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Impacts of temporary pedestrian streetscape improvements on pedestrian and vehicle activity and community perceptions

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A R T I C L E I N F O

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A B S T R A C T

Introduction: Micro-scale streetscape built environment attributes can support or inhibit physical activity over and above macro-scale community design factors. Quick build projects involve rapid and low-cost approaches for modifying streetscape design elements to improve pedestrian safety and support walking. This study evaluated quick build projects at two intersections in low-income neighborhoods.

Methods: Two intersections were identified using a participatory process with community residents. The projects included painted crosswalks and temporary curb extensions to narrow the vehicle traffic lanes. Video and in-person direct observations were conducted before and during implementation to assess the number of pedestrians and vehicles using the intersection and vehicle/driver behaviors. Resident and stakeholder (e.g., public service workers) attitudes towards the projects were captured through surveys and interviews.

Results: Pedestrian activity increased by 23% ($p = 0.030$) and vehicle activity did not change. The number of vehicles that failed to come to a complete stop at a stop sign decreased by 9% ($p = 0.040$) and the proportion of vehicles creating two lanes of traffic at the intersection of single-lane streets decreased from 70% to 0%. The mean rating regarding whether residents wanted the project to become permanent was 3.1 on a 1–4 scale, ranging from strongly disagree to strongly agree. The primary concerns noted related to burden to drivers. Stakeholders had positive attitudes towards the project but some noted concerns related to large vehicles' (e.g., fire engines) ability to make turns in the intersection.

Conclusions: The findings suggest that inexpensive quick build streetscape improvements are promising for increasing pedestrian activity and walking. More research is needed to evaluate long-term outcomes of sustained quick build projects.

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1. Introduction

Walking is an important source of physical activity that is accessible to a majority of the population and recommended by leading public health authorities (U.S. Department of Health and Human Services, 2018). Both youth and adults who engage in walking for transportation typically obtain more minutes of overall physical activity than those who do not engage in walking for transportation (Borner et al., 2018; Cooper et al., 2005; Gordon-Larsen et al., 2005). However, substantial evidence suggests that neighborhood environment attributes serve as a barrier to walking and overall physical activity in many communities (Ding et al., 2011; Saelens and Handy, 2008).

Both macro-scale neighborhood attributes, which describe the overall layout of a community (e.g., residential density and land use mix), and micro-scale streetscape attributes, which describe the characteristics within a street segment and intersection (e.g., sidewalk availability and quality, crosswalk amenities), appear important to influencing physical activity (Bauman et al., 2012; Cain et al., 2014; National Collaborative on Childhood Obesity Research, 2016). Micro-scale attributes are often more feasible, less costly, and quicker to modify than macro-scale attributes because the latter typically require larger-scale efforts and investments. For example, improving pedestrian safety at street crossings is more feasible to accomplish quickly than changing the layout or density of a community. Improvements to micro-scale streetscape attributes are recommended by the Centers for Disease Control and Prevention (U.S. Department of Health and Human Services, 2019a; U.S. Department of Health and Human Services, 2019b), among others, as quick and impactful strategies for increasing population physical activity and providing "complete streets" (Smart Growth America, 2019) that support all users rather than primarily automobiles.

In concert with such recommendations, efforts have emerged to modify existing streetscape attributes to improve pedestrian safety, such as Safe Routes to School (Safe Routes to School National Partnership, 2018), tactical urbanism (Tactical Urbanist's Guide, 2019a), and quick build (People for Bikes, 2016) movements. Such efforts are often community driven in partnership with local governments, with a goal of creating rapid and community-appropriate streetscape improvements. These efforts can be either temporary demonstration projects, or permanent projects that are more modifiable, adaptable, and affordable than traditional infrastructure projects. For example, a project could implement movable barriers rather than pouring concrete curb extensions (Tactical Urbanist's Guide, 2019b). Despite the growing momentum for such efforts, few studies have evaluated the impacts of community-informed quick build streetscape improvements on walking activity.

The purpose of this study was to evaluate two temporary quick build demonstration projects targeting pedestrian streetscape improvements at two intersections in low-income and traditionally underserved communities. The projects were delivered using a community-based participatory approach and the evaluation focused on the projects' impacts on pedestrian and vehicle activity, as well as community perceptions of the quick build demonstrations.

2. Methods

2.1. Intervention

2.1.1. Community selection

The Northeast Neighborhood in Kansas City, MO, which was developed in the early 1900s, was selected as the target community because it is a traditionally underserved community with high rates of poverty and preventable diseases, poor pedestrian safety in many areas, low rates of walking and biking, and limited access to transportation.

2.1.2. Community engagement

To inform the design and locations of the quick build projects, community engagement activities were conducted with the five formalized neighborhoods within the larger Northeast Neighborhood community and during three existing community events (e.g., schoolyear kickoff event). Each neighborhood represented an approximately 0.5–0.8 square mile (0.8–1.3 square kilometer) area and 3620 to 5165 residents (City of Kansas City Missouri, 2019a, 2019b). The objective of the community engagement events was to learn about pedestrian safety-related barriers residents face when deciding whether to walk to, from, and around local primary schools, and to identify specific intersections to target for pedestrian-oriented safety improvements. The engagement events were led by a community liaison with expertise in community planning and development and extensive knowledge of the targeted community. During the engagement events, the community liaison showed pictures of similar projects to demonstrate the type of improvements that could be made. The liaison then presented maps of the schools in the study neighborhood area and asked residents and officials to note specific concerns at intersections near primary schools (Kindergarten through 5th or 6th grade) that they considered to be the most dangerous for pedestrians to cross and for which they would like to see improvements. Input from community officials such as the fire department, police department, school board, and transit agency was solicited through email and phone contact. Across the community engagement activities, four intersections emerged as being of primary interest for targeting improvements. From this list of four intersections, one was eliminated due to a competing utility services construction project, and the two to receive the quick build projects were selected to involve two of the five neighborhood association boundary areas and maximize reach and impact as perceived by the study team.

2.1.3. Intersection descriptions

Intersection 1 was a four-way stop and each adjacent block consisted of single family residences. The WalkScore (Walk Score, 2019) was 64 ("somewhat walkable") and the speed limit was 35 miles per hour (56 km per hour) on both streets. There were bus transit stops on the eastbound and westbound sides of the intersection. The nearest cluster of commercial destinations was 0.1 miles (0.2 km) and the nearest primary school was 0.4 miles (0.6 km) from the intersection. The cross streets were both two-lane roads (one lane in each direction). The east-west street had a single through lane in each direction with dedicated left turn lanes at the intersection. The streets were wide enough at the intersection to allow two vehicles to form two lanes within each lane, thus creating a four-lane road. Intersection 2 comprised two two-lane streets (one lane in each direction); north-south traffic had right of way and a 35 miles per hour (56 km per hour) speed limit, and east-west traffic had a stop sign and a 25 miles per hour (40 km per hour) speed limit. The WalkScore was 50 ("somewhat walkable"). The adjacent blocks included single family residences, multifamily residences, and one business. The nearest cluster of commercial destinations was approximately 0.1 miles (0.2 km) and the nearest primary school was 0.2 miles (0.3 km) from the intersection. There was freeway access via the north-south street 0.3 miles (0.5 km) away. The intersections were 1.8 miles (2.9 km) from one another. Sidewalks were present on all streets at both intersections. Sociodemographic characteristics were similar between the two local ZIP codes encompassing each intersection. A greater proportion of residents in these communities were Hispanic/Latino (37.5% vs. 17.6%) and a lower proportion were White non-Hispanic (36.7% vs. 61.5%) as compared to the entire U.S. population (U.S. Department of Commerce, 2019). The median annual household income in these communities was lower than in the entire U.S. population ($28,958 vs. $63,179) (Guzman, 2019).

2.1.4. *Description of quick build streetscape transformations*

The goal of the quick builds was to increase pedestrian activity through improvements in pedestrian safety. Cross-sectional studies in multiple age groups have shown that the presence of crossing amenities, including visible crosswalks and curb extensions, were associated with more walking for transportation (Cain et al., 2014), so these features were prioritized in the present quick build transformations. The city agency responsible for transportation infrastructure, Kansas City Missouri Public Works, outfitted each intersection with four permanent painted crosswalks just prior to the quick build intervention. BikeWalkKC, a local non-profit bike/pedestrian advocacy and education organization, outfitted all four corners of each intersection with temporary curb extensions. Curb extensions provide higher visibility of pedestrians entering the intersection, a narrower street width and crossing for pedestrians, and reduced vehicle turn speeds (U.S. Department of Transportation, 2019). Yellow-painted lumber and three foot bollards marked the curb extensions (Fig. 1). The specific materials used for the curb extensions were informed by the Tactical Urbanist's Guide to Materials and Design (Tactical Urbanist's Guide, 2019b) and selected to be lightweight so that they could be easily transported and assembled/dissembled. All quick build modifications adhered to the city's traffic standards (i.e. lane width and turn radii) and were approved by the Kansas City Public Works Department.

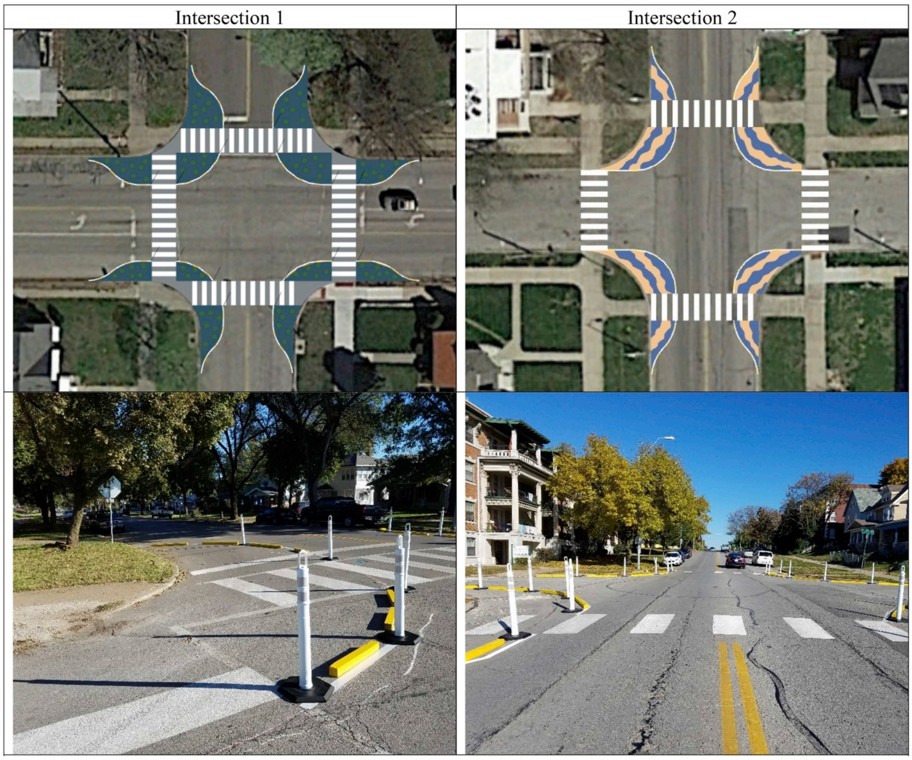

Fig. 1. Photographs showing the quick build intervention at each intersection.

2.1.5. Timing

Each quick build was conducted in October 2018 and included a Saturday morning kick-off event on the first day of each implementation. Weather was generally favorable during the two-week (across intersections) implementation period, with most daily low temperatures between 40° and 55 °F (4° and 13 °C) and daily high temperatures between 60° and 75 °F (16° and 24 °C) (Department of Commerce, 2019). BikeWalkKC staff and members of the evaluation team were present at each event to provide residents with education and solicit feedback about the project. A maintenance phase followed the kick-off event, where projects remained for 1 week, at which point the quick build intervention was disassembled. The 1-week duration was used because this was the allowable period dictated by the city.

2.2. Overview of evaluation

The evaluation consisted of pre-post observations of pedestrian and vehicle activity at the intersections, a post-implementation survey of neighborhood residents, and post-implementation interviews with community agencies representing various community sectors. All post measures were conducted during the week-long project implementation period. Weather was favorable and there was no precipitation during the observation periods, including for the camera-assisted counts. The study was approved by the Institutional Review Board at Children's Mercy Hospital.

2.3. Participants and procedures

2.3.1. Pedestrian and vehicle observations

Both camera-assisted counts and in-person direct observations were conducted before and after implementation. The camera-assisted counts were used to capture longer periods of time than feasible by in-person observers, and the in-person observations provided information not available from the camera-assisted technology, such as the number of vehicles that failed to come to a complete stop at a stop sign. The camera-assisted counts were conducted for 12 h on one weekday before each quick build was implemented and on the same day of the week during the week-long implementation period. In-person observations were only conducted at Intersection 1, due to safety concerns for study staff during the first observation visit at Intersection 2. The observations were conducted by trained study staff during three time periods on two weekdays during the week before the quick build was implemented and during the same time of day and days of the week during the week-long implementation period. All post-implementation data were collected $\geq$3 days after the kick-off event.

2.3.2. Survey participants

Surveys were administered in person, through the mail, and online. In-person surveys were collected at a kickoff event that was held at each intersection on the first day of implementation. Pedestrians who walked by the intersection were asked to complete the survey. Additionally, surveys were mailed to all residences within one block in each direction of the intersections. Resident addresses were identified by reverse lookup in Google Maps. These mailed surveys included an offer of a $10 cash card to incentivize respondents. The link to the online version of the survey was distributed to the leaders of five neighborhood associations involved in the engagement process to distribute to their resident contact lists. All administrations of the survey included both English and Spanish versions.

2.4. Measures

2.4.1. Camera-assisted counts

Miovision, which uses proprietary computer vision algorithms, was used to count the number of pedestrians passing through the intersection from video recordings (Yan et al., 2016). The videos were collected using a Miovision Scout camera that was secured to a light post near the intersection so that an overhead view of the entire intersection could be captured. The algorithms are automated and Miovision manually verifies 12% of each hour of video for accuracy (Miovision Technologies Inc, 2019b). Miovision boasts 95% count accuracy for pedestrian counts (Miovision Technologies Inc, 2019a).

2.4.2. In-person direct observation

Two observers were deployed during each observation time period to count the number of vehicles passing through the intersection as well as the number of vehicles that failed to come to a complete stop at a stop sign. At Intersection 1, each street comprised one lane in each direction, but the large width of the streets allowed vehicles to travel next to one another or even pass one another. For example, when a car was stopped at the intersection waiting to go straight or turn left, the following car would frequently stop directly to the right of the first car if they were planning to turn right or go straight (the latter was true if the first car was turning left). This created situations during times of heavy traffic when two lines of cars would form next to one another within the same lane at the intersection. Thus, at Intersection 1 observers additionally estimated the proportion of drivers who created a second lane at the stop sign. In-person direct observations for Intersection 2 were cancelled due to study staff witnessing violent crime during the first observation visit.

2.4.3. Resident survey

Respondents were asked to provide their gender, age, and ZIP code as well as whether they walked or cycled in the neighborhood for various purposes. A series of seven statements about the impact of the project was presented and respondents were asked to indicate their agreement using a 4-point Likert scale (strongly disagree, disagree, agree, and strongly agree). Responses across the seven items were averaged to create an overall favorableness score. Respondents also were asked an open-ended question about their general feedback and opinion of the project. Responses were grouped as being positive, negative, or neutral, and common themes within the positive and negative comments were identified using inductive thematic analyses.

2.4.4. Community sector interviews

Community sector contacts were identified by the community-engagement consultant and contacted via telephone call for a brief interview. The interviewees were asked for their feedback on the projects and how they thought the projects would impact their sector's work and the community.

2.4.5. Census information

The race/ethnic distribution and median annual household income of the two ZIP codes encompassing each intersection were obtained from the 2017 American Community Survey (U.S. Department of Commerce, 2019).

2.5. Statistical analyses

Repeated measures ANOVA was used to test whether the total number of pedestrians (from Miovision), number of vehicles that failed to come to a complete stop (from in-person observations), and total number of vehicles (from in-person observations) changed from the pre to post assessment time point. Descriptive statistics were used to summarize the resident survey data, and differences between intersections were investigated using independent samples t tests (for the Likert-scale items) and chi square test (for the number of positive or neutral versus negative open ended comments). All analyses were performed in SPSS v24.

3. Results

3.1. Results of Miovision counts

Across both intersections, 23% more pedestrians were observed using the intersections after the quick build was implemented than before ($F\,(1,23) = 5.39$, $p = 0.030$; Table 1). The increase in pedestrian activity was larger at Intersection 1 (32%) than Intersection 2 (16%). The largest increases by time of day were during the before and after school commute periods (7–10AM and 1–4PM).

3.2. Results of in-person direct observation

Based on the in-person observations at Intersection 1, there was no change in vehicle traffic volume after the quick build was implemented than before (Table 2). However, the number of vehicles that failed to come to a complete stop decreased by 9% ($F\,(1,35) = 4.72$, $p = 0.040$). The proportion of vehicles that drove by another vehicle traveling in the same direction, thus creating two lanes of traffic as opposed to one lane, decreased from 70% before implementation to 0% after implementation.

Table 1
Pedestrian counts from Miovision before and after each quick build was implemented.[a].

	Number of pedestrians			
Time	Pre	Post	Post-pre	% difference
Intersection 1				
7am–10am	20	35	15	75%
10am-1pm	24	28	4	17%
1pm–4pm	54	71	17	31%
4pm–7pm	43	52	9	21%
Total	141	186	45	32%
Intersection 2				
7am–10am	42	48	6	14%
10am-1pm	51	46	−5	−10%
1pm–4pm	37	62	25	68%
4pm–7pm	57	61	4	7%
Total	187	217	30	16%
Both intersections				
7am–10am	62	83	21	34%
10am-1pm	75	74	−1	−1%
1pm–4pm	91	133	42	46%
4pm–7pm	100	113	13	13%
Total	328	403	75	23%

[a] One 12-h period was captured at each intersection, both before and after implementation.

Table 2
Counts of vehicles that failed to come to a complete stop at the stop sign from direct observation before and after each quick build was implemented (Intersection 1 only).

	Number of vehicles that failed to come to a complete stop			
Time	Pre	Post	Post-pre	% difference
7am–10am	1045	827	−219	−21%
11am-2pm	899	868	−31	−4%
3pm–6pm	1305	1248	−57	−4%
Total	3249	2943	−306	−9%
Total Number of Cars	5884	5867	−17	0%

3.3. Results of survey data

The majority of responses were obtained from neighborhood meetings and intercept surveys (Table 3). Most respondents were residents of the ZIP code where the project was implemented or a neighboring ZIP code, with a few exceptions such as a USPS worker and fire department officials. Overall, respondents had positive attitudes in relation to the project, including that they would like to see the project or similar projects become permanent (Table 4). Respondents from Intersection 2 were significantly more likely to respond positively to the quick build project than those from Intersection 1. Of the 45 responses to the open-ended survey question, 25 were coded as reflecting positive attitudes, 15 as negative, and 5 as neutral/neither. Positive themes included how the quick build improved pedestrian safety by slowing traffic and increasing driver awareness, and how the quick build could be improved with additional built environment changes. Negative themes included impacts on drivers, such as making turning more difficult and lengthening the time it takes to get through the intersection, and the aesthetics of the materials used for the quick build. At Intersection 1, 63% of the comments were positive or neutral and 80% were positive or neutral at Intersection 2, but these differences were not significantly different (chi square = 1.03; $p = 0.310$).

3.4. Results of stakeholder interviews

Several general comments were made by stakeholders praising the degree to which the project was communicated to and influenced by community residents (Table 5). Multiple respondents mentioned that reduced vehicle speed was observed and that this had a positive impact on the safety of pedestrians. Suggested improvements for future projects were largely focused on signage and communication to drivers. Some stakeholders expressed concern that the narrowing of the lanes would make it difficult for large vehicles (e.g., fire engines) to move through the intersection safely.

4. Discussion

The present study found that quick build streetscape pedestrian safety improvement projects that used evidence-informed design principles from planning and health research (Cain et al., 2014) resulted in significant increases in the number of pedestrians using the intersections and decreases in driving behaviors that negatively impact pedestrian safety. The projects also were well received by a majority of community resident respondents and stakeholders. While financial cost is commonly a barrier to implementing neighborhood walkability-related improvements, the quick build projects in this study were implemented quickly and with limited cost and resources. These findings suggest that even somewhat minor infrastructure improvements may support increases physical activity. By using more permanent but still inexpensive materials (Tactical Urbanist's Guide, 2019b), quick build projects have the potential for contributing to long and meaningful impacts on community health.

The level of increase in pedestrians using the intersection was 23% or 75 people over a 12-h period across the two intersections.

Table 3
Characteristics of survey respondents.

Total number of respondents	71
Number of responses from Intersection 1	52
Number of responses from Intersection 2	19
Number of respondents from kick-off event	27
Number of respondents from mailings	9
Number of respondents from neighborhood meetings	35
Mean (SD) age of Respondents	44.8 (14.8)
% female	45
% with children under 18	39
% who work for government agency	9
% who walk/bikes for transportation	27
% who walk/bike for recreation/leisure	54
% who walk/bike for exercise	51
% who resided in the local or a neighboring ZIP code	87

Table 4
Community perceptions of each quick build implementation.

Survey item	Mean (SD)			t	p
	All respondents (N = 67)	Intersection 1 (N = 48)	Intersection 2 (N = 19)		
I would find the area more visually appealing if changes like this were made permanent. (1–4)	3.1 (1.1)	2.8 (1.2)	3.6 (0.6)	−2.88	0.005
The health of the community would improve if projects like this became permanent. (1–4)	3.0 (1.1)	2.7 (1.2)	3.6 (0.6)	−3.21	0.002
I would like to see this or similar projects become permanent in this neighborhood. (1–4)	3.1 (1.1)	2.9 (1.2)	3.6 (0.7)	−2.31	0.024
I would feel safer from traffic when walking in this area if projects like this became permanent. (1–4)	2.9 (0.9)	2.9 (1.1)	3.6 (0.7)	−2.68	0.009
I would be able to get around the neighborhood more easily if projects like this became permanent. (1–4)	2.9 (1.1)	2.7 (1.1)	3.5 (0.7)	−2.76	0.008
I would spend more time walking in my neighborhood if projects like this became permanent. (1–4)	2.9 (1.1)	2.7 (1.1)	3.5 (0.8)	−2.90	0.005
I would feel more connected to the community if projects like this became permanent. (1–4)	2.9 (1.1)	2.6 (1.1)	3.5 (0.7)	−3.28	0.002
Overall favorableness (1–4)	3.0 (1.0)	2.8 (1.1)	3.6 (0.6)	−3.06	0.003

Table 5
Public sector perceptions of the quick build implementations.

Organization	Comments	Suggested Improvements/Future Directions
Public transit	• Makes pedestrians more visible to drivers • City buses still had adequate room to move through intersection	• Make the curb extensions a part of the bus stop. • Make turn radius gradual enough for bus to still have enough room to move easily.
Fire	• Safer for pedestrians but more difficult for drivers. • Curb extensions diminished lanes to where bigger ladder trucks would not be able to make it through intersection.	• Would like curb extensions to be like a curb so that trucks can still go through the intersection without damage. • Do not want to see planter type curb extensions. • Signage (stop signs) for intersection needs to be farther back for larger trucks not to run into and damage when making a turn.
Police	• Slowed traffic, making it safer for pedestrian traffic. • The crosswalks give community an opportunity to walk in a safer environment.	• None.
Public works	• Great job communicating and doing outreach with the community. • Curb extensions work particularly well at Intersection 2	• Need to make sure crosswalks are up to American's with Disabilities Act (ADA) requirements. • Public Improvements Advisory Committee Sales Tax Fund would be a good option to consider if projects like this were made permanent at Intersection 1.
Schools	• Forced drivers to use intersection as 4-way stop and not create a turn lane. • Made drivers more conscientious of stop signs. • Made it safer for students who are walking to and from school. • Slowed traffic down.	• Temporary materials were not sturdy. • Materials not aesthetically pleasing. • Should focus more on community neighbors and educating them on the project.
Community development corporation	• Project directly affects the health of the community that lives there. • Temporary environment improved the physical safety of residents in the area. • Making the neighborhoods look visibly walkable with calm traffic will make it more likely for individuals to start businesses and buy homes in the area.	• Having a detailed plan showing how the project would look/become permanent with funding would create a likelihood for someone to take the plan and help make it permanent.

This increase was not likely due to people coming to the intersections to see the changes, because the post-implementation assessments were conducted ≥3 after the kick-off events and there was no change in the number of vehicles passing through the intersection. Thus, the observed increases in pedestrian activity likely were due to the improved pedestrian safety in the intersection. The specific aspects of pedestrian safety that were improved, as indicated by the direct observation findings, were that the number of vehicles that failed to come to a complete stop and the number that made two lanes at the intersections were reduced. Of note, the largest increases in pedestrian activity were during the before- and after-school commute times, which is not surprising because of the proximity of the intersections to primary schools and the particular importance of pedestrian safety for children's walking (Carver et al., 2008). Such increases in pedestrian activity in the community may lead to meaningful increases in residents' physical activity, because active travel has been shown to be a key behavior distinguishing active from insufficiently active individuals (Borner et al., 2018).

The findings from the community survey suggest that many community residents desire pedestrian safety-related improvements. This is important information for decision makers because they are often more likely to make decisions based on community preferences than health outcomes. Attitudes towards the projects were similarly positive between residents and officials/stakeholders (e.g., city services), but some concerns were expressed related to the ability of large vehicles (e.g., fire engines) to make turns in the intersections. However, while some respondents noted that the quick build caused concerns for drivers, the number of vehicles using the intersection did not change. This suggests that the benefits to pedestrians may have been more salient to residents than the barriers to drivers. Furthermore, all design modifications adhered to the city's street design standards and engineering best practices for lane widths and turn radii, and the intersection was configured in a manner consistent with numerous intersections across the city where trucks and emergency vehicles operate.

There were several differences between intersections with regards to the existing design elements unrelated to the quick build, and residents had more favorable attitudes towards the project at Intersection 2 than Intersection 1. This was likely because pedestrian safety was poorer at Intersection 2 prior to the quick build. Thus, pedestrian safety improvements that pose barriers to drivers are likely to be best received when addressing existing conditions that are unsafe for pedestrians (i.e., when benefits outweigh costs). However, increases in pedestrian activity were larger at Intersection 1, perhaps because at Intersection 2 crime was perceived to be higher by our study team and pedestrian safety barriers remained after implementation due to the two-way rather than four-way stop and relatively high vehicle traffic. Thus, both potential impacts and community perceptions appear to be important considerations in selecting intersections for quick build projects. It is important to note that both of the intersections in this study were in "walkable" neighborhoods based on relatively high residential density, mixed land use, and connected streets (Frank et al., 2010). Quick build projects may produce different results in low-walkable areas and this should be tested in future studies.

4.1. *Strengths, limitations, and future directions*

This study was among the first to assess the impacts of quick build pedestrian safety streetscape improvements on pedestrian and vehicle activity. Study strengths included the pre-post design, objective data collection using direct observation and Miovision, and qualitative data capture to increase the depth of information. Strengths of the intervention included the participatory process involving residents, which likely led to increased resident buy-in and should be considered in similar projects; the use of evidence-informed design principles; and being led by a community bicycle-pedestrian advocacy organization, which are common across the U.S. thus supporting scalability. The small number of intersections and inclusion of only one community limits generalizability, but the focus on low-income neighborhoods was a strength because such neighborhoods are where the greatest health improvements are needed. The low number of responses from the community surveys means that the survey findings may not generalize to all community residents. In particular, participants in the present sample appeared to be more likely to engage in active transportation than the general U.S. population, for which <5% walk or bike to work (U.S. Department of Health and Human Services, 2019c).

While the observed increases in pedestrian activity were likely to relate to increases in active travel and overall physical activity in some residents, minutes of active travel and physical activity were not assessed and should be considered in future studies. It is possible that the observed increase in pedestrians reflected existing pedestrians changed their route rather than more people walking or existing pedestrians walking more. Future studies could investigate whether quick build projects lead to increases in time spent walking in community residents and/or people who regularly pass through the intersections. Since project implementation was limited to only one week, less is known about their potential for having longer-term impacts on pedestrian activity. Future studies should investigate longer-term projects and follow-up assessments to provide information on sustainability. Future projects should investigate other types of streetscape modifications than curb extensions and painted crosswalks, and additional materials such as planters, which could be informed by the Tactical Urbanist's Guide to Materials and Design (Tactical Urbanist's Guide, 2019b). Future research should also investigate strategies for mitigating concerns related to fire and police vehicles, such as conducting educational outreach with residents and testing some of the suggestions presented in Table 5, such as adding signage. While it is likely that the quick build projects lead to reduced traffic speed, this was not measured in the present study and thus should be investigated in future research. Miovision is able to assess traffic speed but requires two cameras to be employed a short distance apart and would be more valuable to capture near the middle of a street segment rather than at an intersection where there is a stop sign.

It is important to note that pedestrian safety at intersections is only one of many factors that have been shown to influence active walking for transportation and leisure. Combining quick build streetscape improvements with other strategies for supporting walking in the community is likely to have greater impacts than single strategy interventions, such as pairing quick build strategies with crime reduction strategies. The relative impact of various strategies should also be compared, and since a goal of quick build projects is to create low-cost improvements, future studies should compare cost-effectiveness across different strategies and between quick build and more traditional infrastructure projects.

4.2. *Conclusions*

Pedestrian activity appeared to increase in the present study, suggesting that inexpensive quick build streetscape pedestrian safety improvement projects that add painted crosswalks and curb extensions are promising for increasing pedestrian activity and walking. Such projects are often more feasible to implement than large-scale community design changes and are recommended by leading health organizations such as the Centers for Disease Control and Prevention for increasing population levels of physical activity (U.S. Department of Health and Human Services, 2019a; U.S. Department of Health and Human Services, 2019b). Larger studies are needed to investigate strategies for maximizing impacts of quick build projects, such as by comparing different types of intersections and design elements. Strategies for implementing more permanent or longer-term quick build projects also need to be identified, such as materials selection and city permitting.

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