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Testing the hierarchy of effects model: ParticipACTION's serial mass communication campaigns on physical activity in Canada

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SUMMARY

The hierarchy of effects (HOE) model is often used in planning mass-reach communication campaigns to promote health, but has rarely been empirically tested. This paper examines Canada's 30 year ParticipACTION campaign to promote physical activity (PA). A cohort from the nationally representative 1981 Canada Fitness Survey was followed up in 1988 and 2002–2004. Modelling of these data tested whether the mechanisms of campaign effects followed the theoretical framework proposed in the HOE. Campaign awareness was measured in 1981. Outcome expectancy, attitudes, decision balance and future intention were asked in 1988. PA was assessed at all time points. Logistic regression was used to sequentially test mediating and moderating variables adjusting for age, sex and education. No selection bias was observed; however, relatively fewer respondents than non-respondents smoked or were underweight at baseline. Among those inactive at baseline, campaign awareness predicted outcome expectancy which in turn predicted positive attitude to PA. Positive attitudes predicted high decision balance, which predicted future intention. Future intention mediated the relationship between decision balance and sufficient activity. Among those sufficiently active at baseline, awareness was unrelated to outcome expectancy and inversely related to positive attitude. These results lend support to the HOE model, in that the effects of ParticipACTION's serial mass media campaigns were consistent with the sequential rollout of its messages, which in turn was associated with achieving an active lifestyle among those initially insufficiently active. This provides support to an often-used theoretical framework for designing health promotion media campaigns.

Key words: mass media; community intervention; population based; social marketing

INTRODUCTION

The widespread recognition of the health risks and associated public health burden of low levels of physical activity (PA) has stimulated the development of population-wide health promotion efforts. Informational strategies are an initial component of a comprehensive program for PA, by motivating and encouraging people to become active and providing tips on overcoming barriers to increasing PA (Task Force on Community Preventive Services, 2002). Other community-based approaches that have been found to be effective range from 'point of decision prompts' through complex multi-faceted community-wide interventions with multiple strategies and targeting changes at the individual, interpersonal, community/setting and societal/organizational levels (Task Force on Community Preventive Services, 2002). The effects associated with community-wide health promotion programs with a mass

communication component (Reger-Nash *et al*., 2008) and national mass media campaigns (Booth *et al.*, 1992; Wimbush *et al*., 1998; Hillsdon *et al*., 2001; Bauman *et al*., 2003; Cavill and Bauman, 2004; Craig *et al*., 2007) illustrate the utility of periodic mass health communication efforts as one in a mix of strategies to increase PA. Adopting and maintaining a physically active lifestyle is a complex behaviour change process and mass communication campaigns have been employed in an attempt to initially encourage individuals in this process. Understanding the impact of mass campaigns requires further exploration of some of the theory underpinning the putative outcomes of mass-reach communications campaigns. An opportunity to do this exists in Canada, where ParticipACTION was launched in 1971 'to motivate all Canadians be more active and to improve general levels of fitness over the long term' (Edwards, 2004). ParticipACTION is one of the longest running mass health promotion campaigns in the world, with messages appearing regularly on 350 television and cable stations, and an estimated 580 radio stations, and various print media including 110 daily and 950 community newspapers (Edwards, 2004).

In 1971, social marketing for health was not well developed as a discipline (Kotler and Zaltman, 1971), although it is now well established in health promotion (Smith *et al*., 2006). Moreover, mass campaign evaluation strategies are now well developed (Cavill and Bauman, 2004; Bauman *et al*., 2006). One proposed model of media campaign effects is that they result, at least in part, from a 'cascade', from initial short-term campaign awareness through intermediate effects on perceptions, attitudes and beliefs, that are dependent on the messaging strategy (McGuire, 1984; Cavill and Bauman, 2004). Finally, long-term effects include trialing PA, and the long-term adoption and maintenance of an active lifestyle. This model is widely used in mass media campaign planning, but has seldom been empirically tested in population-level research.

A *post hoc* analysis described the sequencing of ParticipACTION's mass media messages during its first two decades of operation (ParticipACTION Archive). In the initial phase, 1973–1975, the main focus of the campaign was to influence outcome expectancy through ParticipACTION's tagline, 'the Canadian movement for personal fitness', and its messages (Table 1). Messages were also designed to influence knowledge and social norms. In the late 1970s, campaigns reinforced outcome expectancy and social norms. However, despite a few messages such as 'low cost' and depictions of adults playing like kids, it was primarily the 'Walk a block a day', and 'Fitness now' campaigns in the mid-late 1970s that attempted to influence attitudes and decision balance for PA. With the inclusion of a few messages to shape knowledge, the mid-phase from 1981–1985, represented a call to action through its 3-year long 'Do it! Campaign'. It paired the overall 'do it' message with messages reinforcing social outcomes and attitudes. In summary, the sequencing of messages through the rollout of ParticipACTION's campaigns could be theoretically characterized as 'campaign awareness' leading to outcome expectancy, in turn leading to positive attitudes, then decision balance and finally intention to be active.

ParticipACTION's name and logo are recognized by most Canadian adults (Bauman *et al*., 2004). Yet it is not known if the campaign impact was limited to those receptive to its promotional messages, such as those already more active. Therefore, the purpose of this paper is to examine the communication effects proposed by the hierarchy of effects (HOE) model associated with ParticipACTION's sequential introduction of campaign messages, and whether any effects on PA behaviour and its antecedents were observed among those insufficiently and sufficiently physically active at baseline.

METHODS

Sample

Participants were respondents of the 1981 Canada Fitness Survey (CFS) and its two prospective follow-ups, the 1988 Campbell Survey on Well-Being in Canada (CSWB) and the September 2002 to April 2004 Physical Activity Longitudinal Study (PALS). Details of the sampling method, protocol, attrition and potential biases have been published elsewhere (Craig *et al*., 2005). Briefly, the CFS ($n = 23\,500$ aged 7 and older) was a randomly selected multi-stage, cluster sample of the non-institutionalized population. The PALS cohort was established as a 20% subsample of CFS participants. As such, the CSWB follow-up

Table 1: Constructs associated with ParticipACTION's television and radio messages

Campaign[a]	Messages	Probable construct[b]
60 year Swede 1973	Poor fitness level of Canadians; Get Canada moving	Outcome expectancy
Canada's kids 1973	Fitness decreases as early as 6; Obesity & postural defects increasing	Heath beliefs
	Canadian movement for personal fitness; Get moving	Outcome expectancy
Food for thought 1974	Get into shape & your body works better; Movement for personal fitness, you will be a better person for it	Outcome expectancy
Word association 1974	Overcome fear of exercise; Low cost; Ways you can like it	Attitude
	Many ways to get active and be healthy	Decision balance
	Movement for personal fitness you will be a better person for it	Outcome expectancy
Road Hockey (1975)	Adult playing and having fun like a child	Attitude
	Sleep better and feel better	Outcome expectancy
Motivated 1975	Squeezing in PA is a question of motivation–Funeral director ad	Intention
Walk a block 1975	Walk a block a day it's a beginning; It's an easy way to get a little fitter	Attitude
	Taxi ad—convenient; Standard block ad—easy	Decision balance
	Walking the beat ad—exercises legs and that exercises the heart	Outcome expectancy
Tennis racket 1976	Exercise 3–4 times a week	Knowledge
	Getting in shape is not as hard as you think	Attitude
Scream 1976	Get active 3 times a week;	Knowledge
	Get fit feel better;	
	Scream to feel better	Outcome expectancy
Fat to fit 1979	Go to fit from fat; Be active and get into shape	Outcome expectancy
	Canadians are into fitness now	Social norm
Fitness now 1979 (rollerskating)	Hate exercise—take up something you like	Decision balance
	Canadians are into fitness now	Social norm
Harvey lasy bones 1981	Get back into action; Get back into shape	Outcome expectancy
Don't just think about it do it 1983–1985	Don't just think about it do it; Let's see you do it; Get with the action	Intention (Call to action)
	Do it for your muscles; You look strong and healthy	Outcome expectancy
	Not fatiguing	Attitude
Challenge, 1985	Our community, fitness in the nation	Social norm
	Have fun	Attitude
	We can win-let's see us, do it	Intention
Skating 1984	Canada's outdoors the greatest fitness facility in the world	Social norm
	Let's see you do it.	Intention

[a]ParticipACTION Archive Project.
[b]The construct was determined *post hoc* by examining the content of the message.

($n = 4200$) was also a randomly selected multi-stage, cluster sample of the non-institutionalized population. Respondents to both the CFS and CSWB completed self-administered questionnaires and fitness measures conducted within their homes. Subsequent to the CSWB, new family members were added to the cohort. The current study was limited to those 13 years or older in 1981 who answered all pertinent 1981 ($n = 3313$) and 1988 questions ($n = 2462$). Of these participants, 1247 responded in 2002–2004 to a mailed survey. Although no selection bias was evident, examination of the follow-up data revealed that fewer respondents smoked or were underweight at baseline compared to non-respondents (Craig *et al*., 2005). PALS was approved by the Ethics Review Board of the University of Montreal. In 1981, 1988 and 2002–2004, informed written consent was obtained either from a parent or guardian or directly from participants 18 years and older.

Measures

Awareness of ParticipACTION was asked as prompted recall of its logo (Have you ever seen this logo? Yes/no/don't know) reproduced in the 1981 self-administered questionnaire. In 1988, additional questions operationalizing outcome expectancy, attitudes, decision balance and future intention were asked by self-administered questionnaire. Outcome expectancy was assessed by 'How much does (or would) participation in vigorous physical activity help you to', followed by 17 itemized outcomes on a Likert scale from 1 'a great deal' to 5 not at all' (Stephens and Craig, 1990). The six items that probed aspects contained in ParticipACTION's messages (feel better physically; feel better mentally; improve/maintain overall fitness; improve/maintain cardiovascular fitness; improve/maintain muscular strength and endurance; improve/maintain flexibility) were summed to create an overall score (Cronbach $\alpha = 0.92$) and categorized as high ($\leq$12, equivalent to providing the highest or second highest rating on the 5-point scale for each of the six items), medium (13–23) or low ($\geq$24). Attitudes were characterized using a 5-point scale with bipolar anchors (fun/boring; harmful/beneficial; pleasant/unpleasant; inconvenient/convenient; painful/not painful; difficult/easy). Responses were dichotomized as positive (1 or 5 depending on the item) or not and a sum of at least four positive items were considered a high positive attitude (Cronbach $\alpha = 0.77$). High decision balance was defined as strong agreement with the statement 'if you wanted to, you could easily participate in vigorous PA 3 or more times a week for at least 20 minutes at a time'. Finally, future intention to participate in vigorous PA in the following year was asked (never; less than once a week; one to two times per week; three times per week, four to five times per week; six or more times a week).

PA was asked using adaptations of the Minnesota Leisure-Time Physical Activity Questionnaire (Taylor *et al*., 1978) with reasonable criterion validity and good one month test–retest reliability (Craig *et al*., 2002). The follow-up version reduced the number of activities probed, eliminated the use of a prompt card to aid in the recall of physical activities and changed the recall of occasions from number per month for each of the 12 previous months to number in the year, but these change did not impact comparability of the instruments (Craig *et al*., 2002). A weekly MET-minute score was calculated by summing the products of occasions by duration per occasion in minutes by the standard metabolic cost of each activity reported and then dividing by 52 (Craig *et al*., 2004). 'Sufficient physical activity' was defined as accumulating at least 1260 MET-minutes, an amount equivalent to 1 h of moderate-intensity walking daily (Craig *et al*., 2004).This cut point is consistent with the hour a day of PA recommended in Canada's Physical Activity Guideline, but higher than the widely used minimal recommendation of at least '30 minute of moderate intensity activity on 5 days a week' (Haskell *et al*., 2007).

Participant's age at baseline in 1981 was categorized as: 13–24 years; 25–44 years and 45 years and older. Educational attainment was classified as the highest level of education reported by follow-up in 2002–2004 (less than secondary, secondary, some post secondary, university).

Analysis

Logistic regression was used to test the cascade of communication effects according to the rollout of ParticipACTION messages, with age, sex and education as covariates. In order to examine the individual effects posited by the model, a series of sequential models was tested

for those 'insufficiently active for health' and for those 'sufficiently active' at baseline. Subsequently, moderation and mediation of effects among all participants were tested using the method of Baron and Kenny (Baron and Kenny, 1986). A variable was tested as a moderator by determining if there was a significant interaction effect between it and the preceding predictor in the model. A variable was determined to be a mediator if: (i) the proposed mediator was a significant predictor of the subsequent variable in the model; (ii) the preceding variable in the model predicted both the proposed mediator and the subsequent variable in the model and (iii) when including both the preceding variable and the proposed mediator in the model, the preceding variable was no longer a predictor. All analysis was performed using SPSS version 15 with Holm adjustments applied during inference to limit the occurrence of Type 1 errors due to the number of tests required (Aickin and Gensler, 1996; Bender and Lange, 2001). The reported results were based on all data points available; results did not differ when restricted to participants with data at all time periods.

RESULTS

In total, 1106 males and 1356 females participated in the 1988 follow-up. These represented 692 individuals aged 13–24 years; 1138 aged 25–44 years and 632 aged 45 years and older. The majority had some post-secondary ($n = 854$) or university education ($n = 614$) with 446 having secondary and 470 having less than secondary education. Similar patterns in the distribution of characteristics were seen in 2002–2004 with respect to sex ($n = 495$ males, 631 females), but the distribution of baseline age group ($n = 338$ aged 13–24 years; 610 aged 25–44 years; 178 aged 45 years and older) and education (131, less than secondary; 190, secondary; 439, some post-secondary, 361, university) reflected the higher relative loss to follow-up of those in the 45 years and older age group.

Table 2 shows the likelihood of being aware of ParticipACTION at baseline, intending to be active regularly in the 12 months following 1988 and of being sufficiently active in 2002–2004, adjusting for demographic factors. At baseline, the likelihood of recognizing ParticipACTION's logo was lower among those older than 25 years compared to the youngest age group and was higher among those who completed at least secondary school. A similar pattern was found in 1988 with respect to intention to participate in vigorous activities at least three times weekly. In the 2002–2004 follow-up survey, females were 27% less likely than males to accumulate sufficient activity, but no relationship with age at baseline or educational attainment was observed.

Most participants recalled the ParticipACTION logo at baseline and had high outcome expectancy scores at the first follow-up (Table 3). A higher percentage of initial, intermediate and longer term outcomes were observed among those

Table 2: Socio-demographic correlates of 1981 awareness, 1988 intention and 2003 physical activity level

	Aware of ParticipACTION 1981 ($n = 2462$)		Intend to be active 3 or more times weekly 1988 ($n = 2462$)		Sufficiently active 2003 ($n = 1126$)	
	%	AOR[a]	%	AOR[a]	%	AOR[a]
Males	87	Referent	40		38	
Females	88	1.13 (0.85, 1.50)	39	1.02 (0.87, 1.20)	30	0.73 (0.57, 0.93)
Age group in 1981						
13–24 years	97	Referent	47		34	
25–44 years	93	0.46 (0.27, 0.76)	40	0.74 (0.62, 0.92)	34	0.98 (0.74, 1.30)
45 years and older	73	0.14 (0.08, 0.23)	31	0.62 (0.48, 0.79)	33	0.96 (0.64 1.43)
Education						
<secondary	75	Referent	28		29	
Secondary	90	1.85 (1.21, 2.83)	37	1.33 (0.99 1.76)	30	0.88 (0.54, 1.44)
Some post secondary	92	2.08 (1.44, 3.01)	41	1.54 (1.20, 1.99)	32	0.95 (0.62, 1.46)
University	92	1.79 (1.19, 2.69)	48	2.06 (1.58, 2.69)	40	1.36 (0.88, 2.10)

[a]Adjusted for age, sex and educational attainment.

Table 3: Potential communication effects among those insufficiently and sufficiently active at baseline

	Insufficiently active at baseline (1981) % (95% CI)	Sufficiently active at baseline (1981) % (95% CI)
Recalled ParticipACTION logo (1981)	89.8 (88.4, 91.1)	92.6 (90.2, 94.5)
High outcome expectancy score (1988)	71.8 (69.7, 73.8)	78.8 (75.4, 81.9)
High positive attitude (1988)	17.0 (15.4, 18.8)	23.9 (20.6, 27.5)
High decision balance score (1988)	41.8 (39.6, 44.1)	52.8 (48.7, 56.8)
Intend to be active in vigorous activity ≥3 weekly (1988)	35.7 (33.5, 37.9)	53.6 (49.6, 57.6)
Sufficiently activity at follow-up (2002–2004)	29.4 (26.5, 32.6)	48.4 (42.5, 54.3)

Table 4: Cascading communication effects among those insufficiently and sufficiently active at 1981 baseline

	Communication effects among those insufficiently active (1981) AOR[a] (95% CI)	Communication effects among those sufficiently active (1981) AOR[a] (95% CI)
Aware (1981)→Outcome expectancy (1988)	($n = 1866$)	($n = 595$)
Not aware	Referent	
Moderate outcome expectancy	1.7 (0.87, 3.36)	1.7 (0.35, 8.67)
High outcome expectancy	1.9 (1.01. 3.56)*,**	3.3 (0.76, 14.20)
Outcome expectancy (1988)→positive attitude (1988)	($n = 1866$)	($n = 595$)
Low outcome score	Referent	
Moderate outcome score	3.8 (0.90, 16.33)	0.5 (0.12, 2.31)
High outcome score	11.2 (2.71, 46.59)**,****	1.6 (0.39, 6.20)
Positive attitude (1988)→decision balance (1988)	($n = 1866$)	($n = 595$)
Lower attitude score	Referent	
High positive attitude score	2.9 (2.24–3.74)**,*****	3.3 (2.12, 5.00)**,*****
Decision balance (1988)→intention (1988)	($n = 1866$)	($n = 595$)
Lower decision balance score	Referent	
High decision balance score	5.1 (4.07, 6.16)**,*****	3.5 (2.44, 4.89)**,*****
Intention (1988)→sufficiently active (2002–4)	($n = 1404$)	($n = 480$)
Less than 3 times weekly	Referent	
3 or more times weekly	2.1 (1.59, 2.89)**,*****	4.0 (2.32, 6.74)**,*****

[a]Adjusted for age, sex and educational attainment.
*$p<0.05$ prior to Holm's adjustment for multiple comparisons.
**$p<0.05$ after Holm's adjustment for multiple comparison.
***p<0.001 prior to Holm's adjustment for multiple comparisons.
****$p=0.000$ prior to Holm's adjustment for multiple comparisons.

sufficiently active compared to those insufficiently active at baseline in 1981. This was true for all outcomes: 1981 logo recall; 1988 high outcome expectancy; high positive attitude; high decision balance score, intention to be active at least three times a week in the subsequent year and sufficient activity at follow-up (2002–2004).

Table 4 shows the cascade of communication effects analysed separately for those 'insufficiently' and 'sufficiently' active at baseline. Each of the following relationships among those 'insufficiently active' at baseline were significant: 1981 awareness led to outcome expectancy that predicted positive attitude, then decision balance, then intention and finally led from intention to 'sufficient activity' (2002–2004). In contrast, among those sufficiently active at baseline, awareness did not predict outcome expectancy, nor did outcome expectancy predict positive attitude. However, all other relationships further down the hypothesized cascade of effects were significant. As social norm was not measured, the pathways from awareness to social norms and subsequent predictors could not be tested.

Figure 1 summarizes these communication effects, and associates them with the timing of ParticipACTION's campaigns, after testing each variable in the cascade for moderation and mediation. All variables were independent predictors and none were moderators. (That is, outcome expectancy and positive attitudes were independent predictors of high decision balance with no interaction effect between the two;

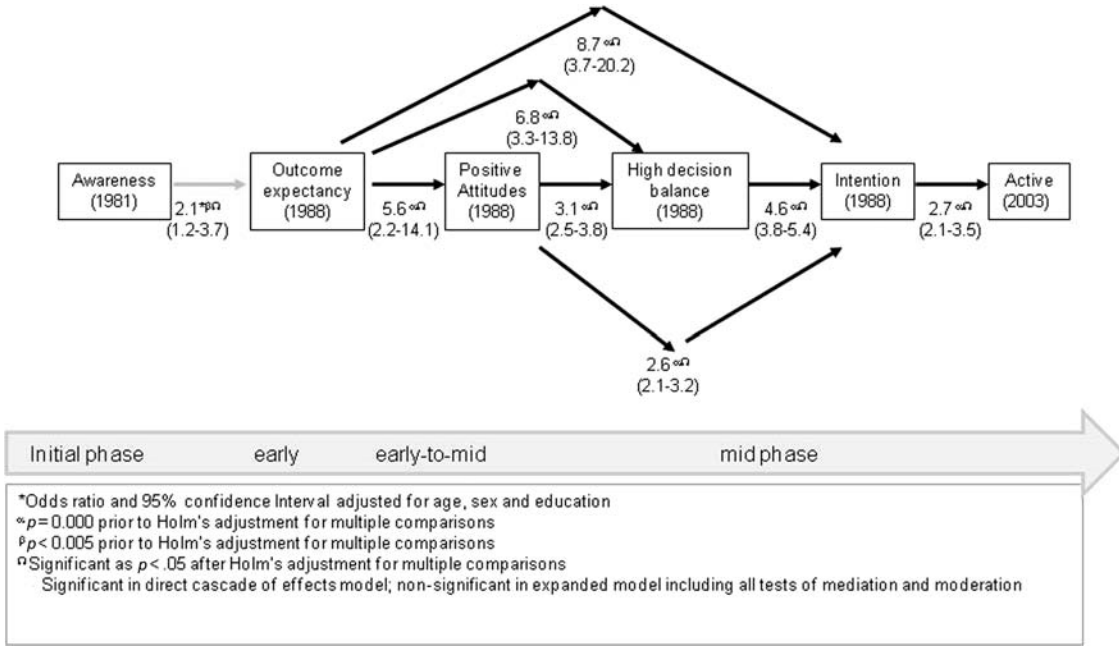

Fig. 1: Post hoc analysis of the hierarchy-of-effects model associated with ParticipACTION's messaging.

outcome expectancy and positive attitudes were significant predictors of future intention with no interaction; and so on.) As a result of testing mediation, it was found that positive attitudes did not mediate the relationship between high outcome expectancy and high decision balance. Similarly, neither positive attitudes nor high decision balance mediated the relationship between high outcome expectancy and future intention. Furthermore, having a high decision balance did not mediate the association between having a high positive attitude and future intention to be active. However, future intention (1988) mediated the relationship between a high decision balance score in 1988 and being sufficiently activity in 2002–2004 (decision balance→sufficient activity, AOR 1.47, 95% CI 1.14–1.88, $p < 0.003$); (decision balance→sufficient activity controlling for future intention, AOR 1.03, 95% CI 0.78–1.35, $p = 0.85$).

DISCUSSION

This study examined an often-used but little tested theoretical HOE model, which proposes a cascade of cognitive and behavioural effects following mass-reach social marketing campaigns (McGuire, 1984; Cavill and Bauman, 2004; Bauman *et al*., 2008). This is an important contribution to understanding the theory underpinning effects observed following health promotion campaigns. We found that the observed relationships between variables associated with ParticipACTION's campaign timing lend some support to the model of cascading communication effects. ParticipACTION sequentially introduced new messages while reinforcing earlier messages. It is not surprising, therefore, to observe relationships between earlier variables in the cascade and ones further down the hierarchy. It is interested to note that a model of cascading communication effects was a better fit among the target audience, those 'insufficiently active' at baseline, than among those already sufficiently active.

One concern in mass communications to increase PA may be whether the communication effects are observed among the primary target audience, those who are insufficiently active, or only among those already active. At baseline, recall of ParticipACTION was quite high among both the insufficiently and sufficiently active. This suggests that ParticipACTION campaign was effective in reaching all Canadians so that those recalling the messages were not simply those 'predisposed' to paying attention to a

message about PA. The subsequent pattern of communication effects was similar between these two population groups; however, only the effects in the hierarchy from positive attitude to high decision balance through future intention to sufficient activity at follow-up were significant among those sufficiently active at baseline. The lack of relationship between recall and outcome expectancy and outcome expectancy and positive attitude may be due in part to the smaller sample size. Other possible explanations may include potentially higher levels of outcome expectancy and positive attitude among those active so that messaging to overcome barriers and alter elements of decision balance may have been more relevant to this audience and therefore represented a more appropriate starting point for assessing the cascade of effects. The appropriate targeting of initial messages to various population segments lies outside the realm of this study and warrants future investigation.

Similar to these results, earlier evaluations of campaigns to increase PA among adults found changes in the proximal communication effects posited by the HOE model (Bauman *et al*., 2001; Hillsdon *et al*., 2001; Reger-Nash *et al*., 2002; Craig *et al*., 2006). In Australia (Bauman *et al*., 2001) and the USA (Reger-Nash *et al*., 2002), campaigns have demonstrated changes in awareness, knowledge of PA and sometimes, in short-term PA. In the UK, increases in knowledge were associated with campaign timing, but were not directly attributable to recall of the campaign (Hillsdon *et al*., 2001), whereas in Scotland (Wimbush *et al*., 1998) changes were observed in beliefs as well as knowledge and these were associated with recall. In Canada, awareness and ownership of pedometers was associated with recall of a campaign to increase walking through pedometer use (Craig *et al*., 2006). In contrast, findings related to the more distal impact of campaigns on PA are equivocal: increases in walking were found in an earlier Australian campaign (Booth *et al*., 1992) and those in Canada (Craig *et al*., 2007) and the USA (Reger-Nash *et al*., 2002), but not in the later Australian campaign (Bauman *et al*., 2001), and not the ones in the UK (Wimbush *et al*., 1998; Hillsdon *et al*., 2001). However, these studies were not designed as a test of HOE. One of the two previous studies testing the HOE found some support for the model in the evaluation of the VERB campaign targeting young adolescents (Bauman *et al*., 2008). Among this group of young teenagers, awareness led to an increase in understanding, which in turn led directly to behaviour change bypassing other hypothesized mediators in a cascade of effects model. An evaluation of the adoption of family planning methods in Tanzania found that a cascade of effects model was useful in determining the effects of the campaign in moving groups of people through a stages of change process toward adoption (Vaughn and Rogers, 2000). The present study further adds to this literature by examining the applicability of the HOE in evaluating communication effects associated with individual adult behaviour change resulting from a long-term mass media campaign in Canada.

One limitation of the study was the length of time between exposure to the messaging and follow-up. For example, among those who were sufficiently active at baseline, no relationship was observed between awareness of the early campaigns and its early messaging. It may be that those sufficiently active at baseline already had a higher degree of outcome expectancy associated with PA than those insufficiently active and that the early messages served to reinforce their existing outcome expectancies rather than shape them. Alternatively, it is possible that those active at baseline were positively influenced by the early campaigns prior to measurement of the variables. In addition, the vigorous activity message that permeated society in the 1980s and was reflected in the 1988 items was later superseded by national recommendations of more moderate-intensity PA (Health Canada & Canadian Society for Exercise Physiology, 1998; Haskell, 2007). Therefore, the results provide support for potential mediation of intervening variables, but more frequent follow-up assessments would have been needed for definitive assessment of mediation.

Although its initial focus was to improve fitness, as the ParticipACTION's goal suggests, campaign messages were primarily promoting participation in PA. Messages in the first two decades were to portray PA as 'fun' with only a few disease-oriented messages. Therefore, most Canadians would have understood the brand as a single behaviourally focused and recognizable campaign (Bauman *et al*., 2004).

Increasing individual motivation through sustained mass communication campaigns is not

the only pathway to becoming more active. Ecological models provide a framework for understanding the interrelationships of individual, social and physical environmental factors resulting in a myriad of other pathways influencing PA levels. As a result of this complex interplay of messages, strategies and programs in Canada, reported leisure time PA has increased in Canada over the 20-year period covered by this study (Craig *et al*., 2004). Given this shift and the cascade of potential communication effects observed particularly among the insufficiently active, it appears that sequential messages may have contributed, at least in part, to the overall changes in population-level PA. This supports the contention that media messages may positively contribute to sustained efforts at achieving population-level change (Cavill and Bauman, 2004). These findings further suggest that the HOE model may indeed be useful in planning and evaluating serial population-level health promotion campaigns, and help us better understand the ways in which sustained social marketing campaigns may influence population awareness of an issue, create a predisposition to change and contribute to increased levels of PA, especially for those insufficiently active.

Conflict of interest. C.L.C. been involved on various committees and advisory groups for ParticipACTION. The Canadian Fitness and Lifestyle Research Institute (CFLRI) was previously contracted by the ParticipACTION to perform research and surveillance—C.L.C. is President of CFLRI but received no personal compensation for the contracted work.

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