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Does community type moderate the relationship between parent perceptions of the neighborhood and physical activity in children?

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Abstract

Purpose—To examine whether residing in a community designed to promote physical activity moderates the relationship between parent perceptions of the neighborhood and general physical activity or active commuting to school in their children.

Design—Cross-sectional

Setting—San Bernardino County, California.

Subjects—365 families (one parent and one child in grades 4th-8th). 85 reside in a smart growth community designed to be more conducive to physical activity.

Measures—Parent perceptions assessed using the Neighborhood Environment Walkability Scale. General child physical activity measured using accelerometers, and active commuting was self-reported by children.

Analysis—Two sets of regressions were performed: one for general physical activity, and one for active commuting. Separate models were run in the two sets for each of the 14 NEWS factors, while controlling for demographics.

Results—For general physical activity, walking infrastructure, lack of cul-de-sacs and social interaction had significant main effect associations ($p < 0.05$). No factors were moderated by community. The relationships between active commuting to school and perceived crime, traffic hazards, hilliness, physical barriers, cul-de-sac connectivity, aesthetics, and walking infrastructure were significant for those in the smart growth community only ($p < 0.05$).

Conclusions—Living in an activity friendly environment is associated with positive relationships between parent perceptions and active commuting behaviors in children. Future interventions should account for both the perceived neighborhood environment and available physical activity infrastructure.

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Keywords

physical activity; built environment; active commuting; smart growth; moderation; perceptions

Indexing keywords

Manuscript format: research; Research purpose: modeling/relationship testing; Study design: quasi-experimental; Outcome measure: behavioral; Setting: family; local community; Health format: physical activity; Strategy: built environment; Target population age: youth, adults; Target population circumstance: geographic location

Purpose

In the effort to determine causal factors related to persistently low levels of physical activity in children and the concomitant rise in the number of individuals who are overweight, the built environment is now generally regarded as an important factor that must be accounted for if these trends are to be reversed¹⁻³. Recent research has shown that a number of environmental features, both perceived and objectively measured, are associated with physical activity in children. Objectively measured presence of recreation facilities, sidewalks, traffic lights, crime incidence, and traffic patterns are associated with physical activity.⁴⁻⁸ Subjective perceptions of public transportation availability, controlled street crossings, pedestrian safety, aesthetics, recreation facilities and the presence of other active people in the neighborhood have also been linked to physical activity in children.^{7, 9, 10}

Aside from general levels of physical activity, there has been a great deal of interest in promoting active commuting to school (e.g., walking, biking, skating, etc.) as a means to integrate regular physical activity into children's lives. As with general physical activity, multiple features of the environment have been linked to this behavior. Parent perceptions of a lack of street crossings, traffic lights, other children present in the neighborhood, and knowing many people in the neighborhood are associated with active commuting.¹¹⁻¹³ Objectively measured distance to school, a steep or busy road barrier, road density, land use mix and urbanization are also associated with active commuting.^{11, 13-17}

While results from these primarily cross-sectional studies are far from conclusive, they do indicate that both perceived and objective measures of the environment play a role in physical activity and active commuting to school. Despite this work, very little research has been done to determine the manner in which the two domains of measurement relate to each other.¹⁸ Defining this relationship will help inform future interventions, as it will give us a better sense of precisely where on the causal pathway we should target programs and policies, and what combination of modifications to perceptions and the physical environment would prove most effective.

One proposed relationship is that of mediation, whereby the causal pathway between objective features of the neighborhood and behavior are mediated by a resident's individual perceptions of that objective reality.^{19, 20} If this were true, features of the neighborhood environment could be modified, which would in turn effect change in resident perceptions,

and result in changes in their actual behavior. There are several potential problems with this view, however, including that perceptions may be informed by a variety of factors beyond objectively measureable features of the neighborhood, including psychosocial factors such as stress and depression, as well as the level of social cohesion and social capital that exists in the neighborhood.²⁰

Another problem arises from the results of studies that indicate there can be a lack of concordance between what residents perceive and the objectively measured characteristics of their neighborhood.^{18, 21} These results have been extended to show that even if a resident lives in a neighborhood that objectively speaking is less conducive to physical activity, their own perceptions that the neighborhood *is* conducive to physical activity is associated with more exercise as compared to their neighbors with negative perceptions.²² Thus, the proposed mediation pathway may not be the best explanation of how subjective and objective features relate to each other, and subsequently to health behavior.

Another less discussed pathway is that of moderation, whereby the objective features of the neighborhood moderate the relationship between perceptions and behavior. The logic underlying this pathway is that while perceptions matter in determining physical activity behaviors, they only matter to the extent that individuals are actually able to act on those perceptions. Unlike the mediation process, this pathway does not specify any causal factors of perceptions, but does propose that objective reality facilitates the perception-behavior causal pathway. Within built environment research, moderation is primarily studied with respect to demographic factors such as gender, ethnicity or socioeconomic status, though several studies have examined the role of the objectively measured environment as a moderator in the context of interventions to increase physical activity, while another examined distance to school as a moderator of the effect of the environment on active commuting to school.^{14, 23-25}

This study examines moderation as a possible explanation of the relationship between objective and subjective assessments of the neighborhood environment, and their impacts on physical activity. To this end, we will attempt to understand whether the type of community an individual lives in will moderate any observed relationships between parent perceptions of the neighborhood and child behavior. We are able to take advantage of a natural experiment in which a community was purposely built to be more walkable and activity-friendly than the more conventional subdivisions in surrounding cities by using an underlying framework of “smart growth” principles to guide the design of the community. These principles encourage reduced lot size and denser housing, increased walking infrastructure, access to parks and green space, alternative modes of transit, and a mixture of housing, retail and office space.²⁶ This is one of the only communities of this kind in Southern California, and is the only one from which participants were recruited. The increased use of natural experiments such as this has been encouraged recently, and has previously demonstrated its utility as an important way to understand the effects of real environmental change.^{27, 28}

This study first sought to determine whether community of residence moderates the relationship between parents' perceptions and physical activity in their children, including

non-motorized transport to school, and second, if there is no evidence of moderation, to examine whether perceptions of the neighborhood are associated with physical activity. For the first goal, we hypothesize that positive parental perceptions will be more significant correlates of child physical activity in residents of the smart growth community, and for the second goal, our hypothesis is that more positive perceptions of the neighborhood will be associated with higher levels of physical activity.

Methods

Sample

Data for the present study comes from the first year of a four year, controlled trial seeking to determine characteristics of the built environment that affect physical activity, eating behaviors and body mass. Potentially eligible families, defined as one parent and one of their children, were recruited via informational fliers distributed at schools and community gathering places, advertisements in local newspapers, and postcards mailed to homes in the targeted cities. Upon learning of the study, parents were asked to call the study office to complete eligibility screening. Eligibility criteria included residence in the study target area (San Bernardino County, California), having a child in the 4th-8th grade, and a total household income of less than \$165,000. The income limits were used to focus the study on lower to middle income families who are at higher risk of obesity. Available for this analysis is data from 365 families.

Measures

Perceptions of the neighborhood environment were collected from parents using the Neighborhood Environment Walkability Scale (NEWS). This instrument consists of questions designed to characterize an individual's perceptions of their neighborhood in terms of 14 factors, including residential density, land use mix-diversity, land use mix-access, street connectivity, infrastructure and safety for walking, aesthetics, traffic hazards, crime, lack of parking, lack of cul-de-sacs, hilliness, physical barriers, walkways connecting cul-de-sacs, and social interaction while walking. The first eight factors are composites of multiple single items, while the last four are single items. For most questions, response choices are on a four point scale, with one being "strongly disagree" and four being "strongly agree." The crime, traffic hazards, hilliness and physical barriers factors are scored such that a lower score indicates higher walkability, but for all others, a higher score indicates higher walkability. The NEWS has previously been validated and shown to be reliable in adults.²⁹ Within this sample, Cronbach's alphas for the eight multi-item factors ranged from 0.73 to 0.94, with one exception ($\alpha=0.51$ for street connectivity factor).

To objectively measure physical activity levels, children were asked to wear Actigraph accelerometers for a period of seven days. The accelerometers count tri-axial movement in 30 second epochs, and the number of counts in each epoch determines whether that period of time is classified as sedentary, moderate, hard, or very hard activity. The Freedson et al equation was chosen to determine age-specific cutpoints due to its superiority to other proposed equations.^{30, 31} Epochs were summed, divided by two (to convert the epochs to minutes), and then divided by the number of valid days the accelerometer was worn to

produce average minutes per day in each activity category. Non-motorized transport to school was assessed through a single item on the child questionnaire that asked how they usually get to and from school. Choices were walking, skating, biking, car and bus. For analysis purposes, children were coded as actively commuting to school if they answered any of the first three choices and non-actively commuting if they selected car or bus. Demographic information obtained from the child questionnaire included gender, race/ethnicity, age, and whether they received free or reduced price lunch at school, which was used as a marker of socioeconomic status. From the parent questionnaire we obtained self-reported data about the proximity of schools to their residence. Informed consent was obtained from parents and children, and the study was approved by the University of Southern California Institutional Review Board.

Analysis

To address our question concerning the role of perceptions of the neighborhood, we conducted two sets of regression analyses. The first was a linear regression for average daily minutes of moderate-to-vigorous physical activity (MVPA). Each of the 14 NEWS factors was examined separately as an independent variable, while also controlling for the previously mentioned demographic factors, plus a dummy variable indicating whether that family resided in the smart growth community. After running the initial multivariable models, there was evidence of non-linearity for some of the factors, violating a basic assumption of regression. As a result, a fractional polynomial approach was taken to find transformations that better fit the data. To find the best fitting transformation, the Multivariable Fractional Polynomial procedure was used in Stata version 11.³² An alpha level of 0.05 was used for all tests. Diagnostic tests were performed to check for evidence of collinearity among predictors.

The moderating effects of living in a community designed to be more conducive to physical activity was assessed by constructing interaction terms between each of the NEWS factors and the dummy variable for community of residence. After establishing the initial main-effects relationship using the procedures outlined above, this interaction term was added to the model. A p-value for the interaction term of less than 0.15 was considered evidence of effect modification.³³ To more fully explore this effect, a subsequent analysis was done on models that had an initial significant interaction term by calculating point estimates and confidence intervals separately for the two community types, but still within the context of the model with the interaction term.³⁴ This simple slopes analysis is only reported when at least one slope is significant at the 0.05 level. For each NEWS factor with evidence of moderation, predicted values of the dependent variable were graphed separately for the two community types, while holding all other covariates at their means in order to provide a visual representation of the moderation effect. In the event of a non-linear main effects model that was best fit by a second degree fractional polynomial, we used only the first degree term to construct the interaction, because including in the model interaction terms using both the first and second degree transformations would result in high collinearity between the two terms.

The above procedures were repeated for a set of logistic regressions that assessed the odds of using some form of non-motorized transport to travel to school. The one difference in this set is that we also included a covariate for proximity to school, as reported by parents. Logistic model fit was assessed using the Hosmer-Lemeshow goodness-of-fit test, the specification link test (which re-fits the model using only the predicted value and the square of the predicted value), and the area under the receiver operating characteristic curve (ROC).³⁵

Results

Sample characteristics are reported in table 1. Approximately 91% of those who were approached to participate and met eligibility requirements actually participated. There were 280 participants residing in the conventional communities and 85 in the smart growth community. The total sample of children was approximately evenly split between males and females, the plurality identified as Hispanic, average age was 11.7, and one-third received free or reduced price lunch at school. Average time in residence (as reported by adults) for smart growth residents was 19.8 months (SD=14.6), while it was 94.8 months (SD=78.9) for conventional community residents. Children engaged in an average of 35 minutes (SD=23) of combined moderate and vigorous physical activity each day, 15% averaged at least 60 minutes per day, and 31% actively commuted to school.

Results from the first set of analyses are presented in table 2. Parent perceptions of the neighborhood were largely unassociated with MVPA. The exceptions were for scales concerning infrastructure for walking, presence of cul-de-sacs, and social interaction while walking. For every unit increase on the walking infrastructure scale, children engaged in an additional four minutes of MVPA per day. For each unit increase on the lack of cul-de-sacs measurement scale (that is, parents perceive fewer and fewer cul-de-sacs), daily MVPA increases by two minutes. The social interaction factor was best fit by a first degree fractional polynomial. To aid in interpretation, a graph of the predicted average daily minutes of MVPA is presented in figure 1A for scores ranging from one to four on the scale, holding other covariates at their mean. The largest increase takes place at the low end of the scale, and flattens out as scores increase, for an approximate gain of 12 minutes per day of MVPA over the range of the scale. Additionally, no interaction terms remained significant for any NEWS factors in simple slopes analysis, indicating that for this outcome, community of residence did not modify the relationship between perceptions and physical activity.

The shaded portion of Table 2 shows the association between parent perceptions of the neighborhood and whether their children actively commute to school for models where the interaction term was non-significant. Three NEWS factors were significantly associated with active commuting. For every unit increase in the land use mix diversity scale, an indicator of the proximity of a variety of land uses, such as shops, banks, restaurants, schools, parks and transit stops, the odds of a child actively commuting decreased by 35% (95% CI=0.46-0.90). While land use mix diversity was modeled with a linear term, the other two significant factors were not. Hard parking and social interaction were both best fit using a first degree fractional polynomial. As with social interaction from the first set of analyses, interpreting these terms is not straightforward. Figures 1B and 1C present graphs for the predicted

probability of actively commuting to school by scores on the parking difficulty and social interaction scales, holding all other covariates at their mean, and they provide a visual indication of the positive association uncovered in both these models.

Finally, the non-shaded portion of table 2 presents results for NEWS factors for which the interaction term was significant. These interactions are visually represented in figures 2 and 3. For each of the factors related to crime, traffic hazards, hilliness, physical barriers, cul-de-sac connectivity, aesthetics, and walking infrastructure, there is no significant association between the factor and active commuting for those in the conventional communities, while for those in the smart growth community the odds increase as perceptions become more favorable.

For results of the logistic regressions, it should be noted that the area under the receiver operating characteristic curve was generally at less than desirable levels, ranging from a low of 0.62 to a high of 0.78. This indicates that the models predicting active commuting to school may be under fit and there are possibly other variables that if added to the model would increase their explanatory power. However, given that the Hosmer-Lemeshow and link tests were at acceptable levels, it is unclear if under fitting is truly a problem.

Discussion

The primary goal of this paper was to examine whether residing in a community designed from the ground-up to be more conducive to physical activity and active living had a moderating effect on the main effect relationship between perceptions and activity. For overall MVPA, there was no evidence that the perception-physical activity relationship was dependent upon community of residence. When all subjects were combined into the same analysis, only cul-de-sacs, walking infrastructure and social interaction were significant correlates.

Walking infrastructure, which subsumes perceptions of sidewalk availability and condition, bike paths, street lighting, crosswalks and pedestrian signals, had the greatest association with MVPA. All other things equal, children whose parents are on the high end of the scale would be expected to be physically active for 12 minutes more per day, on average, than children of parents who report their perceptions of this factor to be on the low end. Environmental interventions designed to increase the availability of walking infrastructure in existing neighborhoods, or policies requiring it for new construction, are achievable near-term interventions (as opposed to longer-term changes in patterns of land use) that could make an important contribution towards children reaching the most recent United States recommendation of 60 minutes per day of physical activity^{36, 37}.

While walking infrastructure represents an enabling factor of neighborhood design in terms of activity, cul-de-sacs represent an inhibiting factor because they create obstacles to free movement around a neighborhood.³⁸ This was apparent in our results, where fewer perceived cul-de-sacs were associated with greater MVPA. Though existing cul-de-sacs are less amenable to change, policies designed to limit their use in new construction would be a natural complement to policies promoting greater walking infrastructure.

A third significant factor was social interaction, which was positively associated with MVPA. As with walking infrastructure, it would be expected that on average, children whose parents are on the high end of the scale would be physically active for 12 minutes more per day than children of parents who report their perceptions of this factor to be on the low end. Unlike many of the other factors measured by the NEWS, this is a “non-structural” feature of the neighborhood, meaning it is not directly modifiable through infrastructure improvements and policy changes, at least not in the same way that factors such as residential density or street connectivity can be. Increased social interaction instead may be more a function of the demographics, socioeconomic status, and the overall social cohesion of a particular neighborhood.³⁹ This indicates that interventions aimed at increasing physical activity may need to target not just infrastructure and policy but also upstream factors related to the social environment.

When we examined perceptions as they relate to active commuting to school, we found multiple significant associations, including evidence that community type is a moderator. The higher number of significant factors associated with active commuting than overall physical activity may well be explained by the fact that at least a portion of the trip to school must occur in the neighborhood. Therefore, perceptions should exert a stronger effect here than for the less contextual measure of overall physical activity.⁴⁰

First, for factors that were significant correlates but not modified by community of residence, a negative relationship was found between land use diversity and odds of active commuting. While higher levels of land use diversity in and around a neighborhood are expected to increase physical activity due to greater numbers of destinations that can be reached through walking or biking, the opposite was true here.⁴¹⁻⁴³ This may be due to safety concerns on the part of parents who do not want their children walking by storefronts or commercial areas in which a large number of strangers congregate. If this finding is corroborated in future research, it raises an interesting dilemma for advocates of increased mixture of residential and commercial districts: While it may serve to increase transport-related walking among adults, it may simultaneously decrease the probability of children getting to school by walking, biking or skating.

As with MVPA, social interaction was positively associated with active commuting, again indicating a need to address related neighborhood constructs, such as collective efficacy, social cohesion and social capital. Finally, parking difficulty was positively associated with actively commuting to school. This implies that active commuting could be encouraged by reducing parking availability in neighborhoods, either by eliminating parking spots, metering spaces, or limiting the number of street parking permits each household is allowed. Of all the significant factors identified in this study, this factor may be the most straightforward and cost effective to modify, though it would require a shift in attitudes among many who have come to see free parking as something approaching a right.³⁶

Turning to those factors that appeared to be moderated by community of residence, the findings for the crime, traffic hazards, hilliness, physical barriers, cul-de-sac connectivity, aesthetics, and walking infrastructure factors support what was hypothesized. The idea that a smart growth community could moderate the effects of perceptions on physical activity is

predicated on the belief that those who live in a more activity-friendly environment are better able to act on their positive perceptions, and therefore engage in greater amounts of activity. For the aforementioned factors, as scores on those factors improved, children of those who live in the objectively more walkable environment had a higher probability of actively commuting to school, whereas there was no change for those in the conventional communities. This seems to indicate that the objective reality helps facilitate the pathway from perceptions to actions. The implication then is that with respect to these specific factors, psychosocial interventions designed to create more positive perceptions of the neighborhood environment would be most effective in terms of increasing active commuting to school if implemented among those who reside in more objectively walkable environments. This is not to say that interventions could not be effective in low-walkable communities, but they would likely need to take a more holistic approach and come with at least some degree of modification to the environment as well.

While our analysis indicates that the differential effects of perceptions on active commuting between the two community types is due to differences in the actual neighborhood environment, there are several additional explanations for this. The differences observed between communities on the crime, traffic hazards, hilliness and physical barriers scales, which are worded in a negative manner on the NEWS and could be conceptualized as “fear” variables, may be due to the fact that on average, residents of conventional communities have lived in their communities longer, and have been able to establish a certain level of familiarity with their neighborhood, as well as trust among their neighbors. This familiarity can be thought of as a buffer against the effects of negative perceptions. The smart growth community residents, due to their shorter time in residence, may not have had time or the opportunity to develop these relationships and familiarity with the neighborhood, and therefore are more sensitive to negative perceptions of the environment. Though somewhat speculative, other studies have acknowledged the potential influence of time in residence when studying neighborhood perceptions.^{44, 45}

A second explanation concerns the economic status of the two communities as measured by the percentage of students who receive free or reduced price lunch. If parents in the smart growth community have more negative perceptions of the environment, they may be in better position to provide alternative transport to school, including driving their children. However, children in the conventional communities may not have that option, as their parents may have earlier work hours, only one vehicle, or rely on public transit. In this case, the child would have no option other than to actively commute, regardless of their parent's perceptions, especially if they do not have school bus service.

We attempted to control for the former explanation by including time in residence as a covariate, but its impact was never sufficient to keep it in any model. The latter was accounted for through inclusion of a proxy variable for socioeconomic status (free and reduced lunch status), but this is a somewhat broad, single item indicator. While it seems the primary reason for the difference in relationship between the two community types is more favorable physical environment of the smart growth community, we cannot discount the above factors as possible explanations.

Limitations & Strengths

Limitations of this study include the fact that we are unable to account for the likely nested nature of the data. Participants who reside in the same neighborhood might be more similar to each other than to those in other neighborhoods; this clustering could bias our results. Unfortunately, we do not have data on the specific neighborhoods our participants come from, so we cannot integrate it into our models. However, given the lack of clear agreement about what defines a true neighborhood, it may be better that we have not included a clustering adjustment in our analysis. A second limitation is that our objectively measured physical activity data has no context; that is, we do not know where this activity is taking place. It could be in the neighborhood, but given that these are children, it could be occurring in a sports league on the opposite end of town. It may not be reasonable to expect neighborhood perceptions to affect activity occurring outside the neighborhood.

The results of this study are strengthened by the use of a multivariable fractional polynomial approach to model non-linear terms. A recent review of epidemiological literature has shown that often data analysts either do not properly account for non-linear terms in their models, or if they do, they fail to describe how this was accomplished in their methods.⁴⁶

The importance of choosing the correct function to model non-linearity cannot be overstated, and future analyses should account for this basic assumption, as well as be more transparent in methods of dealing with it. Another strength is the flipside of one of our limitations. While accelerometry derived measures of physical activity lack context, they also provide a more accurate record of physical activity. Studies that utilize contextual measures of physical activity, such as walking in the neighborhood for transport or recreation, invariably obtain this data from self-report questionnaires; the limitations of this data, especially in children, are well known.

Conclusion

This research represents one of the few examinations of both the effects of parent perception on physical activity in their children, as well as whether living in a specific kind of community can moderate the effects of perception. Three factors significantly predicted MVPA, while multiple factors were found to predict non-motorized transport to school, including some that were moderated by community of residence, indicating that perceived and objective realities play an interconnected role in active commuting to school.

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So what?

What is already known on this topic?

Both perceptions and objectively verified features of the neighborhood environment are associated with physical activity and active commuting behaviors in children. Less certain is how these dual interpretations of the neighborhood relate to each other.

What does this article add?

Multiple features of the perceived environment were related to higher levels of general physical activity and active commuting, including several, such as crime, aesthetics and walking infrastructure, that held only among those who reside in a neighborhood designed to be more activity-friendly.

What are the implications for health promotion practice or research?

Multi-level interventions that take account of both the physical environment and an individual's perceptions of that environment may be necessary to increase the practice of active commuting to school. Future interventions should focus on creating real environmental change, as well as increasing positive perceptions of the environment. Additionally, interventions could focus on fostering social support for active commuting among residents.

Figure 1. Non-moderated relationships of neighborhood perception factors with moderate to vigorous physical activity (panel A) or active commuting to school (panels B & C)

Figure 2. Moderated relationships of neighborhood perception factors with active commuting to school (items worded in negative direction)

Figure 3. Moderated relationships of neighborhood perception factors with active commuting to school (items worded in positive direction)

Table 1
Sample Characteristics

Child Characteristic	Total Sample (n=365)	Smart Growth Residents (n=85)	Conventional Community Residents (n=280)
	% (n) or mean (sd)		
Female	49% (179)	51% (43)	49% (136)
Age	11.7 (1.49)	11.5 (1.28)	11.8 (1.54)
Receive free or reduced lunch	32% (118)	19% (16)	36% (102)
Hispanic	43% (158)	31% (26)	47% (132)
White	25% (90)	22% (19)	25% (71)
Other race	32% (117)	47% (40)	28% (77)
Actively commute to school	31% (114)	44% (31)	28% (77)
60 minutes MVPA daily	15% (55)	11% (9)	16% (46)
30-59 minutes MVPA daily	37% (136)	42% (36)	36% (100)
29 minutes MVPA daily	48% (174)	47% (40)	48% (134)

Table 2

Regression coefficients and 95% confidence intervals predicting minutes per day of moderate to vigorous physical activity (MVPA).

NEWS Factor	Coefficient	95% Confidence Interval
Residential Density	0.002	-0.04, 0.04
Land Use Mix-Diversity	-0.17	-2.57, 2.23
Land Use Mix-Access	-1.14	-3.89, 1.59
Street Connectivity	1.37	-1.46, 4.23
Walking Infrastructure	4.11 *	0.67, 7.54
Aesthetics	1.24	-2.18, 4.65
Traffic Hazards	0.51	-2.82, 3.84
Crime	2.97	-0.20, 6.14
Hard Parking	0.99	-1.34, 3.31
Lack of cul-de-sacs	2.00 *	0.10, 3.89
Hilliness	2.06	-0.37, 4.49
Physical Barriers	1.95	-0.55, 4.45
Walkways connecting cul-de-sacs	-0.43	-2.32, 1.47
Social interaction ²	-12.28 **	-21.27, -3.28

Controls for child age, gender, race/ethnicity, free/reduced lunch status, and community of residence dummy variable.

Interaction term between NEWS factor and community of residence was not significant in the above models.

* p 0.05;

** p 0.01

Table 3
Odds ratios and 95% confidence intervals predicting active commuting to school

NEWS Factor	Community of Residence	Odds Ratio	95% Confidence Interval
Residential Density	<i>Combined</i>	1.00	0.99, 1.00
Land use mix-diversity	<i>Combined</i>	0.65*	0.46, 0.90
Land use mix-access	<i>Combined</i>	0.91	0.67, 1.24
Lack of cul-de-sacs	<i>Combined</i>	1.07	0.87, 1.32
Hard parking ²	<i>Combined</i>	0.33**	0.18, 0.60
Social interaction ³	<i>Combined</i>	1.03**	1.01, 1.04
Street Connectivity	<i>Combined</i>	1.12	0.82, 1.53
Crime	Conventional	1.06	0.74, 1.53
	Smart Growth	0.19*	0.04, 0.85
Traffic Hazards	Conventional	0.94	0.61, 1.43
	Smart Growth	0.20**	0.08, 0.51
Hilliness	Conventional	1.08	0.81, 1.45
	Smart Growth	0.15*	0.02, 1.02
Physical Barriers	Conventional	1.01	0.75, 1.36
	Smart Growth	0.24*	0.07, 0.87
Cul-de-sac Connectivity	Conventional	0.99	0.78, 1.26
	Smart Growth	1.60*	1.00, 2.56
Aesthetics	Conventional	1.46	0.93, 2.29
	Smart Growth	2.91**	1.31, 6.46
Walking Infrastructure	Conventional	1.23	0.78, 2.02
	Smart Growth	2.42*	1.18, 4.95

Controls for child age, gender, race/ethnicity, free/reduced lunch status, community of residence dummy variable, and proximity to school

Shaded portion of table indicates factors for which the interaction term with community of residence was not significant

* p 0.05;

** p 0.01