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ORIGINAL ARTICLE

Moderating Effect of Socioeconomic Status on the Relationship between Health Cognitions and Behaviors

Mark Conner, BSc, PhD · Rosemary McEachan, BSc, PhD · Cath Jackson, BSc, PhD · Brian McMillan, BSc, PhD, MD · Mike Woolridge, BSc, DPhil · Rebecca Lawton, BA, PhD

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Abstract
Background There is an established link between socioeconomic status (SES) and performance of health behaviors with more health protective and fewer health-risking behaviors in higher SES groups.
Purpose This research is novel in testing the moderating effect of SES on the relationship among intention, self-efficacy, and subsequent behavior.
Methods Effects were tested on data from three prospective correlational studies examining smoking initiation in adolescents (N=826), breastfeeding in primiparous women (N=202), and physical activity in working adults (N=509).
Results Despite examining different behaviors, samples, time intervals, and measures of SES, each study showed significant interactions between intention and SES in predicting behavior. In all three tests, the intention–behavior relationship was attenuated among individuals from lower SES groups. No moderation effects of SES were found for self-efficacy.
Conclusions The intention–health behavior relationship can be attenuated in lower SES samples. This finding may contribute to our understanding of SES differences in health behaviors.

Keywords Socioeconomic status · Intention · Self-efficacy · Smoking initiation · Breastfeeding · Physical activity

Engagement with health behaviors varies reliably with socioeconomic status (SES) [1–3]. Research has also examined various health cognitions as more proximal predictors of health behaviors that might mediate the relationship between SES and health behaviors [4]. In contrast, comparatively little research [5] has examined how SES and health cognitions interact in predicting health behaviors. The present research tested if the impact of behavior-specific health cognitions (i.e., intention and self-efficacy) on the performance of health-risk behaviors (smoking initiation) and health protective behaviors (breastfeeding and physical activity) is attenuated in lower SES groups.

SES refers to the social standing of an individual or group in the social hierarchy and is measured by factors such as relative material deprivation, income, education, and occupational classification. Low SES is consistently associated with both increased morbidity and mortality rates [1, 2, 6–8]. Research has long demonstrated parallel differences in engagement with a variety of health behaviors by SES (e.g., [2, 9]) with health-risk behaviors such as smoking [10] and alcohol dependency [11] being increased and health protective behaviors such as physical activity [12] and healthy eating [13] being decreased in lower compared to higher SES groups. Indeed, recent research has suggested that the link between SES and mortality is attributable to differences in engagement with various health behaviors [14]. SES influences engagement with health behaviors because it captures aspects of the roles, status, and expectations associated with membership of particular social categories as well as the resources and opportunities that accrue from such membership [3, 15, 16]. The present research tested these effects of SES in available datasets containing the appropriate measures for three diverse health behaviors: smoking initiation, breastfeeding initiation, and physical activity. The health risks associated with smoking [17] and the health benefits of breastfeeding [18, 19] and physical activity [20, 21] are well known. Rates of smoking are negatively related to SES [1, 2, 10, 22–24], while breastfeeding rates [25, 26] and rates

M. Conner · R. McEachan · C. Jackson · B. McMillan · M. Woolridge
University of Leeds, Leeds, UK

R. Lawton (✉)
Institute of Psychological Sciences, University of Leeds, Leeds LS2 9JT, UK
e-mail: r.j.lawton@leeds.ac.uk

of engagement with physical activity [12, 27, 28] are positively related to SES.

Research in psychology on health behaviors has focused less on social structural factors such as SES and more on proximal and readily modifiable determinants of health behaviors [4]. Behavior-specific cognitions or health cognitions are one set of factors that are reliably associated with various health behaviors that can be targeted in health interventions. A range of theories that incorporate such health cognitions have been developed and applied to a broad range of health behaviors (see [4] for a review). These theories include Protection Motivation Theory [29], Social Cognitive Theory [30], and the Theory of Planned Behavior (TPB [31]). They describe the key health cognitions and their relationship to behavior. In general, these theories assume the effects of factors such as SES on behavior are mediated by the health cognitions in the model. For example, the Social Cognitive Theory [30] assumes social structural factors such as SES will only impact on behavior through changing goals. However, social structural factors could moderate the impact of health cognitions on behavior. For example, social structural factors might reduce the financial resources available to spend on health behaviors (e.g., costs of eating a healthier diet) or environmental factors may make behaviors more difficult to perform (e.g., lack of availability of sports centers to those from more deprived areas). The present research tests the moderating effects of SES on the health cognition–behavior relationship. Supportive evidence could both increase understanding and provide a basis for designing more effective interventions targeted at particular groups.

The Protection Motivation Theory, Social Cognitive Theory, and TPB converge on viewing intention as the key proximal determinant of behavior. Intentions are decisions or motivation to perform the behavior. Social Cognitive Theory and TPB also converge in seeing self-efficacy (labeled perceived behavioral control in the TPB) as the other key direct determinant of behavior. Self-efficacy is the perceived confidence the individual has that he/she can perform the behavior. A recent meta-analytic review of the TPB [32] has shown that intentions and self-efficacy/perceived behavioral control provide good levels of prediction of risk behaviors such as smoking (R^2=.15, k=29), dietary behaviors (R^2=.21, k=30), and physical activity (R^2=.24, k=103). McEachan et al. [32] also showed intention to have a medium–large-sized relationship with behavior (risk behaviors such as smoking: r_+=.38, k=29; dietary behaviors: r_+=.44, k=30; physical activity: r_+=.48, k=103), while self-efficacy/perceived behavioral control had a medium-sized relationship with behavior (risk behaviors such as smoking: r_+=.24, k=29; dietary behaviors: r_+=.35, k=30; physical activity: r_+=.34, k=103). The relationship between intentions and self-efficacy/perceived behavioral control was also large (r_+=.54, k=217).

Studies have tested mediation effects of health cognitions for social structural variables such as SES but only for some health behaviors. For example, in relation to breastfeeding, McMillan et al. [33] reported the direct effects for education and household deprivation on behavior to be partially mediated by TPB variables. Similarly, in relation to physical activity, Godin et al. [5] reported the direct effects for education and income on behavior to be partially mediated by TPB variables. In addition to mediation effects, it is possible to test for moderation effects (analogous to examining direct effects and interaction effects). As far as we are aware, only two studies have reported how social structural variables such as SES might moderate the impact of health cognitions on health behavior. In a cross-sectional study, Abraham et al. [34] reported SES to moderate the relationship between intention and condom use, such that this relationship was stronger in the higher SES group (although this effect was not present when other moderation effects were considered). In a prospective study, Godin et al. [5] showed that education moderated the intention–behavior relationship for self-reported physical activity, such that this relationship was stronger in the better educated group. Godin et al. argued that this may be attributable to education influencing people's ability to translate their intention into action. Godin et al. [5] also showed this moderation effect to be mediated by the temporal stability of intention, i.e., lower stability of intention in lower educated groups. That intention remains stable from when measured to when behavior is assessed is a limiting condition of the TPB [31, 35]. Several studies have shown stable intentions to be more predictive of behavior [36]. Sheeran et al. [37] showed that intention stability explained the moderating effect of other variables (e.g., anticipated regret) on the intention–behavior relationship. The mediated moderation findings of Godin et al. [5] suggest that differences in the stability of intentions might account for any moderating effect of SES on the intention–behavior relationship.

In summary, the present research tested whether measures of SES moderated the impact of health cognitions on performance of three health behaviors. This extends previous research in five important ways. First, we test whether SES moderates the effect of *two* key health cognitions (i.e., intention, self-efficacy) on behavior. Second, we test these effects on more than one behavior (i.e., smoking initiation, breastfeeding initiation, and physical activity). Third, we test these effects for both self-reported (smoking and physical activity) and objective (breastfeeding) behavior measures. Fourth, we test moderation using different measures of SES (i.e., non-self report area-level deprivation statistics or self-reported occupational group). Fifth, we tested whether the moderating effects of SES on health cognitions-behavior is explained by an intention by intention stability interaction (study 3).

Study 1

Study 1 used a prospective design over a 2-year period to examine self-reported smoking initiation in a sample of adolescents and a SES measure based on level of deprivation of the school.

Method

Participants

Participants were recruited from 20 schools and aged 11–12 years at initial testing. They participated by completing questionnaires about self-reported smoking at several time points over a 2-year period. As considerable data on all measures were missing at baseline, we used data from the second time point (collected 3 months after baseline) to predict smoking initiation over the longest time period available (24 months after baseline). Of the initial sample of 1,209, complete measures were available on all variables including behavior measures for 826 (68 % of original sample).[1] Ethical approval for this study was granted by the University Ethics Committee.

Measures

All measures were assessed by questionnaire. Participants reported gender (1=boy; 2=girl). A measure of socioeconomic status was assessed at the level of school using a median split of the proportion of children receiving free school lunches (1=lower SES; 2=higher SES).

Intention to not smoke was measured using three items that were averaged (α=.82), "I plan not to smoke this term," "I do not want to smoke this term," "I will try not to smoke this term," strongly disagree–strongly agree, scored 1–5. *Self-efficacy over not smoking* was assessed by three items that were averaged (α=.67), "I am confident I could resist smoking this term," strongly disagree–strongly agree, "For me to not smoke this term would be…," difficult–easy, "How much control do you feel that you have over not smoking this term?," no control–complete control, scored 1–5. Both variables were highly skewed and therefore each was dichotomized using a median split (1=low, 2=high). *Self-reported smoking behavior* was measured using an item adapted from Jarvis [38]; "Cross one of the following: I have not smoked at all last term; I have only ever tried smoking once last term; I used to smoke sometimes last term, but I never smoke cigarettes now; I sometimes smoked cigarettes last term, but not as many as one a week; I usually smoked between one and six cigarettes a week last term; I usually smoked more than six cigarettes a week last term." Responses were coded as zero if the first response was checked and 1 if any other response was checked. This measure was used at baseline to tap past behavior and follow up to tap behavior.

Analyses

A similar approach was taken to analyzing the data from each of the three studies. First, we examined the distribution and intercorrelation of measures. Second, we tested for differences between the final sample and those lost to drop out on the initial measures. Third, we used logistic or multiple regression to predict behavior based on measured variables. At step 1, the demographic variables were entered. At step 2, past behavior, intention and self-efficacy were added. At step 3, we tested the significance of interactions between SES and intention or self-efficacy. In order to minimize problems of multicolinearity, variables were mean-centered before computing interaction terms [39]. Where interactions were significant, we explored the moderating effect by examining the effect of each predictor at different levels of SES.

Results

Table 1 (above diagonal) reports the intercorrelations, means, and standard deviations for the measured variables. In general, they showed reasonable variance. Past behavior, intention to not smoke, self-efficacy over not smoking, and gender (more smoking in girls) were all significant correlates of smoking, with past behavior being the strongest predictor. Intention to not smoke and self-efficacy over not smoking were both negatively correlated with smoking. Multivariate analysis of variance (MANOVA) comparing that portion of the sample that was retained with that lost to drop out on baseline measures of past behavior, intention to not smoke, self-efficacy over not smoking, SES and gender indicated a significant multivariate effect, $F(5,1089)=3.26$, $p=.006$. Examination of the univariate effects indicated significant differences for past behavior [$F(1,1093)=5.01$, $p=.02$], intention to not smoke [$F(1,1093)=8.18$, $p=.004$], self-efficacy over not smoking [$F(1,1093)=4.62$, $p=.03$], and SES [$F(1,1093)=5.22$, $p=.02$]. Those lost to follow-up were more likely at baseline to smoke, have weaker intention to not smoke and weaker self-efficacy over not smoking, and lower SES.

Table 2 summarizes the findings from the binary logistic regression analyses predicting smoking. At step 1, entry of the demographic variables explained a significant proportion of the variance in smoking, model χ^2 (2, N=826)=28.48, $p<.001$. The odds ratios showed that smoking was more likely

[1] In both study 1 (see [48]) and study 3 (see [49]), participants were part of intervention studies. However, in neither case did controlling for condition change the findings. In addition, there were no significant interactions between condition and the variables examined here.

Table 1 Means, standard deviations and intercorrelations for measured variables (study 1 smoking initiation above diagonal, N=826; study 2 breastfeeding below diagonal, N=205)

Variables	1	2	3	4	5	6	7	8	9	Mean	SD
1. Gender	–	–	–	–	−.01	.02	.18**	−.03	−.06	1.50	0.50
2. Age	–	–	–	–	–	–	–	–	–	–	–
3. Ethnicity	–	.11	–	–	–	–	–	–	–	–	–
4. Education	–	.31**	−.12	–	–	–	–	–	–	–	–
5. Socioeconomic status (SES)	–	.07	.30**	−.04	–	.00	.00	−.01	.03	1.56	0.50
6. Past behavior	–	–	–	–	–	–	.26**	−.24**	−.15**	0.18	0.39
7. Behavior	–	.24**	−.28**	.25**	−.03	–	–	−.21**	−.19**	0.28	0.38
8. Intention	–	.19*	−.29**	.20*	−.02	–	.65**	–	.38**	1.84	0.37
9. Self-efficacy	–	.13	−.31**	.12	−.01	–	.36**	.63**	–	1.73	0.44
Mean	–	23.90	0.39	17.60	5.73	–	0.68	4.09	3.70		
SD	–	5.38	0.49	2.56	2.02	–	0.47	1.34	1.18		

*p<.01; **p<.001.

in girls. At step 2, addition of past behavior, intention to not smoke, and self-efficacy over not smoking explained a further significant proportion of variance in smoking, step χ^2 (3, N=826)=69.40, p<.001. The odds ratios showed gender, past behavior, intention to not smoke, and self-efficacy over not smoking to be significant at this step. At step 3, we entered the interactions between SES and intention and between SES and self-efficacy. This explained a further marginally significant proportion of variance in smoking, step χ^2 (2, N=826)= 5.32, p=.07 (addition of the interaction between SES and intention alone did produce a significant increment in variance explained, p<.05). The odds ratios for the final equation show that gender, past behavior, intention to not smoke (negative), self-efficacy over smoking (negative), and the interaction between SES and intention (negative) were each significant. Smoking was associated with being a girl, past smoking, weaker intention to not smoke and weaker self-efficacy over not smoking, and lower levels of the interaction between intention and SES.

In order to decompose the interaction, we examined the relationship between intentions to not smoke and smoking separately in the lower SES and higher SES groups (Fig. 1, top panel). This demonstrated that the impact of intentions to not smoke on smoking was weak and non-significant in the lower SES group (B=−0.09, SE=.33, odds ratio=0.91, 95 % CI=0.41—2.01) but strong, significant and negative in the higher SES group (B=−1.14, SE=.33, odds ratio=0.32, 95 % CI=0.17–0.60).

Discussion

Study 1 provided some initial support for our predictions. In particular, group level SES significantly moderated the

Table 2 Hierarchical logistic regressions of smoking initiation onto demographic variables, intention, self-efficacy, and interaction terms for study 1 (N=826)

Step	Predictors	Unstandardized B	SE of B	Odds ratio	95 % CI
1	Gender	0.99	.19	2.70***	1.85–3.95
	SES	0.04	.19	1.04	0.72–1.49
2	Gender	1.00	.20	2.72***	1.83–4.06
	SES	0.04	.20	1.04	0.71–1.52
	Past behavior	1.23	.22	3.41***	2.22–5.23
	Intention	−0.70	.25	0.50**	0.31–0.81
	Self-efficacy	−0.54	.22	0.58**	0.38–0.90
3	Gender	0.98	.20	2.67***	1.79–3.98
	SES	−0.03	.20	0.97	0.66–1.45
	Past behavior	1.22	.22	3.38***	2.19–5.21
	Intention	−0.67	.26	0.51**	0.31–0.85
	Self-efficacy	−0.55	.22	0.58**	0.37–0.89
	SES×intentions	−1.15	.51	0.32*	0.12–0.88
	SES×self-efficacy	0.21	.44	1.22	0.51–2.89

Step 1 model fit, −2 log likelihood=754.30, Nagelkerke R^2=.06; step 2 model fit, −2 Log likelihood=684.91, Nagelkerke R^2=.18; step 3 model fit, −2 log likelihood=679.69, Nagelkerke R^2=.19

*p<.05; **p<.01; ***p<.001

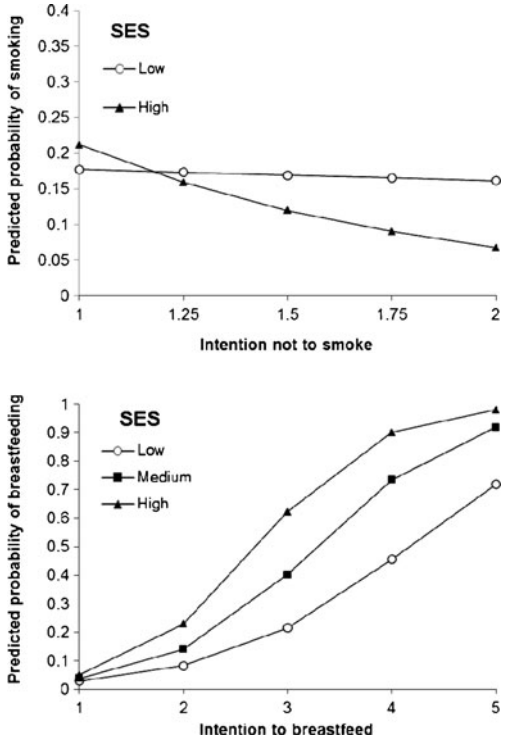

Fig. 1 Plot of simple slopes showing relationship between intention and behavior at different levels of SES (study 1—smoking initiation, *top panel*; study 2—breastfeeding, *bottom panel*)

relationship between intention to not smoke and later smoking after controlling for various other predictors of smoking. As SES increased, the (negative) impact of intention to not smoke on smoking also increased. In the lower SES group, intention to not smoke was unrelated to later smoking, while in the higher SES group, intention to not smoke had strong (negative) correlations with subsequent smoking. In other words, those adolescents with strong intention to not smoke were less likely to become smokers if they were from a higher SES school (7 %) than if they were from a lower SES school (16 %). These findings support the idea that lower SES may impede attempts to translate healthy intentions (i.e., to not smoke) into healthy actions (refraining from smoking). We should also note that our final sample was biased compared to the initial sample. In particular, those lost to follow-up were more likely at baseline to smoke, have weaker intention to not smoke, weaker self-efficacy over not smoking, and lower SES. There is no particular reason to suppose that these biases impacted on our key moderation test, and these baseline measures were controlled for in our analyses. Nevertheless, it would be useful to confirm our findings in an unbiased sample.

Study 2

Study 1 showed the moderating effect of SES on the health cognition–health behavior relationship in a group of adolescents using a self-report measure of smoking. In study 2, we attempted to replicate this effect in a sample of deprived women for a different behavior. Study 2 used a prospective design over a 2-month period to examine breastfeeding initiation in women, employed an objective measure of behavior, and used a measure of SES based on level of deprivation in the area of the home postal/zip code. Similar findings across the studies would contribute to generalizability.

Method

Participants

Participants were pregnant women, with no previous live births, living in areas of economic deprivation. Midwives identified and approached 449 eligible pregnant primiparous women at approximately 20 weeks gestation who lived in geographically defined areas of material deprivation of whom 411 agreed to participate, although only 303 returned questionnaires (see [33] for further details). On average, questionnaires were completed and returned 6–8 weeks before birth. Complete measures were available on all variables including behavior for 205 (50 % of original sample). Ethical approval for this study was granted by a Multicenter Ethics Committee.

Measures

All measures except behavior were assessed by questionnaire. Breastfeeding was defined on the front cover of the questionnaire as feeding a baby any breast milk, including feeding expressed breast milk from a bottle. Participants provided date of birth (from which we computed age), age of leaving full time education (from which we computed years in education), and ethnicity (coded into nonwhite=0, white=1). A measure of socioeconomic status was derived from postcode (zip code) data. Based on postcode data, we were able to derive a measure of household deprivation (Townsend index [40]): range, 0.80–10.20. We computed a measure of SES as 11—Townsend deprivation score, i.e., higher scores indicate higher SES. *Intention* was measured using a single item, "Do you intend to breastfeed your baby?," definitely do not–definitely do, scored 1–5. *Self-efficacy* was assessed by three items: "For me breastfeeding my baby would be…," difficult–easy; "If I breastfed my baby, things might get in the way that would stop me from doing it," likely–unlikely; "How confident are you that you could breastfeed your baby if you wanted to," not at all confident–very confident, all scored 1–5. These items were summed and averaged (α=.67). *Behavior* was measured objectively based on hospital records and indicated method

of feeding at discharge from hospital (approximately 2 days after birth). Responses were coded into "no breastfeeding" (scored 0) and "any breastfeeding" (scored 1).

Results

Table 1 (below diagonal) reports the intercorrelations, means, and standard deviations for the measured variables. In general, the measures were not excessively skewed and showed reasonable variance. Intention, self-efficacy, ethnicity, education, and age were all significant correlates of breastfeeding, with intention being the strongest predictor. MANOVA comparing that portion of the sample that was retained with those lost to drop out on baseline measures of intention, self-efficacy, ethnicity, education, age, and SES revealed no significant multivariate effect, $F(6,277)=0.70$, $p=.63$, indicating that the retained sample were representative of the initial sample on baseline measures

Table 3 summarizes the findings from the binary logistic regression analyses predicting breast feeding. At step 1, entry of the demographic variables explained a significant proportion of the variance in breastfeeding, model χ^2 (4, $N=205$)= 39.58, $p<.001$. The odds ratios showed that breastfeeding was more likely in older, nonwhite and better educated participants. At step 2, the addition of intention and self-efficacy explained a further significant proportion of variance in breastfeeding, step χ^2 (2, $N=205$)=68.01, $p<.001$. The odds ratios showed age, ethnicity, and intention to be significant at this step. At step 3, we added the interactions between SES and intention or self-efficacy. Addition of these interactions marginally significantly improved the fit of the model, step χ^2 (2, $N=205$)=5.62, $p=.06$ (addition of the interaction between SES and intention alone did produce a significant increment in variance explained, $p<.05$). The odds ratios for the final equation show that age, ethnicity, intention, and the interaction between SES and intention were each significant. Breastfeeding was associated with being older, being nonwhite, having stronger intention, and higher levels of the interaction. In order to decompose the interaction, we examined the relationship between intention and breastfeeding at lower (1 SD below mean), medium (at mean) and higher (1 SD above the mean) levels of the moderator (SES). This demonstrated that the relationship between intention and breastfeeding was small but significant ($B=0.82$, SE=.37, odds ratio=2.28, 95 % CI=1.10—4.72) among lower SES women but became stronger as SES increased to moderate ($B=1.62$, SE=.29, odds ratio=5.05, 95 % CI=2.87—8.89) and higher ($B=2.09$, SE=.53, odds ratio=8.08, 95 % CI= 2.87—22.72) levels (see Fig. 1, lower panel).

Discussion

Study 2 provided further support for our predictions. In particular, SES (based on household area level deprivation statistics) significantly moderated the relationship between intention to breastfeed as stated during pregnancy and objectively assessed breastfeeding 6–8 weeks later (i.e., 2 days after birth). As SES increased the impact of intention on breastfeeding also

Table 3 Hierarchical logistic regressions of breastfeeding onto demographic variables, intention, self-efficacy and interaction terms for study 2 ($N=205$)

Step	Predictors	Unstandardized B	SE of B	Odds ratio	95 % CI
1	Age	0.11	.04	1.12**	1.04–1.20
	Ethnicity	−1.45	.36	0.24***	0.12–0.47
	Education	0.18	.08	1.19*	1.02–1.40
	SES	0.07	.09	1.07	0.91–1.26
2	Age	0.11	.05	1.11*	1.01–1.22
	Ethnicity	−1.13	.47	0.32*	0.13–0.81
	Education	0.16	.10	1.17	0.97–1.41
	SES	0.02	.11	1.02	0.83–1.27
	Intention	1.48	.26	4.37***	2.64–7.25
	Self-efficacy	−0.33	.24	0.72	0.45–1.16
3	Age	0.13	.05	1.14**	1.03–1.26
	Ethnicity	−1.17	.48	0.31*	0.12–0.80
	Education	0.17	.10	1.19	0.98–1.44
	SES	−0.08	.13	0.92	0.72–1.19
	Intention	1.62	.29	5.05***	2.87–8.89
	Self-efficacy	−0.08	.26	0.73	0.44–1.20
	SES × intentions	0.37	.17	1.45*	1.04–2.02
	SES × self-efficacy	−0.10	.15	0.90	0.67–1.21

Step 1 model fit, −2 log likelihood=218.04, Nagelkerke $R^2=.25$; step 2 model fit, −2 log likelihood=150.02, Nagelkerke $R^2=.57$; step 3 model fit, −2 log likelihood=144.40, Nagelkerke $R^2=.59$

*$p<.05$; **$p<.01$; ***$p<.001$

increased. At low levels of SES (1 SD below the mean; i.e., higher deprivation), intention to breastfeed had only a weak relationship to subsequent breastfeeding. While at high levels of SES (1 SD above the mean; i.e., lower deprivation), intention to breastfeed had strong positive impacts on subsequent breastfeeding. These findings support the idea that higher levels of deprivation (i.e., lower SES) may impede attempts to translate healthy intentions into healthy actions. SES did not moderate the self-efficacy–behavior relationship.

Study 3

Study 3 attempted to replicate the effects of studies 1 and 2 in a sample of working adults on an additional behavior. Study 3 used a prospective design over a 6-month period to examine physical activity in working adults and used a measure of SES based on an individual's occupational category. In addition, study 3 tested whether any moderating effect of SES on the intention–behavior or self-efficacy–behavior relationships could be explained in terms of the moderating effects of intention stability. Formally, this is a test of *mediated moderation* [41]. Godin et al. [5] illustrated the nature of this model. Their findings showed that both education and the temporal stability of intention each had significant interactions with intention in predicting exercise behavior (i.e., participants who had more education or more stable intention were more likely to translate their exercise intention into behavior compared to their counterparts). However, findings also showed that the intention × intention stability interaction term mediated the impact of the education x intention interaction (i.e., this interaction was no longer significant when the intention × intention stability interaction term was taken into account). In the present study, the mediated moderation of the SES × intention (or SES × self-efficacy) would be observed if findings showed that interactions between SES and intention (or SES × self-efficacy) were mediated by the intention × intention stability interaction term, i.e., the SES × intention (or SES × self-efficacy) interaction was rendered nonsignificant when the intention × intention stability interaction was included.

Method

Participants

Working adults from a range of organizations were invited to take part in a study on physical activity (see footnote 1). Participation involved completing self-report questionnaires at three time points (time 1 to 2 and time 2 to 3 were both 6-month intervals). Of the initial sample of 1,260 participants, 536 completed the questionnaires and 526 provided measures at all time points (41.7 %). Ethical approval was granted by the ethics committees of the University and local health service.

Measures

At time 1, participants recorded their age (years), gender (1 = female; 2 = male), and completed the self-coded version of the National Statistics Socio-Economic Classification [42]). This is an SES measure derived from occupational job type, size of organisation and whether an employee supervises other employees. For the purposes of the present analyses, the measure was recoded into higher (professional occupations, managers and administrators; coded 2) and lower (clerical, technical, craft, manual, and service occupations; coded 1) SES groups.

Intention and self-efficacy were measured at time 2 (with intention also measured at time 1). *Intention* was measured by asking participants the extent to which they agreed with the statement: "I intend to do the recommended levels of physical activity over the next three months" (strongly disagree–strongly agree; scored 1–7). Intention stability was computed as 1—the absolute difference between time 1 and 2 intention scores (see [36]). *Self-efficacy* was assessed by the items: "I have control over whether or not I do the recommended levels of physical activity over the next three months"; "I am confident that I could do the recommended levels of physical activity over the next three months" (strongly disagree–strongly agree; both scored 1–7 with higher scores indicating greater efficacy or control). The scores were averaged (α=.60). *Physical activity* was measured using the short form of the International Physical Activity Questionnaire (IPAQ) at times 2 and 3. The IPAQ produces an estimate of minutes per week an individual engages in three types of activity (walking, moderate, and vigorous) as well as sitting. Walking (3.3), moderate (4.0), and vigorous (8.0) activity each have a MET score (a multiple of resting metabolic rate). This is multiplied by the minutes of each type of activity recorded by the participant during the week to give a MET-minute score for walking, moderate and vigorous activity. Total MET-minutes/week is then calculated by summing these three scores. In the present study, total MET-minutes at time 2 was used as a measure of past behavior, while total MET-minutes at time 3 was used as the key dependent variable. The data contained a number of outliers (very high values>9000 METs; these were >3SDs above the mean) at both time points that likely represented inaccurate recording of physical activity levels. Data from these participants (N=17) were excluded from all analyses leaving a final sample of 509.[2]

[2] Current guidelines suggest that individuals should aim to engage in physical activity of at least moderate intensity activity for 150 min every week or vigorous activity for 75 min every week [50]. This level is equivalent to 600 MET-minutes of activity as assessed by the moderate and vigorous questions of the IPAQ. According to this level between about one quarter and one half of the sample met the recommended criteria at the different time points.

Results

Table 4 reports the intercorrelations, means, and standard deviations for the measured variables. In general, the measures were not excessively skewed and showed reasonable variance. Examination of the simple correlations (Table 4) did not indicate excessive correlation among predictor variables. Past behavior, intention, self-efficacy, and age were all significant correlates of future behavior, with past behavior being the strongest predictor. MANOVA comparing that portion of the sample that was retained with those lost to drop out on baseline measures of intention, self-efficacy, past behavior, age, gender, and SES revealed no significant multivariate effect, $F(6,453)=1.20$, $p=.31$, indicating the retained sample were representative of the initial sample on baseline measures.

Multiple regression of time 3 physical activity onto demographic variables, past behavior, intention, self-efficacy, and interaction terms is reported in Table 5. At step 1, entry of age, gender, and SES explained a marginally significant proportion of the variance in behavior, $\Delta R^2=.01$, $F(3,505)=2.46$, $p=.06$, although only age was a significant predictor. Addition of past behavior (measured at time 2), intention, and self-efficacy at step 2 explained a significant additional proportion of variance, $\Delta R^2=.23$, $F(3,502)=50.24$, $p<.001$, with past behavior, intention, self-efficacy, and age significant at this step. Addition of the interaction between SES and intention and SES and self-efficacy at step 3 explained a marginally significant additional proportion of the variance in behavior, $\Delta R^2=.01$, $F(2,500)=2.36$, $p=.10$ (addition of the interaction between SES and intentions alone did produce a significant increment in variance explained, $p<.05$). Past behavior, intention, age, and the interaction between SES and intention were significant at this step.

The final part of our analysis tested our mediated moderation prediction (not shown in Table 5). At step 4, addition of intention stability and the interaction between intention stability and intention explained a further significant additional proportion of the variance in behavior, $\Delta R^2=.02$, $F(2,498)=7.73$, $p<.001$. As at step 3, age, past behavior, intention, and the interaction between SES and intention remained significant predictors. As predicted, the interaction between intention stability and intention was also significant at this step ($B=80.50$, SE=21.30, beta=.17, $p<.001$). The fact that the SES×intention interaction remained significant did not support the mediated moderation prediction.

In order to explore the two significant interactions we used simple slope analyses [39] by examining the regression

Table 5 Hierarchical multiple regressions of physical activity onto demographic variables, past behavior, intention, self-efficacy, and interaction terms for study 3 ($N=509$)

Step	Predictors	Unstandardized B	SE of B	Beta
1	Age	13.60	7.00	.09*
	Gender	−226.00	151.00	−.07
	SES	−47.80	151.00	−.01
2	Age	14.50	6.22	.09*
	Gender	−188.00	133.00	−.06
	SES	113.00	134.00	.03
	Past behavior	0.52	0.05	.39***
	Intention	146.00	43.10	.15***
	Self-efficacy	96.80	43.80	.09*
3	Age	13.40	6.23	.09*
	Gender	−184.00	133.00	−.06
	SES	114.00	134.00	.03
	Past behavior	0.52	0.05	.39***
	Intention	112.00	45.90	.11*
	Self-efficacy	100.00	44.20	.10*
	SES×intention	164.00	79.70	.09*
	SES×self-efficacy	21.80	26.10	.03

For step 1, $R^2=.01$, $F(3,505)=2.46$, $p=.06$; step 2, R^2 change=.23, F change (3,502)=50.24, $p<.001$; step 3, R^2 change=.01, F change (2,500)=2.36, $p=.10$.

*$p<.05$; **$p<.01$; ***$p<.001$

Table 4 Means, standard deviations, and intercorrelations for study 3 (physical activity) variables ($N=509$)

TPB variables	1	2	3	4	5	6	7	8
1. Age	–	−.17***	.05	.06	.10*	−.10*	−.10*	−.08
2. Gender		–	.04	−.01	−.08	−.05	.03	−.02
3. Socioeconomic status (SES)			–	.11*	.02	−.02	.07	.02
4. Past behavior				–	.44***	.23***	.16**	.07
5. Behavior					–	.27***	.20***	.08
6. Intention						–	.36***	.54***
7. Self-efficacy							–	.19***
8. Intention stability								–
Mean	41.90	1.55	1.39	1,140.00	1,910.00	4.97	5.50	−0.39
SD	10.70	0.50	0.49	1,270.00	1,670.00	1.66	1.61	1.52

*$p<0.05$; **$p<0.01$; ***$p<0.001$

lines at different levels of the moderator. For the interaction between SES and intention, we examined simple slopes for that portion of the sample classified as lower SES and higher SES as this was a dichotomous variable. These analyses (Fig. 2, upper panel) demonstrated that among lower SES participants, intention was unrelated to physical activity behavior (B=−16.10, p=.83), while among higher SES participants, intention was strongly related to physical activity behavior (B=184.00, p=.002). Thus, as predicted, the power of intention to predict physical activity 6 months later was stronger in higher compared to lower SES groups. Similarly, for the interaction between intention stability and intention, we examined simple slopes at three levels of the moderator, i.e., at low (mean−1 SD), moderate (mean), and high (mean+1 SD) levels of intention stability. These analyses (Fig. 2, lower panel) showed that the power of intention to predict physical activity behavior increased as the stability of intentions increased from low (B=89.10, p<.05), to moderate (B=197.00, p<.01), to high (B=305.00, p<.001). Thus, as predicted, the power of intention to predict physical activity 6 months later became stronger as intention stability increased.

Discussion

Study 3 provided further support for our predictions. In particular, an individual level measure of SES was shown to significantly moderate the relationship between intention and self-reported physical activity 6 months later after controlling for baseline physical activity and other predictors. Similar to studies 1 and 2, the impact of intention on behavior was greater in the higher compared to lower SES parts of the sample. These findings again support the idea that lower levels of SES may impede attempts to translate healthy intentions into healthy actions. Study 3 showed these effects to be present for a sample of working adults in relation to physical activity levels. No moderating effects were found for self-efficacy.

Study 3 also showed that the relationship between intention and physical activity was significantly moderated by levels of intention stability (measured prior to the measures of intention). Stronger intention–behavior relationships were observed for those with more stable intention. This finding supports a number of previous studies showing more stable intentions are better predictors of subsequent behaviors (e.g., [36, 37]). More pertinently, the moderating effect of SES on the power of intention to predict behavior did not appear to be explained by any impact on the stability of intention, i.e., a mediated moderation prediction. The inclusion of intention stability and the interaction between intention stability and intention had little impact on the power of the SES by intention interaction to predict behavior.

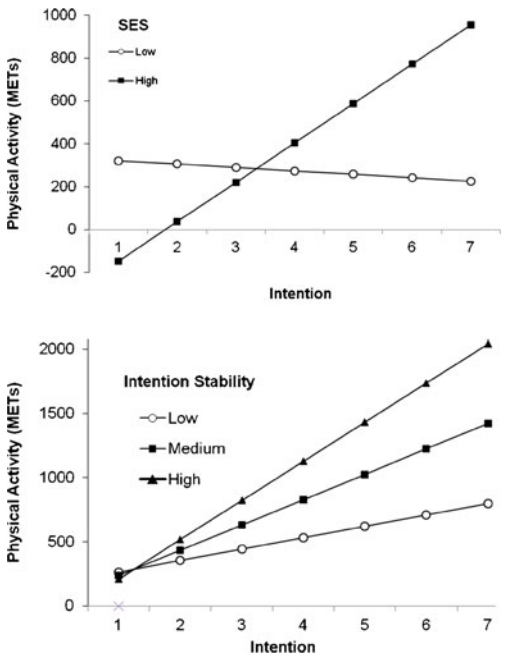

Fig. 2 Plot of simple slopes for study 3—physical activity showing relationship between intention and physical activity levels at different levels of SES (*upper panel*) or intention stability (*lower panel*)

General Discussion

Across the three studies that we observed, the same pattern of findings: SES moderated the intention–behavior relationship but not the self-efficacy-behavior relationship (Tables 2, 3, and 5). Exploration of these moderation effects (Figs. 1 and 2) showed the intention–behavior relationship to be attenuated in lower SES participants. This pattern was replicated across studies despite testing different behaviors (smoking initiation, breastfeeding initiation, and physical activity) in different samples (adolescents, pregnant women, and working adults), over different time intervals (2–24 months), using different measures of SES (school- or area-level statistics or individual-level occupational group), and controlling for other predictors of behavior including past behavior. This supports the potential generalizability of the effect. The observed SES moderation effect may contribute to explaining differences in the engagement with health behaviors across SES groups. Given engagement with health behaviors has been shown to explain differences in mortality [2, 14], the present findings may also contribute to understanding of differences in mortality rates across SES groups. In particular, the present findings suggest that the fact that individuals from lower SES groups are poorer at translating their healthy intentions into behavior may contribute to the poorer health outcomes they experience. Further empirical and theoretical work might usefully focus on

the factors underlying this moderating effect of SES on the relationship between intentions and behaviors [43, 44].

The failure to find any moderating effect of SES on the relationship between self-efficacy and behavior is also worth noting. Models such as the TPB suggest that perceived behavioral control (a similar measure to self-efficacy) influence behavior to the extent that they tap actual control over the behavior. If levels of SES tap constraints on behaviour, it is surprising that they do not also moderate the self-efficacy–behavior relationship. Although not directly assessed here, this could be attributable to the relationship between perceived and actual control varying across SES groups. It is also worth noting that SES and self-efficacy were unrelated in each of the studies (Tables 1 and 4). The lack of interaction effect also suggests the potential value of targeting self-efficacy for behaviour/population combinations where self-efficacy emerges as a predictor of behavior as our findings would suggest such an intervention might be equally effective in all SES groups.

The present research (study 3) confirmed a number of previous studies in showing a significant intention by intention stability moderating effect (e.g., [5, 36, 37]). Individuals with more stable intentions had intentions that were more predictive of behavior. Interestingly, the present data also showed that, unlike Godin et al. [5], this intention stability moderating effect did not mediate the moderating effect of SES on intention–behavior relationships. Thus, unlike a number of other moderators of the intention–behavior relationship [37], the impact of SES is not explainable by differences in stability of intentions across groups. The contrast with Godin et al. [5] may be attributable to the use of a more general measure of SES (i.e., education) in that study. Future research might usefully explore the factors that explain why lower SES individuals are less successful in translating their healthy intentions into healthy actions. These factors might include available economic resources such as available money, environmental constraints such as opportunity, or psychological resources such as self-esteem. One implication of this work is that interventions that promote intentions may be more effective for higher compared to lower SES groups, suggesting the value of targeting interventions at different SES groups. This might help explain why behavior change interventions that often target factors such as intentions (e.g., media campaigns) can lead to increases in inequalities because they produce more behavior change in higher compared to lower SES groups [45, 46]. In contrast, interventions succeeding in promoting the formation of stable intentions may be similarly effective in both lower and higher SES groups.

Four limitations of the present research should be acknowledged. First, both studies 2 and 3 used a single-item measure of intentions. Such measures do not allow us to assess internal reliability and potentially do not cover the full range of a construct. However, it is not necessarily the case that single-item measures are of low reliability. Indeed, single-item scales have been developed and shown to have good predictive validity for assessing constructs such as self-esteem [47]. Study 1, which employed a multi-item measure of intention, did not show substantively different findings to the other studies. Second, the time frame specified in the intention questions in both studies 1 and 3 did not exactly match the time frame of the behavior measures, although the match was greater in study 2. There is no specific reason to believe this problem would produce the effects observed here, although it would be useful to ensure that the effects can be replicated with measures where the time frames exactly match the period over which prediction takes place. Third, the behavior measures used in both studies 1 and 3 relied on self-report, although study 2 confirmed this effect with an objective behavior measure. Further confirmation of these findings with objective measures of behavior over a range of time intervals would be useful. Fourth, the measures of SES varied from individual (study 3) to area (study 2) or school (study 1) level depending on what was available in the particular studies. Future research might usefully more systematically explore the effects of using different SES measures on the observed relationships between health cognitions and behaviors.

In conclusion, the present study showed that SES moderated the relationship between intention and behavior, but not self-efficacy and behavior across three studies that varied in the behaviors, time intervals, samples, and SES measures used. These effects were observed despite controlling for other predictors of behavior such as past behavior. Those from lower compared to higher SES groups had intentions that were significantly weaker predictors of later health behaviors. This finding may help explain SES differences in health behaviors. It might also suggest weaker effects on health behavior change in lower SES groups for interventions only targeting intentions, although targeting self-efficacy may be equally effective in both groups. In lower SES groups, additional interventions to help overcome problems in effectively enacting healthy intentions may be necessary (e.g., implementation intentions [48]). The findings of study 3 would, however, suggest that if we can create stable positive intentions to engage in health behaviors, these may be effective in producing behavior change in both lower and higher SES groups. Research exploring the factors influencing intention stability is currently lacking although some research suggests targeting attitudes and self-efficacy as one way to promote stable intentions [36].

Conflict of Interest Statement The authors have no conflict of interest to disclose.

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