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Parental Active Transportation Routines (PATRns) as a Moderator of the Association Between Neighborhood Characteristics and Parental Influences and Active School Transportation

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Abstract

Successful implementation of interventions to stimulate active school transportation (AST) requires better understanding of this behavior. This study explored the associations between Parental Active Transportation Routines (PATRns) and children's AST use, as well as the role of PATRns as a moderator of the association between the neighborhood characteristics

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and parental influences and AST. The study sample consisted of 722 8- to 12-year-old children and their parents living in the Netherlands. Multivariate linear regression analyses were performed, with the frequency of AST use as the dependent variable. Moderation by PATRns was tested by including interaction terms between PATRns and independent variables in the regression equation, and stratified analyses were conducted as a result of significant interactions. PATRns were a positive correlate of AST and were found to moderate the association between both parental facilitation of child physical activity and stranger danger and the use of active transportation, emphasizing the relevance of PATRns in increasing AST use.

Keywords
public health, behavior change, physical activity (walking, cycling, exercise), children, person-environment, transportation, neighborhood, community, ecological behavior

Background

Active school transportation has been identified as an opportunity to increase daily physical activity (Cooper, Jago, Southward, & Page, 2012; Faulkner, Buliung, Flora, & Fusco, 2009), as increasing numbers of children do not meet the recommended level of daily physical activity (De Vries & Chorus, 2010; World Health Organization [WHO], 2010). A substantial number of initiatives have been undertaken to increase the use of active transportation, but effects have been limited (Chillon, Evenson, Vaughn, & Ward, 2011). Correlates and working mechanisms underlying the use of active school transportation need to become clearer if effective interventions are to be developed.

According to socio-ecological frameworks, social environmental characteristics might interact with physical environmental characteristics in influencing behavior (Gubbels, Van Kann, de Vries, Thijs, & Kremers, 2014; Kremers, 2010), which indicates the need for focusing on the interactions rather than solely on separate main effects of physical and social characteristics on active transportation. Three major factors that could be involved in such interactions are physical environmental characteristics, social environmental characteristics, and routines or habits (Kremers, 2010).

Several attributes in the physical environment have been reported to be associates of active school transportation (Pont, Ziviani, Wadley, Bennett, & Abbott, 2009), such as distance (McDonald, 2008; Trapp et al., 2012), traffic safety–related attributes (Wong, Faulkner, & Buliung, 2011), and perceived

neighborhood safety (Carver, Timperio, & Crawford, 2008; Kerr et al., 2006). However, even when most physical environmental preconditions for active transport are fulfilled, such as sidewalks and bicycle lanes, many children still do not use active transportation (Van Kann et al., 2014), which is in line with the statement of Napier, Brown, Werner, and Gallimore (2011) that creating a walkable environment is a necessary but not a sufficient condition to increase active school transportation.

In the first years of life, parents are the main decision makers with regard to transportation choices for their children (Carver, Watson, Shaw, & Hillman, 2013; Hume et al., 2009; Panter, Jones, & van Sluijs, 2008; Pont, Ziviani, Wadley, & Abbott, 2011) and could therefore probably be considered as the most important social environmental characteristic for children's mode of transportation to school. Parental modeling behavior of active transportation has recently been associated with children's active school transportation (Carlson et al., 2014). In Carlson's study, however, modeling was conceptualized as engaging in any active travel by the parent. Several other important parental physical activity supporting behaviors or practices seem relevant (Edwardson & Gorely, 2010; Hohepa, Scragg, Schofield, Kolt, & Schaaf, 2007), such as supporting children by providing facilitation in terms of transport and paying fees for activities in which physical activity is involved, for example, a sports club (Hoefer, McKenzie, Sallis, Marshall, & Conway, 2001; Sallis et al., 1992), and providing emotional support (Davison, 2004).

Active transportation can be regarded as a highly habitual behavior (Gardner, 2009; Murtagh, Rowe, Elliott, McMinn, & Nelson, 2012). Habits have been conceived as learned sequences of acts that, as a result of frequent performance in similar situations, are triggered automatically by environmental cues (Ouellette & Wood, 1998; Triandis, 1980). Based on the important position of parents with active school transportation choices, their own habitual engagement in active transportation could be a strong contextual factor for children's mode of transportation to school. Parental Active Transportation Routines (PATRns) could thus interact with the influence of physical and social environment characteristics on children's active school transportation. PATRns reflect the extent to which parents use an active mode of transport instead of a motorized mode to destinations within a relatively short distance, such as posting a letter and going for a few groceries in the local neighborhood. The mode of transportation for such short travels is considered as a routine behavior that is probably more automatically triggered rather than the result of an extensive deliberation process. PATRns refer to implicit messages that parents send out to their children, creating a family climate toward the use of active or motorized transportation. The working mechanism behind PATRns is thus more than just modeling parental

behaviors but also reflects implicit family norms, routines, and habits. Including PATRns in current explanatory models for children's mobility to school could substantially contribute to explaining children's use of active school transportation and guide further development of effective interventions to increase active school transportation. Parental routines can be considered as a relatively stable contextual factor that varies widely across families.

The hypothesis that PATRns interact with the physical and social environment characteristics in determining active school transportation follows the tenets of habit theories, which assume that environmental features interact with habit strength in determining individual behavior (Triandis, 1977). Including a habitual component in explanatory models, i.e. PATRns, might provide a more comprehensive understanding of determinants underlying active transportation behavior (Gardner, de Bruijn, & Lally, 2011).

The purpose of the current study was to investigate the associations between PATRns and children's active school transportation, as well as the association between physical and social neighborhood characteristics, parental physical activity support, and active school transportation. Moreover, the focus of this study is to explore the role of PATRns as a moderator of the association between the physical and social neighborhood characteristics and children's active school transportation. It is hypothesized that for children who are raised in families with more exposure to active transportation (i.e., stronger PATRns), effects of supportive physical and social environments on active school transportation will be stronger and the effects of hindering environments weaker.

Method

Data collection took place during the fall of 2012 in the Southern Limburg region of the Netherlands. All grades 6 and 7 of the 21 participating primary schools were visited (Dutch regular primary school system comprises grades 1-8). Each child completed a questionnaire focusing on their physical activity and the environmental attributes of physical activity in the classroom, while researchers were present to answer possible questions and to ensure comparability of contexts across classes. None of the children refused to fill in the questionnaire. All children received a questionnaire for their parents, and these questionnaires were collected 1 week afterwards at school. The questionnaires focused on parental perceptions of the physical and social environment, parental physical activity support, and PATRns. The study was given ethical approval by the Medical Ethics Committee of the Maastricht University Medical Center (reference number METC 12-4-077).

Measures

The questionnaire data provided by the children were used to define the primary outcome variable in this study, i.e. the total number of days a week that children had used active school transportation in the previous week. Active school transportation was measured by the question "On how many days in the past week did you come to school on foot or by bike?" This question resulted in a continuous variable ranging from 0 to 5 days a week. In addition, several *demographic* variables were assessed, including the children's age, grade, sex, home address, and country of birth. Parents were asked to report their household situation (i.e., single-parent household, two-parent household), level of education based on highest obtained degree (low education = lower vocational education or below, medium = between secondary vocational school and high school, high = higher professional education or university education), number of cars in the household, and country of birth (dichotomized into Western–non-Western).

PATRns. PATRns were assessed in the parental questionnaire using four statements: "If I have to go somewhere nearby, I am always inclined to take the bike or to go on foot"; "I often find myself using the car for a distance that could easily have been traveled by bike" (reverse coded so that high numbers describe less car use); "Taking the bike to go somewhere is a habit for me"; and "Going somewhere on foot is a habit for me" (1-5 Likert-type scale: 1 = *totally disagree* to 5 = *totally agree*; Cronbach's $\alpha = .713$). Based on these items, two scales were constructed; a PATRns total score (range = 4-20) and a dichotomized scale indicating either strong or weak PATRns. Strong PATRns were defined as engaging in all dimensions of the PATRns scale (*agree* or *strongly agree*; 4 or 5); all other respondents were classified as having weak PATRns.

Physical and social neighborhood characteristics. Physical and social neighborhood characteristics were collected using a validated systematic observation instrument (SPACE checklist; De Vries, Hopman-Rock, Bakker, Hirasing, & van Mechelen, 2010). Observations were carried out by two trained observers. Inter-rater reliability (IRR) was substantial (Cohen's Kappa = .73, $p < .01$; Landis & Koch, 1977). A previous study in a similar Dutch context showed that the "aesthetics" and "safety" clusters were the strongest associates of children's active school transportation (Van Kann et al., 2014), so neighborhood characteristics of these two clusters were observed and included in the analyses. In addition, the safety cluster was subdivided into social safety and traffic safety for the purpose of the current study. In total, 44

neighborhood characteristics were assessed in an 800 m (0.5 miles) crow-fly buffer around participating schools. For each cluster, a sum score was calculated based on all items measured on aesthetics, social safety, or traffic safety. All sum scores were coded in a positive direction toward to the use of active transportation. An aesthetics score could range between 9 and 36 and was observed by items such as "presence of neighborhood parks" and "presence of litter." Social safety could range between 4 and 22 and included items such as "presence of street lightning" and "presence of hang outs." Finally, traffic safety was observed by items such as "presence of traffic lights" and "presence of speed humps" and could range between a score of 21 and 96. *Distance* to school was defined by calculating the distance in meters of the shortest walking route between the home address and the school address via Google Maps.

In addition to observed neighborhood characteristics, *social neighborhood characteristics* were defined by measuring *parental perceived traffic load* and *parental perceived stranger danger*, by presenting two statements. The statement for parental perceived traffic load was "There is a lot of heavy traffic in the neighborhood I am living in" and the statement for parental perceived stranger danger was "I am worried about strangers in the neighborhood I am living in" (1-5 Likert-type scale: 1 = *totally agree* to 5 = *totally disagree*; Timperio et al., 2006).

Parental physical activity support. Parental *physical activity support* was measured by parental practices with regard to emotional support, facilitation, and modeling. A parental *emotional support* scale was constructed using four items: "How often do you stimulate your child to be physically active?" "How often do you stimulate your child to play outdoors?" "How often do you offer your child choices for physical activity (PA)?" and "How often do you praise your child for being physically active?" (1-5 Likert-type scale: 1 = *never* to 5 = *very often*; Cronbach's $\alpha = .674$, scale ranging from 4 to 20) (Davison, Li, Baskin, Cox, & Affuso, 2011). Parental *facilitation* was operationalized as providing logistic support to children for being physically active and was measured by two items: "Do you facilitate your child in participating in sports or other activities that stimulate PA?" and "Do you take your child to places where he/she can be physically active?" (1-5 Likert-type scale: 1 = *never* to 5 = *very often*; Cronbach's $\alpha = .682$, scale ranging from 2 to 10) (Davison et al., 2011). Parental *modeling practices* were measured by six items: "How often do you play sports or are you physically active together with your child?" "How often do you use your own behavior as an example to encourage your child to engage in PA?" "How often do you play sports or are you physically active yourself?" "How often does your child see you

being physically active?" "How often does your child see you being physically active for recreation?" and "How often does your child hear you talking about sports and PA?" (1-5 Likert-type scale: 1 = *never* to 5 = *very often*; Cronbach's $\alpha = .747$, scale ranging from 6 to 30) (Davison et al., 2011).

Data Analysis

All analyses were performed using SPSS version 20.0 (SPSS Inc., Chicago), with a p value of .05 indicating statistical significance. Attrition analyses were conducted to study differences between children whose parents did return the parental questionnaire and children whose parents did not. No statistically significant differences were found between both groups.

All independent variables were correlated to each other to check for multicollinearity and potential suppressor effects. All correlations were <.30, and the variables were therefore considered to measure non-overlapping constructs, leading to inclusion of all constructs into the regression analyses.

A multilevel structure of the data based on school level was tested by calculating the intraclass correlation coefficient (ICC) of a random intercept model, revealing an ICC of .0376, indicating a non-nested data structure. Therefore, analyses were conducted without correction for multilevel structure.

Multivariate linear regression analyses were conducted using the enter method. The number of days of using active transportation was included as the dependent variable, and demographics, physical and social neighborhood characteristics, parental physical activity support, and PATRns were entered as independent variables (Figure 1). PATRns were included as a continuous variable. Moreover, PATRns were included in the analyses as a potential moderating factor of the association between the other independent variables and active school transportation by computing interaction terms of all constructs with the continuous PATRns variable. By backward deletion (least significant interaction term was deleted first), interaction terms were eliminated. In case of significant interaction terms in the final model, stratification by PATRns (strong vs. weak) took place. Multivariate linear regression analyses as described above were then repeated for both strata.

Results

Description of Research Population

In total, 1,327 sixth- and seventh-grade students completed a questionnaire distributed among 21 primary schools in the South Limburg region in the

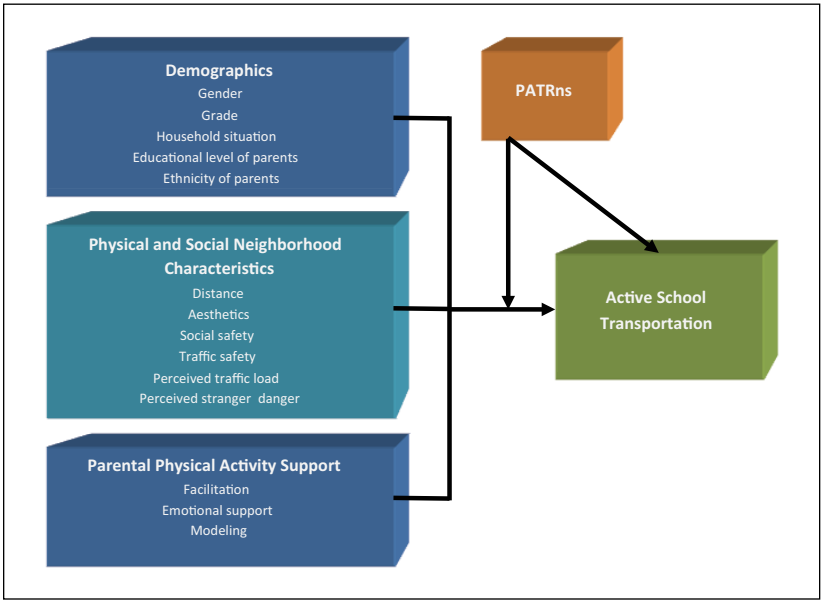

Figure 1. Graphical representation of research model.
Note. PATRns = Parental Active Transportation Routines.

Netherlands, and 817 of these children's parents completed the parental questionnaire (62%). Matching children to their parents resulted in 735 valid child–parent matches of which 13 matches were excluded based on invalid answers on key variables, resulting in 722 child–parent matches in our study (54%). The children's mean age was 9.68 ($SD = 0.72$) years, ranging between 8 and 12 years. The gender distribution was almost equal, and 95% of the children had a Western background. Fifty-nine percent ($n = 420$) of the parents had a medium (i.e., vocational to high school degree) level of education, and 81% of the children lived within a suitable distance from school to use active transportation (Table 1), which was defined as 1.2 km or 0.75 miles (about 15 min of walk based on a walking speed of 5 km/hr).

The strong PATRns group consisted of 122 child–parent matches while the group with weak PATRns consisted of 600 child–parent matches. We found two significant differences in independent variables between these groups (Table 2). Children included in the strong PATRns group lived closer to schools compared with matches in the weak PATRns group. Furthermore, parents in the strong PATRns group indicated modeling behavior for physical activity more often compared with parents in the weak PATRns group. The

Table 1. Description of the Study Population.

Variable	*n* (%)[a]
Gender	
Boys	340 (47.6)
Girls	375 (52.4)
Grade	
6	384 (53.4)
7	335 (46.6)
Household situation	
Single-parent household	94 (13.1)
Two-parent household	626 (86.9)
Educational level of parents	
Low	57 (8.0)
Medium	420 (58.6)
High	239 (33.4)
Ethnicity of parents	
Western	688 (95.3)
Non-Western	34 (4.7)
Distance to school	
0-400 m	134 (19.0)
400-800 m	255 (36.2)
800-1,200 m	178 (25.3)
1,200-1,600 m	47 (6.7)
>1,600 m	90 (12.8)
	M (*SD*)
Parental Active Transportation Routines (PATRns)	11.03 (4.29)
Physical and social neighborhood characteristics	
Aesthetics (9-36)	21.80 (2.52)
Social safety (4-22)	16.49 (2.69)
Traffic safety (21-96)	62.10 (4.65)
Perceived traffic load (0-2)	0.80 (0.92)
Perceived stranger danger (0-2)	1.08 (0.88)
Parental physical activity support	
Facilitation (2-10)	8.37 (1.35)
Emotional support (4-20)	15.53 (2.42)
Modeling (6-30)	19.39 (4.27)

Note. Total *N* = 722.
[a]*n* is based on valid cases; missing continuous values replaced by means, missing categorical values replaced by median.

Table 2. Description of Strong and Weak PATRns Strata and Differences Between Strata.

	Strong PATRns (n = 122)	Weak PATRns (n = 600)	
Variable	n (%)[a]	n (%)[a]	t value (df)
Gender			*ns*
Boys	59 (48.8)	281 (47.3)	
Girls	62 (51.2)	313 (52.7)	
Grade			*ns*
6	63 (52.1)	321 (53.7)	
7	58 (47.9)	277 (46.3)	
Household situation			*ns*
Single-parent household	13 (10.7)	81 (13.5)	
Two-parent household	108 (89.3)	518 (86.5)	
Educational level of parents			*ns*
Low	8 (6.6)	49 (8.2)	
Medium	69 (57.0)	351 (59.0)	
High	44 (36.4)	195 (32.7)	
Ethnicity of parents			*ns*
Western	115 (94.3)	573 (95.5)	
Non-Western	7 (5.7)	27 (4.5)	
Distance to school			4.354* (df = 222)
0-400 m	25 (20.8)	109 (18.7)	
400-800 m	56 (46.7)	199 (34.1)	
800-1,200 m	32 (26.7)	146 (25.0)	
1,200-1,600 m	2 (1.7)	45 (7.7)	
>1,600 m	5 (4.2)	85 (14.6)	
	M (SD)	M (SD)	
Physical and social neighborhood characteristics			
Aesthetics (9-36)	22.16 (2.38)	21.73 (2.55)	*ns*
Social safety (4-22)	16.23 (2.95)	16.54 (2.63)	*ns*
Traffic Safety (21-96)	62.26 (4.99)	62.07 (4.58)	*ns*
Perceived traffic load (0-2)	0.81 (0.94)	0.80 (0.92)	*ns*
Perceived stranger danger (0-2)	1.16 (0.87)	1.07 (0.87)	*ns*
Parental physical activity support			
Facilitation (2-10)	8.21 (1.36)	8.40 (1.35)	*ns*
Emotional support (4-20)	15.62 (2.31)	15.51 (2.45)	*ns*
Modeling (6-30)	21.55 (3.41)	18.96 (4.29)	7.294* (df = 207)

Note. PATRns = Parental Active Transportation Routines.
[a]n is based on valid cases.
*Significant difference strong and weak PATRns strata (p < .05).

distribution of children did not differ across 21 schools for the strong and weak PATRns groups.

Associates of Active School Transportation

Distance to school was negatively associated with active transportation, i.e. the longer the commute distance, the less often children actively traveled to school. PATRns were positively associated with active school transportation as was attending a higher grade. There was also a small positive association between traffic safety and active school transportation (Table 3). In total, this model explained more than 26% of the variance. Distance to school explained 17% of the variance in the model, while PATRns explained more than 3%, school grade almost 2%, and traffic safety about 1%. No parental physical activity support scales were significantly associated with active school transportation (Table 3).

PATRns as a Moderator

PATRns were found to significantly moderate the association between parental physical activity facilitation ($\beta = .266$; $p < .01$) and perceived stranger danger ($\beta = -.593$; $p < .01$) and the use of active school transportation. Stratification on the PATRns (strong vs. weak) revealed that facilitation was significantly associated with active school transportation in both strata, whereas this effect was not found when the total sample was analyzed (i.e., without stratification by PATRns). For parents with strong PATRns, parental physical activity facilitation was significantly and positively associated with active transportation. By contrast, if parents had weak PATRns, the association between parental physical activity facilitation and active transportation was significantly negative (Table 3). The association between perceived stranger danger and active school transportation was also moderated by PATRns. In the weak PATRns group, a marginally significant positive effect was found, that is, the less perceived stranger danger in the school environment, the more the children were inclined to use active transportation. In the strong PATRns group, however, perceived stranger danger was not found to be associated with active school transportation.

Discussion

The purpose of this study was to explore the associations between PATRns and children's use of active school transportation. In addition, we aimed to examine the role of PATRns as a moderator of the association between the

Table 3. Associations With Active School Transportation: Total Sample and Stratification by PATRns.

	Total (N = 722)			Strong PATRns (n = 122)			Weak PATRns (n = 600)		
	β (95% CI)	p	R^2 (%)	β (95% CI)	p	R^2 (%)	β (95% CI)	p	R^2(%)
Demographics									
Gender (ref = boy)	−.002 [−.248, .237]	.97		.118 [−.160, .744]	.20		−.020 [−.356, .207]	.60	
Grade (ref = grade 6)	**.125 [.207, .687]**	**<.01**	**1.6**	.159 [−.075,.859]	.10		**.125 [.191, .746]**	**<.01**	**1.6**
Household situation (ref = single-parent household)	−.011 [−.444, .317]	.75		.133 [−.315, 1.361]	.32		−.021 [−.549, .316]	.60	
Education of parents (ref = high)									
Low	−.036 [−.717, .243]	.33		.092 [−.538, 1.491]	.35		−.067 [−.991, .109]	.12	
Medium	−.036 [−.393, .132]	.33		.006 [−.500, .528]	.96		−.058 [−.523, .085]	.16	
Ethnicity of parents (ref = Western)	.049 [−.181, 1.030]	.17		−.133 [−2.083, .468]	.21		.075 [−.019, 1.368]	.06	
PATRns	**.182 [.046, .106]**	**<.01**	**3.3**	NA	NA		NA	NA	
Physical and social neighborhood characteristics									
Distance[a]	**−.417 [−.709, −.510]**	**<.01**	**17.4**	**−.312 [.−653, −.169]**	**<.01**	**9.7**	**−.454 [−.779, -.558]**	**<.01**	**20.6**
Aesthetics	−.049 [−.099, .030]	.29		−.064 [−.160, .082]	.60		−.025 [−.093, .056]	.62	
Social safety	−.012 [−.058, .042]	.76		−.202 [−.178, .008]	.07		−.018 [−.071, .045]	.66	
Traffic safety	**.088 [.001, .067]**	**.04**	**0.8**	.064 [−.043, .074]	.60		.084 [−.005,.074]	.08	
Perceived traffic load	−.056 [−.246, .028]	.12		−.158 [−.495,.172]	.16		−.059 [−.279,.037]	.13	
Perceived stranger danger	.052 [−.038, .250]	.15		−.087 [−.409,.172]	.42		.070 [−.015, .318]	.07	
Parental physical activity support									
Facilitation	−.039 [−.149, .048]	.32		**.288 [.057, .464]**	**.01**	**8.3**	**−.103 [−.255, −.027]**	**.02**	**1. 1**
Emotional support	−.020 [−.069, .039]	.58		−.096 [−.169, .065]	.38		−.031 [−.085, .038]	.45	
Modeling	−.056 [−.055, .008]	.15		−.052 [−.097, .058]	.62		−.006 [−.037, .032]	.88	

Note. Values in bold indicate $p < .05$; R^2 is given when $p < .05$. Dependent variable = number of days a week of active school transport. PATRns = Parental Active Transportation Routines; CI = confidence interval; ref = reference category.

[a]Distance is categorized; 0 = 0-400 m, 1 = 401-800 m, 2 = 801-1,200 m, 3 = 1,201-1,600 m, 4 ≥ 1,600 m.

environment (physical and social neighborhood factors as well as parental support) and active school transportation. We found that PATRns were positively associated with active school transportation. When parents were more inclined to use active transportation as a routine behavior, their children more often used active transportation to school. Furthermore, PATRns were found to moderate the association between both facilitation and perceived stranger danger with active school transportation.

The direct positive association between PATRns and the use of active transportation supports the suggestion that the PATRns are an important concept in explaining children's use of active school transport. By incorporating the use of active transportation in parents' daily life patterns, irrespective of the contextual use of their active transportation (e.g., traveling to school, shops, sport clubs), children might more often travel actively to school, and potential physical and social environment barriers might become less decisive.

Interestingly, PATRns were found to moderate the association between parental physical activity facilitation and active school transportation, whereas no association was found for this factor in the total sample. The stratified analysis indicated that children of facilitating parents with strong PATRns walk or cycle to school more often. The opposite association was found for parental physical activity facilitation among parents who have weak PATRns. Jago and colleagues (2014) also failed to find an association between facilitation and active travel, in line with our results in the total sample. Our stratified results, however, reject Jago's assumption that facilitation for participation in physical activity does not influence active transportation (Jago et al., 2014). Our results imply that the facilitation will only positively affect active school transport in children who live in families with strong PATRns. Parents in the strong PATRns group are inclined to use active transportation as the mode of travel, including taking their child to a sports club (as facilitation is operationalized as providing logistics support for participation in physical activity). Using active transportation as a means of facilitating the child could thus be considered positive parental modeling behavior, and could also serve as an opportunity for children to actively develop traffic-related skills, such as dealing with traffic regulations. In contrast, parents in the weak PATRns group provide an inactive transportation family climate, resulting in an opposite association.

Another significant interaction by PATRns was found for the association between stranger danger and active school transportation. Several other studies identified stranger danger as major barrier for active transportation (Ahlport, Linnan, Vaughn, Evenson, & Ward, 2008; Carver et al., 2008). Although non-significant, our stratified analyses showed the same direction

of the association for children in the weak PATRns group. For the strong PATRns group, the opposite, also non-significant, association was found. This result was quite unexpected based on evidence from previous studies. It is possible that by performing routine behavior, i.e. having strong PATRns, potential barriers become less dominant in explaining active school transportation, which could be the result of an exposure effect. When active transportation behavior becomes more familiar in a particular environment, barriers, such as stranger danger, might become less dominant. It is also possible that parents with strong PATRns are more familiar with their neighborhood and are thus less concerned about stranger danger. These suggestions are in line with a previous study (Salmon, Salmon, Crawford, Hume, & Timperio, 2007) that found consistently lower perceived barriers for active transportation for children who lived closer to school.

In this study, distance to school was the strongest correlate of active school transportation in all analyses. This finding is in line with most other studies assessing the effect of distance on active transportation, as distance has generally been indicated to be a strong correlate of active transportation (McDonald, 2007, 2008; Oliver et al., 2014; Panter et al., 2008; Trapp et al., 2012). We hypothesized that influences of potentially hindering physical environmental characteristics are smaller for children of parents with strong PATRns, such as distance. Note that the association (i.e., standardized beta) between distance and active school transportation was substantially lower in the strong PATRns group than in the weak PATRns group. The moderation test, however, was non-significant indicating no statistically significant difference in association between both groups. This non-significant interaction could be partly caused by the unequal distribution of sample size in the two strata (strong PATRns, $n = 122$, vs. weak PATRns, $n = 600$). Prompted by the finding that the strong PATRns group in our sample lived significantly closer to school than did children in the weak PATRns group, we performed additional sensitivity analyses for children living within 800 m of school ($n = 389$). In this subsample, a significant interaction between PATRns and distance was found in the explanation of active school transportation ($\beta = .730$, $p = .05$). For children in the strong PATRns group, distance was not associated with active school transportation ($\beta = -.041$, *ns*), whereas distance was the strongest negative correlate of active school transportation in the weak PATRns group ($\beta = -.234$; $p < .01$). This finding is in line with our hypothesis that environmental barriers may become less dominant for children whose parents have strong PATRns.

We advocate the focus on interactions between physical and social environmental characteristics in the investigation of environmental influences on physical activity in children (Gubbels et al., 2011; Gubbels et al., 2014). Pont,

Wadley, Ziviani, and Khan (2013) recommended an integrated approach to stimulate active school transportation. Our study supports this view by illustrating that insight in the interplay of parental practices and routines with other (physical and social) environmental factors will increase our understanding of determinants of active school transportation more than remaining focused on separated or isolated effects of environmental characteristics. Moreover, this study showed that parental practices seem to positively influence children's behavior, and strong PATRns have the potential to eliminate environmental barriers. Therefore, it would be recommendable to include parental components in interventions focusing on increasing children's active transportation.

This study had a number of strengths and limitations. A strong point of the study was the study sample. In total, more than 700 children and their parents, distributed over 21 neighborhoods, filled in the questionnaires. In addition, we were able to observe environmental features and objectively calculate the distance of the shortest route from home to school for each individual child. A weakness of our study was that the number of days on which children used active school transportation was self-reported, which could have led to an overestimation due to social desirability. In addition, we used cross-sectional data, which only allowed us to study associations, rather than predictors of active school transportation. Note that stratified analyses were conducted with two non-equal groups, due to the theory-based classification of PATRns. Based on the dimensions in the PATRns scale, a content-based cutoff was preferred to a data-driven cutoff (e.g., using median split). This content-based cutoff enables comparability across studies, and this procedure ensured the valid formation of a strong PATRns group. In any case, secondary analyses applying a median split resulted in outcomes similar to those presented here. The smaller size of the strong PATRns group when applying the content-based cutoff could, however, have influenced the significance level of the results (relative to the weak PATRns group) in stratified analyses.

Conclusion

The current study emphasizes the importance of the concept of PATRns. PATRns were associated with active school transportation and were found to be a moderator of the association between facilitation and active school transportation and between perceived stranger danger and active school transportation. Our findings indicate that the social environment in which a child operates should be taken into account when studying determinants of active transportation use. In previous research, environmental correlates of children's use of active transportation might have been biased by not including

the habitual context in which the association was studied. Including parental routines into research and exploring interaction effects with environmental characteristics could provide more insight in determinants underlying the use of active school transportation. For health practitioners, the impact of parental habits and routines on children's behavior should be acknowledged in interventions to promote active school transportation resulting in an integrated approach to stimulate active school transportation.

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