2014) and at least one study has found that the travel modes of students
169 are associated with the travel modes of their roommates (Bopp, Behrens & Velecina, 2014). If
170 moving-house changes the social context of the household, as indicated by a student's own
171 perceptions of the importance of this change (Wood et al., 2005), then moving-house would be

172 associated with this and, in turn, these perceptions would be associated with travel behaviour
173 change. Therefore, we asked the following research question.

174 RQ 4: ~~To what extent is~~ Is moving to a new house (X) associated with changes in travel
175 behaviour (Y) through perceptions of household life change (M)?

176

177 **The Present Study**

178 In the UK, university students tend to change their term-time accommodation (move-
179 house) in late September, before the beginning of a new academic year (NUS, 2014: pp. 27-28).
180 Student participants in our study completed a research questionnaire in May, or early June, and a
181 second research questionnaire between October and November. We recruited approximately
182 equal numbers of students who did, and did not, intend to move to a new house between
183 university terms. After September, changes in travel behaviour (university commuting) were
184 compared between movers and non-movers.

185

186

Method

187

188 **Participants**

189 University students studying full-time in the UK were recruited through advertisements,
190 which appeared on the notice board feature of the student intranet at a ~~particular~~ UK university
191 and in different Facebook groups used by different university students across the UK. Students
192 on external work-placements, distance learners, and final-year students were excluded, having no
193 reason to commute to their university consistently. Quota sampling was used to recruit

194 approximately equal groups of people *intending* to move-house and people intending not to, as
195 well as equal proportions of post-graduates within each group.

196 Of 361 participants, 250 (69.3%) completed the study. Of these, 153 (61.2%) were
197 confirmed movers and 97 (38.8%) were confirmed non-movers. Most movers had made a
198 tenancy agreement with a landlord before they began the study but had yet to move into the
199 house (116, 75.8%). Many participants (164, 65.6%) were aged between 18 and 21 years;
200 seventy-four (29.6%) were aged between 22 and 30. The majority of participants (185, 74.0%)
201 were female. Around one-fifth (51, 20.4%) were postgraduate students. Many participants were
202 studying at one particular university, 155 (62.0%). At the beginning of the study, most
203 participants commuted as pedestrians or cyclists (182, 72.8%); others either took public
204 transport, 43 (19.3%), drove, 16 (7.1%), or used two of more modes equally, 8 (3.6%). Some
205 students were not UK licensed motorists (87, 34.8%): 5 of these students (5.7%) qualified during
206 the study. Many of the students lived close to their university: before moving, median home-
207 university distances were 1.25km (with interquartile range 2.06km). Movers tended to live with
208 different people – a student moving into a five-bedroom house might, on average, share their
209 new house with three new housemates and two of their previous housemates. Movers also
210 tended to perceive changes in their living arrangements as important, $M (SD) = 4.31 (1.86)$,
211 compared to non-movers, $M (SD) = 1.82 (1.68)$, $t (219.86) = -10.95, p < .001$.

212

213 **Materials**

214 **Mover/Non-mover.** This was assessed in the second questionnaire. To confirm if a
215 house-move had taken place, participants read a short definition of *term time accommodation* (as
216 distinct from a family home), before being asked: *when did you last move into new term-time*

217 accommodation? [After September 1st, 2015; August 2015; June or July 2015; May 2015; Before
 218 May 1st, 2015]. Those who indicated moving to a new house during or after May 2015 were
 219 also asked to provide a specific date for the move: none of these dates were before May 1st.
 220 Therefore, participants answering “before May 1st 2015” were coded as ‘non-movers’ (‘0’) and
 221 other participants coded as ‘movers’ (‘1’).

222 **Travel Frequency and Travel Behaviour Change.** Participants were asked how many
 223 days in a typical week they visit the university [Never, 1 day, 2 days, 3 days, 4 days, 5 days, 6 or
 224 7 days]. The answers to this question in the second questionnaire were used as a travel
 225 frequency variable. Participants were then asked to indicate the number of days in a typical
 226 week where they use each of several different modes of transport to get to and return from the
 227 university. Figure 1 shows the answer-form presented to the participants. A short explanation of
 228 combined transport modes followed, before participants were asked for an open response to this
 229 question: *if you combine modes of travel in a single trip, when travelling to or from the*
 230 *university during a typical week, then please describe how you do so.* Where answers indicated
 231 combining two modes of travel (for walking, 5 or more minutes of walking) then *half* a journey
 232 was recorded for each mode. The proportion of walked journeys was calculated using this data.
 233 These questions were asked in both questionnaires and travel behaviour change was calculated as
 234 the proportion from the second questionnaire less the proportion from the first. This calculation
 235 is given in the equation below, where ‘F’ is the frequency of journeys: either by active modes
 236 (walking or cycling) or in total; either in the second questionnaire (‘T=2’) or in the first (‘T=1’).

$$237 \quad \Delta \text{Travel Behaviour} = \frac{F_{Active}^{T=2}}{F_{Total}^{T=2}} - \frac{F_{Active}^{T=1}}{F_{Total}^{T=1}}$$

238 Thus, this variable could differ vary between ‘-1’ (complete change to motorised transport) to ‘1’
 239 (complete change to active transport).

	To get to university from your term time accommodation							To return from university to your term time accommodation						
	Never	1 day	2 days	3 days	4 days	5 days	6 or 7 days	Never	1 day	2 days	3 days	4 days	5 days	6 or 7 days
Walk	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cycle	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Car or motorcycle (as driver)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Car or motorcycle (as passenger including taxis)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Train	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bus or Tram	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

240 *Figure 1.* Answer form for university commuting travel behaviour. ‘Never’ was the
 241 default.
 242

243 **Travel Habit Change.** Habit-strengths were assessed using the 4-item Self-Report

244 Behavioural Automaticity Index (Gardner et al., 2012), which is a sub-scale of the 12-item Self

245 Report Habit Index (Verplanken & Orbell, 2003). So, for each of three travel mode types

246 participants rated these items on a 5-point scale anchored between *strongly agree* and *strongly*

247 *disagree*. These items were: *when I travel during the university term, travelling [by car or by*

248 *motorcycle / by walking or by bicycle / by bus or by train] is something... (1) ...I do*

249 *automatically, (2) ...I do without having to consciously remember, (3) ...I do without thinking,*

250 *(4) ...I start doing before I realize I’m doing it.* Travel habit scores were the average of scores

251 across these four items, for a travel mode type. Scales were reliable, with Cronbach’s Alphas

252 exceeding .95. Travel habit (behavioural automaticity) change was the difference between scores

253 for second and first questionnaires, potentially varying between -4 and +4 units. Participants

254 without a driving-license were not asked motoring-habit questions.

255 We chose the SRBAI over the SRHI for practical reasons: to measure three different
256 habits whilst using substantially fewer items (12 as opposed to 36). We acknowledge the cost of
257 this approach is that behavioural automaticity is not necessarily always the same thing as habit,
258 though the two measures are closely correlated (Gardner, 2015). For brevity, we have used
259 ‘habit’ and ‘behavioural automaticity’ synonymously.

260 **Planning to Walk.** This was assessed in the first questionnaire and, hence, prior to
261 moving-house. Participants answered the question *during the next 6 months I will get to and*
262 *from the university by either walking or by cycling* twice, on a 7-point scale, with respect to
263 different anchors reflecting different aspects of intention: *strongly agree* (1) and *strongly*
264 *disagree* (7); *definitely will* (1) and *definitely won't* (7). The mean of the scores was taken for the
265 planning to walk variable. The items were closely correlated ($R = .870$).

266 **Distance Change.** Journey distance was approximated using home-university distance:
267 the linear distance (calculated as great-circle distances: Chamberlain, 1996) between the centre
268 of a participant's postcode and a representative point at their university. This representative
269 point, for each university, was a university main-building, central-square or student's union
270 building, except when the participant's degree-subject suggested that they attended a different
271 campus (such as a hospital or engineering campus), in which case their degree-subject school
272 building was used. Distance change was the difference between distances from second and first
273 questionnaire responses in kilometres.

274 **Perceptions of Change.** In the second questionnaire, participants were asked ~~to~~ *please*
275 *indicate how far you have experienced important life changes in the following areas of your life*
276 *over the past 3 months*. Five items described different aspects of life-change, including personal
277 relationships and career/ education. One of the five items was used to assess perceptions of

278 household life change: ...*in your living arrangements e.g. moving house or city, living with*
279 *different people*. Ratings were made on a 7-point scale, with anchors *no change* (1) and a
280 *profound change* (7) and a mid-point label of *an important change* (4).

281 **Human Values.** The 40-item Portrait Value Questionnaire (PVQ: Schwartz et al., 2001)
282 was used to assess human values. In both questionnaires, participants were asked to assess
283 whether descriptions were like (or unlike) themselves for different statements. For example:
284 *thinking up new ideas and being creative is important to him. He likes to do things in his own*
285 *original way* (items were phrased according to the participant's stated gender, 'he/his' or
286 'she/her'). Ratings were made on a 6-point scale, with anchors *very like me* (1) and *not like me at*
287 *all* (6), and *don't know* (7). Four value-dimension scores ("conservation" (CN), "self-
288 transcendence" (ST), "self-enhancement" (SE) and "openness to change" (OTC)) were
289 calculated; to correct individual differences in scoring, the means were centred using the
290 participant's mean across all 40 statements (Schwartz, 2003: p. 275). Self-transcendence values
291 are most associated with concern for the environment (Schultz & Zelezny, 1999). Scales were
292 reliable, with Cronbach's Alphas ranging between .739 and .852. In all reported analyses, value-
293 scores from the first questionnaire are used; values did not differ significantly (with Bonferroni
294 adjustment for multiple comparisons): CN, $t(249) = .162, p > .0125$; ST, $t(249) = 2.190, p$
295 $> .0125$; SE, $t(249) = -.254, p > .0125$; OTC, $t(249) = -.1377, p > .0125$.

296 **Environmental Concern.** Agreement/disagreement with six items from the revised New
297 Ecological Paradigm scale (Dunlap et al, 2000; see Whitmarsh & O'Neill, 2010) was used to
298 measure environmental concern. For instance: *humans are severely abusing the planet* and
299 *humans were meant to rule over the rest of nature* (a reverse-score item). Ratings were made on
300 a 5-point scale with anchors *Strongly Disagree* (1) and *Strongly Agree* (5). Environmental

301 concern measured in the first questionnaire was used in analyses; environmental concern did not
302 differ significantly between questionnaires: $t(247) = -.735, p > .05$.

303

304 **Procedure**

305 The first questionnaire began with a briefing and online-consent form, before asking
306 several screening questions. Participants then completed the questionnaire and provided contact
307 details in confidence. All participants completed this first questionnaire between the 5th of May
308 2015 and the 10th of June 2015 (the majority, 92.4%, during May). Most house-moves took
309 place in September 2015 (95, 62.1%); almost all other house-moves took places in June, July and
310 August (52, 34.0%). All participants were re-contacted by E-mail on the 28th of October and
311 asked to complete the second questionnaire, doing so between the 28th of October 2015 and the
312 21st of November 2015 (the majority, 70.4%, during October). After completing the second
313 questionnaire, participants were thanked, shown a written debrief and were remunerated. The
314 duration of the study for participants ranged between 141 days and 193 days (with a mean of 169
315 days).

316

317

Results

318 A prior study (Haggard, 2016: pp. 94-126) provided an effect-size estimate for the present
319 study, with respect to the effect of moving-house on travel behaviour change: $R = .159$ ($d = .322$).
320 Falling short of a recruitment target of 311 for a power of .80, a level of a priori power was re-
321 estimated using the achieved sample-size ($N = 250$), less four participants as a heuristic
322 adjustment for lost power due to unequal group sizes (Rosnow, Rosenthal & Rubin, 2000). For a
323 sample of 246 participants, power in multiple regression was re-estimated at .70. (sensitivity to

324 effect-sizes of $R = .189$ ($d = .386$) in multiple regression). Compared to multiple regression,
325 mediation and moderation analyses can require additional statistical power (Fritz & MacKinnon,
326 2007; Dawson, 2014) to detect comparable effects.

327 Several additional variables were included as alternative explanations and controls. For
328 travel and habit changes, *initial levels of travel and habit* (respectively) allow for regression to
329 the mean (Alison, 1990; e.g. Lanzini & Thøgersen, 2014). *Distance change* has been accounted
330 for in both planned travel and travel changes to control for the influence of distance changes that
331 occur when students move-house; distance is an important factor in travel choices (Ewing &
332 Cervero, 2010) including those of students (Bopp et al., 2014; Shannon et al., 2006; Simons et
333 al., 2014). *Environmental concern* has been allowed for in estimating planned travel to represent
334 a prior motive for walking/cycling. *Travel frequency* (the number of days the student travelled to
335 the university each week) helps to separate the influence of behaviour change on habit change
336 from that of the extent of repetition (Lally et al. 2010; see also Friedrichsmeier, Matthies &
337 Klöckner, 2013).

338 A bootstrapping approach was used to address potentially problematic non-normality of
339 residuals (a symmetric leptokurtic distribution) and to optimise statistical power (Howell, 2013).
340 We report a conditional process model (path model) alongside, ~~for comparison,~~ a simpler
341 mediated multiple regression model for comparison; both were bootstrapped with 5000 bootstrap
342 samples and Bias-Corrected and accelerated (BCa) 95% confidence intervals; they were
343 calculated using the PROCESS macro for SPSS (Hayes, 2018); variables were *not* centred or
344 standardized. Key statistics for this model are presented in Figure 2; descriptive statistics and
345 correlations (Table A1), as well as tabulated results for each model (Tables A2 and A3), are
346 reported in the Appendix.

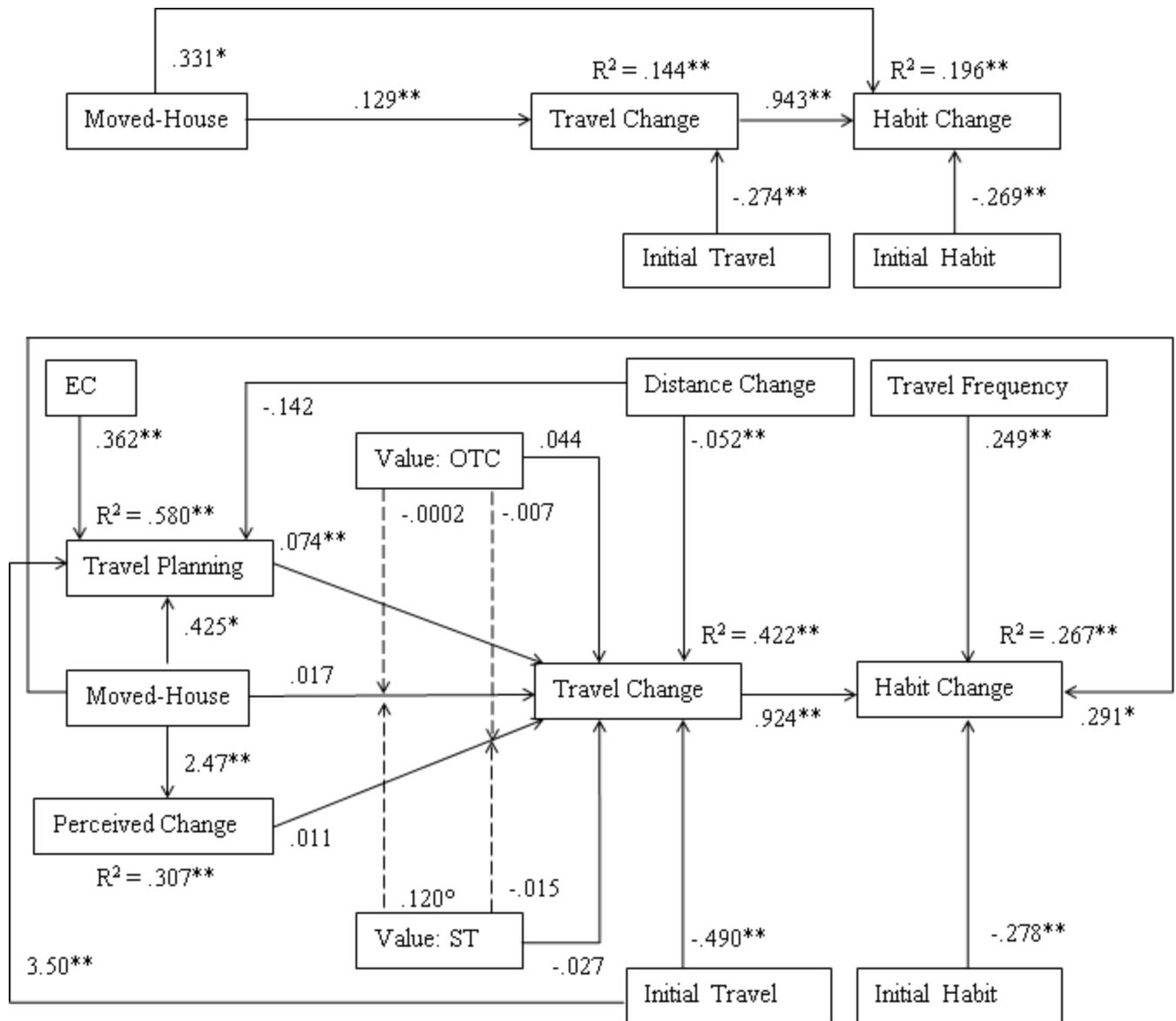


Figure 2. Mediated multiple regression (top) and conditional process models of the associations between moving-house, changing walking/cycling behaviour and changing walking/cycling habits. Variables are measured in their original units and are not centred. “OTC” is ‘Openness to Change’; “ST” is ‘Self-Transcendence; “EC” is ‘Environmental concern’. Dashed lines represent moderation (interaction) effects. ° $p < .1$; * $p < .05$; ** $p < .01$.

347

348 **Habits and Habit Discontinuity**

349

The first part of our primary research question was: ~~to what extent~~ is moving to a new

350

house between academic years (X) associated with change in travel habits (Y) through changes

351 *in travel behaviour (M)*. Figure 2 (top) shows that changes in walking/cycling to the university
 352 statistically mediate ~~some of the~~ association between moving-house and changes in
 353 walking/cycling habits. ~~However, much of the association is not mediated through behaviour-~~
 354 ~~change~~. This pattern of association was also found once allowing for other ~~paths and~~ variables
 355 (Figure 2, bottom). Therefore, moving to a new house is associated with change in travel habits
 356 through changes in travel behaviour. The second part of our primary research question was: ~~To~~
 357 ~~what extent is travel mode change, for movers and non-movers, associated with changes in~~
 358 *habits for current and previous travel mode use*. We addressed this question by considering
 359 patterns of correlation. Changes between motorised and active travel modes were closely
 360 negatively correlated for movers (active-public, $R = -.67$, active-driving, $R = -.42$) but motorised
 361 mode changes were not statistically significantly correlated, indicating that, for the most part,
 362 movers switched to or from active travel modes. Table 1 shows how travel modes changes were
 363 associated with habit changes for movers.

Table 1 Correlations [with 95% confidence intervals] between Changes in Habit and Travel Behaviour

		Travel Behaviour Change		
		Active	Driving ^a	Public
Habit Strength Change	Active	.456** [.303, .583]	-.244 [-.407, -.086]	-.343** [-.474, -.184]
	Driving ^a	-.266 [-.384, -.052]	.358* [.172, .590]	.124 [-.063, .248]
	Public	-.389** [-.523, -.234]	.043 [-.082, .253]	.478** [.322, .594]

Note. $N = 152$. Statistical significance was Bonferroni adjusted to correct for multiple comparisons.

^a Sub-sample of legal motorists ($n = 91$).

** $p < .001$. * $p < .0056$.

364 ~~Left diagonal~~ Same-mode correlations were moderately positive, indicating that adopting
 365 new modes was associated with strengthening habits for these new modes. ~~Some off-diagonal~~
 366 Other correlations indicate that switching between active and public transport modes was
 367 associated with weakening habits for the previous mode. That ~~other~~ off-diagonal correlations did

368 not reach significance can be partly attributed to smaller sample sizes (few motorists in the
369 sample) and partly to the lack of switching between public transport and driving. By comparison
370 to movers, non-movers showed evidence of switching between all modes (active-public, $R =$
371 $-.44$, active-driving, $R = -.60$, public-driving, $R = -.453$). However, associations between travel
372 and habit changes for non-movers tended not to reach statistical significance, beyond public
373 transport habits for new users strengthened, $R = .458$, and public transport habits amongst new
374 users of active transport weakened, $R = -.281$). Therefore, travel mode change, for movers and
375 non-movers, is associated with changes in habits for current and previous travel mode use. ~~travel~~
376 ~~mode change was sometimes associated with strengthening habits for current travel modes~~
377 ~~and/or weakening habits for previous travel modes, but~~ Patterns of association, however, do also
378 differ descriptively between movers and non-movers. ~~and, for non-movers, cannot be easily~~
379 ~~attributed to modal changes alone.~~

380 Altogether, contrary to the idea that habits are mostly formed through repetition, travel-
381 mode change explains some of the association between moving-house and travel habit changes
382 ~~but does not explain it completely.~~ This may be related to the way in which changes in travel
383 habits with travel modes are manifest for both movers and non-movers but differ descriptively
384 between the two groups.

385

386 **Motivation and Context**

387 Our second research question was: ~~to what extent~~ *is moving to a new house (X)*
388 *associated with changes in travel behaviour (Y) through planning to use a particular type of*
389 *travel (M)*. Figure 2 (bottom) shows that the association between moving-house and changes in
390 walking/cycling was *entirely* accounted for by planning to walk/cycle. Therefore, moving to a
391 new house is associated with changes in travel behaviour through planning to use a particular

392 type of travel. This indicates that if moving-house lead to this behaviour change through habit
393 discontinuity, then this facilitated behaviour changes that were already being contemplated.
394 While marginal, the full mediated path from moving-house to habit change through planned
395 travel changes is statistically significant, $B = .029$, 95% CI [.0005, .0723], which raises the
396 possibility that moving-house leads to implementing plans to walk/cycle that lead to stronger
397 habits of walking and cycling.

398 Our third research question was: ~~to what extent~~ *is moving to a new house (predictor, X)*
399 *associated with changes in travel behaviour (criterion, Y) only for those with particular values*
400 *(moderator, W)*. ~~and~~ Our fourth research question was: ~~to what extent~~ *is moving to a new house*
401 *(X) associated with changes in travel behaviour (Y) through perceptions of household life change*
402 *(M)*. Our model (Figure 2, bottom) shows that both these questions may be answered ~~in the~~
403 ~~negative~~ negatively. Once other factors were accounted for, there was no evidence that
404 perceptions of change mediated an association between moving-house and changes in
405 walking/cycling. No such associations were evident, either, when a moderating effect of values
406 was considered. So, when planned travel is accounted for, there is no evidence to suggest that
407 value-activation or context-change, occurring *after* moving-house, influences travel behaviour.

408

409

Discussion

410

411

412

413

414

We studied how the travel mode choices of a sample of university students in the UK
changed between university terms, focusing upon the effect of moving-house as a moment of
change (Thompson et al., 2011). From the habit discontinuity hypothesis (Verplanken et al.,
2008), we predicted that movers (students who moved-house) would more often make new travel
mode choices and, in turn, develop new travel mode habits when compared to non-movers. Our

415 predictions were correct, ~~but only to a limited extent~~. Moreover, summarising our findings as a
416 whole, we found that students who made plans to walk or cycle to university were more likely to
417 do so if they moved to a new house, despite little scope for change, initially, given 73% of
418 participants already walking or cycling to the university when the study began.

419 We found that much of the association between moving-house and travel *habit* change
420 was not explained by the changes in travel *behaviour* that we measured. This raises the
421 possibility that this direct association could be explained through the travel behaviour changes
422 we did *not* measure (e.g. for shopping trips), as is implied by the concept of a generalised habit
423 (Verplanken & Aarts, 1999) and previous approaches to measuring habitual travel mode choices
424 (Verplanken, Aarts, van Knippenberg & van Knippenberg, 1994). It is also plausible that
425 moving-house changed the context of travel in a way that facilitated habit development
426 independently of practice, such as by altering the structure of habitual routines (scripts) within
427 which travel choice habits may be nested (see Judah, Gardner and Aunger, 2012). This latter
428 account is suggested (but by no means evidentially supported) by the patterns of correlation we
429 report, whereby movers show a more general pattern of habit change with travel mode change,
430 whereas non-movers showed habit changes limited to particular modal changes (to and from
431 public transport upon public transport habits). Our findings further support the idea that habit
432 learning is not merely a function of repetition (Lally et al., 2010).

433 From ideas of planned behaviour, value activation and contextual change, we considered
434 the mediating or moderating roles of planned walking/cycling, human values and perceptions of
435 important household changes in the association between moving-house and travel choices. We
436 found that planning to walk/cycle entirely explained this association and so perceptions of
437 change did not, regardless of the values of the participants. This is consistent with a habit

438 discontinuity leading only to students enacting previously contemplated travel changes or
439 starting to contemplate travel changes but without putting these into action (Dahlstrand & Biel,
440 1997; Prochaska, Redding & Evers, 2008; Bamberg, 2013). We might also speculate that value-
441 activation operates through the activation only of quite specific values (see Maio, 2010) rather
442 than universal human values (Schwartz et al., 2001), in which case future work might
443 concentrate on the activation of specific value judgements (see also Schwartz, 1977). However,
444 given that students as a group are thought to be concerned about the environment (Cotton &
445 Alcock, 2013), it is not surprising that we found (irrespective of moving-house) that concern for
446 the environment influenced students' plans to walk or cycle in the future.

447 With respect to the role of context change (as indicated by perceptions of change), we
448 found no evidence that this accounted for changes in walking/cycling with moving-house.
449 Accurate measurement of context changes through self-report, as well as identifying the salient
450 context changes for a certain behaviour, is difficult (Wood et al., 2005) and a subjective measure
451 may not accurately detect changes in contextual cues that operate without consciousness (Bargh
452 & Chartrand, 1999). More-controlled studies will be necessary to better isolate the potential
453 effects of contextual cues upon travel behaviour (e.g. Wansink, Ittersum & Painter, 2006; Orbell
454 & Verplanken, 2010); contextual cuing is, indeed, important in separating habits from other
455 forms of automaticity (Wood & R nger, 2016).

456 Our findings contribute to the existing evidence that moving-house marks a window of
457 opportunity for changing behaviour (Bamberg, 2006; Sch fer et al., 2012; see also Thompson et
458 al., 2011) and habits (Rothman et al., 2015). They are also consistent, broadly, with the habit
459 discontinuity hypothesis (Verplanken et al., 2008), ~~albeit inconsistent with some of the specific~~
460 ~~ideas about how it functions.~~ So, while our findings tend to favour moving-house as a moment

461 of change during which university students may be more inclined to change their travel
462 behaviour and cultivate new habits of travel, they provide only a partial account of the
463 underlying factors involved. One clear finding is the importance of prior planning, which has
464 been emphasised in the results of previous work (Bamberg, 2006; Schäfer et al., 2012; Jones &
465 Ogilvie, 2012). It follows that attempts to change student travel behaviour through interventions
466 (e.g. Kormos, Gifford & Brown, 2015; Wilson et al., 2016; see also Michie, van Stralen & West,
467 2011) might consider intervening both during house-hunting and after students move to their new
468 accommodation, in order to maximise the impacts of planned and unplanned changes in travel
469 choices and unstable travel habits. As our findings are also inconclusive with respect to the
470 activation of values, an educational or persuasive intervention (Michie, van Stralen & West,
471 2011) to target morally concerned students (Eriksson, Garvill & Nordlund, 2008) may be
472 effective in bringing value-motives into focus (c.f. Verplanken & Roy, 2016).

473 Our study was limited in several respects. It lacked statistical power, with the
474 consequence that small effects may not have been detected and the coefficients of effects we did
475 detect are not estimated with much certainty. We have used contrasts to show patterns of
476 association: we collected data both before and after the house-move, to establish a sequence of
477 events, and compared movers and non-movers, to establish group differences over time.
478 However, these contrasts cannot evidence causes and effects, but only statistical associations
479 consistent or inconsistent with different causal accounts. Similarly, we cannot exclude the
480 possibility that the links we show between variables do not arise spuriously, due to confounding
481 factors, though we have taken account of some commonplace explanations. For instance,
482 distance remains an important alternative explanation: while, in our sample, students tended to
483 live relatively close to the university, this is not always the case (Davison, Ahern & Hine, 2015).

484 Similarly, our study does not take account of situational factors that might be particular to
485 students (Klößner & Blöbaum, 2010) and so it is plausible that our findings would differ when
486 students are compared to non-students, particularly with respect to the actual control students
487 have over their own travel choices under financial and other constraints. We also note that our
488 measurements, being derived from self-report, lacked precision; and that habit (as behavioural
489 automaticity), journey distance (as home-university distance) and contextual-change (as
490 perceived life-event importance) were measured by proxy and not directly. However, it is
491 encouraging, with respect to future application of our findings, that active transport use increases
492 were made even in a sample where active transport use was prevalent and so opportunities for
493 increasing behavioural frequency were limited (see Friedrichsmeier, Matthies & Klößner,
494 2013).

495 The findings of our study add to the evidence concerning travel changes with residential
496 relocation, habit discontinuity and habit change. Our findings support the general conclusion
497 that moving-house is a moment at which some students choose to change their travel behaviour
498 and that this can lead to increases in the use of physically active travel modes for commuting.
499 Our more specific findings are less clear with respect to the habit discontinuity hypothesis and
500 self-activation hypotheses, showing a comparative importance of prior planning rather than
501 reconsideration after moving-house. This study is also one of the few to address the question of
502 how the absence of context-cues could link a moment of change (such as moving-house) to a
503 weakening of habits and subsequent changes in behaviour, though we found no evidence for this
504 process. Less theoretically, our study demonstrates some potential for intervening to change
505 university student travel behaviour during predictable annual changes in accommodation that
506 may mark a moment during which university students are better able to take control of their

507 travel behaviour to walk and cycle to the university more often, benefitting the environment and
 508 their own health.

509

510

Appendix A: Statistical Tables

Table A1: Descriptive Statistics and Bivariate Correlations

	1	2	3	4	5	6	7	8	9	10	11	12
1	1	.378**	.562**	.004	.009	-.134*	.057	.389**	-.031	.129*	.028	.413**
2	.378**	1	.342**	.213**	.017	.017	.055	.740**	.013	.170**	-.049	.716**
3	.562**	.342**	1	.046	.062	-.033	.101	.273**	-.064	.218**	.046	.298**
4	.004	.213**	.046	1	.107	.344**	.010	.116	-.073	-.022	.098	.048
5	.009	.017	.062	.107	1	.041	-.005	.032	.059	.053	.002	.031
6	-.134*	.017	-.033	.344**	.041	1	.003	-.049	.040	-.033	.158*	-.131*
7	.057	.055	.101	.010	.005	.003	1	-.317**	-.456**	.060	.287**	-.024
8	.389**	.740**	.273**	.116	.032	-.049	-.317**	1	.205**	.112	-.156*	.740**
9	-.031	.013	-.064	-.073	.059	.040	-.456**	.205**	1	-.054	-.322**	.107
10	.129*	.170**	.218**	-.022	.053	-.033	.060	.112	-.054	1	.229**	.136*
11	.028	-.049	.046	.098	.002	.158*	.287**	-.156*	-.322**	.229**	1	-.308**
12	.413**	.716**	.298**	.048	.031	-.131*	-.024	.740**	.107	.136*	-.308**	1
M	.61	5.84	3.35	3.79	.31	.39	-.01	.73	-.01	5.46	-.05	4.08
SD	.488	2.080	2.163	.690	.619	.551	.291	.418	1.756	1.101	.993	1.360
N	250	250	250	250	250	250	250	250	246	250	248	250

Note: 1 = Moved-House; 2 = Planned Travel; 3 = Perceptions of change; 4 = Environmental Concern; 5 = Openness-To-Change; 6 = Self-Transcendence; 7 = Travel change; 8 = Initial Travel; 9 = Distance Change; 10 = Travel Frequency; 11 = Habit Change; 12 = Initial Habit.

* p <.05, ** p <.01.

511

512

Table A2: Travel Change (M) Mediated Multiple Regression Model of Association Between Moving-House (X) and Habit Change (Y)

Criterion	Predictor	B (SE)	95% CI
Travel change	Constant	.110 (.033)**	[.049, .179]
	Moved-House	.129 (.043)**	[.047, .214]
	Initial Travel	-.274 (.055)**	[-.383, -.171]
R ²		.144	
F		20.587**	
Habit Change	Constant	.852 (.207)**	[.463, 1.279]
	Moved-House	.332 (.158)*	[.029, .652]

	Travel Change	.943 (.311)**	[.340, 1.572]
	Initial Habit	-.269 (.056)**	[-.382, -.167]
R ²		.196	
F		19.876**	
N		248	

Note: SE = standard error. CI = confidence interval.

p < .05. ** p < .01

513

Table A3: Conditional Process Model of Moving-House (X) and Habit Change (Y) Association, Mediated by Travel Planning (M1), Perceived Change (M2) and Travel Change (M3)

Criterion	Predictor	B (SE)	95% CI
Travel Planning	Constant	1.68 (.560)**	[.594, 2.800]
	Moved-House	.425 (.208)*	[.016, .842]
	Distance Change	-.142 (.077)	[-.298, .009]
	Env. Concern	.362 (.137)**	[.101, .637]
	Initial Travel	3.50 (.307)**	[2.893, 4.091]
R ²		.580	
F		82.791**	
Perceived Change	Constant	1.851 (.172)**	[1.539, 2.207]
	Moved-House	2.474 (.229)**	[2.003, 2.911]
R ²		.307	
F		107.805**	
Travel Change	Constant	-.131 (.051)**	[-.234, -.035]
	Moved-House	.017 (.051)	[-.083, .117]
	Travel Planning	.074 (.018)**	[.039, .109]
	Perceived Change	.011 (.012)	[-.012, .035]
	Value: ST	-.027 (.045)	[-.116, .064]
	ST*Moved	.120 (.064)	[-.005, .245]
	ST*P.Change	-.016 (.016)	[-.048, .016]
	Value: OTC	.044 (.045)	[-.044, .129]
	OTC*Moved	.002 (.056)	[-.102, .120]
	OTC*P.Change	-.007 (.012)	[-.030, .015]
	Distance Change	-.052 (.020)**	[-.090, -.013]
	Initial Travel	-.490 (.090)**	[-.660, -.306]
	R ²		.422
F		15.491**	
Habit Change	Constant	-.464 (.383)	[-1.220, .302]
	Moved-House	.291 (.144)*	[.010, .576]
	Travel Change	.924 (.289)**	[.350, 1.487]

	Travel Frequency	.249 (.072)**	[.108, .388]
	Initial Habit	-.278 (.056)**	[-.390, -.171]
R ²		.267	
F		21.886	
N		245	

Note: SE = standard error; CI = confidence interval; "Env. Concern" is 'Environmental Concern'; "OTC" is 'Openness-to-change'; "ST" is 'Self-Transcendence'. "Moved" is 'Moved-House'; "P.Change" is 'Perceived Change'.

* $p < .05$. ** $p < .01$

514

515

516

517

References

Allison, P. D. (1990). Change Scores as Dependent Variables in Regression Analysis. *Sociological Methodology*, 20, 93-114. Retrieved from: https://www.researchgate.net/profile/Paul_Allison/publication/243785652_Change_scores_as_dependent_variables_in_regression_analysis/links/5469e96a0cf2f5eb18063016.pdf

Ampt, E., Stopher, P., & Wundke, J. (2005). *Households on the Move – Experiences of a New Approach to Voluntary Travel Behaviour Change*. Unpublished Manuscript, Institute of Transport and Logistics Studies, The University of Sydney, Australia. Retrieved from: <http://ws.econ.usyd.edu.au/itls/wp-archive/itls-wp-06-23.pdf>

Bamberg, S. (2006). Is a Residential Relocation a Good Opportunity to Change People's Travel Behavior? Results from a Theory-Driven Intervention Study. *Environment and Behavior*, 38, 820-840. doi: 10.1177/0013916505285091

Bamberg, S. (2013). Applying the stage model of self-regulated behavioral change in a car use reduction intervention. *Journal of Environmental Psychology*, 33, 68-75. doi: 10.1016/j.jenvp.2012.10.001

Barandiaran, X., & DiPaolo, E. (2014). A Genealogical Map of the Concept of Habit. *Frontiers in Human Neuroscience*, 8, 522-528. doi: 10.3389/fnhum.2014.00522

Bargh, J. A., & Chartrand, T. L. (1999). The Unbearable Automaticity of Being. *American Psychologist*, 54(7), 462-479. doi: 10.1037/0003-066X.54.7.462

Bopp, M., Behrens, T. K., & Velecina, R. (2014). Associations of Weight Status, Social Factors, and Active Travel Among College Students. *American Journal of Health Education*, 45, 358-367. doi: 10.1080/19325037.2014.948652

Dahlstrand, U., & Biel, A. (1997). Pro-Environmental Habits: Propensity Levels in Behavioral Change. *Journal of Applied Social Psychology*, 27(7), 588-601. doi: 10.1111/j.1559-1816.1997.tb00650.x

Chamberlain, R. (1996, Oct.) Q5.1: What is the best way to calculate the great circle distance (which deliberately ignores elevation differences) between 2 points? [Online FAQ]. Retrieved from: <http://www.movable-type.co.uk/scripts/gis-faq-5.1.html>

Clark, B., Lyons, G., & Chatterjee, K. (2016). Understanding the process that gives rise to household car ownership level changes. *Journal of Transport Geography*, 55, 110–120. doi: 10.1016/j.jtrangeo.2016.07.009

Cotton, D. R. E., & Alcock, I. (2013). Commitment to environmental sustainability in the UK student population. *Studies in Higher Education*, 38(10), 1457-1471. doi: 10.1080/03075079.2011.627423

Davison, L., Ahern, A., & Hine, J. (2015). Travel, transport and energy implications of university-related student travel: A case study approach. *Transportation Research Part D*, 38, 27–40. doi: 10.1016/j.trd.2015.04.028

Dawson, J. F. (2014). Moderation in Management Research: What, Why, When, and How. *Journal of Business Psychology*, 29, 1-19. doi: 10.1007/s10869-013-9308-7

de Nazelle, A., Nieuwenhuijsen, M. J., Antó, J. M., Brauer, M., Briggs, D., Braun-Fahrlander, C., [...] & Lebrecht, E. (2011). Improving health through policies that promote active travel: A review of evidence to support integrated health impact assessment. *Environment International*, 37, 766–777. doi: 10.1016/j.envint.2011.02.003

Dunlap, R. E., Van Liere, K. D., Mertig, A. G., & Jones, R. E. (2000). New trends in measuring environmental attitudes: measuring endorsement of the new ecological paradigm: a revised NEP scale. *Journal of social issues*, 56(3), 425-442. doi: 10.1111/0022-4537.00176

Easterbrook, M., & Vignoles, V. L. (2012). Different Groups, Different Motives: Identity Motives Underlying Changes in Identification With Novel Groups. *Personality and Social Psychology Bulletin*, 38(8), 1066-1080. doi: 10.1177/0146167212444614

Easterbrook, M., & Vignoles, V. L. (2015). When friendship formation goes down the toilet: Design features of shared accommodation influence interpersonal bonds and well-being. *British Journal of Social Psychology, 54*, 125–139. doi: 10.1111/bjso.12062

Eriksson, L., Garville, J., & Nordlund, A. M. (2008). Interrupting habitual car use: The importance of car habit strength and moral motivation for personal car use reduction. *Transportation Research Part F, 11*, 10–23. doi: 10.1016/j.trf.2007.05.004

Ewing, R., & Cervero, R. (2010). Travel and the Built Environment: a Meta-Analysis. *Journal of the American Planning Association, 76*(3), 265-294. doi: 10.1080/01944361003766766

Friedrichsmeier, T., Matthies, E., & Klöckner, C. A. (2013). Explaining stability in travel mode choice: An empirical comparison of two concepts of habit. *Transportation Research Part F, 16*(1), 1–13. doi: 10.1016/j.trf.2012.08.008

Fritz, M. S., & MacKinnon, D. P. (2007). Required sample size to detect the mediated effect. *Psychological science, 18*(3), 233-239. doi: 10.1111/j.1467-9280.2007.01882.x

Fujii, S., Gärling, T., & Kitamura, R. (2001). Changes in Drivers' Perceptions and Use of Public Transport During a Freeway Closure: Effects of Temporary Structural Change on Cooperation in a Real-Life Social Dilemma. *Environment and Behavior, 33*(6), 796-808. doi: 10.1177/00139160121973241

Gardner, B. (2009). Modelling motivation and habit in stable travel mode contexts. *Transportation Research Part F, 12*, 68–76. doi: 10.1016/j.trf.2008.08.001

Gardner, B. (2015). A review and analysis of the use of ‘habit’ in understanding, predicting and influencing health-related behaviour. *Health Psychology Review, 9*(3), 277-295. doi: 10.1080/17437199.2013.876238

Gardner, B., Abraham, C., Lally, P., & de Bruijn, G. J. (2012). Towards parsimony in habit measurement: Testing the convergent and predictive validity of an automaticity subscale of the Self-Report Habit Index. *International Journal of Behavioural Nutrition and Physical Activity, 9*(1), 102. doi: 10.1186/1479-5868-9-102

Gifford, R., (2011). The Dragons of Inaction: Psychological Barriers that Limit Climate Change Limitation and Adaptation. *American Psychologist, 66*(4), 290-302. doi: 10.1037/a0023566

Gillson, F., Standage M., & Verplanken, B. (2014). A cluster randomised controlled trial of an intervention to promote healthy lifestyle habits to school leavers: study rationale, design, and methods. *BMC Public Health*, *14*, 221-230. doi: 10.1037/a0016136

Hagggar, P. (2016). *Habit Discontinuity and Travel Choices* (Doctoral thesis, Cardiff University). Retrieved from: <http://orca.cf.ac.uk/96712/1/2016hagggarphd.pdf>

Hayes, A. F. (2018). *Introduction to Mediation, Moderation, and Conditional Process Analysis: a regression-based approach*. London, UK: Guildford Press.

Heath, S. (2004). Peer-Shared Households, Quasi-Communes and Neo-Tribes. *Current Sociology*, *52*(2), 161-179. doi: 10.1177/0011392104041799

Hoffmann, C., Abraham, C., White, M. P., Ball, S., & Skippon, S. M. (2017). What cognitive mechanisms predict travel mode choice? A systematic review with meta-analysis. *Transport Reviews*, *37*(5), 631-652. doi: 10.1080/01441647.2017.1285819

Howell, D. (2013). *Statistical Methods for Psychology*. Canada: Cengage Learning.

Jager, W. (2003) Breaking 'bad habits': a dynamical perspective on habit formation and change. In L. Hendrickx, W. Jager, L. Steg, (Eds.) *Human Decision Making and Environmental Perception. Understanding and Assisting Human Decision Making in Real-life Settings. Liber Amicorum for Charles Vlek*. Groningen: University of Groningen.

Jones, C. H., & Ogilvie, D. (2012). Motivations for active commuting: a qualitative investigation of the period of home or work relocation. *International Journal of Behavioral Nutrition and Physical Activity*, *9*(1), 1-12. doi: 10.1186/1479-5868-9-109

Judah, G., Gardner, B., & Aunger, R. (2012). Forming a Flossing Habit: An Exploratory Study of the Psychological Determinants of Habit Formation. *British journal of Health Psychology*, *18*(2), 338-353. doi: 10.1111/j.2044-8287.2012.02086.x

Klöckner, C. (2004, September). *How single events change travel mode choice—a life span perspective*. Paper Presented at the 4th International Conference of Traffic and Transport Psychology, Nottingham.

Klöckner, C. A., & Blöbaum, A. (2010). A comprehensive action determination model: Toward a broader understanding of ecological behaviour using the example of travel mode choice. *Journal of Environmental Psychology*, *30*, 574-586. doi: 10.1016/j.jenvp.2010.03.001

Klößner, C. A., & Matthies, E. (2012). Two Pieces of the Same Puzzle? Script-Based Car Choice Habits Between the Influence of Socialization and Past Behavior. *Journal of Applied Social Psychology, 42*(4), 793–821. doi: 10.1111/j.1559-1816.2011.00817.x

Kormos, C., Gifford, R., & Brown, E. (2015). The influence of descriptive social norm information on sustainable transportation behavior: a field experiment. *Environment and Behavior, 47*(5), 479-501.

Kurz, T., Gardner, B., Verplanken, B., & Abraham, C. (2015). Habitual behaviors or patterns of practice? Explaining and changing repetitive climate-relevant actions. *WIREs Climate Change, 6*, 113–128. doi: 10.1002/wcc.327

Lally, P., van Jaarsveld, C. H., Potts, H. W., & Wardle, J. (2010). How are habits formed: Modelling habit formation in the real world. *European Journal of Social Psychology, 40*, 998-1009. doi: 10.1002/ejsp.674

Lanzini, P., & Kahn, S. A. (2017). Shedding light on the psychological and behavioural determinants of travel mode choice: A meta-analysis. *Transportation Research Part F, 48*, 13–27. doi: 10.1016/j.trf.2017.04.020

Lanzini, P., & Thøgersen, J. (2014). Behavioural spillover in the environmental domain: An intervention study. *Journal of Environmental Psychology, 40*, 381-390. doi: 10.1016/j.jenvp.2014.09.006

Maio, G. R. (2010). Mental Representations of Social Values. In M. Zanna (Ed.), *Advances in Experimental Social Psychology* (pp. 1-43). Burlington: Academic Press.

McCormack, G. R., & Virk, J. S. (2014). Driving towards obesity: A systematized literature review on the association between motor vehicle travel time and distance and weight status in adults. *Preventive Medicine, 66*, 49–55. doi: 10.1016/j.ypmed.2014.06.002

Michie, S., van Stralen, M. M., & West, R. (2011). The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implementation science, 6*(1), 42. doi: 10.1186/1748-5908-6-42

Moors, A. (2016). Automaticity: Componential, Causal, and Mechanistic Explanations. *Annual Review of Psychology, 67*, 263–87. doi: 10.1146/annurev-psych-122414-033550

Müggenburg, H., Busch-Geertsema, A., & Lanzendorf, M. (2015). Mobility biographies: A review of achievements and challenges of the mobility biographies approach and a framework for further research. *Journal of Transport Geography, 46*, 151-163. doi: 10.1016/j.jtrangeo.2015.06.004

National Union of Students [NUS] (2014). *Homes fit for study: The state of student housing in the UK*. Retrieved from NUS website: <https://www.nus.org.uk/en/news/one-in-five-students-live-in-vermin-infested-homes/>

Neal, D. T., Wood, W., & Drolet, A. (2013). How Do People Adhere to Goals When Willpower Is Low? The Profits (and Pitfalls) of Strong Habits. *Journal of Personality and Social Psychology, 104*(6), 959–975. doi: 10.1037/a0032626

Neal, D. T., Wood, W., Wu, M., & Kurlander, D. (2011). The pull of the past. When Do Habits Persist Despite Conflict With Motives? *Personality and Social Psychology Bulletin, 37*, 1428–1437. doi: 10.1177/0146167211419863

Orbell, S., & Verplanken, B. (2010). The Automatic Component of Habit in Health Behavior: Habit as Cue-Contingent Automaticity. *Health Psychology, 29*(4), 374–383. doi: 10.1037/a0019596

Ouellette, J., & Wood, W. (1998). Habit and Intention in Everyday Life: The Multiple Processes by Which Past Behavior Predicts Future Behavior. *Psychological Bulletin, 124*(1), 54–74. doi: 10.1037/0033-2909.124.1.54

Plotnikoff, R. C., Costigan, S. A., Williams, R. L., Hutchesson, M. J., Kennedy, S. G., Robards, S. L., Allen, J., Collins, C. E., Callister, R., & Germov, J. (2015). Effectiveness of interventions targeting physical activity, nutrition and healthy weight for university and college students: a systematic review and meta-analysis. *International Journal of Behavioral Nutrition and Physical Activity, 12*(1), 45. doi: 10.1186/s12966-015-0203-7

Prochaska, J. O., Redding, C. A., & Evers, K. E. (2002). The transtheoretical model and stages of change. In K. Glanz, B. Rimer, & F. Lewis (Eds.), *Health Behavior and Health Education* (pp. 99–120). San Francisco: Jossey-Bass.

Quinn, J. M., Pascoe, A., Wood, W., & Neal, D. T. (2010). Can't Control Yourself? Monitor Those Bad Habits. *Personality and Social Psychology Bulletin, 36*(4), 499–511. doi: 10.1177/0146167209360665

Rosnow, R. L., Rosenthal, R., & Rubin, D. B. (2000). Contrasts and Correlations in Effect-Size Estimation. *Psychological Science, 11*(6), 446–453.

Rothman, A. J., Gollwitzer, P. M., Grant, A. M., Neal, D. T., Sheeran, P., & Wood, W. (2015). Hale and hearty policies: How psychological science can create and maintain healthy habits. *Perspectives on Psychological Science, 10*(6), 701–705. doi: 10.1177/1745691615598515

Rugg, J., Ford, J., & Burrows, R. (2004). Housing advantage? the role of student renting in the constitution of housing biographies in the United Kingdom. *Journal of Youth Studies*, 7(1), 19-34. doi: 10.1080/1367626042000209930

Schäfer, M., Jaeger-Erben, M., & Bamberg, S. (2012). Life Events as Windows of Opportunity for Changing Towards Sustainable Consumption Patterns? Results from an Intervention Study. *Journal of Consumer Policy*, 35, 65-84. doi: 10.1007/s10603-011-9181-6

Schwartz, S. H. (1977). Normative Influences on Altruism. *Advances in Experimental Social Psychology*, 10, 221-279. doi: 10.1016/S0065-2601(08)60358-5

Schwartz, S. H. (2003). Chapter 7: A Proposal for Measuring Value Orientations across Nations. In *The ESS Questionnaire Development Report* (pp. 259-318). Retrieved from: <http://www.europeansocialsurvey.org>

Schwartz, S. H., Melech, G., Lehmann, A., Burgess, S., Harris, M., & Owens, V. (2001). Extending the Cross- Cultural Validity of the Theory of Basic Human Values with A Different Method of Measurement. *Journal of Cross-Cultural Psychology*, 32(5), 519-542. doi: 10.1177/0022022101032005001

Shannon, T., Giles-Corti, B., Pikora, T., Bulsara, M., Shilton T., & Bull, F. (2006). Active commuting in a university setting: Assessing commuting habits and potential for modal change. *Transport Policy*, 13, 240–253. doi: 10.1016/j.tranpol.2005.11.002

Schultz, P. W., & Zelezny, L. (1999). Values as predictors of environmental attitudes: Evidence for consistency across 14 countries. *Journal of environmental psychology*, 19(3), 255-265.

Simons, D., Clarys, P., De Bourdeaudhuij, I., de Geus, B., Vandelanotte, C., & Deforche, B. (2014). Why do young adults choose different transport modes? A focus group study. *Transport Policy*, 36, 151–159. doi: 10.1016/j.tranpol.2014.08.009

Sims, R., Schaeffer, R., Creutzig, F., Cruz-Núñez, X., D’Agosto, M., Dimitriu, D., [...] & Tiwari, G. (2014). Transport. In O. Edenhofer, R. Pichs-Madruga, Y. Sokona, et al. (Eds.) *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 599-670). Cambridge, UK and New York, USA: Cambridge University Press.

Thomas, G. O., Fisher, R., Whitmarsh, L., Milfont, T. L., & Poortinga, W. (2018). The impact of parenthood on environmental attitudes and behaviour: a longitudinal investigation of the legacy hypothesis. *Population and Environment*, 39(3), 261–276. doi: 10.1007/s11111-017-0291-1

Thomas, G. O., Poortinga, W., & Sautkina, E. (2016). Habit Discontinuity, Self-Activation, and the Diminishing Influence of Context Change: Evidence from the UK Understanding Society Survey. *PLOS one*, *11*(4): e0153490. doi:10.1371/journal.pone.0153490

Thomas, G. O., & Walker, I. (2015). Users of different travel modes differ in journey satisfaction and habit strength but not environmental worldviews: A large-scale survey of drivers, walkers, bicyclists and bus users commuting to a UK university. *Transportation Research Part F*, *34*, 86–93. doi: 10.1016/j.trf.2015.07.016

Thompson, S., Michaelson, J., Abdallah, S., Johnson, V., Morris, D., Riley, K., & Simms, A. (2011). 'Moments of change' as opportunities for influencing behaviour: A report to the Department for Environment, Food and Rural Affairs. The New Economics Foundation [NEF]. London: DEFRA.

Thrailkill, E., & Bouton, M. (2014). Contextual Control of Instrumental Actions and Habits. *Journal of Experimental Psychology: Animal Learning and Cognition*, *41*(1), 69-80. doi: <http://dx.doi.org/10.1037/xan0000045>

Verplanken, B. (2006). Beyond Frequency: Habit as a Mental Construct. *British Journal of Social Psychology*, *45*, 639-656. doi: 10.1348/014466605X49122

Verplanken, B., & Aarts, H. (1999). Habit, Attitude, and Planned Behaviour: Is Habit an Empty Construct or an Interesting Case of Goal-directed Automaticity? *European Review of Social Psychology*, *10*(1), 101-134. doi: 10.1080/14792779943000035

Verplanken, B., Aarts, H., & van Knippenberg, A. (1997). Habit, information acquisition, and the process of making travel mode choices. *European Journal of Social Psychology*, *27*, 539-560. doi: 10.1002/(SICI)1099-0992(199709/10)

Verplanken, B., & Holland, R. W. (2002). Motivated Decision Making: Effects of Activation and Self-Centrality of Values on Choices and Behavior. *Journal of Personality and Social Psychology*, *82*(3), 434–447. doi: 10.1037/0022-3514.82.3.434

Verplanken, B., & Orbell, S. (2003). Reflections on Past Behavior: A Self-Report Index of Habit Strength. *Journal of Applied Social Psychology*, *33*(6), 1313 -1330. doi: 10.1111/j.1559-1816.2003.tb01951.x

Verplanken, B., & Roy, D. (2016). Empowering interventions to promote sustainable lifestyles: Testing the habit discontinuity hypothesis in a field experiment. *Journal of Environmental Psychology*, *45*, 127-134. doi: 10.1016/j.jenvp.2015.11.008

- Verplanken, B., Walker, I., Davis, A., & Jurasek, M. (2008). Context change and travel mode choice: Combining the habit discontinuity and self-activation hypotheses. *Journal of Environmental Psychology*, 28, 121–127. doi: 10.1016/j.jenvp.2007.10.005
- Verplanken, B., & Wood, W. (2006). Interventions to Break and Create Consumer Habits. *Journal of Public Policy and Marketing*, 25(1), 90-103. doi: 10.1509/jppm.25.1.90
- Walker, I. (2011). Chapter 26 – Bicyclists. In B. E. Porter (Ed.), *Handbook of Traffic Psychology* (pp. 367-373). doi: 10.1016/C2009-0-01975-8
- Walker, I., Thomas, G. O., & Verplanken, B. (2015). Old Habits Die Hard: Travel Habit Formation and Decay During an Office Relocation. *Environment and Behaviour*, 47(10), 1-18. doi: 10.1177/0013916514549619
- Wansink, B., Van Ittersum, K., & Painter, J. E. (2006). Ice cream illusions: bowls, spoons, and self-served portion sizes. *American journal of preventive medicine*, 31(3), 240-243.
- Whitmarsh, L., & O'Neill, S. (2010). Green identity, green living? The role of pro-environmental self-identity in determining consistency across diverse pro-environmental behaviours. *Journal of Environmental Psychology*, 30(3), 305-314. doi: 10.1016/j.jenvp.2010.01.003
- Wilson, D., Bopp, M., Colgan, J., Sims, D., Matthews, S., Rovniak, L., & Poole, E. (2016). A Social Media Campaign for Promoting Active Travel to a University Campus. *Journal of Healthcare Communications*, 1(2). doi: 10.4172/2472-1654.100011
- Wood, W., & Neal, D. T. (2007). A New Look at Habits and the Habit–Goal Interface. *Psychological Review*, 114(4), 843–863. doi: 10.1037/0033-295X.114.4.843
- Wood, W., & Rünger, D. (2016). Psychology of Habit. *Annual Review of Psychology*, 67(11) 1-26. doi: 10.1146/annurev-psych-122414-033417
- Wood, W., Tam, L., & Witt, M. G. (2005). Changing circumstances, disrupting habits. *Journal of Personality and Social Psychology*, 88(6), 918-933. doi: 10.1037/0022-3514.88.6.918
- Woodcock, J., Edwards, P., Tonne, C., Armstrong, B. G., Ashiru, O., Banister, D., [...] & Roberts, I. (2009). Public health benefits of strategies to reduce greenhouse-gas emissions: urban land transport. *Lancet*, 374, 1930–1943. doi: 10.1016/S0140-6736(09)61714-1