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# Affective stimuli in behavioural interventions soliciting for health check-up services and the service users' socioeconomic statuses: a study at Japanese pachinko parlours

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## ABSTRACT

**Background** Socioeconomically vulnerable people are likely to have more health risks because of inadequate behaviour choices related to chronic social stresses. Brain science suggests that stress causes cognitively biased automatic decision making, preferring instant stress relief and pleasure (eg, smoking, alcohol use and drug abuse) as opposed to reflectively seeking health-maintenance services (eg, health check-ups). As such, hedonic stimuli that nudge people towards preventive actions could reduce health behaviour disparities. The purpose of this intervention study was to test this hypothesis.

**Methods** An instant health check-up service company had 320 health check-up sessions at pachinko (Japanese gambling) parlours; 1721 persons in intervention sessions and 6507 persons in control sessions received the service. The stimuli the company used in the intervention sessions were young women wearing mildly erotic nurse costumes, who solicited the pachinko players for health check-up services. We compared the prevalence of socioeconomically vulnerable individuals between the intervention and control sessions, adjusting for individual-level and parlour-level potential confounders.

**Results** Even adjusting for health risks and within-parlour clustering, the intervention sessions gathered more socioeconomically vulnerable customers than the regular sessions. Compared with control sessions, in intervention sessions the adjusted prevalence ratios were 1.15 (95% CI 0.99 to 1.35) for not having a job (vs having a job) and 1.36 (95% CI 1.00 to 1.86) for holders of National Health Insurance (which includes more socially vulnerable people than other insurance programmes).

**Conclusion** The results supported our hypothesis. Offering health check-up opportunities equipped with 'tricks' that nudge people to act might be effective for anyone but is potentially more valuable for socially vulnerable people. Ethical discussions are needed to further consider the use of erotic stimuli and other essential drivers of human behaviour.

## INTRODUCTION

Every year, millions die by non-communicable diseases globally. Diabetes, cardiovascular disease, lung disease and cancer—the four most prevalent non-communicable diseases—are key targets of recent global health activities. Many non-communicable diseases are associated with human

behaviours. Therefore, public health promoters should target daily personal choices concerning diet, physical activity, consumption of tobacco and alcohol and the utilisation of healthcare services. Public health campaigns have aimed to increase individuals' awareness of the risks of inadequate behaviours, expecting them to make healthier choices in reflective ways. However, recent systematic reviews suggest that these campaigns are not effective or only have small effects.<sup>1</sup>

There are two pillars in the goals of public health: improving overall population health and reducing health disparity across social classes. Evidence suggests that most diseases, both communicable and non-communicable, are more prevalent among socioeconomically vulnerable populations in terms of income/wealth, education and work.<sup>2</sup> This is because inadequate health behaviours are also more prevalent among them.<sup>3,4</sup> There are two alternative mechanisms that potentially cause inadequate health behaviour among the socially vulnerable: materialistic and psychosocial. First, impoverished people are materially deprived, having limited access to necessary goods and services to maintain their health. Second, chronic daily stressors due to socioeconomic hardship (eg, financial insecurity, job insecurity or inadequate social comparisons against wealthier peers) may cause worry, frustration and anger, and alter health behaviours. Studies in social psychology and behavioural economics suggest that psychosocial stressors and the relevant negative emotions may strengthen cognitive biases for one's preferences towards temporality and risks, resulting in short-sighted decisions. The effects of strong cognitive biases mirror the higher prevalence of hedonic and addictive behaviours, including tobacco, alcohol and drug use, among socially disadvantaged populations.<sup>1,2,5</sup>

Given this theoretical and empirical evidence, health-promoting interventions aiming to reduce health disparities may perform better by targeting the automatic decision-making processes that, in theory, contribute more to socially vulnerable people. However, evidences on the effectiveness of those interventions regarding reducing health disparities are lacking. Recent studies have suggested potential triggers of automatic choices, including financial incentives, positive affect, peer pressures and hedonic or sexual attraction.<sup>6-10</sup> In this study, we specifically focused on positive affect



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**Figure 1** Differences in staff costumes between the intervention and control sessions. (A) Intervention: with young female staffs wearing short-skirted nurse costumes (B) Control: with nurses and staffs dressed normally.

(ie, a positive feeling state induced by modest positive events).<sup>9</sup> More specifically, we evaluated the effects of a sexually attractive young woman soliciting actions as a potential strong stimulus triggering behaviour change. Erotic stimuli can be a strong cue to action, given its inherence stemming from human evolution.<sup>11</sup>

In this clustered, non-randomised controlled study, we tested this idea using real-world data: the data of the customers who obtained instant health check-up services at Japanese pinball (*pachinko*) parlours, where there were many adults who were engrossed in an arcade game. In the intervention sessions, female staff members wore mildly erotic nurse costumes (ie, short skirts and typical nurse caps, figure 1). We hypothesised that, compared with regular health check-up sessions, socially vulnerable customers may be more likely to obtain health check-ups in the intervention sessions. Since the solicitation was performed by a young female in this intervention, we believed the effect would be stronger for male *pachinko* players than for female players.

## METHODS

### Data

We used individual data from 8485 customers who used instant health check-up services (eg, measuring weight and height, blood glucose and other biomarkers of cardiovascular risk) provided by a company. The private company provides instant health check-up services. They provide these services at their own retail shops as well as mobile service sessions at alternative locations, such as shopping malls, local market-places and metro rail stations, which are frequented by many socially vulnerable people. The *pachinko* parlour is one such place. *Pachinko* is a type of commercial amusement arcade game originating in Japan. A player snaps small metal balls, and the balls cascade down a vertically set board with densely nailed pins. The balls may be captured by a jackpot or bingo, resulting in the release of more balls. Players try to gather as many balls as possible since each ball has value and players can exchange them for prizes. Many *pachinko* parlours also have slot machines. The *pachinko* market is large, with reported earnings of 34862 billion yen in 2005.<sup>12</sup> Like any form of gambling, *pachinko* has long been discussed concerning its strong link with addiction.<sup>13</sup>

### The intervention

Between 2011 and 2013, the company operated 320 health check-up sessions at 110 *pachinko* parlours. To overcome the problem that *pachinko* players were not interested in the health services, in 63 sessions, the company hired young

female staff members from temporary staff service companies (intervention sessions). To solicit customers, in intervention sessions these female staff members wore sexually attractive nurse costumes. In other sessions (control sessions), the staffs wore ordinary suits or regular medical white coats. The average number of staffs in a session was not systematically different between the intervention and control sessions, with one company staff who dealt with reception and health check-up services, and a few other staffs who solicited customers. The solicitation staffs wore nurse costumes in the intervention sessions. We thought that solicitation by the costumed young women might trigger individuals to take the examination due to automatic cognitive processes that shortcut reflective cost considerations.

These sessions comprised normal business activities, and no special arrangements were made for the sake of this study. The researchers did not provide financial subsidies to the company or the customers. Hence, the funding for the present study was used for data analysis and manuscript preparation.

### Measurements

*Socioeconomic status (SES)*. In the check-up sessions, customers responded to a brief, self-reported questionnaire that asked for information related to SES: occupational status and type of public health insurance. We generated two binary outcome variables representing having no job (vs have a job) and using National Health Insurance Services (NHIS) (vs other insurance types) as representing low SES. Japan has universal public healthcare insurance coverage based on multiple insurance schemes. Among them, NHIS mainly targets the self-employed or those without jobs, who are likely to be less socially privileged. Occupation was categorised as no job, home maker, part-time job, employee, self-employed, business manager, student or other. We dichotomised this variable as 'no job' or 'other'.

### Covariates

From the information provided by the firm, we used age, time since last health check-up (years) and biomarkers from blood samples, including serum triglyceride, serum total cholesterol and fast blood glucose. For time since last check-up, we asked, "When did you get your last health check-up?" Response options were *within 1 year*, *1–3 years*, *4–9 years* and *10 years or more*. We dichotomised this variable as '0–3 years' or '4 years or more'. Using dry blood spot sampling, blood tests were conducted by the customers themselves under staff guidance. The results were immediately reported and recorded in the database. The

company staff members calibrated the blood test devices at the beginning of the daily sessions.

### Statistical analysis

First, we evaluated differences in the basic characteristics of customers who used the services between the intervention and control groups using a  $X^2$  test, a t-test or a Wilcoxon test, where appropriate. Since we only had access to the data of those who used the health check-up service, we could not calculate the odds of using the health check-up service among *pachinko* customers. Then, following a recent statistical recommendation, we used Poisson regression and calculated the prevalence ratios (PRs) of customers with poor SES in the check-up sessions using nurse costumes (intervention) against regular sessions (control).<sup>14 15</sup> When modelling covariates, the three biomarkers from the blood samples were log-transformed and standardised to normalise right-skewed distributions. Since data availability for the health check-up items depended on the customer's choice, some data were missing. To address potential biases due to missing data, we employed multiple imputation, creating 100 fully imputed datasets and statistically combining them to obtain the estimates of interest. Following recent statistical guidelines, we used expectation-maximisation with a bootstrapping algorithm.<sup>16–18</sup> We adjusted for within-parlour clustering, employing parlour random effects in the generalised estimating equation.<sup>19</sup> For a robustness check, we conducted a sensitivity analysis based on the application of multiple imputation procedures (only data with complete cases or imputed) and clustering adjustments. We conducted both sex-combined and sex-stratified analyses. All

P values were two-tailed. All analyses were conducted with the statistical package R V.3.3.2 for Windows.

### Patient involvement

No patients were involved in setting the research question or the outcome measures, nor were patients involved in planning the design or implementation of the study. No patients were asked for advice on the interpretation or presentation of the results.

### RESULTS

In total, 1721 persons (986 men and 735 women) participated in the intervention sessions and 6507 persons (3436 men and 3071 women) participated in the control sessions. Additional characteristics of interest are shown in [table 1](#).

The results of Poisson regression showed that, even after adjusting for multiple covariates, customers with a low SES, defined as having no job and using NHIS, were more prevalent in the intervention sessions. The fully adjusted PRs were 1.36 (95% CI 1.00 to 1.86) for NHIS holders and 1.15 (95% CI 0.99 to 1.35) for not having a job. When stratifying by gender, women showed somewhat larger PRs than men; the adjusted PR of NHIS holders was 1.45 among women and 1.32 among men, while the PRs for not having a job were 1.27 among women and 1.13 among men ([table 2](#)).

Sensitivity analyses using non-imputed (complete case) data provided stronger associations, specifically on the PRs for not having a job among women and weaker associations for women with NHIS ([table 2](#)). The full results of our sensitivity analysis are provided in online supplementary table S1.

**Table 1** Basic characteristics of those who took health check-ups by operation types

	Men		P value	Women		P value
	Intervention	Control		Intervention	Control	
	N (%)	N (%)		N (%)	N (%)	
Age (years)						
≤39	215 (21.8)	839 (24.4)	0.18	90 (11.3)	460 (15.0)	0.01
40–59	323 (32.8)	1050 (30.6)		247 (31.1)	1004 (32.7)	
≥60	448 (45.4)	1547 (45.0)		458 (57.6)	1607 (52.3)	
Socioeconomic status						
Type of health insurance programme						
National Health Insurance	432 (69.1)	1164 (67.5)	0.46	385 (70.6)	1017 (64.1)	0.006
Other	193 (30.9)	560 (32.5)		160 (29.4)	569 (35.9)	
Job status						
No job	225 (22.7)	659 (19.3)	0.01	104 (13.1)	249 (8.1)	<0.001
Home maker	4 (0.4)	7 (0.2)		333 (41.9)	1220 (40.0)	
Part-time job	53 (5.3)	182 (5.3)		94 (11.8)	349 (11.5)	
Employed, self-employed, manager	407 (41.0)	1602 (46.9)		97 (12.2)	434 (14.2)	
Student, other	304 (30.6)	967 (28.3)		166 (20.9)	795 (26.1)	
Last health check-up						
0–3 years ago	573 (81.9)	1958 (80.1)	0.30	78.53 (1693)	78.49(1)	0.98
≥4 years ago	127 (18.1)	486 (19.9)		21.47 (464)	21.51 (0)	
	Mean (SD)	Mean (SD)	P value	Mean (SD)	Mean (SD)	P value
Age	54 (16.2)	54 (17.3)	0.84	59.2 (13.9)	57.7 (15.7)	0.01
Last health check-up (years ago)	3.2 (4.3)	3.3 (4.5)	0.26	3.4 (4.4)	3.5 (4.6)	0.98
Serum cholesterol (mg/dL)	198.6 (41.4)	196.1 (36.1)	0.47	213.1 (39.7)	211.3 (39.4)	0.28
Serum triglycerides (mg/dL)	188.9 (124.2)	183.2 (126)	0.04	191.9 (126.2)	184.4 (126)	0.02
Serum glucose (mg/dL)	109.7 (100.9)	106 (38.7)	0.57	101.4 (31.4)	100.9 (26.4)	0.86

**Table 2** Prevalence ratio (95% CIs) of being of low socioeconomic status for those using health check-up services in intervention sessions (with nurse costumes) compared with control sessions (without nurse costumes)

	Low socioeconomic status measured as			
	Having National Health Insurance		Not having job	
	Complete case	Imputed*	Complete case	Imputed*
<b>All</b>				
Crude	1.37 (0.99, 1.88)	1.38 (1.00, 1.89)	1.26 (1.01, 1.57)	1.20 (0.98, 1.46)
Age-adjusted	1.34 (0.98, 1.83)	1.36 (1.00, 1.87)	1.22 (1.04, 1.43)	1.16 (0.99, 1.35)
Age, check-up history and biomarkers adjusted	1.32 (1.07, 1.63)	1.36 (1.00, 1.86)	1.31 (1.10, 1.55)	1.15 (0.99, 1.35)
<b>Men</b>				
Crude	1.29 (0.89, 1.88)	1.30 (0.90, 1.88)	1.18 (0.88, 1.56)	1.16 (0.90, 1.50)
Model 1: age-adjusted	1.27 (0.87, 1.86)	1.30 (0.89, 1.89)	1.17 (0.94, 1.47)	1.14 (0.92, 1.40)
Age, check-up history and biomarkers adjusted	1.45 (1.09, 1.93)	1.29 (0.89, 1.88)	1.13 (0.88, 1.44)	1.13 (0.92, 1.39)
<b>Women</b>				
Crude	1.46 (1.12, 1.91)	1.47 (1.13, 1.92)	1.50 (1.16, 1.93)	1.35 (1.07, 1.69)
Age-adjusted	1.43 (1.11, 1.84)	1.45 (1.12, 1.87)	1.37 (1.06, 1.76)	1.27 (1.01, 1.60)
Age, check-up history and biomarkers adjusted	1.19 (0.98, 1.46)	1.45 (1.12, 1.86)	1.87 (1.27, 2.75)	1.27 (1.01, 1.59)

\*Prevalence ratios were calculated with Poisson regression adjusted for within-parlour clustering using parlour random effects.

## DISCUSSION

The results supported our hypothesis: solicitation by young women wearing sexy nurse costumes to promote taking instant health check-up services gathered more socially disadvantaged *pachinko* players (ie, jobless or having NHIS). Interestingly, however, the finding was contradictory to our hypothesis on sex differences. That is, despite our expectations, the proportion of socially disadvantaged people in intervention sessions were larger among women rather than men, suggesting stronger disparity-reducing effects for women than men.

Many studies on behaviour economics and marketing have investigated the effects of various incentives on altering personal choices. Thaler and Sunstein's seminal work suggests that 'choice architecture', which is nudging people towards specific personal choices, could be a powerful strategy for social innovations.<sup>20</sup> In the field of public health, most studies relevant to that subject have dealt with financial incentives.<sup>6</sup> A randomised controlled trial by Blakely *et al* tested the impacts of price discounts on healthy foods at supermarkets on the levels of healthy food purchasing per consumers' socioeconomic disadvantages. They found ethnicity differences in the intervention effects, but none across income or education levels.<sup>21</sup> To our knowledge, few studies have investigated the effects of other behavioural change triggers including non-financial incentives and positive affect on socioeconomic disparities in health behaviour.<sup>9,22</sup> Therefore, this study is the first to investigate the impacts of sexual stimuli as a trigger of positive affect inducing healthy behaviour and their variations by SES.

Based on an appraisal tendency framework and theoretical models on affect and behaviour choice, the potential underlying mechanisms of our findings may be twofold.<sup>5</sup> First, as mentioned in the introduction, psychosocial stressors due to socioeconomic hardships may strengthen cognitive biases and the automatic processes of affective decision making. Observational and interventional studies of impoverished Indian farmers suggest that poverty directly impedes cognitive ability, which prevents those of lower SES from making rational decisions (in this case, buying fertilisers).<sup>23</sup> In our study, socially stressed persons may irrationally choose to pay for health check-up services regardless of their actual interests in health-maintaining behaviours, as they are simply attracted to the sexy costumed women. Alternatively,

positive emotions such as happiness, pride, relief, hope, and surprise may enhance cognitive capacity and promote reflective decision making.<sup>24</sup> In this study, positive environmental moods created by the costumed women may support *pachinko* players to understand the importance of health-improving behaviours, leading to the rational choice of obtaining a check-up.

In either case, the cue triggering the *pachinko* players' action towards using the health check-up service was the solicitation by young women wearing sexually attractive nurse costumes. People are more likely to pay attention to targets of their sexual interest.<sup>11</sup> According to recent neuroscientific studies, compared with women, men are more likely to have their cognitive ability influenced by women.<sup>25</sup> Another study found that a picture of attractive women on an advertising letter promoting bank loans increased men's attention by 25% compared with a letter with a picture of a reliable male agent.<sup>26</sup> Therefore, we initially thought that the intervention sessions would be more powerful with male participants than their female counterparts.

However, the results of this study did not support this, showing potentially stronger effects for socially vulnerable people in the intervention sessions among women. We propose three possible explanations for this. First, the interventions by costumed women might have induced specific emotions that affected women more than men concerning improving decision-making pathways (eg, risk perception and communication, valuation and reward seeking and interpersonal attribution).<sup>5</sup> However, evidence is scant on such sex-gap mechanisms.<sup>27-29</sup> Second, nurse costumes might have increased the trustworthiness of the health check-up services via psychological halo effects. In other words, customers' overall impressions of the service agency or brand influenced their thoughts about the services provided by the agency. This might have occurred more among females than males. A study of college roommates suggested a stronger social contagion of mental illness (ie, being depressed influenced by roommates' depression) among women than men.<sup>30</sup> Third, staff preferences for soliciting men or women might have varied, leading to unbalanced effects of customer gender. For example, in the intervention sessions, the costumed women might have solicited more women than men because it was less mentally taxing to talk to same-sex individuals. Meanwhile, there could have been male staffs who were popular among potential female



customers. We knew of the existence of a few such male staffs in our conversations with a staff of the company. However, there were no clear indications that they would have been more likely to be on duty during the intervention sessions.

This study has some limitations. First, we did not have denominator data. Although we evaluated the share of each socioeconomic groups among the persons using the services, ideally, we would have calculated between-group differences in the prevalence of service utilisation. To calculate this, the data of all people who visited the *pachinko* parlours in each session are necessary. Because of this, our study design is specifically vulnerable to the overall variations in the sociodemographic backgrounds across the customers of all *pachinko* parlours. However, in most cases, each parlour had both intervention and control sessions and our statistical approach accounted for parlour variability, minimising the impact of this denominator bias. Second, this was not a genuine, cluster randomised trial; therefore, the results are threatened by selection bias between the sessions with or without costumed women. However, in our interviews with workers at the company (the company providing the health check-up service), we did not find major sources of bias that could have affected the selection of sessions that involved costumed women. The company used external staffing services per the availability of those services as well as their own employees for solicitation. One potential uncontrolled source of bias is the variability in the number of staffs in a session. Sessions with more staffs might have been more successful for attracting customers with low SES. Moreover, if some external staffs were extremely skilled in getting customers who are socioeconomically vulnerable, the existence of such external staffs could have been a source of bias. Although we did not have data for the number of staffs in a session or the existence of highly skilled external staffs, given the rationale of using external staff services, we think the number of staffs could have been balanced between the intervention and control sessions. We also interviewed the company staffs, but they did not recall any such ‘superstar’ staffs among either the company staffs or the staffs from external staffing companies. Third, available covariates are limited, potentially leading to residual confounding and limited considerations for mechanisms. For example, future studies should gather more accurate sociodemographic information about customers such as income, educational attainment, social stressors, time preference, risk attitudes and so on.

We should acknowledge two potential criticisms of this research. First, this ‘sexy strategy’ could be harmful because it is addictive. Like other addictive unhealthy behaviours, including smoking and gambling, unnecessary repeating of health check-up services increases users’ financial burden. This could be more serious among the socially disadvantaged because many of them already have financial burdens due to other addictions (eg, *pachinko*). Second, this strategy could be applied for health-harmful commercial services; for instance, selling ineffective ‘functional’ foods. Ethical discussions are critical to use erotic stimuli and other essential drivers of human behaviour. In this study, the trigger was young women wearing mildly erotic nurse costumes; however, alternative tools could be used and should be investigated in the future in various intervention settings.

This study has important implications for public health and applied behaviour sciences. A direct implication is that while offering health check-up opportunities equipped with ‘tricks’ that nudge people to act could be effective for anyone, they might be more valuable for socially vulnerable individuals. In public health theory, this is consistent with the concept of proportionate universalisms for tackling health disparity, positing that ‘actions must be universal, but with a scale and

intensity that is proportionate to the level of disadvantage’ (p. 15).<sup>31</sup> We do not broadly recommend using mild sexual stimulus as an alternative measure to promote health equity. Rather, this research should be regarded a case study that investigated using the ‘nudge’ concept to address health disparity issues. We recommend that public health interventions aiming to tackle health disparities should give more consideration to the proper use of recent concepts and evidence from applied behaviour sciences.

### What is already known on this subject

- ▶ Mental stress due to social vulnerability induces affective and hedonic behaviour choices that often link to health risks.
- ▶ We hypothesise that affective but safe stimuli nudging people towards preventive actions may reduce health disparities.
- ▶ Mild sexual attraction could provide such stimuli.

### What does this study add

- ▶ Health check-up sessions with women wearing mildly erotic nurse costumes gathered more socially vulnerable people than ordinary sessions.
- ▶ Using techniques related to affective responses could be an alternative measure for promoting health equity.

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**Contributors** NK conceived the ideas, gathered and analysed data, reviewed articles and drafted the manuscript. YI helped conceptualise the study, reviewed articles and drafted the manuscript.

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**Competing interests** None declared.

**Patient consent** Detail has been removed from this case description/these case descriptions to ensure anonymity. The editors and reviewers have seen the detailed information available and are satisfied that the information backs up the case the authors are making.

**Ethics approval** In all service sessions, the health check-up service company informed customers about the potential utilisation of the data obtained from their services for academic research. The company has regularly required customers to submit this data-use agreement before providing services. We obtained data from individuals who provided written informed consent. Individual identification, including names and addresses, was removed before the data were sent to us. This study was approved by the Ethical Review Board of the Medical School at the University of Tokyo (No. 10481).

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### REFERENCES

- 1 Marteau TM, Hollands GJ, Fletcher PC. Changing human behavior to prevent disease: the importance of targeting automatic processes. *Science* 2012;337:1492–5.

- 2 WHO Commission on Social Determinants of Health. *Closing the gap in a generation: health equity through action on the social determinants of health. Final Report of the Commission on Social Determinants of Health*. Geneva: World Health Organization, 2008.
- 3 Murata C, Yamada T, Chen CC, *et al*. Barriers to health care among the elderly in Japan. *Int J Environ Res Public Health* 2010;7:1330–41.
- 4 Fukuda Y, Nakamura K, Takano T. Accumulation of health risk behaviours is associated with lower socioeconomic status and women's urban residence: a multilevel analysis in Japan. *BMC Public Health* 2005;5:53.
- 5 Ferrer RL, Klein W, Lerner JS, *et al*; *Emotions and health decision-making: extending the appraisal tendency framework to improve health and healthcare*. Chanhbridge: Harvard University Press, 2014.
- 6 Giles EL, Robalino S, McColl E, *et al*. The effectiveness of financial incentives for health behaviour change: systematic review and meta-analysis. *PLoS One* 2014;9:e90347.
- 7 Eckles D, Kizilcec RF, Bakshy E. Estimating peer effects in networks with peer encouragement designs. *Proc Natl Acad Sci U S A* 2016;113:7316–22.
- 8 Downward P, Rasciute S. 'No man is an island entire of itself.' The hidden effect of peers on physical activity: John Donne, Meditation XVII. *Soc Sci Med* 2016;169:149–56.
- 9 Mancuso CA, Choi TN, Westermann H, *et al*. Increasing physical activity in patients with asthma through positive affect and self-affirmation: a randomized trial. *Arch Intern Med* 2012;172:337–43.
- 10 Veilleux JC, Conrad M, Kassel JD. Cue-induced cigarette craving and mixed emotions: a role for positive affect in the craving process. *Addict Behav* 2013;38:1881–9.
- 11 Panksepp J. *Affective neuroscience: the foundation of human and animal emotion*. New York: Oxford University Press, 1998.
- 12 Japan Productivity Center for Socio-Economic Development (nippon seisan-sei honbu). *White Paper on Leisure (lejaa hakusho)*. Tokyo, 2015.
- 13 Brooks G, Ellis T, Lewis C. Pachinko: a Japanese Addiction? *Int Gambli Stud* 2008;8:193–205.
- 14 Lee J, Tan CS, Chia KS. A practical guide for multivariate analysis of dichotomous outcomes. *Ann Acad Med Singapore* 2009;38:714–9.
- 15 Barros AJ, Hirakata VN. Alternatives for logistic regression in cross-sectional studies: an empirical comparison of models that directly estimate the prevalence ratio. *BMC Med Res Methodol* 2003;3:1–13.
- 16 Honaker J, King G, Blackwell M. Amelia II: a Program for Missing Data. *J Stat Softw* 2011;45:1–47.
- 17 King G, Honaker A, Joseph A, *et al*. Analyzing incomplete political science data: an alternative algorithm for multiple imputation. *American Political Science Review* 2001;95:49–69.
- 18 Honaker J, King G. What to do about missing values in time-series cross-section data. *Am J Pol Sci* 2010;54:561–81.
- 19 Halekoh U, Hojsgaard S, Yan J. The R Package geepack for Generalized Estimating Equations. *J Stat Softw* 2006;15:1–11.
- 20 Thaler RH, Sunstein CR. *Nudge: improving decisions about health, wealth, and happiness*. New York: Penguin Book, 2009.
- 21 Blakely T, Ni Mhurchu C, Jiang Y, *et al*. Do effects of price discounts and nutrition education on food purchases vary by ethnicity, income and education? Results from a randomised, controlled trial. *J Epidemiol Community Health* 2011;65:902–8.
- 22 Howe KB, Suharlim C, Ueda P, *et al*. Gotta catch'em all! Pokémon GO and physical activity among young adults: difference in differences study. *BMJ* 2016;355:i6270.
- 23 Mani A, Mullainathan S, Shafir E, *et al*. Poverty impedes cognitive function. *Science* 2013;341:976–80.
- 24 Chepenik LG, Cornew LA, Farah MJ. The influence of sad mood on cognition. *Emotion* 2007;7:802–11.
- 25 van Hooff JC, Crawford H, van Vugt M. The wandering mind of men: ERP evidence for gender differences in attention bias towards attractive opposite sex faces. *Soc Cogn Affect Neurosci* 2011;6:477–85.
- 26 Bertrand M, Karlan D, Mullainathan S, *et al*. What's advertising content worth? evidence from a consumer credit marketing field experiment. *Q J Econ* 2010;125:263–305.
- 27 Proverbio AM. Sex differences in social cognition: The case of face processing. *J Neurosci Res* 2017;95:222–34.
- 28 Kuk K, Akkermann K. Fluctuations in negative emotions predict binge eating both in women and men: An experience sampling study. *Eat Disord* 2017;25:65–79.
- 29 Opwis M, Schmidt J, Martin A, *et al*. Gender differences in eating behavior and eating pathology: The mediating role of rumination. *Appetite* 2017;110:103–7.
- 30 Eisenberg D, Golberstein E, Whitlock JL, Downs MF, *et al*. Social contagion of mental health: evidence from college roommates. *Health Econ* 2013;22:965–86.
- 31 Marmot M, Allen J, Goldblatt P, *et al*. Marmot M, ed. *Fair society, healthy lives: the marmot review, strategic review of health inequalities in England post-*. London, 2010.