Determinants of pro-environmental behavior among excessive smartphone usage children and moderate smartphone usage children in Taiwan

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Abstract

Introduction: Although there is evidence linking the relationships between smartphone usage with health, stress, and academic performance; however, there is still inadequate knowledge about the influence on pro-environmental behaviors. This study seeks to bridge this gap by adapting the theory of attribution framework to examine the effects of personal norms, social norms, perceived behavioral control on pro-environmental behavior of smartphone usage in children.

Methods: A total of 225 children aged between 11 to 12 from eight selected public primary schools at the Hsinchu Science and Industrial Park in Taiwan were surveyed. Two distinct groups (excessive versus moderate usage) were purposefully selected for comparison, of which 96 participants were excessive smartphone users while the remaining 129 were moderate smartphone users.

Results: Findings revealed significant differences between excessive and moderate smartphone usage children groups in personal norms ($p < 0.001$), social norms ($p = 0.002$), perceived behavioral control ($p = 0.001$), and pro-environmental behavior ($p = 0.001$). Findings for excessive smartphone usage children showed that social norms ($\beta = 0.428$, $t = 4.096***$, $p < 0.001$) had a direct predictive impact on pro-environmental behavior. In contrast, while there was no direct path established between personal norms and pro-environmental behavior ($\beta = 0.177$, $t = 1.580$, $p > 0.05$), as well as social norms and pro-environmental behavior for moderate smartphone usage children ($\beta = 0.181$, $t = 1.924$, $p > 0.05$), but such a relationship could be

40 developed through the mediating effect of perceived behavioral control ($\beta = 0.497$, $t = 4.471***$,
41 $p < 0.001$).
42 **Discussion:** Results suggested that excessive smartphone usage children lack positive perceived
43 behavioral control, and their pro-environmental behavior could only be predicted through
44 explicit social norms. Whereas, pro-environmental behavior of moderate smartphone usage
45 children was implicitly influenced by personal norms through perceived behavioral control.
46

Introduction

48 Nowadays, smartphones are becoming increasingly popular that have brought many changes to
49 our day-to-day lives, particularly with the ease of access to a vast variety of mobile applications
50 for the purpose of internet browsing, gaming, social networking, communication, and so on. This
51 phenomenon has seen the number of smartphone users grow steadily from 2.5 billion in 2016 to
52 2.9 billion in 2018 and is expected to reach 3.8 billion by 2021 globally (Statista, 2020). The
53 growth is stimulated by the many benefits (e.g. entertainment, banking, socializing, and gaming)
54 offer by smartphones, and this has been attested by past studies (Kang & Jung, 2014; Lemola et
55 al., 2015; Susanto et al., 2016). Although there are numerous advantages of using smartphones,
56 but several side effects have also arisen due to the excessive smartphone usage. Particularly, the
57 widespread use of smartphones is regarded as a factor influencing pro-environmental behavior,
58 leading to disconnect people from the natural environment which has become substantial
59 worldwide psychological and behavioral issues (Kadir et al., 2015; Lee et al., 2014; Chiang et
60 al., 2019). While it remains controversial whether smartphone usage cause disconnectedness
61 between people and natural environment (Fletcher, 2017; Miles et al., 2018), studies have found
62 that adults who spent extended amount of time on smartphone in a day are more likely to exhibit
63 a stronger negative pro-environmental behavior (Kesebir & Kesebir, 2017; Miles et al., 2018).
64 Such extensive smartphone usage behavior is not only limited to adults, but also evident in
65 children who are increasingly smartphone users nowadays. The smartphone technology has
66 changed a child's growth and development, and there is evidence to support a close correlation
67 between health, behavior, and smartphone usage (Dennison et al., 2013; Lee et al., 2014).
68   Studies show that children have spent more time and energy on smartphones nowadays that
69 have led to a decrease in their physical outdoor activities and curiosity about the natural
70 environment (Haug et al., 2015; Tian et al., 2018). Other studies have also investigated several
71 different aspects of smartphone usage, such as factors influencing smartphone usage (Aljomaa et
72 al., 2016; Park et al., 2013), impact of smartphone usage on social relationships (Choi et al.,
73 2012), the effects of smartphone usage on academic performance (Samaha & Hawi, 2016), the
74 relationship between smartphone usage and stress (Chiu, 2014; Wang et al., 2015), and
75 relationship between smartphone usage and social anxiety and loneliness (Gao et al., 2016).
76 However, there are very few studies attempted to combine the two fields of smartphone usage
77 and environmental behaviors together, let alone explore their relationship. Therefore, the key
78 focus of this study is to fill this gap by specifically investigating the impact of smartphone usage
79 on children's pro-environmental behaviors. This is particularly important because experiences

80 gained through interactions with the environment during the early human development phase can
81 have a considerable influence on a person's perception of the environment (Bandura, 2006).
82 **Conceptual framework and hypotheses**
83 In the present study, we used Attribution Theory to explain the causes of children's pro-
84 environmental behavior. Pro-environmental behavior refers to the behavior of a person who
85 consciously minimizing his/her negative impact on the environment (Kollmuss & Agyeman,
86 2002). Attribution Theory posits that a behavior can be influenced by situations that arise from
87 internal and/or external attributions (Heider, 2013; Kassin & Fein, 2010). Internal attributions
88 refer to causes of behavior related to some internal characteristic, and two key elements involve
89 are: (1) perceived behavioral control, and (2) personal norms (Onu et al., 2019; Wated &
90 Sanchez, 2005; Xu et al., 2020). Perceived behavioral control is related to an individual's
91 perceived ease or difficulty of performing personal capabilities to control external challenges
92 (Ajzen, 1985). Whereas personal norms refer to the internal motivation of an individual's
93 perceived moral obligations when taking an action; it is a kind of environmental self-awareness
94 and self-discipline, which is believed to be associated with the generation of pro-environmental
95 behavior (Ajzen & Driver, 1991; Bertoldo & Castro, 2016; Esfandiar et al., 2019; Thøgersen,
96 2006). External attributions are causes of behavior that derive from situations outside a person's
97 control. Social norms are a key component of external attributions that goes beyond attitudes that
98 shape people's behaviors with an attempt to conform to a perceived norm (Weiner, 2001; Yoon
99 & Lee, 2016). Social norms refer to what people generally believe to be typical behaviors or
100 actions in the group and there are reciprocal expectations of the people within a reference group
101 (Paluck et al., 2010). Such an inter-dependence of expectation and action can often result in a
102 strong resistant to change by people. The relationship and influence of these three key variables
103 (i.e. perceived behavioral control, personal norms, social norms) on pro-environmental behaviors
104 will be further discussed next.
105 *Personal norms, social norms and pro-environmental behaviors*
106   Studies using the theory of value-belief-norm have found personal norms to be one of the key
107 motivations for individuals to be more autonomous and self-demanding to adopt pro-
108 environmental behaviors (Abrahamse et al., 2009; Stern et al., 1999). In a study by Quinn and
109 Burbach (2008), farmers' pro-environmental behaviors to improve surface water quality are
110 found to be positively influenced by personal norms. Other previous studies have also suggested
111 that pro-environmental behaviors are positively affected by personal norms. For example,
112 personal norms can be used to predict recycling and environmentally friendly consumer
113 behaviors (Ahn et al., 2012; Thøgersen, 2006; Turaga, 2010), influence conservation behaviors
114 (Kaiser et al., 2005), increase riding on public transportation (Thøgersen, 2006), and reduce car
115 usage (Abrahamse et al., 2009). Therefore, to understand the effect of personal norms on pro-
116 environmental behaviors of children using smartphone in Taiwan, the following hypotheses are
117 proposed:
118   **Hypothesis 1 (H1).** *Personal norms influence the pro-environmental behavior of excessive*
119 *smartphone usage children.*

120   **Hypothesis 6 (H6).** *Personal norms influence the pro-environmental behavior of moderate*
121   *smartphone usage children.*
122   Farrow et al. (2017) have identified various conceptualizations of social norms that are used to
123   investigate the effects of social norms on pro-environmental behavior, and there is evidence to
124   support the relationship. Previous studies have also used different theoretical models of behavior
125   (e.g. Theory of Planned Behavior, Theory of Normative Expectations) from the social
126   psychology and economics literature to explore the influence of social norms on pro-
127   environmental behaviors, and the findings indicate the existence of a relationship between them
128   (Azjen, 1991; Lapinski & Rimal, 2005). Vu et al. (2020) reveal that peer farmers' behaviors have
129   a positive influence on farmers' adoption of organic fertilizer, and socially desired behaviors
130   have been used more broadly to encourage pro-environmental farming practices in developed
131   countries. Findings from a study by Duron-Ramos et al. (2020) suggest that children who show
132   more altruistic values and sociable behavior toward others are more likely to demonstrate pro-
133   environmental behaviors. Other studies have also found social norms affect recycling, organic
134   food purchases, and the utilization of public transportation behaviors (Ferdinando et al., 2011;
135   Thøgersen, 2006). Thus, this study seeks to understand the role that social norms play in the pro-
136   environmental behaviors of children using smartphone in Taiwan. Given the above, two
137   hypotheses are proposed:
138   **Hypothesis 2 (H2).** *Social norms influence the pro-environmental behavior of excessive*
139   *smartphone usage children.*
140   **Hypothesis 7 (H7).** *Social norms influence the pro-environmental behavior of moderate*
141   *smartphone usage children.*
142   ***Personal norms, social norms and perceived behavioral control***
143   Perceived behavioral control can be divided into internal and external controls. Internal
144   control factors relate to personal behaviors such as personal skills, capabilities, or emotions,
145   while external control factors include information, opportunities, and dependence on others from
146   the outside world (Chan & Bishop, 2013). Thus, perceived behavioral control is likely to be
147   affected by both internal (i.e. personal norms) and external (i.e. social norms) attributions.
148   Previous studies related to reduce car usage (Abrahamse et al., 2009), adoption of organic
149   fertilizer (Vu et al. 2020), energy saving intention (Ru et al., 2018), sustainable food
150   consumption (Han & Hansen, 2012), and binning behavior in national parks (Esfandiar et al.,
151   2019) have shown that personal norms affect perceived behavioral control. A study by Wall et al.
152   (2008) on commuter travel-mode choices indicate that personal norms and perceived behavioral
153   control are invoked together and can have significant influence on car usage intention. Although
154   personal norms may be present, but a low level of perceived behavioral control can still prevent
155   that norm from being converted into pro-environmental behaviors. Thus, it is proposed that the
156   following hypotheses are examined in relation to the pro-environmental behaviors of children
157   using smartphone in Taiwan.
158   **Hypothesis 3 (H3).** *Personal norms influence the perceived behavioral control of excessive*
159   *smartphone usage children.*

160   **Hypothesis 8 (H8).** *Personal norms influence the perceived behavioral control of moderate*
161 *smartphone usage children.*
162   Prior studies have also revealed that social norms are related to perceived behavioral control
163 (Bamberg & Möser, 2007). In the context of recycling and organic food purchase behaviors,
164 Ferdinando et al. (2011) suggest that social norms have positive influence on perceived
165 behavioral control. Another study by Leung and Rosenthal (2019) also found that there is a link
166 between social norms and perceived behavioral control toward recycling intention and behaviors.
167 When fellow colleagues are supportive of a particular behavior, individuals tend to perceive a
168 stronger norm and have more behavioral control that contribute to positive recycling behaviors.
169 Other areas of studies that suggested a relationship between social norms and perceived
170 behavioral controls include: waste separation (Zhang et al., 2015), adolescents' environmental
171 intention (Lee, 2011), green poultry by farmers (Gholamrezai et al., 2021), tourists' responsible
172 environmental behaviors (Wang et al., 2018). As such, the following hypotheses are proposed to
173 explore the pro-environmental behaviors of children using smartphone in Taiwan.
174   **Hypothesis 4 (H4).** *Social norms influence the perceived behavioral control of excessive*
175 *smartphone usage children.*
176   **Hypothesis 9 (H9).** *Social norms influence the perceived behavioral control of moderate*
177 *smartphone usage children.*
178 ***Perceived behavioral control and pro-environmental behavior***
179   According to Ajzen (1991), perceived behavioral control is a crucial factor in the Theory of
180 Planned Behaviors that affects behaviors. Past studies in the fields of conservation behavior
181 intention (Kaiser et al., 2005), household-waste prevention behaviors (Bortoleto et al., 2012), air
182 pollution prevention behaviors (Liu et al., 2018), recycling behaviors (Leung & Rosenthal,
183 2019), and eco-friendly behaviors of travelers (Han, 2015) have shown that perceived behavioral
184 control plays a role in influencing pro-environmental behaviors. Given that perceived behavioral
185 control may be influenced by both personal and social norms, it is posit that perceived behavioral
186 control can possibly be a moderator between personal norms, social norms, and pro-
187 environmental behaviors. Thus, the following hypotheses are proposed for the pro-environmental
188 behaviors of children using smartphone in Taiwan.
189   **Hypothesis 5 (H5).** *Perceived behavioral control influences the pro-environmental behavior*
190 *of excessive smartphone usage children.*
191   **Hypothesis 10 (H10).** *Perceived behavioral control influences the pro-environmental*
192 *behavior of moderate smartphone usage children.*
193 This study aims to investigate the pro-environmental behavior of children in Taiwan, whereby
194 the ownership of smartphones in children aged between 10 to 12 has grown significantly from
195 38.7% in 2013 to 82.7% in 2019 (The Child Welfare League Foundation, 2019b). This alarming
196 trend has elicited considerable related discussions (e.g. counter measurements for smartphone
197 usage, responsibilities of the government and parents, social impact, cyber bullying), and is an
198 increasingly concerning social phenomenon in Taiwan that requires further understanding of the
199 situation (The Child Welfare League Foundation, 2019a). This research seeks to examine how

200   internal (i.e. perceived behavioral control, personal norms) and external (i.e. social norms)
201   attributions are related to children's pro-environmental behavior. Thus, this study proposed the
202   following research framework (Figure 1) to be investigated.
203   **Inserted Fig 1 here**

Materials & Methods

Research area

206   This study was carried out in Hsinchu City, Taiwan, one of the major technological and
207   industrial cities in Asia as described in Fang et al. (2017). Specifically, the research was
208   undertaken at the elementary schools around the Hsinchu Science Park, which was founded in
209   1980 with a development area of 653 hectares at the Hsinchu Park that resembles the Silicon
210   Valley in the United States (Hsinchu Science Park, 2016). In 2017, there were 520 companies in
211   Hsinchu Science Park with a total of 150,000 employees that generated an overall revenue
212   exceeding NT$1 trillion (Hsinchu Science Park, 2016). There were several elementary schools
213   situated in the Hsinchu Science Park area that cater to the needs of many families working there.

Participants and procedure

215   A probability cluster sampling method was adopted in this study with the selection of eight
216   public elementary schools around the Hsinchu Science and Industrial Park located at Hsinchu
217   City, Taiwan as described in Fang et al. (2017). A total of 16 classes (one each from grades five
218   and six, age between 11 to 12) were randomly selected from eight elementary schools. Prior to
219   conducting this research study, written information (e.g. purpose and objectives of the study, no
220   financial incentives or payments involve) about the survey and consent forms were sent to
221   children, parents, school principals and class teachers to brief them about the research and obtain
222   their agreement to participate in the study as outlined in Fang et al. (2017). At the same time,
223   their rights to withdraw from the study at any time were also conveyed to them. Participants
224   were again informed verbally about the purpose of the study and procedures to follow, as well as
225   given the opportunity to have their queries answered prior to completing the survey. Participants
226   had approximately 15 minutes in class to complete the questionnaire survey and the class teacher
227   would collate them when completed as described in Fang et al (2017). All participants, parents,
228   class teachers and school principals provided written informed consent. The National Taiwan
229   Normal University Research Ethics Committee had approved (201707HS001) this study and
230   endorsed informed consent acquired from the respective class teachers and school principals as
231   adequate. In addition, parents could opt their child out of the study at any time prior to the
232   questionnaire commencing. A total of 260 questionnaires were distributed and were all returned.
233   However, 35 were considered invalid due to their incomplete responses. Therefore, statistical
234   analysis was performed using the remaining 225 questionnaires.

Measures

236   This study was supported by the literature reviewed on the impact of cognitive and psychological
237   factors on pro-environmental behavior (De Leeuw & Valois, 2014; De Leeuw et al., 2015;
238   Esfandiar et al., 2019). Data were collected as previously described in Fang et al. (2017). As
239   described in Fang et al. (2017), this study specifically sought to measure three key dimensions:

240 (1) perceived behavioral control, (2) personal norms, and (3) social norms that were considered
241 influential to pro-environmental behavior (Culiberg & Elgaaied-Gambier, 2016; Esfandiar et al.,
242 2019; Farrow et al., 2017). This research adopted the self-administered questionnaire survey
243 method that included two key sections related to background and psychological variables (please
244 see Appendix A1).

245 *Background variables*
246 In the background variables, personal data were gathered about participants' gender, grade level,
247 and smartphone usage. Gender and grade level were measured through nominal variables (i.e.
248 Gender – Male or Female; Grade level – Grade 5 or Grade 6), whereas smartphone usage was
249 measured by the question "How many hours per day do you usually spend on smartphone during
250 a typical day?" with five possible multiple-choice responses (i.e. none, less than 1 hour, between
251 1 to 2 hours, between 2 to 3 hours, between 3 to 4 hours, between 4 to 5 hours, more than 5
252 hours). While there is no one single agreed definition for excessive smartphone usage, but it can
253 be broadly defined as the extended use of smartphone by individuals that interferes their daily
254 lives (Hair Jr et al., 2016). Studies have shown that there were about 50% of children used
255 smartphones for more than 2 hours per day (Haug et al., 2015), and approximately 70% of
256 children's daily screen time exceeded the American Academy of Pediatrics recommendations
257 (i.e. more than two hours per day) (Hair Jr et al., 2014; Henseler, 2017). Thus, for the purpose of
258 this study, excessive smartphone usage is considered to be more than two hours per day. In this
259 research study, two groups of children (i.e. excessive smartphone usage group - more than two
260 hours per day of smartphone usage, and moderate smartphone usage group - less than 2 hours of
261 smartphone usage per day) were purposefully selected for comparison.

262 *Psychological variables*
263 The psychological variables in the questionnaire survey were mainly compiled and adapted from
264 previously conducted pro-environmental behavior research studies, specifically related to
265 perceived behavioral control, social norms and personal norms dimensions (Abrahamse et al.,
266 2009; Henseler, 2017; Thøgersen, 2006). As for the questionnaire items for pro-environmental
267 behavior, they were predominantly derived from the classification by Erdogan and Ok (2011).
268 Three experts and 50 children in grades five and six had pre-tested the questionnaire survey and
269 some changes (e.g. simplified wordings) had been made accordingly to ensure an easier
270 understanding of the context. Nonetheless, the original meaning of the items adapted from the
271 previous studies were retained. A five-point Likert scale (i.e., 1 = "Strongly disagree" to 5 =
272 "Strongly agree") was applied for the measurement of the personal norms, social norms,
273 perceived behavioral control, and pro-environmental behaviors in this study as described in Fang
274 et al. (2017). The Cronbach's α values of the respective dimensions were perceived behavioral
275 control (0.686), personal norm (0.766), social norm (0.886), and pro-environmental behavior
276 (0.846), which demonstrated internal reliability since their values were greater than the 0.6
277 requirement. The Kaiser–Meyer–Olkin and Spherical Bartlett tests as described in Fang et al.
278 (2018) had indicated a value of 0.885 and 2496.758 (p< 0.001) respectively. Factor analyses
279 were subsequently conducted in PLS and the factor loading of each question in the key

280   dimensions had exceeded the value of 0.4 (Pett et al., 2003). Given the outcome of these test
281   values, the scales used for the psychological variables could be regarded as reliable.
282   **Statistical analysis**
283   The statistical analysis in this study was carried out as previously described in Fang et al. (2017)
284   and Fang et al. (2018), using the Statistical Package for Social Sciences (version 22) software
285   program. Specifically, frequency analysis was used to identify the total number of occurrences,
286   the mean and standard deviation (SD) scores for the demographic questions and items in the key
287   dimensions of perceived behavioral control, personal norms, social norms, and pro-
288   environmental behavior. In addition, Pearson's correlation coefficient was used to evaluate the
289   intensity and direction of the relationship between the key dimensions. Whereas the multiple
290   regression analysis was used to determine the influence of perceived behavioral control, personal
291   norms, social norms on pro-environmental behavior. The SmartPLS 2.0 statistical software was
292   utilize in this study to perform the path analysis, which were then used to assess the magnitude
293   and significance of the causal relationships between perceived behavioral control, personal
294   norms, social norms, and pro-environmental behavior.
295   **Results**
296   **Descriptive statistics**
297   Overall results showed that both males (48.9%, n=110) and females (51.1%, n=115) were
298   relatively well represented in this study. Among them, 47.6% (n=107) were in grade five and the
299   remaining 52.4% (n=118) were in grade six. Of the two control groups investigated, the
300   excessive smartphone usage group accounted for 42.7% (n=96), whereas the moderate
301   smartphone usage group was 57.3% (n=129). Findings revealed significant differences between
302   males and females in their perceived behavioral control (df = 223, two-tailed, $t = 2.126 > 1.96$, p
303    $= 0.035$). Similarly, significant differences were also identified between grade five and grade six
304   children in terms of their personal norms (df = 223, two-tailed, $t = 2.095 > 1.96$, $p = 0.037$) and
305   perceived behavioral control (df = 223, two-tailed, $t = 2.498 > 1.96$, $p = 0.013$). Furthermore,
306   significant differences between excessive smartphone usage group children and moderate
307   smartphone usage group children were also evident in personal norms (df = 223, two-tailed, $t =$
308    $4.693 > 1.96$, $p < 0.001$), social norms (df = 223, two-tailed, $t = 3.205 > 1.96$, $p = 0.002$),
309   perceived behavioral control (df = 223, two tailed, $t = 3.465 > 1.96$, $p = 0.001$), and pro-
310   environmental behavior (df = 223, two-tailed, $t = 3.520 > 1.96$, $p = 0.001$). Table 1 presents a
311   brief summary of the demographic findings and their association with personal norms, social
312   norms, perceived behavioral control, and pro-environmental behavior.
313   **Inserted Table 1 here**
314   As shown in Table 2, the mean score for the overall perceived behavioral control was 3.62.
315   Among the four perceived behavioral control related items, "I can save water resources" had the
316   highest mean score (3.92), and this was followed by "I can observe environmental cleanliness"
317   (3.80), "I take the initiative to go outdoors" (3.38), and "I have involvement in and disseminate
318   information beneficial to the environment" (3.37). The results indicated an internal consistency

319   reliability measurement with the Cronbach's α value of 0.686 for perceived behavioral control
320   related items.
321   **Inserted Table 2 here**
322   Findings for the overall personal norms revealed a mean score of 3.68. There were three personal
323   norms related items, namely "For self-discipline, I carry my own water cup when I go out"
324   (3.79), "For self-discipline, I carry my own cutlery when I go out" (3.70), and "I must not
325   arbitrarily abandon pets or plant garden plants in the wild" (3.45). Results of the personal norms
326   related items are displayed in Table 3 below. There was a consistent reliable measurement for the
327   personal norms related items with the Cronbach's α value of 0.766.
328   **Inserted Table 3 here**
329   Results (see Table 4) indicated that the mean score for the overall social norms was 3.61. There
330   were six social norms related items whereby "People I know do not litter arbitrarily", and
331   "People I know go outdoors instead of staying indoors with air conditioning" had the highest
332   (3.78) and lowest (3.22) mean score respectively. Other items also include: "People I know are
333   aware of how to save water" (3.77), "People I know expect me to go outdoors and use less air
334   conditioning" (3.68), "People I know want me to carry a water cup and cutlery when I go out"
335   (3.63), and "People I know carry their own cutlery when they go out" (3.59). The Cronbach's α
336   value of 0.886 suggested internal consistency for the social norms related items.
337   **Inserted Table 4 here**
338   In terms of the overall pro-environmental behavior, findings revealed a mean score of 3.32.
339   There were five items related to pro-environmental behavior, and of which "I go outdoors in my
340   free time, rather than watching TV and sitting in front of the computer" received the highest
341   mean score (3.62). This was followed by "I participate in conducting surveys on animal and
342   plant-related activities in the vicinity of the community" (3.52), "I persuade others to sort waste"
343   (3.34), "I visit the park and volunteer" (3.14), and "I participate in environmental activities
344   conducted outdoors" (2.97). Results of the pro-environmental behavior related items are outlined
345   in Table 5 below. The internal consistency reliability for the pro-environmental behaviors related
346   items was measured, with the Cronbach's α value of 0.846.
347   **Inserted Table 5 here**
348   **Correlation analysis**
349   As shown in Table 6, the correlation analysis results indicated that personal norms and perceived
350   behavioral control were highly correlated with a value of 0.723 ($p < 0.01$). The correlation
351   coefficient of the remaining relationships indicated a moderate correlation; social norms and
352   perceived behavioral control ($r = 0.520$, $p < 0.01$); perceived behavioral control and pro-
353   environmental behavior ($r = 0.598$, $p < 0.01$); personal norms and pro-environmental behavior ($r
354   = 0.536$, $p < 0.01$); social norms and pro-environmental behavior ($r = 0.522$, $p < 0.01$). Hence,
355   personal norms, social norms, perceived behavioral control, and pro-environmental behavior
356   were considered to be correlated.
357   **Inserted Table 6 here**
358   **Regression and path analysis**

359 Results of the partial least squares regression analysis indicated different paths influencing pro-
360 environmental behavior for both excessive smartphone usage, and moderate smartphone usage
361 children. In the excessive smartphone usage group (as shown in Table 7), the average variance
362 extracted (AVE) values for personal norms (0.5297), social norms (0.5363), perceived
363 behavioral control (0.5219), and pro-environmental behaviors (0.5782) were above 0.50. The
364 composite reliability (CR) values for personal norms (0.7660), social norms (0.8736), perceived
365 behavioral control (0.8130), and pro-environmental behaviors (0.8711) were at least 0.70.
366 Therefore, the model statistically supported the convergent validity and reliability for the
367 measurement model between the latent variables and their respective dimensions (Hair Jr et al.,
368 2016; Hair Jr et al., 2014; Henseler, 2017). The Cronbach's α values for social norms (0.8280),
369 and pro-environmental behaviors (0.8173) were above 0.7, and thus achieved a high level of
370 internal consistency. While the Cronbach's α values for personal norms (0.5604), and perceived
371 behavioral control (0.6976) were below the value of 0.7, but they were higher than the acceptable
372 value of 0.5, which indicated that the survey items had demonstrated an acceptable level of
373 internal consistency. The explanatory power (R^2) of the affected dimensions were perceived
374 behavioral control (0.2865), and pro-environmental behavior (0.2964).
375   **Inserted Table 7 here**
376 Figure 2 displayed the path analysis about the relationship between personal norms, social
377 norms, perceived behavioral control, and pro-environmental behavior of excessive smartphone
378 usage children. The bootstrapping method was used to obtain the *t* value of the path in order to
379 examine the significant level. According to the path analysis for excessive smartphone usage
380 children, personal norms (β = -0.044, *t* = 0.395, *p* > 0.05) had no direct influence on pro-
381 environmental behavior, whereas social norms (β = 0.428, *t* = 4.096***, *p* < 0.001) had a direct
382 predictive impact. Therefore, H1 was not supported as there was no evidence of a direct
383 influence of personal norms on pro-environmental behavior for excessive smartphone usage
384 children. However, H2 was supported since social norms had shown a direct positive influence
385 on pro-environmental behavior for excessive smartphone usage children. Although personal
386 norms (β = 0.304, *t* = 2.721**, *p* < 0.01), and social norms (β = 0.333, *t* = 2.779**, *p* < 0.01) had
387 a significant impact on perceived behavioral control, but there was no evidence suggesting a
388 relationship existed between perceived behavioral control (β = 0.220, *t* = 1.823, *p* > 0.05) and
389 pro-environmental behavior. Hence, H3 and H4 were supported since both personal norms and
390 social norms had a positive influence on perceived behavioral control for excessive smartphone
391 usage children. Conversely, H5 was not supported because perceived behavioral control had no
392 direct effect on pro-environmental behavior for excessive smartphone usage children.
393   **Inserted Fig 2 here**
394 For the moderate smartphone usage children group (as shown in Table 8), the average variance
395 extracted (AVE) values for personal norms (0.6549), social norms (0.6270), perceived
396 behavioral control (0.6240), and pro-environmental behaviors (0.6441) had exceeded 0.50. The
397 composite reliability (CR) values for personal norms (0.8496), social norms (0.9093), perceived
398 behavioral control (0.8688), and pro-environmental behaviors (0.9004) were above 0.70.   Thus,

399 the model statistically supported the convergent validity and reliability for the measurement
400 model between the latent variables and their respective dimensions (Hair Jr et al., 2016; Hair Jr
401 et al., 2014; Henseler, 2017). The Cronbach's α values for personal norms (0.7309), social norms
402 (0.8794), perceived behavioral control (0.7989), and pro-environmental behaviors (0.8618) were
403 greater than 0.7, and therefore indicated a high level of internal consistency. The explanatory
404 power (R2) on the affected dimensions of perceived behavioral control, and pro-environmental
405 behavior were recorded as 0.5697 and 0.5684 respectively.
406   **Inserted Table 8 here**
407 The path analysis (as shown in Figure 3) displayed the relationship between personal norms,
408 social norms, perceived behavioral control, and pro-environmental behavior of moderate
409 smartphone usage children. In order to determine the level of significance, the bootstrapping
410 method was used to obtain the *t* value of the path. Analysis results revealed that personal norms
411 and social norms did not have a direct path relationship to pro-environmental behavior, but
412 instead displayed an influence on perceived behavioral control. Therefore, H6 and H7 were not
413 supported since there was no evidence of personal norms and social norms having direct
414 influence on pro-environmental behavior for moderate smartphone usage children. Accordingly,
415 personal norms had a greater impact on perceived behavioral control (β = 0.664, t = 10.357***, p
416 < 0.001) than social norms (β = 0.153, t = 2.160*, p < 0.05), thus H8 and H9 were supported
417 which confirmed the influence of personal norms and social norms on perceived behavioral
418 control for moderate smartphone usage children. Although there was no direct path established
419 between personal norms and pro-environmental behavior, and social norms and pro-
420 environmental behavior, but such a relationship could be developed through the mediating effect
421 of perceived behavioral control (β = 0.497, t = 4.471***, p < 0.001). The *P*-values of the paths
422 from personal norms to pro-environmental behavior, and social norms to pro-environmental
423 behavior were greater than the significance levels (α = 0.05). Therefore, H10 was supported,
424 whereby perceived behavioral control had a positive influence on pro-environmental behavior
425 for moderate smartphone usage children.
426   **Inserted Fig 3 here**

Discussion

428 This study adopted the Social Attribution Theory to explore the impact of personal norms, social
429 norms, and perceived behavioral control on pro-environmental behaviors by two groups of
430 children in Taiwan based on their daily smartphone usage (i.e. excessive versus moderate). The
431 extant literature suggested that there were inadequate studies conducted to understand the
432 relationship between smartphone usage and environmental behaviors, which this study sought to
433 fill the gap by investigating personal norms, social norms, and perceived behavioral control to
434 determine their specific path and level of influence on pro-environmental behaviors. The overall
435 results indicated that moderate smartphone usage children had shown a greater level of pro-
436 environmental behaviors than those children who were excessive smartphone users, and this
437 finding was supported by previous studies (Kesebir & Kesebir, 2017; Richardson et al., 2018).

438   The results also revealed support and accepted six (i.e. H2, H3, H4, H8, H9 and H10) of the 10
439   hypotheses, indicating significant direct positive relationship.
440   **Excessive smartphone usage children group**
441   Results suggested that the relationship between personal norms and pro-environmental
442   behaviors for excessive smartphone usage children was considered weak, and as such H1 was
443   rejected. This outcome indicated that personal beliefs of the excessive smartphone usage children
444   had minimal influence on their pro-environmental behaviors. The absence of this relationship
445   could be explained through a possible lack of one's desire to conform to pro-environmental
446   behaviors and/or a lack of environmental self-awareness and self-discipline that could contribute
447   to exhibiting pro-environmental behaviors.
448   Findings revealed the support for H2 since social norm was a major predictive variable of pro-
449   environmental behaviors for excessive smartphone usage children. This implied that excessive
450   smartphone usage children were more likely to display and engage in pro-environmental
451   behavior when they felt under pressure to conform to the expectation and requirement of
452   normative social influence. This could be explained by the cultural context whereby
453   Confucianism, which is an East Asian ethical and philosophical system that emphasizes on social
454   values, has strong culture roots in countries such as China, Korea, Japan, and Singapore (Chang
455   & Chu, 2007; Westwood & Chan, 1995). This strong emphasis on social values formed the basis
456   for a sense of belonging to the group, which could explain the results emphasizing a greater
457   influence of social norms for excessive smartphone usage children on their pro-environmental
458   behavior. Hence, pro-environmental behaviors were only predicted through social norms,
459   whereby excessive smartphone usage children followed the rules that regulate their life from
460   explicit standards for proper behaviors.
461   Analysis results also indicated that while both personal norms and social norms had a
462   significant impact on perceived behavioral control (i.e. H3 and H4) on the excessive smartphone
463   usage children, but a relationship between perceived behavioral control and pro-environmental
464   behaviors was not established (i.e. H5). The rejection of this hypothesis (H5) could be due to a
465   lack of individual's beliefs about their personal capabilities to overcome challenges that impeded
466   their exhibition of pro-environmental behaviors. Therefore, pro-environmental behaviors were
467   only predicted through social norms, whereby excessive smartphone usage children followed the
468   rules that regulate their life from explicit standards for proper behaviors.
469
470   **Moderate smartphone usage children group**
471   For the moderate smartphone usage children group, findings rejected H6 and H7 since there was
472   no evidence supporting the direct influence of personal norms on pro-environmental behaviors,
473   and social norms on pro-environmental behaviors. This suggested that the pro-environmental
474   behaviors of the moderate smartphone usage children would neither directly affected solely by
475   their perceived moral obligations toward environment, nor when pressured to conform because
476   of external social influences.

477   On the other hand, there was evidence in the moderate smartphone usage children group that
478   indicated a direct influence from personal norms to perceived behavioral control, and social
479   norms to perceived behavioral control, hence H8 and H9 were supported. Although personal
480   norms would have provided moderate smartphone usage children the perceived moral
481   obligations to undertake pro-environmental behaviors, but it did not appear to have a direct
482   impact, instead an indirect influence on pro-environmental behaviors was only achieved through
483   perceived behavioral control. An explanation to this could be that the perceived moral
484   obligations to the environment itself was not strong enough for moderate smartphone usage
485   children to undertake pro-environmental behaviors, but through self-resilience from perceived
486   behavioral control, pro-environmental behaviors were attained (Ali et al., 2010; Schwarzer &
487   Warner, 2013). Studies (e.g. Song & Li, 2019; Tchetchik et al., 2021) showed that individuals
488   with self-resilience attitudes were more likely to demonstrate and adapt positive behavioral
489   change to their surroundings, perception of green living environments and more responsible
490   toward environmental issues. Therefore, personal norms could only affect pro-environmental
491   behaviors through the mediating variable of perceived behavioral control (Abrahamse et al.,
492   2009; Esfandiar et al., 2019). Findings also suggested that perceived behavioral control was a
493   major predictive variable affecting pro-environmental behaviors (i.e. H10) for moderate
494   smartphone usage children. This result aligned with other studies (e.g. De Leeuw et al., 2015)
495   that found perceived behavioral control having a significant role to play in determining pro-
496   environmental behaviors.
497   **Differences between two groups**
498   There were two key differences in the findings between excessive and moderate smartphone
499   usage children investigated in this study. Firstly, results indicated that social norms were
500   considered a key influencing factor for excessive smartphone usage children's pro-environmental
501   behavior. Social norm had a very strong direct positive association with behavioral intention for
502   excessive smartphone users (Lee et al., 2018), and behavioral intention was the most direct
503   predictor of behavior (Glanz et al., 2015). Thus, social requirements and social expectation were
504   more likely to predict pro-environmental behaviors of excessive smartphone usage children than
505   moderate smartphone usage children. This suggested that excessive smartphone usage children
506   might rely on the role of socializing agents in the development of self-regulation, such as parents
507   (i.e., low levels of parental restrictive mediation), teachers, and peers (Chang et al., 2019), and
508   therefore were unable to develop their own thoughts, feelings, and actions toward the exhibition
509   of pro-environmental behavior (Zimmerman, 2000). As such, their norms could not be
510   internalized due to a lack of self-regulation, resulting in their "following the instructions of the
511   teachers and other adults or acting based on observed actions of the peers" behavior. Therefore,
512   their demonstrated pro-environmental behavior was likely to be coercive and conditional under
513   physical and emotional duress that were not necessarily the intended actual behavior of their
514   own. This supported previous studies (Gökçearslan et al., 2016; Jeong et al., 2016) conducted
515   about predictors of self-regulation on smartphone usage.

516   Secondly, the research results revealed that personal norms of moderate smartphone usage
517 children had a greater predictive power on their perceived behavioral control, which
518 subsequently affected pro-environmental behaviors. This indicated that moderate smartphone
519 usage children had internalized their personal norms, and with the perceived ease of their
520 capabilities, to perform pro-environmental behaviors. Hence, the personal norms of the moderate
521 smartphone usage children could have an indirect positive impact on their pro-environmental
522 behaviors via perceived behavioral control. The findings align with previous studies (e.g. Turaga
523 et al., 2010; Thøgersen, 2006; Abrahamse et al., 2009) conducted on the effects of personal
524 norms on environmental behaviors.

525 **Implications, limitations and future research**
526 There are two key implications from the findings in this study. Firstly, pro-environmental
527 behavior of excessive smartphone usage children was predominantly affected by social norms
528 only. Therefore, it is recommended that environmental education programs (formal and
529 informal) at schools need to be targeting independent of knowledge so that children can better
530 understand the relationship between their behavior and the environment. This helps toward
531 attaining a more sustainable pro-environmental behavior of becoming a socially responsible
532 citizen and not just conforming because of the social norm pressure. Next, the increasing concern
533 of excessive smartphone usage by children has also prompted the need to explore different ways
534 to minimize such a harmful behavior. Through the promotion of more outdoor activities and
535 utilizing outdoor venues such as parks and playgrounds, children are then provided with more
536 choices other than engaging with their smartphones (e.g. gaming, internet surfing), therefore
537 reducing the potential of smartphone overuse.

538   There are several limitations in this research study. First, the primary schools were selected in
539 the proximity of the Hsinchu Science and Industrial Park location and thus the findings are not
540 applicable to other geographical areas. To generalize the findings, further research needs to be
541 conducted with a larger sample and tested accordingly. Secondly, research can also be
542 investigated in other country contexts in the future to provide cross-country comparisons. Lastly,
543 follow-up studies can be conducted to gain further in-depth understanding about the relationship
544 of smartphone usage, and other psychological variables (such as attitudes, beliefs) toward
545 environmental knowledge and behaviors.

546 ## Conclusions
547 This study has used the Attribution Theory as the basis to examine the causes of children's pro-
548 environmental behavior in Taiwan. Research results revealed that social norms were the key
549 factor affecting the pro-environmental behavior of excessive smartphone usage children.
550 Conversely, personal norms, through the indirect path of perceived behavioral control, had the
551 greatest level of influence on moderate smartphone usage children's pro-environmental behavior.
552 The findings clearly distinguished the pro-environmental behavior path modes between the
553 excessive smartphone usage children and moderate smartphone usage children. Excessive
554 smartphone usage children would only exhibit pro-environmental behavior through social norms,

555 whereas moderate smartphone usage children displayed higher personal norms and perceived
556 behavioral control toward more environmentally friendly behaviors.
557 **Inserted Appendix A1 here**
558

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566

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Figure 1

Proposed research framework

Social norms is a key component of external attributions that goes beyond attitudes that shape people's behaviors, and can be further classified as (1) subjective norms, and (2) descriptive norms.

```
Personal norms
    (PN)

                    H1, H6
      H3, H8

                Perceived
                behavioral control    H5, H10    Pro-environmental
                    (PBC)                         behavior
                                                   (PEB)

      H4, H9

                          H2, H7

Social norms
    (SN)
```

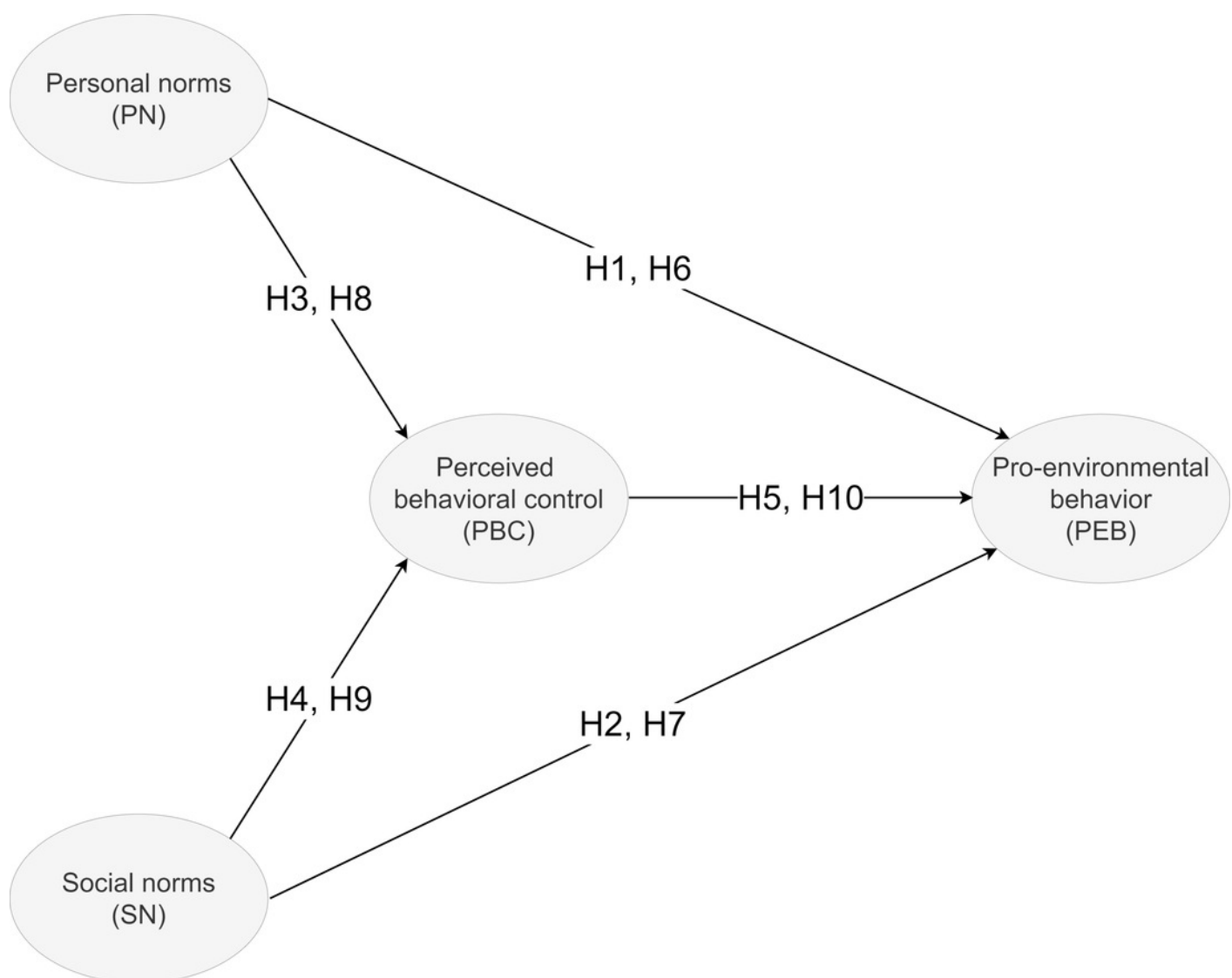



Figure 2

Path diagram on personal norms (PN), social norms (SN), perceived behavioral control (PBC), and pro-environmental behavior (PEB) of excessive smartphone usage children

Figure 2 displayed the path analysis about the relationship between personal norms, social norms, perceived behavioral control, and pro-environmental behavior of excessive smartphone usage children.

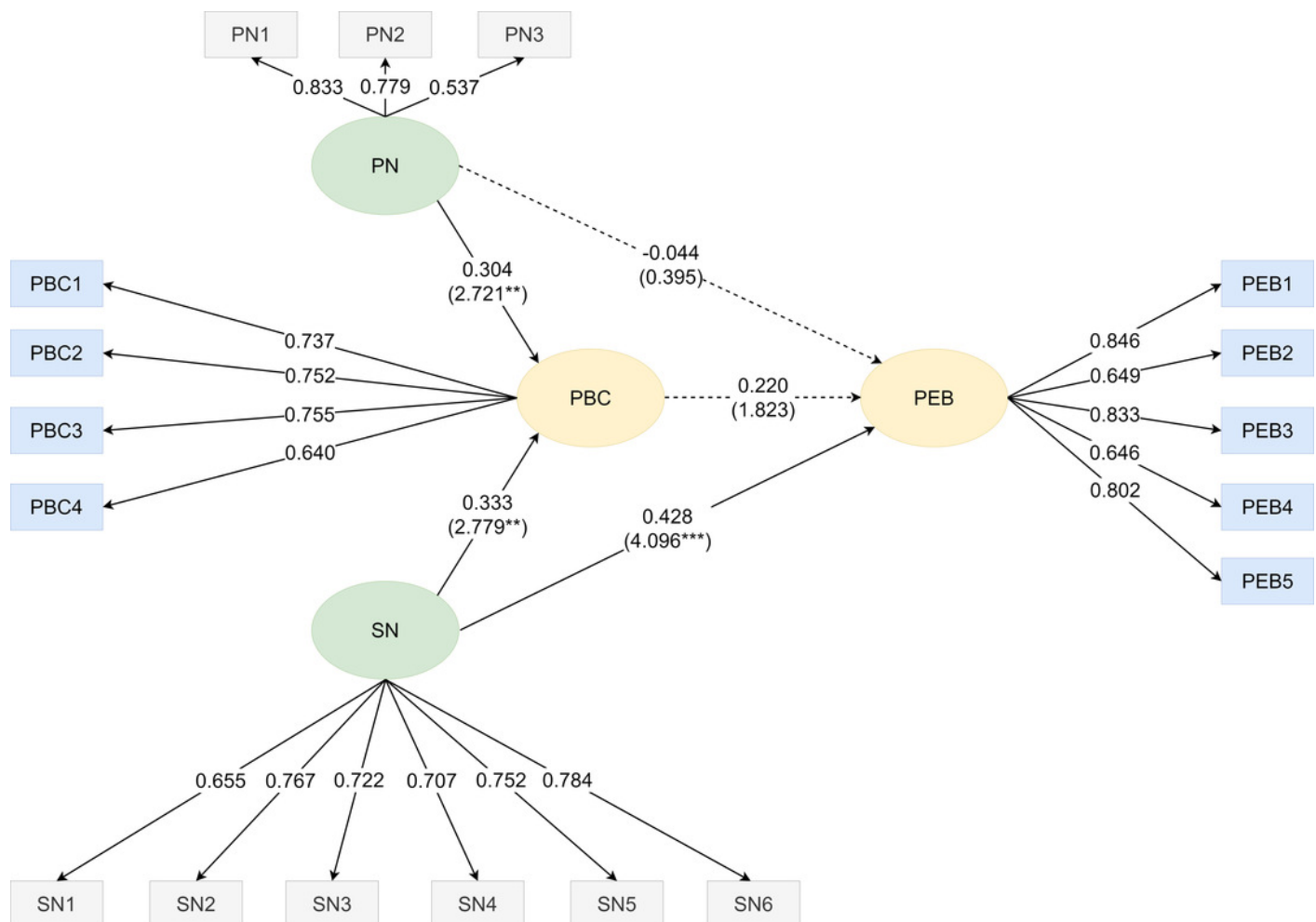



Figure 3

Path diagram on personal norms (PN), social norms (SN), perceived behavioral control
(PBC), and pro-environmental behavior (PEB) of moderate smartphone usage children

Figure 3 displayed the relationship between personal norms, social norms, perceived

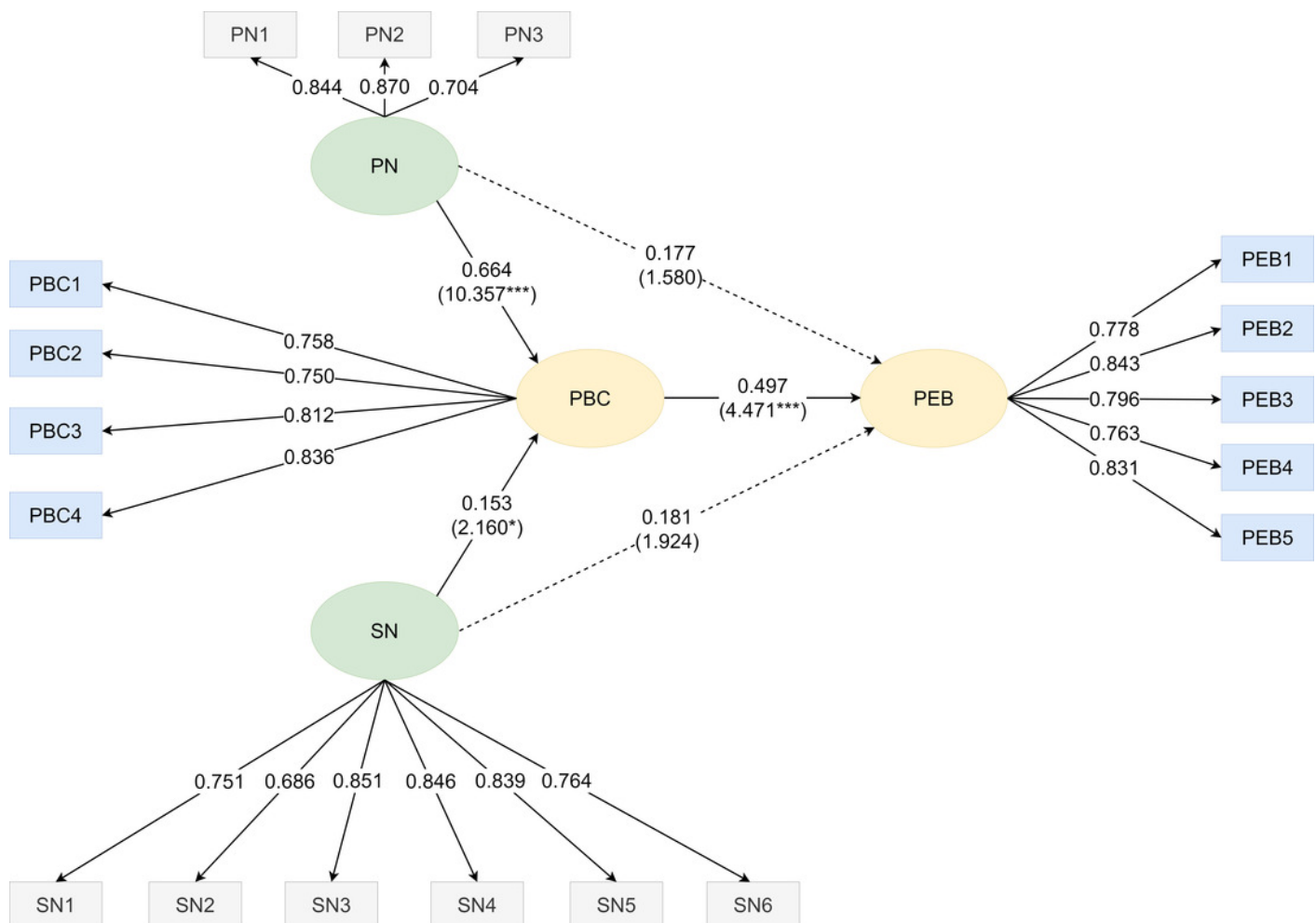
behavioral control, and pro-environmental behavior of moderate smartphone usage children.

Descriptive statistics related to the demographic questions for personal norms, social norms, perceived behavioral control, and pro-environmental behavior

Table 1 presents a brief summary of the demographic findings and their association with personal norms, social norms, perceived behavioral control, and pro-environmental behavior.

1 **Table 1.** Descriptive statistics related to the demographic questions for personal norms, social norms, perceived behavioral control,

2 and pro-environmental behavior

Variables	Freque ncy	Percen t (%)	Personal norms				Social norms				Perceived behavioral control				Pro-environmental behavior			
			Mean	SD	t	p	Mean	SD	t	p	Mean	SD	t	p	Mean	SD	t	p
Gender																		
Female	115	51.1	3.76	0.791			3.60	0.78			3.73	0.78			3.43	0.96		
					1.665	0.097			1.161	0.247			2.126	0.035			1.768	0.078
Male	110	48.9	3.59	0.777			3.48	0.78			3.50	0.84			3.21	0.91		
Grade level																		
Grade 6	118	52.4	3.58	0.76			3.51	0.75			3.49	0.81			3.25	0.88		
					-2.095	0.037			-0.655	0.513			-2.498	0.013			-1.101	0.272
Grade 5	107	47.6	3.80	0.81			3.58	0.82			3.76	0.80			3.39	1.00		
Smartphone usage																		
Excessive	96	42.7	3.41	0.71			3.43	0.68			3.40	0.80			3.07	0.90		
					-4.693	0.000			-3.205	0.002			-3.465	0.001			-3.520	0.001
Moderate	129	57.3	3.89	0.78			3.75	0.74			3.78	0.80			3.50	0.93		

Descriptive statistics for perceived behavioral control related items.

As shown in Table 2, the mean score for the overall perceived behavioral control was 3.62.

1   **Table 2**. Descriptive statistics for perceived behavioral control related items

Perceived behavioral control	Mean	SD
PBC1. I take the initiative to go outdoors.	3.38	1.16
PBC2. I have involvement in and disseminate information beneficial to the environment.	3.37	1.05
PBC3. I can save water resources.	3.92	1.07
PBC4. I can observe environmental cleanliness.	3.80	0.96
Overall perceived behavioral control	3.62	0.82

Descriptive statistics for personal norms related items.

There was a consistent reliable measurement for the personal norms related items with the Cronbach's α value of 0.766.

1 **Table 3**. Descriptive statistics for personal norms related items

Personal norms	Mean	SD
PN1. For self-discipline, I carry my own cutlery when I go out.	3.70	1.08
PN2. For self-discipline, I carry my own water cup when I go out.	3.79	1.06
PN3. I must not arbitrarily abandon pets or plant garden plants in the wild.	3.45	1.08
Overall personal norms	3.68	0.79

Descriptive statistics for social norms related items.

Results indicated that the mean score for the overall social norms was 3.61.

1   **Table 4.** Descriptive statistics for social norms related items

Social norms	Mean	SD
SN1. People I know want me to carry a water cup and cutlery when I go out.	3.63	1.05
SN2. People I know want me to go outdoors instead of staying indoors with air conditioning.	3.68	0.13
SN3. People I know carry their own cutlery when they go out.	3.59	1.06
SN4. People I know are aware of how to save water.	3.77	1.01
SN5. People I know do not litter arbitrarily.	3.78	1.01
SN6. People I know go outdoors instead of staying indoors with air conditioning.	3.22	1.22
Overall social norms	3.61	0.79

Descriptive statistics for pro-environmental behavior related items.

Results of the pro-environmental behavior related items are outlined in Table 5 below. The
internal consistency reliability for the pro-environmental behaviors related items was
measured, with the Cronbach's α value of 0.846.

1 **Table 5.** Descriptive statistics for pro-environmental behavior related items

Pro-environmental behavior	Mean	SD
PEB1. I persuade others to sort waste.	3.34	1.211
PEB2. I go into nature in my free time instead of using smartphone.	3.62	1.174
PEB3. I participate in environmental activities conducted outdoors.	2.97	1.185
PEB4. I participate in conducting surveys on animal and plant-related activities in the vicinity of the community.	3.52	1.203
PEB5. I visit the park and volunteer.	3.14	1.200
Overall pro-environmental behavior	3.32	0.940

Pearson's correlation matrix (Mean).

The correlation coefficient of the remaining relationships indicated a moderate correlation; social norms and perceived behavioral control ($r = 0.520$, $p < 0.01$); perceived behavioral control and pro-environmental behavior ($r = 0.598$, $p < 0.01$); personal norms and pro-environmental behavior ($r = 0.536$, $p < 0.01$); social norms and pro-environmental behavior ($r = 0.522$, $p < 0.01$).

1   **Table 6.** Pearson's correlation matrix (Mean)

	Personal norms	Social norms	Perceived behavioral control	Pro-environmental behavior
Personal norms	1.000			
Social norms	0.559	1.000		
Perceived behavioral control	0.723	0.520	1.000	
Pro-environmental behavior	0.536	0.522	0.598	1.000

2   All correlations are significant, $p < 0.01$ (two-tailed test).

Partial least square regression analysis of personal norms, social norms, and perceived behavioral control that predict pro-environmental behavior of excessive smartphone usage children ($n = 96$).

Results of the partial least squares regression analysis indicated different paths influencing pro-environmental behavior for both excessive smartphone usage, and moderate smartphone usage children. In the excessive smartphone usage group.

1 **Table 7**. Partial least square regression analysis of personal norms, social norms, and perceived

2 behavioral control that predict pro-environmental behavior of excessive smartphone usage

3 children (*n* = 96)

	AVE	CR	R²	Cronbach's α
Personal norms	0.5297	0.7660		0.5604
Social norms	0.5363	0.8736		0.8280
Perceived behavioral control	0.5219	0.8130	0.2865	0.6976
Pro-environmental behavior	0.5782	0.8711	0.2964	0.8173

Partial least square regression analysis of personal norms, social norms, and perceived behavioral control that predict pro-environmental behavior of moderate smartphone usage children ($n = 129$).

All of the convergent validity, i.e. average variance extracted (AVE) values had exceeded 0.50, and similarly the composite reliability (CR) values were above 0.70.

1   **Table 8.** Partial least square regression analysis of personal norms, social norms, and perceived

2   behavioral control that predict pro-environmental behavior of moderate smartphone usage

3   children ($n = 129$)

	AVE	CR	R^2	Cronbach's α
Personal norms	0.6549	0.8496		0.7309
Social norms	0.6270	0.9093		0.8794
Perceived behavioral control	0.6240	0.8688	0.5697	0.7989
Pro-environmental behavior	0.6441	0.9004	0.5684	0.8618

Appendix A1

Appendix A1: Survey Questionnaire 20170810Ver2

Appendix A1: Survey QuestionnaireSurvey Questionnaire
20170810Ver2

A. Questionnaire introduction and informed consent for study participants

To whom it may concern:

This is a survey questionnaire on environmental protection behaviors and learning model subsidized by the Ministry of Science and Technology, Taiwan. The main aim of this questionnaire is to gain a better understanding on the model of environmental protection behaviors. The subjects of the survey are students in grades five and six, age between 11 to 12. Participants and their parents are to sign the written informed consent prior to completing the questionnaire. Please note that each questionnaire can take approximately 15 minutes to complete. Thank you for taking the time to complete it.

This questionnaire has been designed to be completed anonymously and will not identify any individual participant. The research team will take all reasonable steps to maintain your privacy and the confidentiality of the data collected. This research results will be published in academic journals with findings reported as a summary where no individuals will be identified. There are no commercial benefits derived from this study.

Please do not feel obliged to participate in this study, however, once you have submit the written informed consent form, you are deemed to agree to participate. Since this questionnaire is not pre-coded for any identification purpose, therefore the research team will not be able to delete the questionnaire and its contents once it has been filled out and submitted.

If you wish to inquire about the content of this questionnaire, or are interested in knowing the results of the research, you are welcome to request a summary of the research results by contacting (Project PI: Wei-Ta Fang, Tel:02-77496558, email:wtfang@ntnu.edu.tw). Graduate Institute of Environmental Education, National Taiwan Normal University

Professor and Director Wei-Ta Fang
Graduate Institute of Environmental Education, NTNU

B. Basic information

1. Name of school: ________________ Elementary School.

2. Grade level: ☐Grade 5 ☐ Grade 6

3. Gender: ☐Male ☐Female

4. Parent's educational level:

 (1) Father:

 ☐Below middle school (including middle school) ☐High school ☐Bachelor's degree

 ☐Master's degree ☐PhD

 (2) Mother:

 ☐Below middle school (including middle school) ☐High school ☐Bachelor's degree

 ☐Master's degree ☐PhD

5. Parent's occupation

 (1) Father:

  ☐Public servant ☐School staff ☐Electronics and Information Industry

  ☐Business and finance ☐Law, accounting, architect ☐Service industry

  ☐Transportation ☐Self-operated shop owner (retail, catering)

  ☐Agriculture, forestry, fishery, and animal husbandry ☐Unpaid household management

  ☐University professor ☐Medical care ☐Others:____

 (2) Mother:

  ☐Government agency ☐School staff ☐Electronics and Information Industry

  ☐Business and finance ☐Law, accounting, architect ☐Service industry

  ☐Transportation ☐Self-operated shop owner (retail, catering)

  ☐Agriculture, forestry, fishery and animal husbandry ☐Unpaid household management

  ☐University professor ☐Medical care ☐Others:____

C. Mobile phone usage

How many hours per day do you usually spend on smartphone during a typical day?

☐none ☐less than 1 hour ☐between 1 to 2 hours ☐between 2 to 3 hours

☐between 3 to 4 hours ☐between 4 to 5 hours ☐more than 5 hours

D. Social norms, perceived behavioral control, and pro-environmental behavior

Please fill in the level of agreement to the best of your understanding on the following statements.	Strongly disagree (1)	Disagree (2)	Neither agree nor disagree (3)	Agree (4)	Strongly agree (5)
I take the initiative to go outdoors.	☐	☐	☐	☐	☐
I have involvement in and disseminate information beneficial to the environment.	☐	☐	☐	☐	☐
I can save water resources.	☐	☐	☐	☐	☐
I can observe environmental cleanliness.	☐	☐	☐	☐	☐
For self-discipline, I carry my own cutlery when I go out.	☐	☐	☐	☐	☐
For self-discipline, I carry my own water cup when I go out.	☐	☐	☐	☐	☐
I must not arbitrarily abandon pets or plant garden plants in the wild.	☐	☐	☐	☐	☐
People I know want me to carry a water cup and cutlery when I go out.	☐	☐	☐	☐	☐
People I know want me to go outdoors instead of staying indoors with air conditioning.	☐	☐	☐	☐	☐
People I know carry their own cutlery when they go out.	☐	☐	☐	☐	☐
People I know are aware of how to save water.	☐	☐	☐	☐	☐
People I know do not litter arbitrarily.	☐	☐	☐	☐	☐
People I know go outdoors instead of staying indoors with air conditioning.	☐	☐	☐	☐	☐
I persuade others to sort waste.	☐	☐	☐	☐	☐
I go into nature in my free time instead of using smartphone.	☐	☐	☐	☐	☐
I participate in environmental activities conducted outdoors.	☐	☐	☐	☐	☐
I participate in conducting surveys on animal and plant-related activities in the vicinity of the community.	☐	☐	☐	☐	☐
I visit the park and volunteer.	☐	☐	☐	☐	☐