Using an Analytic Framework to Identify Potential Targets and Strategies for Ecologically Based Physical Activity Interventions in Middle Schools

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The objective was to demonstrate the value of applying an ecological analytic framework to formative data in conjunction with ecological planning frameworks (e.g., intervention mapping) to ensure a high degree of ecological program integration as illustrated through a physical activity program for students in middle school. Eight focus groups were conducted with 38 students in four schools to examine student perceptions of who or what in their school made it easy or difficult for students to be physically active. Qualitative data were used to identify potential intervention targets according to the analytic framework. Frequency analysis revealed that most identified physical activity barriers/facilitators were associated with organization (59.4%) targets. Five different intervention strategies were identified, with organizational modification being most popular. Applying the analytic framework to formative data enabled us to identify potential targets, strategies, and activities for an ecologically based physical-activity-promotion program relevant to the priority population.

Keywords: *ecological framework; planning tool; schools; physical activity*

Health Promotion Practice
Month XXXX Vol. X, No. X, xx-xx
DOI: 10.1177/1524839906295886

Ecological models have been advocated for the design and implementation of health promotion programs (Grzywacz & Fuqua, 2000). Ecological approaches to health promotion recognize the dynamic interaction between the individual and elements of their social and physical environments (Green, Richard, & Potvin, 1996; McLeroy, Bibeau, Steckler, & Glanz, 1988; Sallis & Owen, 2002; Stokols, 1992, 1996). Practitioners attempting to design and implement health promotion programs consistent with an ecological approach can make use of planning frameworks such as PRECEDE-PROCEED (Green & Kreuter, 1999) or intervention mapping (Bartholomew, Parcel, Kok, & Gottlieb, 2006).

Physical inactivity is associated with a multitude of negative health outcomes including type 2 diabetes, cancer, stroke, and cardiovascular disease (Bouchard, Shephard, & Stephens, 1994). In children and youth, evidence exists linking physical inactivity with increases in cardiovascular heart disease risk factors (Katzmarzyk, Malina, & Bouchard, 1999), obesity (Tremblay & Willms, 2003), and psychological health complaints (Janssen, Katzmarzyk, Boyce, & Pickett, 2004). Despite known health risks, more than half of children in Canada are deemed not active enough to receive health benefits (Craig, Cameron, Russell, & Beaulieu, 2001), thus making them a priority intervention population.

Authors' Note: *This article was written while the lead author was a doctoral student in the School of Kinesiology and Health Studies, Queen's University, Kingston, Canada under a Social Sciences and Humanities Research Council of Canada doctoral fellowship (No. 752-2003-1338).*

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For children and adolescents, schools represent one possible setting in which to influence physical activity. Organizations and researchers have argued that schools should play a role in promoting physical activity, especially because schools can reach most children regardless of background (Craig et al., 2001; Grantham, 1998; McKenzie, 1999; Wechsler, Devereaux, Davis, & Collins, 2000). Sallis and Owen (2002) have suggested that interventions to promote physical activity involvement based on the multilevel view inherent to an ecological approach may be more effective than interventions with a more limited intrapersonal focus. Planning frameworks such as PRECEDE-PROCEED (Green & Kreuter, 1999) and intervention mapping (Bartholomew et al., 2006) subscribe to an ecological approach to health promotion, and, in the case of intervention mapping, explicitly conceptualize ecological intervention settings and targets. Missing from the practitioner's toolbox is a tool to ensure a high degree of ecological integration for intervention programs in advance of program development.

We aim to illustrate the value of using Richard and colleagues' analytic framework (Richard, Potvin, Kishchuk, Prlic, & Green, 1996) in conjunction with ecological planning frameworks, such as intervention mapping, to ensure a high degree of ecological program integration, as illustrated through a physical activity program for students in middle schools.

BACKGROUND LITERATURE

The theoretical basis for ecological approaches to health promotion programming has been established (Green et al., 1996; McLeroy et al., 1988; Stokols, 1992, 1996). Social-ecological models acknowledge the interplay between personal and environmental factors and specifically posit that behavior is shaped by multiple levels of influence (e.g., intrapersonal, social and physical environment, policy; Sallis & Owen, 2002). Social-ecological models have roots in areas such as psychology and health (for a review of historical roots of social ecological models, see Sallis & Owen, 2002), and early conceptualizations of ecological models include system approaches by Bronfenbrenner (1977, 1979) and Miller (J. G. Miller, 1978; J. L. Miller & J. G. Miller, 1992). Bronfenbrenner's ecology of human development characterizes the ecological environment as a series of hierarchical structures called the microsystem, the mesosystem, the exosystem, and the macrosystem, each nested within the other. However, the Millers' living systems theory depicts all living systems "at eight levels of increasing complexity: cells, organs, organisms, groups, organizations, communities, societies, and supranational systems" (J. L. Miller & J. G. Miller, 1992, p. 1). Flood (2001) further discussed the origins of social-ecological models within systems thinking in the context of action research. In general, systems thinking counters the perspective of reductionism by suggesting that there is value in examining the whole system and not just parts that comprise the whole system (see Emery, 1969 for a more complete review of systems thinking; Flood, 2001). Overall, this early work by Bronfenbrenner and J. G. Miller served to inform the development of various later models also aimed at identifying and conceptualizing key elements of the ecological approach (e.g., Green & Kreuter, 1999; Richard et al., 1996; Sallis & Owen, 2002; Simons-Morton, Simons-Morton, Parcel, & Bunker, 1988; Stokols, 1996).

Since then, the interest toward systems thinking has not faded, and health promotion authors such as Best and colleagues (Best, Moor, et al., 2003; Best, Stokols, et al. 2003) have recently proposed new reflections and conceptualizations based on a systems-thinking conceptualization in health promotion. Several health promotion planning frameworks, such as PRECEDE-PROCEED (Green & Kreuter, 1999) and intervention mapping (Bartholomew et al., 2006) in particular, strive to provide health promotion practitioners with a guide to ecological health promotion program development. In so doing, these frameworks accommodate the dynamic interaction between persons and multiple levels of their environment. Intervention mapping is a planning framework that provides researchers and practitioners with a series of iterative steps that identify the specific processes involved during planning, implementation, and evaluation of evidence and theory-based interventions (Bartholomew et al., 2006). Bartholomew and colleagues (2006) borrow from Green and Kreuter (1999) by using the PRECEDE model in the first step of intervention mapping and conducting a needs assessment of the priority population to investigate individual and environmental determinants of a given health behavior. Intervention mapping uses the

three core processes of (a) reviewing the empirical evidence, (b) using theory, and (c) collecting new data during the multistep development of the intervention, which includes conducting a needs assessment, program planning, implementation, and evaluation (Bartholomew et al., 2006). The latter process is deemed important to fill gaps between literature/theory and perceived needs of the population.

Bartholomew et al. (2006) have suggested that what is learned from needs assessment should serve to inform intervention objectives and that these objectives should be established at each of the recognized ecological levels. Similar to Richard et al., (1996), intervention mapping makes the levels of the environment explicit for the health practitioner noting interpersonal, organizational, community, and societal levels of environmental influence.

Formative research is touted as an important method in conducting needs assessments (Helitzer-Allen & Kendall, 1992), serving to inform intervention development (Gittelsohn et al., 2006). Newes-Adeyi, Helitzer, Caulfield, and Bronner (2000) are among few researchers who have used ecological models to process formative data to inform health promotion program design. They specifically applied an ecological model to formative data that assesses individual, interpersonal, and organizational influences on behavior to develop training programs. Although this represents a first and essential step to enhancing the integration of an ecological approach within a given intervention program, it would be useful if health promotion practitioners could also assess and control the *degree* of integration of an ecological approach in their health promotion program. This would enable health promotion practitioners developing programs to determine whether their planned program is "ecological enough." Using the components of intervention targets, settings, and strategies, Richard and colleagues (1996) developed an algorithm to evaluate the extent to which a program can be deemed ecological.

Based on McLeroy et al.'s 1988 model, Richard et al. (1996) have highlighted five possible intervention targets including individual (IND), interpersonal environment (INT), organization (ORG), community (COM), or political systems (POL). Borrowing from J. G. Miller (1978), four possible intervention settings are organizations (e.g., school, community center), communities (e.g., city municipality), societies (e.g., provinces, states, countries with power over various aspects of individual lives), and supranational systems (e.g., associations of two or more societies such as North America). Figure 1 depicts a schema of the Richard et al. ecological analytic framework for health promotion.

Richard et al. (1996) define intervention strategies as the interaction between the program and target(s) designating a process by which the target can be modified either directly or through the formation of networks. For example, a direct intervention strategy to promote physical activity involvement in the individual could entail educating students about the benefits of physical activity. A direct relationship is denoted graphically by an arrow linking the health promotion team (HP) to the individual (IND) ultimate target(s), HP → IND. Targeting of the individual could also occur through attempts to change an intermediate target. For example, lobbying the government (POL) to implement quality daily physical activity in all schools (ORG) would be depicted by the following strategy: (HP → POL → ORG → IND). A network intervention strategy seeks to establish contact between multiple targets to effect change in an ultimate target. Organizing a forum for schools to brainstorm and share ideas [ORG → ORG] to increase physical activity for students at school is an example of a network approach. Brackets are used to specify a relationship between targets thus denoting a network strategy. The preceding example would thus be depicted as HP → [ORG-ORG] → IND. Richard et al. (1996) have suggested that the more a program includes direct and indirect intervention strategies over multiple targets across a variety of intervention settings, the more ecological it is. An inventory of potential strategies to include in a physical-activity health promotion program in schools is presented in Table 1.

According to Richard et al.'s (1996) algorithm (see Table 2), programs can be scored on a continuum from 0 to 4 to reflect the degree of integration of the ecological approach. A score of 0 is given to programs using only one intervention strategy regardless of the number of settings. A score of 1 is attributed to programs using a minimum of two different strategies that do not include an HP → IND strategy. The number of settings does not influence this score. Scores of 2 through 4 are earned by programs implementing at least two strategies (one of which includes an HP → IND) used in one, two, three or more settings, respectively. A program scoring a 3 could, for example, have strategies targeting the individual (HP → IND) and an organization (HP → ORG → IND) in two different settings: community and organization.

Evaluation of several funded health promotion programs in Canada using this algorithm show that 75% of the programs received a score of 2 or less, indicating a low level of ecological integration (Richard et al., 1996). The integration of the ecological approach has also been evaluated in a physical-activity intervention program (Lévesque, Guilbault, Delormier, & Potvin, 2005), a heart health program (i.e., The North Karelia Project; Lévesque et al., 2000), and tobacco control programs (Richard,

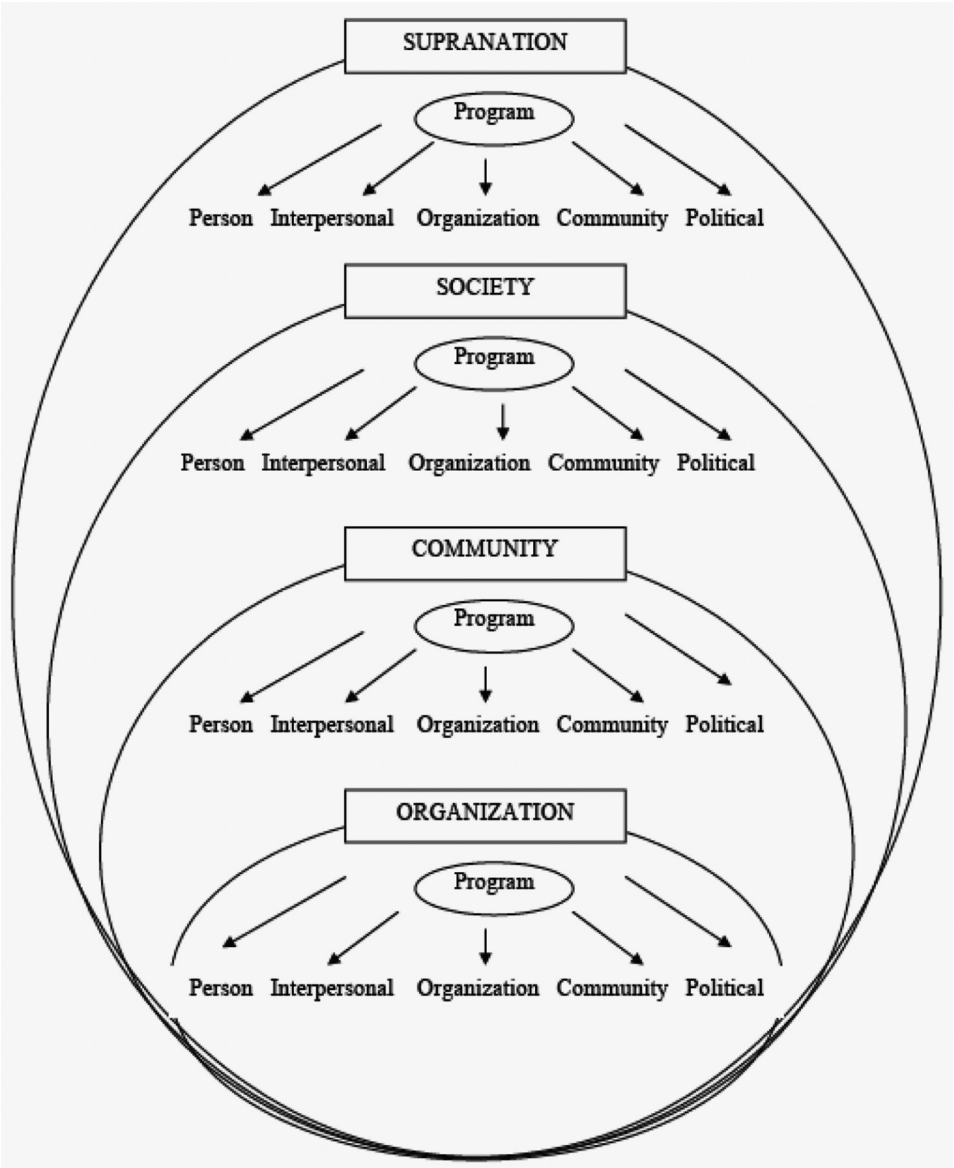

FIGURE 1 Schemata of the Ecological Approach in Health Promotion Programs
SOURCE: Adapted from Richard et al. (1996).

Gauvin, Potvin, Denis, & Kishchuk, 2002). Findings suggest that health promotion practitioners do not often achieve optimal integration of the ecological approach. In addition, the utility of this method in informing the *development* of health promotion programs based on both ecological principles and information gathered from the priority population (i.e., through needs assessment) has not been examined. As such, we suggest that the Richard et al. (1996) framework should be used in intervention program planning in conjunction with an ecological planning framework (such as intervention mapping or PRECEDE-PROCEED). This would ensure a high degree of ecological integration before program implementation, rather than waiting to assess ecological integration on program completion. Using physical activity literature and formative evaluation data from a

TABLE 1
Inventory of Potential Strategies to Include in a Health Promotion Program to Increase Physical Activity Within Schools

Target	*Strategy*	*Type*	*Strategy for a School PA Program*
Person	HP → IND	D	Activities designed to change students' knowledge, attitudes, self-efficacy, barriers, and/or benefits
	HP → [IND – IND]	N	Activities designed to create relationships between students to encourage support or mutual activity to improve student PA
Interpersonal	HP → INT → IND	D	Activities designed to change peers, parents, or others in the students' interpersonal environment
	HP → [INT – INT] → IND	N	Activities designed to create relationships between those in the students' interpersonal environment to improve student PA
Organizational	HP → ORG → IND	D	Activities designed to change the students' physical or social organizational school environment. This can include facilities, programs, and teachers
	HP → [ORG – ORG] → IND	N	Activities designed to create relationships between schools organizations to improve student PA
Community	HP → COM → IND	D	Activities designed to change aspects of the students' physical or social community environment to improve student PA
	HP → [COM – COM] → IND	N	Activities designed to create relationships between communities to improve student PA
Political	HP → POL → IND	D	Activities designed to change aspects of the students' political environment in school to improve student PA
	HP → [POL – POL] → IND	N	Activities designed to create relationships between political groups to improve student PA
Mixes targets	HP → ORG → POL → IND	D	Activities designed to involve and change multiple targets to improve student PA

SOURCE: Adapted from Richard et al. (1996) and Gauvin, Lévesque, and Richard (2001).
NOTE: PA = physical activity; HP = health promotion program/practitioner; IND = person; INT = persons or small groups in the interpersonal environment; ORG = organizations; COM = community; POL = political; D = direct intervention strategy; N = networking intervention strategy.

TABLE 2
Description of Algorithm Scoring to Determine "Ecologicalness" of Health Promotion Programs

No. of Strategies	*Type of Strategy*	*No. of Settings*	*Algorithm Score*
1	Direct and/or networking	NA	0
2+	Direct and/or networking but *excluding* HP → IND	NA	1
2+	Direct and/or networking but *including* HP → IND	1	2
2+	Direct and/or networking but *including* HP → IND	2	3
2+	Direct and/or networking but *including* HP → IND	3+	4

SOURCE: Adapted from Richard et al. (1996).
NOTE: NA = not applicable.

priority population, we attempt to illustrate how health promotion practitioners can use the Richard et al. framework to ensure an enhanced degree of ecological integration within a health promotion program at the onset of the program planning phase.

METHOD

Participants

Participants were 38 middle school students (n = 22 girls, mean age = 12.59, SD = +0.91; n = 16 boys, mean age = 12.56, SD = +1.09) from Grades 6 (n = 10), 7 (n = 11), and 8 (n = 17) located in a midsize Canadian city. Students were selected across four schools that were identified by a school board official to represent diverse demographic profiles to ensure that a broad range of contexts and experiences would be captured. The Queen's University Research Ethics Board granted ethical approval for this study. Active parental consent was obtained for participating students.

Focus Groups

Focus groups were conducted separately for boys and girls at each of the four schools. Actual focus group sizes ranged from three to seven participants to keep the groups small, ensuring that participants would feel more comfortable sharing their experiences (Kreuger & Casey, 2000). Both active and inactive students were encouraged to participate. In some cases, teachers recommended students to participate in focus groups. No incentives were promised to participants; however, students were given a healthy fruit snack during the focus groups. Focus groups were conducted at school in an empty classroom either during lunch time or class time. Focus groups lasted between 25 and 50 minutes and were audiotaped.

The focus group interview protocol included the following questions: (a) What in your school makes it easy for you to be physically active? (b) What in your school makes it hard for you to be physically active? (c) Who in your school makes it easy for you to be physically active? (d) Who in your school makes it hard for you to be physically active? These were designed to investigate students' perceptions of facilitators and barriers to physical activity at school.

Data Analysis

A summary of the steps followed in the present study for ecological program planning are highlighted in Table 3. Focus group interviews were transcribed verbatim and stored in Microsoft Word format. The interviews yielded 122 pages of single spaced typed text. Analysis of the data involved a combination of inductive and deductive approaches and comprised two main steps following the work of Tesch (1990; see also Côté, Salmela, Baria, & Russell, 1993). Unprompted intervention suggestions present in the data along with 'noise' or meaning units that did not address barriers and facilitators to physical activity (e.g., "We have gym twice a week") were removed in order to restrict the analysis to identified barriers and facilitators of physical activity. To help ensure credibility and validity of emergent categories, another researcher trained in applying the ecological framework read a selection of the transcripts and met with the first author to discuss and refine category content, labeling, and strategy identification.

Data were analyzed using an iterative method and involved (a) identifying meaning units, (b) creating categories, and (c) identifying intervention strategies. In the first step, data from questions investigating perceived facilitators and barriers to physical activity at school were assessed. First, we identified meaning units or smaller parts of verbatim text that could be understood and interpreted outside the context of the transcript (Tesch, 1990). For example, the meaning unit "seeing others being active makes it easy for student to be active" was extracted from the following verbatim quote:

> Well, pretty much a lot of the people who like sports, they make it really easy because you see them doing it, and you think maybe I could do that, too, or something like that. And then you try it out and stuff and all the kids around, it makes it easy for you to be physically active.

The separation and coding of smaller pieces of relevant data or text from the overall content of the transcript is what Tesch (1990) refers to as "decontextualizing" the data. We applied the procedure to the data yielded from the four questions. After identifying meaning units, the second step of qualitative analysis involved "recontextualizing" the data with similar meanings from the first step into distinct, flexible, and modifiable categories (Côté et al., 1993; Tesch, 1990). Categories then emerged from further inductive organizing of the data. For example, the meaning unit described above was collapsed with similar meaning units describing the influence of other students on physical activity into the category of peer interactions.

To examine these data through an ecological lens, we then used Richard et al.'s (1996) framework to deductively collapse the categories into five higher-order categories (Step 3) consisting of potential intervention targets (i.e., individual, interpersonal, organization, community, political). The fourth step of the analysis involved identifying

TABLE 3
Steps in Ecological Program Planning for Practitioners

Phases	*Application in Present Article*
I: Needs assessment (IM: Bartholomew et al., 2006)	
Core process 1: Review the evidence	We reviewed the literature on school PA interventions.
Core process 2: Use of theory	We use social ecological models to guide our approach to the study of PA.
Core process 3: Collection of new data	We conducted focus groups with priority population of middle school students.
II: Data Analysis for focus groups	
Step 1: Identify meaning units within the data (Tesch, 1990)	We identified small parts of the transcribed text that could be understood when we removed it from the larger transcript.
Step 2: Create categories from meaning units (Tesch, 1990)	We grouped meaning units that had similar themes and meanings together and formed categories. We gave each category a descriptive label to summarize the theme of the meaning units (e.g., peer interactions).
Step 3: Group categories into higher-order categories based on Richard et al.'s (1996) five possible intervention targets of individual, interpersonal, organizational, community, or political	We took each category of meaning units and placed it into one of Richard et al.'s higher-order categories based on whether that category reflected characteristics of the individual student (IND), the interpersonal environment of the student (INT), the organizational environment of the school (ORG), the community (COM), or the political environment (POL).
Step 4: Identify intervention strategies by applying the Richard et al. framework to each meaning unit in each higher-order category	We applied one of Richard et al.'s intervention strategies (see Table 1) to each meaning unit based on what higher-order category the meaning unit was in (e.g., a meaning unit in the higher-order ORG category would have and HP → ORG as part of the strategy chain. The decision to make the strategy direct or networking was based on the content of the meaning unit (e.g., was the student talking about what how PA could be altered if his/her own school was changed (HP → ORG → IND) or if multiple schools formed relationships for change (HP → [ORG – ORG] →IND).
Step 5: Apply the Richard et al. algorithm to determine the degree of ecological program integration	We applied to Richard et al. scoring algorithm (see Table 2) based on the number of settings and the number and type of strategies to determine how ecological our program was.

NOTE: PA = physical activity; IM = intervention mapping.

intervention strategies based on focus group data. To accomplish this, we applied the Richard et al. framework to each meaning unit. More specifically, we used this framework to envision a potential intervention strategy for each meaning unit within a higher-order category. In other words, each meaning unit was coded according to the Richard et al. framework to either denote a direct change in the ultimate target of the individual (IND) or a change in the ultimate target through the formation of networks. For example, the meaning unit described above was grouped under the category of peer interactions and the higher-order category interpersonal (INT). Applying the Richard et al. framework to this meaning unit resulted in an intervention strategy label of HP → INT → IND. That is, student peers (INT) could be trained or encouraged by health promotion practitioners (HP) to be active to provide support for individual students (IND) to be physically active.

Another example includes the following quotation:

> And X comes in and he plays games with us, he'll start a game of soccer. . . . X is a guy that used to work in the Boys and Girls Club, but he volunteers here now. And he comes here every day and volunteers to play games like soccer and basketball and football and stuff like that outside at recess.

This was coded as a HP → COM → IND strategy, whereby community members (COM) could be trained to go into schools and deliver a recess physical-activity program to students (IND). Although in some cases additional strategies could have been identified for a given meaning unit, we attempted to identify intervention strategies that closely reflected participant data. For example, another strategy for the above meaning unit could involve providing information to schools (ORG) on how to recruit community volunteers (COM) to run recess programs for students (IND). This would be expressed by a HP → ORG→ COM → IND strategy. However, the above meaning unit was only given one strategy, HP → COM → IND. The designation of intervention strategies for meaning units was conducted in a manner that remained as close as possible to participant data. This approach to strategy identification was used in an attempt to maintain researcher objectivity and openness to the participants' views and experiences without imposing the researcher's prior knowledge and experiences (Strauss & Corbin, 1998). To evaluate the interrater reliability of our identified intervention strategies, a subsample (20%) of meaning units were coded by a researcher trained to apply the Richard et al. (1996) framework, but not directly involved in this study, and compared to our coding. The resulting interrater reliability was 75%. This reflects the use of the Richard et al. framework; an iterative process permitting discussion and interpretation of its tenets. Finally, we applied the Richard et al. scoring algorithm to the number and/or type of settings and targets to determine the degree of ecological program integration (Step 5).

RESULTS

Three hundred and eight meaning units were identified, from which emerged 11 categories of barriers and facilitators to school physical activity involvement (see Table 4). Frequency analysis of the meaning units revealed that 59.4% of identified facilitators and barriers of physical activity could be associated with an organization target (ORG), 31.2% with an interpersonal target (INT), 5.8% with an individual target (IND), and 3.6% with community (COM) targets. No policy targets (POL) were identified in the data. Only one setting (school) was identified.

Applying Richard et al.'s (1996) framework to each meaning unit within a category, potential direct and indirect intervention strategies were identified. Five different intervention strategies were found, with the majority of meaning units (58.8%) translating an organizational modification strategy (HP → ORG → IND), such as offering a variety of school physical activity programs to students. Examples of intervention activities for the other intervention strategies identified include emphasizing the benefits of physical activity to students (HP → IND), having peers on athletic councils to plan and encourage various physical activities in the school (HP → INT → IND), having an equipment-sharing program between schools (HP → [ORG – ORG] → IND), or having community volunteers in the school (HP → COM → IND). Table 5 depicts the setting, targets, strategies, and activity examples for a physical-activity-promotion program derived by applying the Richard et al. framework to the focus group data. Because we wished to remain as close to the participant data as possible when coding, this program yields a score of 2 on the algorithm because it includes more than two (i.e., five) intervention strategies (including HP → IND) in a single setting (school).

DISCUSSION

Our objective was to illustrate how health promotion practitioners could use the Richard et al. (1996) analytic framework in conjunction with other planning frameworks, such as intervention mapping, to ensure a high degree of ecological program integration during program planning and development. We attempted to demonstrate the utility of the Richard et al. framework by superimposing its tenets on physical-activity focus group information gathered from a priority population of middle school students. Our findings revealed that students identified four (IND, INT, ORG, COM) intervention targets, with organization (ORG) targets having twice as many meaning units as any of the other targets. Five different intervention strategies, representing both direct and network relationships between the intervention and target, were identified. The majority of strategies were direct strategies to influence change at an organizational level (HP → ORG → IND) to effect change in the ultimate target (IND = students). Based on Richard et al.'s algorithm, a combination of direct and network intervention strategies to target change increases the "ecologicalness" of an intervention program. A program designed to include the four different intervention targets and five strategies derived from the focus group data within a school setting would receive a score of 2 according to the ecological algorithm.

Our findings suggest that Richard et al.'s (1996) framework can be combined with focus group data to plan a targeted physical-activity-promotion program consistent with ecological principles. Most health promotion planning programs advocate conducting needs assessments as a first step to program planning (e.g., Bartholomew et al., 2006; Green & Kreuter, 1999). Information gleaned from

TABLE 4
Frequencies of Meaning Units Per Categories and Higher-Order Categories and Intervention Strategy Chains

		MUs per Higher-Order Category			*No. of MUs Per Strategy Chain*		
Higher-Order Categories	*Categories*	*Number of Raw MUs*	*No.*	*%*	*Intervention Strategy Chains*	*No.*	*%*
IND	Individual's perceptions of skills	7	18	5.84	HP → IND	18	5.84
	What individual's like/dislike about PA	11					
INT	Peer interactions	86	96	31.2	HP → INT → IND	96	31.2%
	Parent encouragement and support	10					
ORG	Type and availability of school PA programs	38	183	59.4			
	How school curricular schedule influences student PA	23					
	How school PA rules influence student PA	16			HP → ORG → IND	181	58.8
	Condition and availability of facilities/equipment for PA at school	33			HP → [ORG → ORG] → IND	2	0.65
	Impact of school personnel on student PA	73					
COM	Volunteers in the school	8	11	3.6	HP → COM → IND	11	3.6
	Community PA information and use of facilities	3					

NOTE: PA = physical activity; MU = meaning unit; IND = individual; INT = interpersonal environment; ORG = organization; COM = community.

applying the Richard et al. framework to focus groups in the present study provided a useful means of conducting a needs assessment and identifying gaps in optimal ecological program planning. In our study, focus groups provided critical information on the perceived barriers and facilitators to physical activity as experienced by the student priority population. Awareness of unique barriers and facilitators allows the program planner to develop specific program strategies that are based on needs and/or characteristics of the priority population. For example, strategies that emerged from the data could include teaching various physical activity skills to students (HP → IND) or develop training programs for teachers on how to increase student physical activity in gym classes (HP → ORG → IND).

The importance of obtaining this type of information from the priority population is one of the three core processes advocated in intervention mapping (Bartholomew et al., 2006). Given that the strategies identified in our study were derived from the priority population group, they may be more effective in promoting physical activity than strategies derived without this information. A review of physical activity interventions suggests that targeting intervention strategies to the specific needs of a priority population may enhance intervention effectiveness (Kahn et al., 2002). Thus, the integration of the Richard et al. (1996) framework with focus group information can increase the likelihood that practitioners can easily determine intervention strategies and activities that will be both relevant to the priority population and span relevant ecological dimensions.

In addition to using the framework to identify settings, targets, and strategies derived from the priority population itself, health promotion planners should also return

TABLE 5
Physical Activity Program in the School Setting Derived From Focus Group Data

Targets	*Strategy*	*Activity Examples*
IND	HP → IND	• Educating students about the benefits of being PA • Teaching students various technical PA skills
INT	HP → INT → IND	• Creating social support among the peer group by instructing students how to encourage other students to be PA • Providing parents with information on why PA is important and giving tips on ways they can encourage their children to be active
ORG	HP → ORG → IND	• Increasing the number of PA opportunities per week (e.g., number of PE classes, minutes of possible PA) • Providing students with supervised access to gym and other facilities before and after school • Provide training to teachers on ways they can increase the amount of PA students receive in PE class and other parts of the curriculum
	HP → [ORG → ORG] → IND	• Meeting with schools to develop ways to share PA equipment and facilities
COM	HP → COM → IND	• Asking individuals affiliated with community organizations (e.g., Boys and Girls Club, local university) to volunteer to run programs in local schools

NOTE: PA = physical activity; IND = individual; INT = interpersonal environment; ORG = organization; COM = community; PE= physical education.

to relevant literature to review evidence-based interventions as suggested in intervention mapping (Bartholomew et al., 2006). Here, planners may not only identify similarities between information garnered from the priority population and relevant literature, but planners may also identify other targets and strategies shown to be effective in intervention settings. In the first instance, student perceptions about school rules, opportunities, schedules, facilities, and staff influence seem to corroborate previous observational findings that have established relationships between the school environment (e.g., lesson context, teacher qualifications and levels of supervision, facilities) and student physical activity (McKenzie, Marshall, Sallis, & Conway, 2000; Sallis et al., 2001). Our analyses of student perceptions of physical activity barriers and facilitators enabled us to detect a number of strategies to influence change at the interpersonal level (INT). Research in sport and physical activity (e.g., Anderssen & Wold, 1992; Wold & Anderssen, 1992) acknowledge that parents and peers may influence physical activity among children and adolescents. Part of an ecological program founded on these results would thus include multiple direct and indirect strategies that focus on changes to the school as an organization in school-based physical activity interventions and to students' interpersonal environment—namely, family or peers.

In addition, from the focus group data, we also gathered that the barriers and facilitators reported by students may not exhaustively represent all relevant ecological targets identified in the literature. By superimposing the Richard et al. (1996) framework, we found that none of the student-reported barriers and facilitators of physical activity at school translated into a political (POL) target as outlined by the framework. However, Sallis and Owen (1999) suggested that policy changes through corporations or governments can influence the physical and social environments in ways that might increase physical activity. For example, given that government legislates and develops curricula for physical education in schools, the impact of policy factors (POL) on student physical activity may be significant. Participants in the present study frequently identified barriers and facilitators related to targets such as INT and ORG that immediately preceded the ultimate target for change (i.e., IND) as inhibiting or facilitating physical activity at school. However, they infrequently reported on the impact of more distal targets such as COM and POL, which may be present in a more complex intervention strategy. Few complex strategies (e.g., networking: HP → [ORG → ORG] → IND or direct multi-targets: HP → COM → ORG → IND) could be drawn from the data despite the importance of these strategies for enhancing the ecological quality of a

physical activity program (Richard et al., 1996). These data seem to imply that when students are asked to report barriers and facilitators of physical activity, they tend to report on who or what is most obvious to them. Thus, children/youth may not necessarily be aware of the entire configuration of targets in more complex strategies. As such, it may be beneficial to enlarge the needs assessment to include key actors in the school (e.g., teachers, principals, school board officials) or community (e.g., public health unit) to capture a broad range of ecological factors influencing student physical activity involvement. Richard, Laforest, Dufresne, and Sapinski (2005) used this type of approach in attempts to differentiate between older adults' and professionals' perceptions of factors impacting quality of life among older adults. Although there was convergence between older adults and professionals in identifying a variety of ecological factors linked to quality of life, older adults provided in-depth information on intrapersonal factors and professionals provided information on salient community factors influencing quality of life (Richard et al., 2005). Overall, applying the Richard et al. (1996) framework to focus group data and reviewing relevant literature through the three core processes identified in intervention mapping (Bartholomew et al., 2006) reflects an iterative process that will enable health promotion planners to ensure a higher degree of ecological integration in program development and to maintain program relevance in the priority population.

The current exercise was restricted in setting by the interview protocol, which asked students about school-related barriers and facilitators to physical activity. It is possible that if setting had not been restricted to schools, students may have offered other targets and settings as barriers and facilitators of physical activity. Additional strategies and settings could have been created and/or identified if we had gone beyond the focus group data. Many health promotion practitioners may look to enhance health behavior in only one setting. Yet to increase the "ecologicalness" of the intervention (i.e., a score of 4 on the algorithm), multiple settings are needed. By adding two settings to the proposed program, we would obtain a maximum score of 4 on the algorithm. The Richard et al. framework could thus be applied to focus group information pertaining to physical activity barriers and facilitators in other settings. For example, we might choose to address student physical activity in the additional settings of a community center (organization) like the Boys and Girls Club or a city (community). When possible, health promotion practitioners should strive to obtain setting, target, and strategy information from participants to ensure the relevance of the intervention programs to the priority population.

CONCLUSION

We present a practitioner-friendly tool that complements other health-behavior-program-planning models to help practitioners develop ecological interventions by providing a specific framework to translate ecological constructs into ecologically based intervention strategies. This process allowed us to interpret focus group data on ecological dimensions by identifying population target relevant strategies for a potential physical activity intervention program. The effectiveness of this procedure when developing interventions for other health behaviors (e.g., diet, smoking cessation) in other populations (e.g., adults, elderly) should be investigated. In addition, the merit of other qualitative or quantitative methods (e.g., interviews, surveys) to obtain information on barriers and facilitators of other health behaviors for a given priority population has yet to be examined with the Richard et al. (1996) framework. Multiple settings should also be encouraged among health promotion practitioners designing ecological interventions. Overall, the exploratory use of the Richard et al. framework combined with information gleaned from the priority population suggests that it may be of value to health promotion planners wishing to design and implement ecologically based intervention programs.

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