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1 **How sales promotion influences consumers' physical exercise and**  
2 **purchase behaviors: Evidence from mobile exercise app data**

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4  
5 Seongsoo Jang <sup>1</sup> (corresponding author)

6 Cardiff Business School, Cardiff University

7 Aberconway Building, Colum Drive, Cardiff CF10 3EU, UK

8 +44 78 5979 2745, [JangS@cardiff.ac.uk](mailto:JangS@cardiff.ac.uk)

9  
10 Hwang Kim <sup>1</sup>

11 Chung-Ang University Business School, Chung-Ang University

12 84-Heukseok-ro, Dongjak-gu, Seoul, Korea

13 +82 2 820 6304, [kimhwang@cau.ac.kr](mailto:kimhwang@cau.ac.kr)

14  
15 Vithala R. Rao

16 Samuel Curtis Johnson Graduate School of Management, Cornell University

17 351 Sage Hall, Ithaca, NY 14853-6201, U.S.A.

18 +1 607 255 3987, [vithalarao@cornell.edu](mailto:vithalarao@cornell.edu)

19  
20  
21 <sup>1</sup> Both authors contributed equally to this manuscript.

26 **How sales promotion influences consumers' physical exercise and**  
27 **purchase behaviors: Evidence from mobile exercise app data**

28

29 **Abstract**

30 **Purpose** – Firms can benefit from designing sales promotions based on the analysis of  
31 consumers' physical exercise and purchase data. This study aims to study mobile exercise app  
32 data to explore how purchasing a promoted or nonpromoted product affects exercisers'  
33 subsequent exercise and purchase behaviors.

34 **Design/methodology/approach** – Drawing from the theoretical framework of  
35 overjustification effect, this study empirically examines the effects of the purchase of  
36 promoted – monetary and nonmonetary – or nonpromoted products on relationships (1)  
37 between past and subsequent exercise behaviors and (2) between past exercise and  
38 subsequent purchase behaviors. Novel data of one million exercise activities and purchase  
39 transactions created by 7,517 mobile exercise app users were collected.

40 **Findings** – The results reveal that monetary and nonmonetary promotions have a negative  
41 effect on overall consumers' amount of physical exercise but increase heavy exercisers'  
42 exercise amount. In addition, nonmonetary (monetary) promotion has a positive (negative)  
43 effect on consumers' purchase expenditure but has no moderating effect on the exercise-  
44 expenditure relationship.

45 **Originality/value** – This study provides a theoretical framework explaining how to mitigate  
46 the dark side of sales promotions while targeting right exercise consumer segments with the  
47 right promotion campaigns.

48 **Keywords** – Mobile exercise app, Sales promotion, Overjustification effect, Postpurchase  
49 behavior

50 **Paper type** Research paper

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## 58 **1. Introduction**

59 Although extant research has studied consumers' immediate response to sales promotion  
60 (e.g., brand choice, purchase), studies have paid little attention to consumers' postpurchase  
61 behaviors. Postpurchase behavior refers to the way consumers think, feel, and act after they  
62 have purchased a product. In this research, we focus on consumers' actions to use the  
63 purchased product or purchase new product(s) subsequently after the previous purchase.  
64 There are two streams of work on consumers' postpurchase behavior. The first stream of  
65 research suggests that promotional tactics (e.g., coupons, displays, and features) lead to  
66 outcomes positively in the short run (e.g., immediate purchases) but negatively in the long  
67 run, in terms of subsequent and aggregate purchases (e.g., Ailawadi et al., 2007; Dodson et  
68 al., 1978; Guadagni and Little, 1983). The second stream of research emphasizes that sales  
69 promotion is not effective if it offers little value or varies depending on the type of promotion  
70 (e.g., monetary vs. nonmonetary) (Nunes and Park 2003; Simonson et al., 1994). However,  
71 empirical evidence is lacking on how the purchase of promoted product affects consumers'  
72 subsequent nonpurchase behavior (e.g., product consumption or purchased product-related  
73 activities) that may also influence subsequent product purchases.

74 The emergence of mobile health and exercise apps enables sporting goods firms to  
75 track consumers' physical exercise and purchase behaviors longitudinally. Over 325,000  
76 mobile health apps were available in Google Play store, which equates to an expected 3.7  
77 billion app downloads (Research2Guidance, 2017). The number of US smartphone users  
78 using health and fitness apps is expected to increase by 27.2% in 2020, from 68.7 million in  
79 2019 to 87.4 million (Phaneuf, 2020). Such booming popularity of exercise apps has  
80 motivated sports brands to use consumers' exercise data to strengthen customer relationship  
81 management. For example, the UA Shop, a mobile shopping app, launched by Under Armour  
82 leverages exercise data generated by 170 million users of four fitness apps to provide in-app

83 product recommendations. Although recent studies have explored mobile exercise apps usage  
84 (Li and Chang, 2021; Whelan and Clohessy, 2021; Yin et al., 2022), no evidence has  
85 answered a question of whether sales promotion affects consumers' physical exercise and  
86 purchase behaviors positively or negatively.

87         Regarding consumers' postpurchase behavior, prior studies have focused primarily on  
88 the conflicting effects of sales promotion on the outcomes (more engaged vs. less engaged) of  
89 consuming the purchased products. Some scholars argue that price promotions can elevate  
90 consumers' moods, and positive moods influence subsequent related and unrelated evaluation  
91 judgments (Cohen et al., 2008) and allow consumers to enjoy consuming the purchased  
92 product more (Knutson et al., 2007). Other scholars argue that price promotions may reduce  
93 consumers' attention during consumption (Wathieu and Bertini, 2007), and the purchase of  
94 discounted products may motivate consumers less to pay attention to the details in an  
95 affective experience (Lee and Tsai, 2014). However, there is little evidence for the effects of  
96 sales promotion on other postpurchase behavior, specifically, exercise behavior in our study.

97         This study fills these gaps in the literature by empirically demonstrating (1) the direct  
98 effects of sales promotion on consumers' postpurchase physical exercise and purchase  
99 behaviors and (2) the moderating roles of past exercise behavior in two relationships:  
100 promotion-exercise and promotion-purchase. The theoretical basis for our work emanates  
101 from the findings from research in social psychology on the overjustification effect (Lepper et  
102 al., 1973); which establishes that extrinsic rewards undermine intrinsic motivation. The  
103 overjustification effect has been established in educational (e.g., Akin-Little and Little, 2004)  
104 and organizational (e.g., Hewett and Conway, 2016) settings and recently in the field of  
105 marketing (e.g., Dholakia, 2006; Kivetz, 2005). This theory suggests that consumers' act of  
106 purchasing promoted products may inadvertently undermine their intrinsic motivation for  
107 exercise or self-determination (i.e., perception of control over their actions) (Dholakia, 2006).

108 In this study, exercise behavior belongs to intrinsic motivation because it occurs in the  
109 absence of an extrinsic reward or benefit (Feingold and Mahoney, 1975). We hypothesize the  
110 differential effects of sales promotion on exercise and purchase actions of heterogeneous  
111 consumers in terms of past exercise amount (e.g., light vs. heavy exercisers).

112 Our research advances marketing and exercise app research in a number of ways.  
113 First, we provide empirical evidence of the dual effects of sales promotion on subsequent  
114 exercise behavior. Specifically, we find that while, overall, consumers' purchase actions of  
115 promoted products decrease their proclivity for subsequent exercise, heavy exercisers are  
116 more motivated to increase their subsequent exercise after purchasing promoted products.  
117 This finding extends the heterogeneity of the overjustification effect (Lepper et al., 1996) by  
118 empirically showing that intrinsic motivation (i.e., exercise) can be strengthened or weakened  
119 by extrinsic rewards and the surrounding situational factors. Second, we identify the  
120 differential effects of sales promotion on subsequent purchase behavior—a positive effect for  
121 consumers who engage in purchasing nonmonetarily promoted products but no effect for  
122 heavy exercisers. This finding shows that heavy exercisers, whose goals are exercise itself  
123 rather than purchasing exercise products, are likely to increase their spending on exercise  
124 products regardless of promotional benefits, which extends the literature on goal-directed  
125 behavior (Higgins et al., 2003; Mannetti et al., 2012). Finally, while previous exercise app  
126 research has largely focused on the usage of the exercise app itself (Li and Chang, 2021;  
127 Whelan and Clohessy, 2021), this study extends our knowledge on the value of exercise apps  
128 by showing the interrelationship among sales promotions, physical exercises, and product  
129 purchases.

130

## 131 **2. Literature review**

### 132 *2.1 Sales promotion and postpurchase behavior*

133 Marketers design short-term sales promotion incentives to stimulate consumers to purchase  
134 products or services within the duration of the promotions. Studies have mostly identified two  
135 types of incentives—monetary (e.g., discount) and nonmonetary (e.g., free gift)—that  
136 influence purchase behaviors (Ramanathan and Dhar, 2010), brand choice (Chandon et al.,  
137 2000), and brand loyalty (Papatla and Krishnamurthi, 1996). Some studies on monetary  
138 promotions have identified mixed effect of coupons on choice (i.e., positive in the short run  
139 but negative in the long run) (Dodson et al., 1978) or the positive effect of reframing  
140 discounts on purchase intentions (Guha et al., 2018). Other studies have demonstrated that  
141 while price promotions encourage purchase amount in a short-term or are more effective for  
142 utilitarian than hedonic products, non-price promotions (e.g., free sample coupons) increase  
143 the longer-term purchase propensity (Eisenbeiss et al., 2015; Park et al., 2018). However,  
144 these studies focus on the immediate response to sales promotion—monetary and  
145 nonmonetary—without investigating consumers’ subsequent behaviors.

146         Along with the studies on the immediate response to sales promotions, some studies  
147 have examined that the effect of sales promotion on subsequent product purchase; this effect  
148 is found to be negative (Guadagni and Little, 1983) or positive (Ailawadi et al., 2007), or  
149 depends on the type of promotion; the effect is found to be negative with coupons but  
150 positive with display and feature promotions (Papatla and Krishnamurthi, 1996). Because  
151 these studies rely on scanner panel or experimental data, they can track purchase-related  
152 activities after sales promotion is offered but cannot observe consumers’ product  
153 consumption or product-related activities over long periods. Although the existing literature  
154 demonstrates the positive or negative effect of sales promotion on repeat or subsequent  
155 purchases, there is little empirical evidence on how sales promotion affects buyers’  
156 consumption or usage behavior toward the purchased product.

157         When individuals purchase an exercise product using a mobile app, two subsequent

158 behaviors—exercise intensity and purchase of related exercise product(s)—can be observed  
159 through the app. The incorporation of two related but distinct behaviors differs from the  
160 incorporation of simply repeat purchases (Ailawadi et al., 2007). The main proposition in this  
161 study is that sales promotion influences two types of exercisers’ postpurchase behavior (Lee  
162 and Tsai, 2014). Table 1 illustrates how this study differs from extant work in the literatures  
163 on sales promotion and postpurchase behavior.

164 [Insert Table 1 about here]

165 Given that the longer-term effects of sales promotions differ across consumer  
166 characteristics (Lim et al., 2005), we use the level of consumers’ past exercise engagement  
167 (e.g., calories burned) as a moderator in the relationship between sales promotion and  
168 subsequent exercise and purchase behaviors. Managerially, we classify exercisers into two  
169 segments (heavy vs. light) in terms of past exercise engagement. Our conceptual framework  
170 considers two aspects: after purchasing a promoted or nonpromoted exercise product, (1)  
171 exercisers decide both postpurchase exercise amount and exercise product purchases, and (2)  
172 exercisers’ postpurchase exercise and purchase behaviors vary across both the act of buying  
173 [non]promotional product and the level of past exercise amount. Figure 1 illustrates our  
174 conceptual model and the related hypotheses that are explained in the following sections.

175 [Insert Figure 1 about here]

176

## 177 *2.2 Roles of sales promotion in exercise decision*

178 People often progress through five distinct stages of exercise behavior: precontemplation,  
179 contemplation, preparation, action, and maintenance (Prochaska and DiClemente, 1983). For  
180 example, people who have never jogged (precontemplation stage) first intend to start jogging  
181 in the near future (contemplation stage), then may purchase running shoes and clothes  
182 (preparation stage), then may start jogging (action stage), and, finally, may even continue



183 jogging in the future (maintenance stage). Like Nike and Adidas, sports brands often promote  
184 their products, through monetary and nonmonetary incentives, to persuade consumers less  
185 interested in exercise to become more exercise-minded through the preparation and action  
186 stages. Then, the question is: can sales promotions drive consumers to purchase the promoted  
187 products and increase the exercise amount in the future? Notably, sales promotions often  
188 focus on short-term effectiveness, such as persuading potential customers to impulsively buy  
189 a specific brand or product (Chandon et al., 2000). Prior research has failed to consider how  
190 the purchase of promotional or nonpromotional products affects consumers' change in  
191 subsequent exercise behavior.

192         According to the overjustification effect (Lepper, 1983; Lepper et al., 1973), if an  
193 individual engages in an activity without extrinsic rewards, the introduction of rewards for  
194 engaging in that activity may make him or her less interested in the activity in the absence of  
195 these rewards. Prior research has demonstrated that rewards or benefits that are contingent on  
196 activity tend to lead to greater overjustification effects than noncontingent rewards or benefits  
197 (Ryan et al., 1983). This study focuses on the potential influence of promotional benefits on  
198 the benefit receiver's exercise behavior. The overjustification setting involves two actors (the  
199 benefit giver and the experienced benefit receiver) and two activities (the behavior a benefit  
200 encourages and the benefit itself). In the domain of exercise, when marketers (the benefit  
201 giver) offer a sales promotion for an exercise product (the benefit), some consumers will  
202 purchase the promoted product immediately (the benefit receiver), and others will purchase  
203 other nonpromoted products in another period (the nonbenefit receiver). After purchasing the  
204 promoted or nonpromoted product, some benefit receivers will increase exercise, and others  
205 will decrease it (the behavior). As such, we use exercise as an activity and the purchase of  
206 promotional product(s) as an extrinsic reward, likely to lead to an overjustification effect.

207         Conversely, the overjustification effect can be mitigated for intrinsically motivated

208 consumers (Fazio, 1981) or self-determined consumers (Dholakia, 2006) if rewards are  
209 designed to support consumers' intrinsic interests. Numerous studies have found that self-  
210 determination is linked to patients' regular attendance to weight-loss program (Williams et  
211 al., 1996), smoking cessation (Curry et al., 1991), and continuous pro-environmental  
212 behaviors (Pelletier et al., 1998). As self-determined choices (e.g., regular jogging) are  
213 accompanied by greater motivation, effort, and engagement over long periods (Ryan and  
214 Deci, 2002), we regard intrinsically motivated people as heavy exercisers who have a strong  
215 interest in the exercise itself and conduct exercise regularly for a long time.

216 As the overjustification effect suggests, consumers who purchase the promoted  
217 product will eventually come to interpret their exercise behavior in extrinsic terms, possibly  
218 by viewing the exercise as a means to an end rather than an end in itself (Kruglanski, 1975).  
219 Because promotional benefits often decrease the perceived price paid, we assume that  
220 promotional benefits may reduce consumer attention during consumption and, thus, decrease  
221 consumption enjoyment of the promoted product (Lee and Tsai, 2014; Wathieu and Marco,  
222 2007). Conversely, exercisers who have purchased a nonpromoted product may increase their  
223 exercise amount because, as a means to exercise, the new product will facilitate the exercise  
224 environment (e.g., a new pair of shoes makes exercisers jog more frequently and farther).  
225 Hence, we suggest the following hypothesis:

226  
227 ***H1:*** (a) The purchase of promoted exercise product(s) will decrease postpurchase exercise  
228 while (b) the purchase of nonpromoted exercise product(s) will increase postpurchase  
229 exercise.

230

231 Although the overjustification effect is the central theory in the benefit–activity  
232 relationship, the assumption is that consumers' interest in doing an activity is not determined

233 solely by the activity itself but by situational factors surrounding the activity engagement  
234 (Higgins et al., 2010). It is possible that a decrease in intrinsic interest in the exercise activity  
235 will occur only insofar as the person's initial interest is not salient to him or her (Fazio,  
236 1981). Similarly, if extrinsic rewards are designed to support individuals' intrinsic interests  
237 (e.g., by targeting coupons and discounts on an exercise product to heavy exercisers), they are  
238 likely to enhance intrinsically motivated people' motivation (Eisenberger and Cameron,  
239 1996). That is, an increase in the salience of initial or intrinsic interests undermines the  
240 overjustification effect (Fazio, 1981). As heavy exercisers tend to have a greater interest in  
241 the exercise activity, the overjustification effect will be mitigated when they purchase a  
242 promoted product that supports the intrinsic interest.

243         Other studies have corroborated this conflicting prediction that extrinsic rewards will  
244 not diminish intrinsic motivation unless the receiver finds the rewards an unnecessary  
245 extrinsic reinforcement (Crano and Sivacek, 1984). That is, if the receiver does not have any  
246 information on the negative aspect of purchasing promoted products, his or her attitude  
247 toward intrinsic motivation to exercise will not change. Because heavy exercisers may regard  
248 the related exercise products as necessary goods, the act of purchasing the promoted product  
249 will reinforce their exercise activities. Therefore, we hypothesize the following:

250

251 **H2:** The effect of purchasing promoted product(s) on postpurchase exercise will be  
252 moderated by the level of past exercise amount; heavy exercisers who purchase promoted  
253 product(s) will increase postpurchase exercise.

254

### 255 *2.3 Roles of sales promotion in exercisers' purchase decision*

256 The effectiveness of sales promotion is determined not only by the benefit of a sales  
257 promotion but also by the congruence of the benefit with consumers (Chandon et al., 2000;

258 Kivetz and Zheng, 2017). In the exercise context, consumers who have exercised in a specific  
259 area (e.g., bicycling, climbing) for long periods are likely to have rich knowledge about the  
260 exercise process, product technologies, and detailed attribute information on multiple  
261 products. Although promotional purchases, especially with little value, may decrease repeat  
262 purchases (Simonson et al., 1994), prior purchases made on sales promotions can increase  
263 consumption of the purchased products and subsequent purchases (Ailawadi et al., 2007;  
264 Papatla and Krishnamurthi, 1996). In exerciser settings, the act of buying an exercise product  
265 is regarded as a goal-directed behavior because the product purchase is influenced by a  
266 exerciser's intention to act (e.g., start or maintain exercise), which is predicted by a desire for  
267 the act (Bagozzi et al., 2003). As exercisers tend to maintain goal-directed progress toward a  
268 specific exercise (Kruglanski et al., 2000), they are likely to regard their buying promoted  
269 products as value-added due to monetary gains and exercise facilitators.

270         In support of this argument, in exercise and shopping situations, market mavens who  
271 buy more promoted products than nonmavens tend to engage in smart buying (Slama et al.,  
272 1992) because they keep track of contemporary sales promotions, due to their need for smart  
273 decision making. Thus, we posit that market mavens are likely to seek out various sales  
274 promotions and their benefits (i.e., monetary and nonmonetary) to a point that they purchase  
275 promoted exercise products rather than nonpromoted products. Hence, we hypothesize the  
276 following:

277

278 **H3:** Exercisers' purchase of promoted product(s) will increase subsequent purchase  
279 expenditure for exercise products.

280

281         Although heavy exercisers view the purchase of promoted products as positive rather  
282 than negative (Crano and Sivacek, 1984), they are likely to focus more on the exercise itself

283 than the promotional benefit (Higgins et al., 2003; Mannetti et al., 2012). As light exercisers  
284 are more extrinsically motivated to exercise, they will initially purchase the promoted product  
285 on impulse, which can lead to greater subsequent purchases (Chandran and Morwitz, 2005;  
286 Dhar et al., 2007). Therefore, we assume that light exercisers tend to engage in impulse  
287 buying induced by monetary and nonmonetary promotions, which will further drive the  
288 subsequent purchases. Conversely, as heavy exercisers are more intrinsically motivated to  
289 exercise, their purchase decisions on promoted exercise products can be regarded as a type of  
290 goal-directed behavior because they may think these products as necessary goods. Because  
291 heavy exercisers are likely to have a high self-control (Gillebaart et al., 2016), they may  
292 purchase promoted or nonpromoted products when they need them. Therefore, sales  
293 promotion may not encourage heavy exercisers to continue purchasing additional products.  
294 Thus, we predict:

295  
296 **H4:** The effect of purchasing promoted product(s) on postpurchase exercise will be  
297 moderated by the level of past exercise engagement; light exercisers who purchase promoted  
298 product(s) will increase subsequent purchase expenditure while heavy exercisers who  
299 purchase promoted product(s) will not increase subsequent purchase expenditure.

300  
301 In our study, we incorporate three control variables (i.e., demographics and  
302 seasonality) that may affect exercise and purchase behavior. Specifically, age is included as a  
303 critical demographic factor because younger consumers are likely to prefer the usefulness of  
304 the exercise app-tracking technology (Venkatesh et al., 2003) and physical activity may  
305 decrease with age (Hallal et al., 2012). In addition, as people tend to exercise more in  
306 particular seasons such as summer and fall (Kim et al., 2018), we capture such seasonality  
307 effects of specific month and year in the study.

308

### 309 **3. Data**

#### 310 *3.1 Data collection*

311 To test our hypotheses, we collected rich data for exercise and purchase behavior with  
312 support from a leading mobile exercise app operator in South Korea. The exercise app tracks  
313 and records the details of users' exercise activity, such as type (e.g., jogging, bicycling), time,  
314 location, distance, burned calories, exercise duration, speed, and altitude. This exercise app  
315 ran in-app (now defunct) marketplace in which manufacturers sold exercise products to app  
316 users. Such in-app commerce functionality enabled us to track app users' purchase  
317 transactions in addition to exercise activities. We found that manufacturers decided the type  
318 of a sales promotion for a specific product, and the specific promotion was offered to all app  
319 users. To analyze the consumers' exercise and purchase journey, we extracted a complete set  
320 of exercise and purchase data of 7,517 app users who purchased exercise products at least  
321 once within three years (January 2013-December 2015) in the marketplace.

322

#### 323 *3.2 Data description*

324 The final dataset consists of two subsets. The first contains five types of exercise activities  
325 such as hiking, walking, bicycling, jogging, and rollerblading. The most popular exercise is  
326 hiking and the second is walking, followed by bicycling. In this sample, 98% of exercise app  
327 users (7,363 of 7,517) engaged in hiking and burned approximately 4,000 calories, on  
328 average, by hiking roughly 19 kilometers per month. In addition, 70% of app users  
329 participated in walking and burned 444 calories, on average, by walking 8.8 kilometers per  
330 month. Finally, 52% of the app users engaged in bicycling and burned 514 calories by biking  
331 23 kilometers per month. Jogging and rollerblading activities were not popular in this sample.

332 The second subset contains the historical data of sales promotions and purchases.

333 Regarding the aggregate-level purchase frequency, 7,305 app users (97.18%) made purchases  
334 1 to 10 times during the three-year period, 189 users (2.51%) 11 to 20 times, 19 users  
335 (0.25%) 21 to 30 times, and 4 users more than 30 times. We classified the type of sales  
336 promotion by first identifying the detailed promotional tag information attached to each  
337 promoted product name (e.g., [free shipping] AAA T-shirts).

338 To measure the type of sales promotion, we first grouped the purchased products into  
339 six categories—free shipping, discount, limited offering, merchandiser recommendation,  
340 special product introduction, and no promotion. Next, we classified six categories into three  
341 categories: (1) MONETARY (free shipping, discount), (2) NONMONETARY (limited  
342 offering, merchandiser recommendation, special product introduction) and (3) NONE. In the  
343 sample, exercise app users purchased promoted (43.8%)—monetary (9.9%) and nonmonetary  
344 (33.9%)—and nonpromoted (56.2%) products. The endogeneity of promotional campaigns  
345 may be a concern, such as when a firm plans and implements its promotional campaigns  
346 using endogenous customer information (Manchanda et al., 2004).

347 Finally, we found that the prices of purchased products ranged from \$1 to \$1,433,  
348 with a mean value of \$78, median value of \$54, and standard deviation of \$84. The  
349 distribution of product prices was positively skewed (skewness: 4.83); purchased products  
350 with prices over \$400, \$300, and \$200 represented 1.15%, 2.07%, and 5.62%, respectively.  
351 Most products were outdoor apparel and accessories useful for different types of exercise. For  
352 example, exercise app users might use outdoor shoes for hiking or walking and t-shirts for  
353 bicycling or jogging.

354

### 355 *3.3 Model-free analysis*

356 Before estimating main models, we conduct a preliminary tabulation analysis to provide  
357 initial evidence of multiple relationships among sales promotions, exercise activities, and

358 purchases. Specifically, we divide consumers in the sample into three equal groups based on  
 359 33% and 66% quantiles of the number of exercise hours: light, medium, and heavy. Then, we  
 360 compare the purchase patterns of each group given the type of purchased product (i.e.,  
 361 nonpromoted vs. promoted). As Table 2 shows, the number of consumers who purchased  
 362 nonpromoted products was bigger than promoted products regardless of the level of exercise  
 363 activities, but light exercisers (71%) purchased promoted products more frequently than  
 364 heavy exercisers (16%). These results imply the different effectiveness of sales promotion  
 365 across exerciser segments; sales promotions tend to be more influential to light exercisers’  
 366 purchase decisions than heavy exercisers. That is, marketers can implement promotion  
 367 campaigns differently depending on consumers’ exercise behavior. Furthermore, the results  
 368 indicate the necessity of building an integrated model that consists of consumers’ exercise  
 369 and purchase behaviors.

370 [Insert Table 2 about here]

371

## 372 **4. Estimation method**

### 373 *4.1 Operationalization of variables*

374 We begin with a definition of the variables for exercise and purchase models. As the proxy  
 375 measure for the level of consumer exercise amount, we use burned calories ( $CALORIE_{it}$ ),  
 376 which refers to the number of calories that consumer  $i$  burns by exercising in month  $t$ . To  
 377 treat the skewedness of three variables, we use logarithmic transformation of the variables.  
 378 Furthermore, to measure the level of consumers’ exercise engagement in the past, we define  
 379 the variable of cumulative exercise amount as follows:

380

$$CALORIE\_CUM_{it} = (1 - \rho_1) \times CALORIE_{it} + \rho_1 \times CALORIE\_CUM_{it-1} \quad (1)$$

where  $0 < \rho < 1$ .





406 influences their postpurchase exercise behavior and also how the relationship is moderated by  
 407 the past exercise amount. We find that exercise amount ( $CALORIE_{it}$ ) is either 0 (a consumer  
 408 did not exercise in month  $t$ ) or positive (a consumer exercised in month  $t$ ). To treat this  
 409 bimodal property of the exercise variable, we develop a Type I Tobit model (Tobin, 1958).  
 410 For  $CALORIE_{it}$ , we define a latent variable,  $U_{it}$  as follows:

$$411 \quad CALORIE_{it} = 0 \text{ if } U_{it} < 0, \text{ and } CALORIE_{it} = U_{it} \text{ if } U_{it} > 0. \quad (2)$$

412  
 413 We hypothesize that consumer  $i$ 's exercise amount in month  $t$  will be affected by (1)  
 414 the purchase of promoted or nonpromoted exercise product(s) in month  $t - 1$  (i.e.,  
 415  $MONETARY_{it-1}$ ,  $NONMONETARY_{it-1}$ , and  $NONE_{it-1}$ ) and (2) its interactions with a  
 416 situational factor of consumer  $i$ 's past exercise amount,  $CALORIE\_CUM_{it-1}$ . Accordingly, we  
 417 specify the latent variable,  $U_{it}^{CALORIE}$ , as follows:

$$418 \quad U_{it} = \beta_0 + \beta_1 CALORIE\_CUM_{it-1} + \beta_2 MONETARY_{it-1} \\
 + \beta_3 NONMONETARY_{it-1} + \beta_4 NONE_{it-1} \\
 + \beta_5 MONETARY_{it-1} \times CALORIE\_CUM_{it-1} \\
 + \beta_6 NONMONETARY_{it-1} \times CALORIE\_CUM_{it-1} \\
 + \beta_7 NONE_{it-1} \times CALORIE\_CUM_{it-1} \\
 + \beta_8 AGE_{it} + \beta_9 MONTH_{it} + \beta_{10} YEAR_{it} + \xi_i + \eta_{it} \\
 + \delta_1 IMR_1 + \delta_2 IMR_2 + \delta_3 IMR_3, \quad (3)$$

419 where  $\xi_i \sim N(0, \sigma_\xi^2)$  and  $\eta_{it} \sim N(0, \sigma_\eta^2)$ .

420  
 421 Although we include the control variables such as age ( $AGE_{it}$ ), month ( $MONTH_{it}$ ),  
 422 and year ( $YEAR_{it}$ ) in the model, some events or occasions might be happening in local  
 423 communities that affect consumers' exercise and purchase decisions. IMR refers to inverse

424 Mills ratio (IMR) that mitigates selection bias (Heckman, 1979), which will be discussed in  
 425 the next section. In addition, our model captures observed individual heterogeneity by  
 426 introducing a random effect term that varies across consumers ( $\xi_i$ ).

427

### 428 *4.3. Selection bias*

429 Noting the possible endogeneity of consumers' choices of promoted products is important.

430 For example, some consumers may tend to purchase products with promotions, while others

431 may not care about promotions. In such cases, whether their purchases of (non)promoted

432 products affect their exercise behaviors may not be attributable to the overjustification effect,

433 as our hypothesis describes, but because of their purchase tendencies or occasions. Also, on a

434 particular day when more promoted products are available, some consumers may likely

435 choose promoted products when others choose promoted products—others influence

436 consumer choices.

437 In this regard, the promotion-related variables,  $\text{MONETARY}_{it-1}$ ,

438  $\text{NONMONETARY}_{it-1}$ , and  $\text{NONE}_{it-1}$  in Equation (3) may suffer from a self-selection-based

439 endogeneity bias. To control for any potential bias from endogeneity due to the self-selection,

440 we introduce IMR, widely used in the management literature (Hamilton and Nickerson,

441 2003). For instance, for the variable of purchasing monetarily promoted product,

442  $\text{MONETARY}_{it-1}$ , we define  $\text{IMR}_1$  in Equation (4) as follows:

443

$$\begin{aligned} \text{IMR}_1 = & I(\text{MONETARY}_{it-1} > 0) \left( \frac{\phi(Z_{it-1}\alpha_1^S + \omega_i)}{1 - \Phi(Z_{it-1}\alpha_1^S + \omega_i)} \right) \\ & + I(\text{MONETARY}_{it-1} = 0) \left( \frac{-\phi(Z_{it-1}\alpha_1^S + \omega_i)}{\Phi(Z_{it-1}\alpha_1^S + \omega_i)} \right) \end{aligned} \quad (4)$$

444 where  $\phi$  and  $\Phi$  are the density and cumulative probability functions, respectively,

445 and  $I(\cdot)$  is an indicator function.

446 We incorporate  $Z_{it-1} = [1, \text{NUM\_MONETARY}_{t-1} \cdot \text{AGE}_{it-1}]$  in the IMR functions,  
447 where  $\text{NUM\_MONETARY}_{t-1}$  indicates the number of other consumers who have made  
448 purchases with monetary promotion. The rationale for this incorporation is that as more  
449 consumers purchased promoted products, consumer  $i$  is also likely to buy promoted products,  
450 possibly due to the social effect ( $\text{NUM\_MONETARY}_{t-1}$ ).<sup>1</sup> Specifically, peer influence may  
451 happen through learning from other users who have purchased monetarily promoted products  
452 (Iyengar et al., 2015; Toker-Yildiz et al., 2017; Trusov et al., 2010)<sup>2</sup>. In addition, if more  
453 promoted products are offered by retailers in a given day, consumers would be likely to have  
454 more opportunities to purchase the promoted products. Finally, the IMR functions incorporate  
455 individual-specific effects, such as age ( $\text{AGE}_{it}$ ) and unobserved heterogeneity ( $\omega_i \sim N(0, \sigma_\omega^2)$ ),  
456 which may control for individual differences in the tendency of purchasing (non)promoted  
457 products. Similarly, we create  $\text{IMR}_2$  and  $\text{IMR}_3$  for the purchase of nonmonetarily promoted  
458 product ( $\text{NONMONETARY}_{it-1}$ ) and the purchase of nonpromoted product ( $\text{NONE}_{it-1}$ ),  
459 respectively. Thus, IMR ( $\text{IMR}_1, \text{IMR}_2, \text{IMR}_3$ ) plays a role in correcting any selection bias<sup>3</sup>.

460

#### 461 *4.4 Purchase model*

462 For the purchase model, we develop a model of purchase (Neslin et al., 1985; Ramanathan  
463 and Dhar, 2010) by analyzing whether the purchase of [non]promoted product(s) affects  
464 subsequent purchase expenditure for exercise product(s) and how the relationship is

---

<sup>1</sup> Our dataset does not support how many products were offered with monetary and nonmonetary promotions or without any promotions. We can observe only purchases made by consumers, not products available to them. In this regard, our dataset does not allow us to disentangle the effect of promoted product availability and the network effect.

<sup>2</sup> The exercise and shopping apps run an online review board where users can leave comments on their shopping and exercise experiences.

<sup>3</sup> In general, the interpretation of the IMR coefficients,  $[\delta_1, \delta_2, \delta_3]$  in Equation (3) is described as follows: When an IMR coefficient is positive, “positive selection” occurs (without the correction, the estimate of  $[\beta_2, \dots, \beta_7]$  would be upward-biased); when it is negative, “negative selection” occurs (without the correction, the estimate of  $[\beta_2, \dots, \beta_7]$  would be downward-biased). If the IMR coefficient is not significant, there may not be a strong selection bias for the  $\text{NONMONETARY\_CUM}_{it-2}$  and  $\text{NUM\_MONETARY}_{t-2}$  variables.

465 moderated by the level of exercise engagement. Here,  $\text{EXPENDITURE}_{it}$  represents how  
 466 much money (\$) consumer  $i$  spent in month  $t$  given a conversion. Similar to Equation (3), we  
 467 develop a linear regression model for  $\ln(\text{EXPENDITURE}_{it})$ . We incorporate sales promotion  
 468 (whether consumer  $i$  has purchased promoted products in month  $t$ ), cumulative exercise  
 469 amount in the past, and the interaction between them. In addition, the model includes the  
 470 control variables of age ( $\text{AGE}_{it}$ ), month fixed effects ( $\text{MONTH}_t$ ), and year fixed effects  
 471 ( $\text{YEAR}_{it}$ ), as follows:

$$\begin{aligned}
 \ln(\text{EXPENDITURE}_{it}) = & \gamma_0 + \gamma_1 \text{CALORIE\_CUM}_{it-1} \\
 & + \gamma_2 \text{MONETARY}_{it-1} + \gamma_3 \text{NONMONETARY}_{it-1} \\
 & + \gamma_4 \text{MONETARY}_{it-1} \times \text{CALORIE\_CUM}_{it-1} \\
 & + \gamma_5 \text{NONMONETARY}_{it-1} \times \text{CALORIE\_CUM}_{it-1} \\
 & + \gamma_6 \text{AGE}_{it} + \gamma_7 \text{MONTH}_t + \gamma_8 \text{YEAR}_t + \psi_i + \varepsilon_{it} \\
 & + \theta_1 \text{IMR}_1 + \theta_2 \text{IMR}_2
 \end{aligned} \tag{5}$$

473  
 474 where  $\psi_i \sim N(0, \sigma_\psi^2)$  and  $\varepsilon_{it} \sim N(0, \sigma_\varepsilon^2)$ . Finally, we include  $\text{IMR}_1$  and  $\text{IMR}_2$  to treat the  
 475 endogenous selection bias as the same manner as described in Section 4.3.

476

#### 477 4.5. Endogeneity due to the random effects

478 Recall that our models in Sections 4.2. and 4.4. incorporate random effects to capture  
 479 unobserved heterogeneity across consumers. The assumption of such a random effect model  
 480 is that the unobserved heterogeneity should not correlate with observed covariates. In  
 481 Equations (3) and (5), unobserved heterogeneity is captured by  $\xi_i \sim N(0, \sigma_\xi^2)$  and  
 482  $\psi_i \sim N(0, \sigma_\psi^2)$ , respectively. If these terms correlate with covariates for purchases  
 483 ( $\text{MONETARY}_{it-1}$ ,  $\text{NONMONETARY}_{it-1}$ , and  $\text{NONE}_{it-1}$  in Equation (3)) and  
 484 ( $\text{MONETARY}_{it-1}$  and  $\text{NONMONETARY}_{it-1}$  in Equation (5)), endogeneity may arise, known

485 in econometrics as the random effects assumption (Wooldridge, 2013).

486 To test such potential endogeneity, we perform the Hausman (1978) test to compare  
487 an estimator assumed to be consistent (e.g., fixed effect) with an efficient estimator (e.g.,  
488 random effect). Specifically,  $\beta_{\text{Random}}$  is a set of estimates with the random effect, and  
489  $\beta_{\text{Fixed}}$  is a set of estimates with the fixed effect. A statistical test H is as follows:

490

$$H = (\beta_{\text{Random}} - \beta_{\text{Fixed}})' [V(\beta_{\text{Random}}) - V(\beta_{\text{Fixed}})]^{-1} (\beta_{\text{Random}} - \beta_{\text{Fixed}}). \quad (6)$$

491

492 The test statistics asymptotically follow the chi-squared distribution with the number  
493 of degrees of freedom equal to the rank of matrix  $V(\beta_{\text{Random}}) - V(\beta_{\text{Fixed}})$ . Our Hausman  
494 test results show that the null hypothesis cannot be rejected; H for the exercise model = 9.20  
495 < 11.07, and H for the purchase model = 1.848 < 12.59. These results imply that estimates  
496  $\beta_{\text{Random}}$  and  $\beta_{\text{Fixed}}$  are both consistent, and therefore, the random effect is unrelated to  
497 covariates and dependent variables.

498

## 499 **5. Results**

### 500 *5.1 Analysis of exercise models*

501 The results of Model 1 show that the effect of purchasing monetarily or nonmonetarily  
502 promoted products on postpurchase exercise amount in terms of burned calories is negative  
503 and significant (Model 1:  $\beta_2 = -1.475$ ,  $\beta_3 = -1.631$ ;  $p < .05$ ). The negative effect of sales  
504 promotion, either monetary or nonmonetary, on exercise may explain that the  
505 overjustification effect occurs for exercisers who are encountered by utilitarian benefits  
506 offered by monetary or nonmonetary benefits. This result can be explained by the benefit  
507 congruency framework of sales promotions (Chandon et al., 2000). On the contrary, the effect  
508 of purchasing nonpromoted products is positive and significant (NONE:  $\beta_4 = 0.902$ ;  $p < .05$ ).

509 Thus, while consumers' actions of purchasing promoted products tend to decrease their  
510 subsequent exercise (i.e., burned calories), their actions of purchasing nonpromoted products  
511 increase their exercise. These results provide support for both H1a and H1b.

512 [Insert Table 4 about here]

513 Furthermore, H2 predicts that heavy exercisers who purchase promoted products will  
514 increase their postpurchase exercise amount. Consistent with this prediction, the interaction  
515 terms of promoted product purchases (MONETARY or NONMONETARY)  $\times$  cumulative  
516 exercise amount (EXERCISE\_CUM) are positive and statistically significant in the exercise  
517 model (Model 1:  $\beta_5 = 0.092$ ,  $\beta_6 = 0.136$ ;  $p < .05$ ). These results support H2.

518 To accurately investigate the interaction effects, Figure 2 visually illustrates  
519 interaction effects between type of purchased products (monetary, nonmonetary,  
520 nonpromoted) and consumers' past exercise behavior. In our sample, the weighted average  
521 from the logarithm of cumulative exercise amount in terms of burned calories lies between 0  
522 and 13 (maximum 12.21). Given this range, we compute the effects of type of purchased  
523 products combined with the moderation of cumulative exercise amount: monetary  
524 ( $\beta_2 + \beta_5 \text{CALORIE\_CUM}_{it-1}$ ), nonmonetary ( $\beta_3 + \beta_6 \text{CALORIE\_CUM}_{it-1}$ ), and  
525 nonpromoted ( $\beta_4 + \beta_7 \text{CALORIE\_CUM}_{it-1}$ ). Interestingly, Figure 2 shows consistent patterns  
526 between monetary and nonmonetary promotions. After purchasing monetarily or  
527 nonmonetarily promoted products, heavy exercisers will exercise more than light exercisers.  
528 These results imply the importance of targeting consumers based on past exercise behavior  
529 and types of promotion campaigns.

530 [Insert Figure 2 about here]

531

## 532 *5.2 Analysis of purchase models*

533 The hypothesized effects of purchase actions of promoted or nonpromoted exercise products

534 and past exercise amount on subsequent purchase expenditure were assessed. Table 4 (Model  
535 2) reports the parameter estimates of the purchase model that has the independent variables of  
536 burned calories. We find that while the purchase of monetarily promoted products has a  
537 negative relationship with the consumer spending on exercise products in the subsequent  
538 period ( $\gamma_2 = -0.099$ ;  $p < .1$ ), the purchase of nonmonetary promoted products increases  
539 consumer spending ( $\gamma_3 = 0.238$ ;  $p < .1$ ), partially supporting H3. This result implies that  
540 nonmonetary promotions work better in eliciting consumers' favorable attitude toward  
541 subsequent shopping than monetary promotions (Yi and Yoo, 2011), possibly because  
542 nonmonetary promotions are perceived separately from price information and regarded as  
543 gains (Sinha and Smith, 2000). However, in contrast with the results of the exercise models,  
544 the interaction term between sales promotion and cumulative exercise amount has no  
545 significant effect on purchase expenditure, not in support of H4.

546

## 547 **6. Discussion**

548 Although effectiveness of sales promotion is critical for increasing product sales and firm  
549 value, firms can have the opportunity to improve human life by promoting better health and  
550 well-being outcomes (Moorman, 2018). In this research, we attempt to contribute to the  
551 stream of research on the role of marketing practice in improving both firm profit and  
552 consumer health, in general, and the effect of sales promotion on consumers' physical  
553 exercise and purchase behaviors, in particular. Our findings shed light on suitable exercise  
554 behavior-based promotion strategies for sports brands and mobile exercise apps that use  
555 consumers' exercise data. In this study, we attempt to better understand how sales promotion  
556 affects consumers' postpurchase behaviors—particularly from the understudied perspective  
557 of subsequent exercise and purchase decisions which may vary across consumer segments.  
558 Using rich data of exercise and purchase activities generated by mobile exercise and



559 shopping app users, we identify the double-edged effects of sales promotion in the exercise  
560 and purchase models.

561 We find that the effects of sales promotion on consumers' exercise and purchase  
562 decisions differ across the type of purchased products (promoted vs. nonpromoted) and the  
563 level of exercise engagement (light vs. heavy). From the exercise perspective, our empirical  
564 findings identify that while the purchase of monetarily promoted (nonpromoted) products  
565 decrease (increase) postpurchase exercise amount ("overjustification effect"), heavy  
566 exercisers who purchase promoted products rather increase postpurchase exercise amount  
567 ("mitigated overjustification effect"). From the purchase perspective, we find that consumers  
568 who engage in purchasing nonmonetarily promoted products increase their spending on  
569 exercise products, whereas heavy exercisers' purchase actions of promoted or nonpromoted  
570 products do not predict their spending on exercise products. These findings translate into  
571 several contributions for marketing and exercise app research and practice.

572

### 573 *6.1 Theoretical implications*

574 The present research represents the first effort to empirically demonstrate how the  
575 overjustification effect occurs in the combined setting of sales promotion and exercise  
576 behaviors. Prior studies have shown that people who are rewarded are less likely to engage in  
577 the task again without a reward (Crano and Sivacek, 1984; Lepper et al., 1973). We extend  
578 this notion of the overjustification effect on exerciser settings by exploring the impact of  
579 purchasing promoted and nonpromoted products on subsequent exercise activities. In support  
580 of the literatures on customer self-determination and overjustification effect, we find that in  
581 the exercise context, the purchase of monetarily or nonmonetarily promoted products  
582 attenuates consumers' motivation to increase their exercise amount. By contrast, we show  
583 that consumers who purchase nonpromoted products continue to increase the postpurchase

584 exercise. This finding is in line with the argument that self-determined choices (e.g., the  
585 purchase of nonpromoted products as a result of consumers' own initiative) support intrinsic  
586 interests (e.g., ongoing exercise) more than firm-determined choices (e.g., the purchase of  
587 exercise products as a result of a firm's introductory promotion) (Dholakia, 2006;  
588 Eisenberger and Cameron, 1996).

589         Next, we extend the overjustification framework by showing the moderating role of  
590 past exercise engagement in the relationship between a consumer's action of purchasing  
591 promoted or nonpromoted products and postpurchase exercise behaviors. Our findings  
592 demonstrated that a promoted product buying behavior does not always result in an  
593 attenuation of exercise attitude if the buyer is already highly engaged in exercise. That is, the  
594 more salient the initial interest is in a particular activity (e.g., exercise), the less likely the  
595 overjustification effect will occur (Fazio, 1981). This conflicting finding can be explained by  
596 prior research that shows that extrinsic rewards do not diminish intrinsic motivation if the  
597 rewards are necessary reinforcement (Crano and Sivacek, 1984) or support people's intrinsic  
598 interests (Eisenberger and Cameron, 1996). We surmise that heavy exercisers consider the  
599 promoted product a necessary extrinsic incentive, which further encourages ongoing exercise  
600 behaviors (Forehand, 2000; Kelley, 1973). The finding of relative effectiveness of sales  
601 promotion is critical for sports brands because it suggests optimal promotion strategies to  
602 target valuable segments.

603         Finally, we identify that while monetary sales promotions decrease subsequent  
604 purchases, nonmonetary sales promotions increase purchases, which extends prior research  
605 on sales promotion (e.g., Ailawadi et al., 2007; Guadagni and Little, 1984; Jones and  
606 Zufryden, 1980; Lim et al., 2005; Papatla and Krishnamurthi, 1996; Sinha and Smith, 2000;  
607 Yi and Yoo, 2011). We also find that although both nonmonetary sales promotion and  
608 cumulative exercise amount are positively related to purchase expenditure separately, the

609 combination of two components does not lead to its increase or decrease. That is, heavy  
610 exercisers are not influenced by sales promotion and may purchase exercise products, either  
611 promoted or nonpromoted, whenever they need them. This finding implies that heavy  
612 exercisers, who tend to have a high self-control to inhibit their impulses (Gillebaart et al.,  
613 2016), are more focused on fulfilling the goal (i.e., exercise itself) than the means (i.e., sales  
614 promotion). In another sense, the results also extends the notion of regulatory mode to the  
615 area of health and exercise context by showing that goal-directed people are more successful  
616 at achieving their health-related goals (e.g., food and nutrition) by overcoming the impulse to  
617 engage in purchasing promoted products (Gillebaart et al., 2016; Higgins et al., 2003;  
618 Mannetti et al., 2012).

619

## 620 *6.2 Managerial implications*

621 Our findings provide meaningful directions for sports brands (e.g., Nike and Adidas) and  
622 mobile exercise apps (e.g., Strava and Fitbit) when they implement and plan promotional  
623 campaigns for selling exercise products. From an implementation perspective, our findings  
624 clearly show that firms should be cognizant of the importance of the exerciser segment they  
625 are targeting when using exercise data. Compared with the absence of sales promotion,  
626 monetary and nonmonetary promotions may increase the postpurchase exercise motivation of  
627 heavy exercisers but discourage overall consumers from exercising in the future. Hence,  
628 mobile exercise apps can maximize their revenue—monetized from both banner ads and  
629 retail margin—by implementing optimal promotion strategies through exercise behavior-  
630 based segmentation. Specifically, exercise apps should target heavy exercisers with sales  
631 promotions because the revenue from retail margin might be higher for heavy exercisers than  
632 light exercisers.

633         Although exercisers who purchase nonpromoted products tend to increase

634 postpurchase exercise (Forehand, 2000; Rosenfield et al., 1980), sporting goods marketers  
635 often offer various types of sales promotion—monetary or nonmonetary—to potential and  
636 existing customers but need to keep in mind that exercisers’ postpurchase behavior could  
637 vary depending on the type of sales promotion. Our finding suggests that nonmonetary  
638 promotions, including limited offering and merchandiser recommendations, are more  
639 effective for increasing consumers’ postpurchase exercise and purchases. This finding can be  
640 explained by a congruency between physical exercise and nonmonetary (hedonic) benefits,  
641 which can elicit exercisers’ favorable attitude toward subsequent exercise and shopping  
642 behaviors (Chandon et al., 2000; Sinha and Smith, 2000).

643         From a planning perspective, marketers should understand that when most of the light  
644 exercisers purchase promoted exercise products, an overjustification effect occurs when they  
645 decide the postpurchase exercise behavior. To alleviate any overjustification concerns of the  
646 light exerciser segment, we provide two specific recommendations. First, marketers should  
647 communicate that the promoted product is focused on the benefit rather than the incentive  
648 offered in the promotion. If consumers believe that the promoted brand is promotion focused,  
649 they will respond less positively to the product (Forehand, 2000). Second, to encourage  
650 consumers’ higher intrinsic motivation to exercise, mobile exercise apps could collaborate on  
651 providing exercise-based rewards, rather than promotion-focused benefits, and turning them  
652 into points that consumers can monetize to purchase exercise products (e.g., Adidas  
653 Runtastic). This task-related reward reflects the level of exercise amount, which can induce a  
654 greater intrinsic motivation to continue exercising (Rosenfield et al., 1980).

655

### 656 *6.3 Limitations and future research directions*

657 This research has several limitations that provide opportunities for further research. First, we  
658 used monthly aggregated data and thus could not conduct dynamic analyses on the interplay

659 among exercise, sales promotion, and purchases. Further research could incorporate real-time  
660 exercise, promotion, and purchase data into an integrated model to uncover the dynamic  
661 relationships relevant to mobile marketing.

662         Second, we conducted the Hausman test to verify that the unobserved heterogeneity  
663 (i.e., random effect) should not correlate with observed covariates (e.g., age). While our result  
664 reveals the consistency of both random-effect and fixed-effect models, this approach may  
665 require other variables to test the heterogeneity including other demographic information  
666 (e.g., gender and disposable income). In addition, designing and implementing field  
667 experiments may allow for manipulating variables of interest in controlled settings (Johnson  
668 et al., 2017).

669         Third, because we focused on the mobility of mobile exercise app users rather than  
670 the locations of the app uses, we did not consider location-based mobile targeting (e.g., Fong  
671 et al., 2015), which can help marketers promote the right products to the right consumers at  
672 the right locations. Further research could incorporate additional exercise data, such as how  
673 much and where an exercise app user exercises at a certain time.

674         Fourth, due to the data limitation, this study could not examine whether purchases of a  
675 specific type of exercise product (e.g., treadmill for indoor exercise) may crowd out the time  
676 of other exercise activities (e.g., running outside), leading to reduction of the total exercise  
677 amount. For example, after someone buys a promoted treadmill, s/he stays at home walking  
678 and does not go to a gym for running or a mountain for hiking. This calls for further research  
679 on validating an overjustification effect in the exercise setting. Hence, researchers must  
680 examine whether the purchase of promoted products reduces the exercise amount due to the  
681 psychological reactance or simply the behavioral change among different exercises.

682         Finally, although exercise is an important topic in public health management, research  
683 could collect more comprehensive data on people's health-related activities, such as fitness,

684 nutrition, and sleep, in addition to exercise. Tracking users' activities throughout the entire  
685 day will provide information about their general health status, which may have an effect on  
686 firms' promotion activities and consumers' purchase behavior. These limitations offer new  
687 insights to explore exercise behavior-based marketing practices.

688

689

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**Table 1.** Overview of relevant sales promotion literature

Source	Research setting	Type of data	Response to sales promotion	Postpurchase behavior	Key findings
Ailawadi et al. (2007)	Promotion-induced stockpiling	Scanner panel	Brand choices and incidences	Repeat purchases	Promotion-induced stockpiling increases consumption and repeat purchases.
Chandon et al. (2000)	Offering monetary and nonmonetary promotions	Experiment	Product choice		The effect of monetary promotions varies depending on benefit congruency, but the effect of nonmonetary promotions is positive.
Dodson et al. (1978)	Offering and retracting a deal	Scanner panel	Choice		The effect of a deal on brand choice is positive in the short run but negative in the long run when the deal is retracted.
Eisenbeiss et al. (2015)	Deal-of-the-day (DoD) promotions	Lab and field experiment	Deal attractiveness, sales		The discount level of DoDs increases promotional effectiveness for utilitarian more than for hedonic products.
Guadagni and Little (1983)	Offering store promotion and price cut	Scanner panel	Brand choice	Subsequent purchase	Promotional purchases decrease the likelihood of a subsequent purchase of that brand.
Guha et al. (2018)	Comparing the discount depth against the sale price	Field and lab experiment	Perceived discount depth, purchase intentions		Framing the price promotion by comparing it with the sale price increases consumers' discount depth perceptions and purchase intentions.
Lim et al. (2005)	Short- and longer-term effects of price promotions	Scanner panel	Product quantity		The longer-term effects of price promotions differ across consumer segments (heavy vs. light, loyal vs. non-loyal vs. switcher)
Neslin et al. (1985)	Offering coupons, advertising, and discounts	Scanner panel	Interpurchase time, purchase quantity		Coupon and discount have a positive effect on quantity but no relationship to interpurchase time. Advertising is relatively ineffective.
Nunes and Park (2003)	Offering monetary and nonmonetary promotions	Experiment	Choice		People attend to absolute benefit (i.e., monetary) rather than relative (i.e., nonmonetary) differences.
Papatla and Krishnamurthi (1996)	Offering coupons, displays and features	Scanner panel	Brand loyalty, price sensitivity	Subsequent purchase	Coupons erode brand loyalty and increase price sensitivity, while prior purchases made on display and feature promotions have a positive effect on subsequent purchases.
Park et al. (2018)	Short- and longer-term effects of mobile price and non-price promotions	Transactions	Purchase incidence and purchase amount		While price discount coupons strengthen the short-term impact on purchase amount, non-price free sample coupons increase purchase propensity over a longer period.
Ramanathan and Dhar (2010)	Offering monetary promotions	Lab and field experiment	Purchase quantity, expenditure		Sales promotion cues affect the size and composition of a consumer's shopping basket.
Simonson et al. (1994)	Offering unneeded promotions	Experiment	Brand choice		Discounts and product features with little value do not increase purchase probability.
<i>This study</i>	Purchasing promoted and nonpromoted products	Exercise and transactions	Purchase expenditure	Subsequent exercise and purchase	The purchase of (nonmonetarily) promoted products decreases (increases) consumers' subsequent exercise (expenditure) but increases heavy exercisers' subsequent exercise.

**Table 2.** Purchase behavioral changes by exercise activities

Exerciser group	Type of purchased product	Consumers		Purchase incidence per consumer	
		Total number	Difference (nonpromoted - promoted)	Average number	% increase (promoted / nonpromoted)
Light	Nonpromoted	2,776	1,879	0.73	71%
	Promoted	897		1.25	
Medium	Nonpromoted	2,722	1,628	0.95	43%
	Promoted	1,094		1.36	
Heavy	Nonpromoted	2,792	1,487	1.42	16%
	Promoted	1,305		1.65	

**Table 3.** Operationalization of variables

Variable	Type	Description
$CALORIE_{it}$	DV	How many calories consumer $i$ burns in month $t$ .
$EXPENDITURE_{it}$	DV	How much consumer $i$ spends given that he or she purchases in month $t$
$CALORIE\_CUM_{it-1}$	IV	Cumulative (weighted average) calories that consumer $i$ has burned until month $t - 1$ .
$MONETARY_{it}$	IV	1 if consumer $i$ purchases a product with monetary promotion in month $t$ , 0 otherwise.
$NONMONETARY_{it}$	IV	1 if consumer $i$ purchases a product with nonmonetary promotion in month $t$ , 0 otherwise.
$NONE_{it}$	IV	1 if consumer $i$ purchases a product without sales promotion in month $t$ , 0 otherwise.
$AGE_{it}$	CV	Age of consumer $i$ in month $t$
$MONTH_t$	CV	A set of 11 dummy variables that represent a specific month in month $t$
$YEAR_t$	CV	A set of 2 dummy variables that represent a specific year (2014, 2015) in $t$

Note: DV, IV, and CV denote dependent variable, independent variable, and control variable, respectively.

**Table 4.** Parameter estimation of exercise and purchase models

Variable	Model 1 (DV: burned calories)		Model 2 (DV: purchase expenditure)	
	Mean	SD	Mean	SD
Intercept	-2.499**	0.126	10.480**	0.078
EXERCISE_CUM <sub>t-1</sub>	0.958**	0.005	0.006**	0.002
MONETARY <sub>t-1</sub>	-1.475**	0.285	-0.099*	0.056
NONMONETARY <sub>t-1</sub>	-1.631**	0.227	0.238*	0.144
NONE <sub>t-1</sub>	0.902**	0.167		
MONETARY <sub>t-1</sub> × EXERCISE_CUM <sub>t-1</sub>	0.092**	0.034	0.015	0.007
NONMONETARY <sub>t-1</sub> × EXERCISE_CUM <sub>t-1</sub>	0.136**	0.027	-0.024	0.018
NONE <sub>t-1</sub> × EXERCISE_CUM <sub>t-1</sub>	-0.257**	0.014		
AGE	0.581**	0.019	0.003	0.013
MONTH (January-November)	Controlled		Controlled	
YEAR (2014-2015)	Controlled		Controlled	
Variance of regression error	4.055	0.009	0.845	0.007
Variance of heterogeneity	2.345	0.028	0.284	0.014
IMR for MONETARY <sub>t-1</sub>	2.729**	0.502	0.015**	0.007
IMR for NONMONETARY <sub>t-1</sub>	2.349**	0.406	0.155**	0.012
IMR for NONE <sub>t-1</sub>	6.087**	0.468		
Carryover effect of past exercise efforts	0.719	0.004		

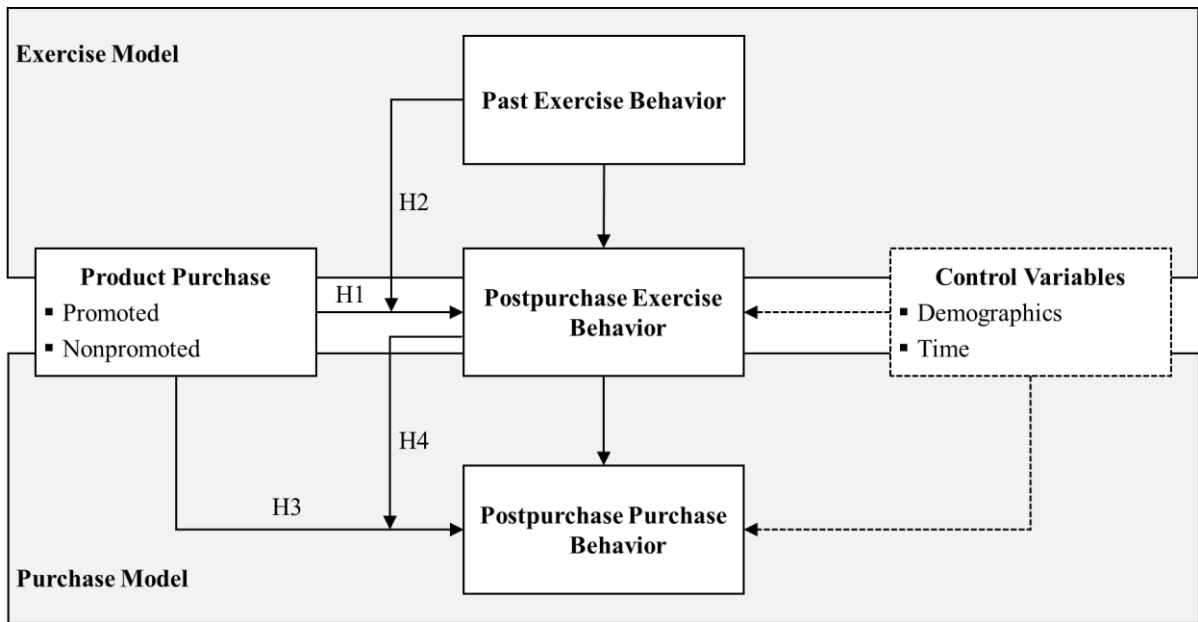
\*\* 95% credible interval does not contain zero.

\* 90% credible interval does not contain zero.

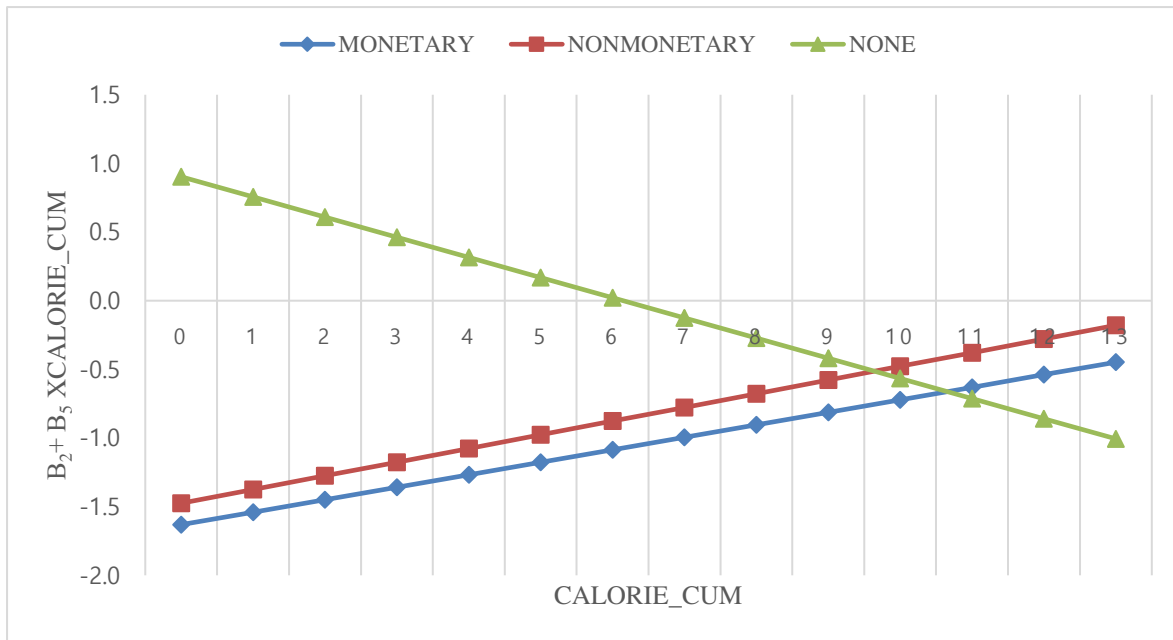
Note: DV and SD denote dependent variable and standard deviation, respectively.

EXERCISE\_CUM is CALORIE\_CUM. As we estimated Model 1 and Model 2 jointly, the coefficient of carryover effect of past exercise efforts was estimated from the integrated model of Model 1 and Model 2.





**Figure 1.** Proposed conceptual framework.



Note: X-axis denotes exercise level (calories), and Y-axis denotes combination of (1) main effect of type of purchased product (monetary, nonmonetary, nonpromoted) and (2) its interaction effect with exercise level.

**Figure 2.** Interactions between type of purchased products and cumulative exercise amount.