Nowhere to go and nothing to do but sit?

Youth screen time and the association with access to neighborhood destinations

Abstract

With not much to do in their neighborhood, youth may spend more time in the home engaged in screen-based activities. Screen time data from 2790 youth in the Western Australian Health and Wellbeing Survey was linked to objectively measured count of types of neighborhood 'services,' 'convenience goods,' 'public open space' and 'youth-related' destinations. On average, youth accrued 801 mean mins/week screen time and had access to seven different types of neighborhood destinations. A larger number of different types of neighborhood 'youth-related,' 'service' and 'total' destinations were associated with less screen time (all $p \leq .05$). A significant gender interaction was observed. Girls with access to ≥12 youth-related destinations had 109 fewer mean mins/week screen time, compared with girls with 0-3 youth-related destinations. Providing alternatives to screen use by ensuring access to a variety of neighborhood places for structured and unstructured activities may be an important strategy for decreasing youth screen time.

Background

Rapid changes in modern technology have meant that youth now have access to many sources of screen based devices (e.g., iphones, tablet and laptop computers, handheld video game systems, televisions, media players etc) (Brown & Bobkowski, 2011; Houghton et al., 2015). Many of these screen based devices are portable and freely available for use particularly in the home (Granich, Rosenberg, Knuiman, & Timperio, 2011; Vandewater & Lee, 2009). They are now part of everyday life for most youth with many using them for education and leisure (Sigman, 2012; Vandewater & Lee, 2009). However youth's leisure-time screen time usage is rapidly increasing at the expense of active leisure time activities – outdoor play and physical activity (Marshall, Gorely, & Biddle, 2006). Outdoor play provides children with numerous physical and social developmental benefits (Ginsburg, 2007; Hüttenmoser, 1995; Islam, Moore, & Cosco, 2014; McCurdy, Winterbottom, Mehta, & Roberts, 2010). Hence, reduced youth's outdoor play and physical activity combined with increased screen time may have a double negative impact on youth health and wellbeing. For example, high levels of overweight and obesity in youth can be partly attributed to a decrease in physical activity and an increase in time spent in sedentary behaviors such as television viewing and computer/electronic game time (Must & Tybor, 2005; Rey-Lopez, Vicente-Rodríguez, Biosca, & Moreno, 2008).

The social-ecological framework acknowledges that there are multiple levels of influence on youth behavior and health outcomes (Sallis & Owen, 1996). A number of individual-level factors (e.g., child age, gender, race/ethnicity, weight status), parent/family-level factors (e.g., parent socio-economic status, family structure, screen time rules), and home and neighborhood-level factors (e.g., TV/computer in the bedroom, number of TVs in the home, neighborhood safety) have been associated with youth screen time (Cillero & Jago, 2010;

LeBlanc et al., 2015). These factors may be restricting children's ability to interact with their neighborhood environment and keeping them home-based. While proximal factors such as the family and home environment are key influences on youth screen time (Granich, et al., 2011; Jago et al., 2008; LeBlanc, et al., 2015; Saelens et al., 2002), the neighborhood environment is also important to consider (Carson, Rosu, & Janssen, 2014; MacLeod, Gee, Crawford, & Wang, 2008; Norman, Schmid, Sallis, Calfas, & Patrick, 2005; Timperio et al., 2012). A number of neighborhood attributes may restrict youth's options for outdoor play and physical activity (Islam, et al., 2014) and/or keep them more home-centered and occupied with screen based devices. For example, youth activities such as playing outside, going out with friends, visiting shops, and riding bikes to the park may be restricted if neighborhoods lack local destinations and places to go. Built environment correlates of youth outdoor time include having a place to play adjacent to home (Islam, et al., 2014), living in areas with higher levels of neighborhood greenness (Grigsby-Toussaint, Chi, & Fiese, 2011) or a higher proportion of commercial/industrial acreage and multi-family units (Copperman & Bhat, 2007). With few local opportunities to engage with the outdoors, youth may have little choice but to spend their leisure time engaged in sedentary screen-based activities.

How does the built environment influence screen use?

A handful of studies have investigated the relationship between youth screen time and the built environment. Measures of public open space (Carson, Kuhle, Spence, & Veugelers, 2010; Veitch et al., 2011) and street connectivity (Esliger, Sherar, & Muhajarine, 2012; Timperio, et al., 2012; Veitch, et al., 2011) have been associated with youth screen time. While some studies suggest that streets that end in cul-de-sacs provide safer play opportunities for younger children because traffic safety is higher compared with grid pattern street networks (Carver, Timperio, & Crawford, 2008b; Handy, Cao, & Mokhtarian, 2008;

Hochschild, 2012, 2013), overall the evidence for an association between street connectivity and children's screen time is mixed. For example, an Australian study showed that cul-de-sac density was positively associated with television viewing (Timperio, et al., 2012), while a US study reported no association with street connectivity (Roemmich, Epstein, Raja, & Yin, 2007). Differences in how street connectivity and cul-de-sac density are measured may partly explain conflicting findings. For example, neighborhoods with greater cul-de-sac density may provide less direct and therefore longer routes to local destinations (Koohsari, Sugiyama, Lamb, Villanueva, & Owen, 2014). They are also more likely to be present in neighborhoods that are mostly residential with fewer local destinations (Hochschild, 2012). The presence of local destinations such as parks is negatively associated with children's screen time. Veitch and colleagues found access to large high quality local public open space was associated with less screen time in Australian children (Veitch, et al., 2011). This suggests that high quality green spaces nearby home may provide youth with opportunities for outdoor leisure that draw them out of the home and away from screens. However, access to local play spaces may not influence young children's (under five years) screen time (Carson, et al., 2014). Carson et al. reported no association between area-level measures of outdoor play/activity space, recreation facilities and distance to closest park, yard at home and screen time in children under five years.

Youth, particularly adolescents with some level of independent mobility, who lack places to go in their neighborhood may have little choice but to stay at home and be occupied with screen-based activities (Veitch, et al., 2011). Independent mobility allows youth to move around their neighborhood without adult supervision (Fyhri, Hjorthol, Mackett, Fotel, & Kyttä, 2011) and provides a number of benefits such as increased physical activity and psychosocial benefits such as awareness of the local environment, improved spatial and way-

finding abilities and opportunity to develop social relationships with other children (Gale et al., 1990; Herman, 1980; Joshi et al., 1999; Rissotto and Tonucci, 2002; Schoeppe et al., 2013; Villanueva et al., 2012a). An Australian study of children's independent mobility found that boys' independent mobility was greater if they had access to local recreational and retail destinations (Villanueva et al., 2013). There is some evidence to show that children spend a large amount of their time in the home (Loebach & Gilliland, 2014) and much of this time is spent in sedentary-related behaviors (Liao, Intille, Wolch, Pentz, & Genevieve Fridlund Dunton, 2014; Tandon et al., 2014). One study suggests that of the time children spend in their neighborhood activity space (as defined by GPS loggers) children spend about half of their time indoors, with one quarter spending more than 70% of their total time in their neighborhood activity space time inside at home (Loebach & Gilliland, 2014). Yet, there is a dearth of studies investigating the relationship between youth screen time and features of the neighborhood built environment such as land use mix and access to destinations (McDonald et al., 2012).

Local neighborhoods can also foster children's social and physical development (Shonkoff & Phillips, 2000). Yet children's opportunity to interact within their local neighborhood has drastically changed in recent decades, as the amount of time spent outdoors has declined (Freeman & Tranter, 2011; Fyhri & Hjorthol, 2009; Louv, 2008; McCurdy, et al., 2010; Zhou, Li, & Larsen, 2015). If children do not have local places to play, then spending time on readily available screen-based devices in their home is an attractive alternative. This suggests that a number of forces may be working together to decrease the amount of time children spend outdoors and increase the time spent indoors using screen based devices. Based on a concept studied by Wilson-Doenges et al. (Wilson-Doenges, 2001), 'push' and 'pull' forces may be working to influence the relationship between the neighborhood environment and

youth screen time. Time spent interacting in the neighborhood is the locus around which 'push' and 'pull' forces operate. Push forces are those neighborhood environment characteristics that make time spent indoors using screens desirable or more likely. These include environment factors such as suburban sprawl, a lack of local places to visit and hang out (destinations), high levels of traffic and reduced home yard space (Hall, 2010). This is epitomized in outer suburban areas that, other than residential, lack a mix of land uses such as retail, office, health & community, entertainment & recreation (Christian et al., 2013). Hence, these areas generally have few destinations to visit and 'push' youth elsewhere (e.g., indoors and to screens). Pull forces are social and technological factors that pull youth indoors and away from the outdoors. Some of these pull forces include busy lifestyles that are more focused on the indoors than outdoors and the widespread availability and use of screen based devices (Wilson-Doenges, 2001). Social factors such as parental concerns about traffic safety and stranger danger (Foster, Villanueva, Wood, Christian, & Giles-Corti, 2014; Giles-Corti, Kelty, Zubrick, & Villanueva, 2009) as well as the popularity of and preference for youth online communication with peers (Vandewater & Lee, 2009) are also strong pull forces pulling young people indoors rather than out into their neighborhood. These neighborhood level push and pull forces may be creating environments that may be contributing to increased screen use in youth. Investigation of the relationship between neighborhood destinations and youth screen time is warranted.

Is the influence of the built environment on screen use the same for all children?

It is unclear how the relationship between the neighborhood built environment and screen time varies by youth developmental age and gender (Veitch, et al., 2011). A recent Canadian study found no association between physical activity related built environment features (e.g., total outdoor play/activity space and recreation facilities) and screen time in children under

five years (Carson, et al., 2014). Evidence is required to understand age and gender differences in the relationship between the neighborhood built environment and screen time in older children. Developmental changes during adolescence (i.e., puberty) are associated with a decline in physical activity, particularly for girls (ABS, 2013; Martin et al., 2008; Sallis, Prochaska, & Taylor, 2000; Troiano et al., 2008), however studies rarely examine the built environment correlates of child health behaviors using gender-specific developmental age categories. Further research is required to elucidate how youth gender and gender-specific developmental age mediate the relationship between the built environment and sedentary behavior. This information would identify whether it is necessary to examine the relationship between the built environment and youth screen time separately for boys and girls and for different youth age groups.

Is influence of the built environment on screen time greater closer to home?

It is also possible that the relationship between screen time and the neighborhood built environment varies by the size of the neighborhood activity space (as measured by a specified road network distance from home). In studies of the built environment and physical activity, buffers of 200m-1600m around participants' homes are typically used because they characterize 'walkable and cyclable' distances to local destinations (Hooper, Foster, Nathan, & Giles-Corti, 2012). Parents have reported that distances of around 800m are acceptable for primary school aged children (5-12 years) to walk alone to school (Timperio et al., 2006; Timperio, Crawford, Telford, & Salmon, 2004), although older children are permitted to walk further (Marten & Olds, 2004) and have increased independent mobility (Prezza et al., 2001). Moreover, girls (11-13 years) with access to parks and sports facilities within 1600m of home undertake more physical activity (Cohen et al., 2006). However, how different sized neighborhood activity spaces influences the relationship between the built environment and

youth screen time remains unknown (Learnihan, Van Niel, Giles-Corti, & Knuiman, 2011; McDonald, et al., 2012). Given parent's concerns for children's safety (Giles-Corti, et al., 2009) and younger children's decreased independent mobility (Carver, Timperio, & Crawford, 2008a), it is plausible that stronger associations will be found using smaller rather than larger neighborhood activity spaces and this may be particularly evident for children compared with adolescents. This is because adolescents' increased independent mobility may afford them greater access to a variety of local places and thus the relationship between screen time and access to local destinations may be less affected by the size of the neighborhood activity space examined. Moreover, land use has been shown to be associated with how far children travel from home as well as the amount of time they spend in their neighborhood. In a sample of 143 9-13 year olds who wore GPS logger Loebach et al. (Loebach & Gilliland, 2014) found that higher proportions of industrial, residential, and agricultural land uses within a 800m circular buffer from a child's home was positively associated with time spent within 400m of home. Higher proportions of commercial land within 800m of home were also associated ($p<0.1$) with children travelling further from home (i.e., a greater neighborhood activity space) (Loebach & Gilliland, 2014). These findings highlight that a mix of different types of neighborhood land uses offer greater opportunities for children to engage with their neighborhood. Further research is required to understand the role of different types of neighborhood destinations and the relationship with the amount of time youth spend indoors engaged with screens.

The aim of this study was to examine the relationship between access to neighborhood destinations and youth screen time, and to determine if these relationships vary according to three factors: 1) child's gender, 2) age, and 3) size of neighborhood activity space. We hypothesized that youth who have access to a greater number of different types of

destinations in their neighborhood spend less time in screen based behaviors; and that these relationships are stronger for smaller neighborhood activity spaces, particularly for younger children.

Methods

Study design and participants.

A cross-sectional sub-study of 2790 youth 5-17 years participating in the Western Australian Health and Wellbeing Survey (2004-2009) was undertaken. A monthly computer-assisted telephone interview (Department of Health Western Australia, 2011; Villanueva et al., 2012). It was administered by the Western Australian Government Department of Health and responses were obtained for a stratified random sample of the state population (N=1,959,088; 2006 Census). Parents provided responses for youth aged 5-15 years. Responses from adolescents 16-17 years were self-reported. The response rate for the Health and Wellbeing Survey was approximately 92% after excluding non-contacts and 76% including non-contacts (Department of Health Western Australia, 2011; Villanueva, et al., 2012). Full details of the study design and methodology have been previously reported (Villanueva, et al., 2012). Ethics approval for the project was obtained from The University of Western Australian Human Research Ethics Committee and the Department of Health of Western Australia's Ethics Committee (#2010/1).

Screen time

Respondents reported screen time as the number of minutes per week spent watching television or videos, or using the computer (for the internet, to play games etc) in a usual week.

Objective measures of the built environment

The count of different types of neighborhood destinations present was generated using GIS (ArcGIS version 10) and included the count of types of 'Services' (pharmacy, post office, dry cleaner, video store, CD/DVD store; range 0-5), 'Convenience Goods' (deli, general store, supermarket, green grocer, gas station shop, other food shop, shopping center; range 0-7), and 'Public Open Space' (sport field, park, beach, school ground; range 0-4) (Christian, et al., 2013). The number of bus stops was also obtained. 'Service' and 'Convenience Goods' destination data were obtained from Sensis Pty Ltd (electronic listing of commercial businesses) and contains the most comprehensive and current destination data for Perth, Western Australia. 'Public open space' destination data were obtained from The University of Western Australia Centre for the Built Environment and Health Parks data layer which includes all green public open space in metropolitan Perth, Western Australia (e.g., parks, natural and conservation areas, degraded or cleared land, school grounds) (Bull, Beesley, Hooper, Boruff, & Wood, 2013; Edwards et al., 2013; Giles-Corti et al., 2005). Transit data were obtained from the Western Australian Public Transport Authority which includes data on the location of all Bus stops, train stations, ferry terminals, free city, bus stops in the Perth central business district, and school bus services' stops. Full details of data sources for all GIS-derived measures have been previously reported (Villanueva, et al., 2012).

The 'total number of neighborhood destination types' included the sum of the Services, Convenience Goods, Public Open Space and transit stops (bus stops and train stations) (range 0-18). A count of the types of youth-related neighborhood destinations (i.e., destinations that youth would be likely to visit) included a subset of the 'total number of neighborhood destination types' (i.e., all destination types except pharmacy, post office and dry cleaner) plus youth-related destinations such as toys and hobby shop, craft and art supply shop,

library, bike shop, recreation center, cinema, sport and recreation shop (range 0-23). The presence of destinations was measured objectively and thus represents youth access to local destinations, however they do not define 'actual' destinations visited by youth.

All destination variables were generated at 1600m and 400m neighborhood activity spaces, defined as service areas based on the road network distance from each young person's home. The 1600m neighborhood service area represents a 20-minute (1600m) walk from home (via the road network) for adolescents (Villanueva et al., 2014b). The smaller neighborhood service area of 400m was used to represent a shorter distance from home that may be a more relevant walkable activity space for young children (Bringolf-Isler et al., 2010; Tandy, 1999).

Covariates

Socio-demographic factors adjusted for in analyses included age, gender and family structure (Family with child or children living with both biological/adoptive parents; Step or blended family; Sole parent family). An individual level measure of socio-economic status was not available thus the socio-economic index for children's residential area (SEIFA), which is a national measure of socio-economic status based on a range of social and economic indicators (Australian Bureau of Statistics, 2008), was used and adjusted for in analyses. The SEIFA score is based on the census collection district of the participant residence and is an area-based index of relative socioeconomic advantage and disadvantage. Census collection districts contain an average of 250 dwellings. Lower SEIFA scores indicate relative socioeconomic disadvantage and higher scores indicate relative advantage. The SEIFA index has a national mean of 1000 and a standard deviation of 100.

High traffic volume is a known correlate of youth physical activity related behaviors (Giles-Corti et al., 2011) and was also adjusted for in analyses. Using GIS, objectively-measured traffic volume exposure was calculated as the proportion of kilometers of higher volume roads compared with the total kilometers of all roads was calculated for each neighborhood service area, with a higher ratio indicating a high traffic exposure (Giles-Corti, et al., 2011).

Statistical analyses

Linear regression was used to examine the association between minutes of screen time per week and destination variables adjusting for age, gender, family structure, area-level socio-economic status and traffic exposure. A gender interaction term was included to determine if associations were different for boys and girls. For boys and girls separately, an age interaction term was included to determine if associations differed across age groups. Different age group cut points were used for boys (5-13 and 14-17) and girls (5-11 and 12-17) to reflect their different rates of development and maturation (National Institutes for Health, 2014). Analyses were conducted for both the 1600m and 400m neighborhood service area.

Results

The mean age of participants was 11.6 (SD=3.7) years, 50.9% were boys, 71.9% were a family with child or children living with both biological/adoptive parents and on average had a socio-economic status score within the 70-80th percentile for the Australian population. On average, participants reported spending 801 (SD=502; range 0-4200) mins/week (114 minutes/day) in screen time. Boys accumulated 844 (SD=515) mins/week (boys 5-13yrs=785 mins/week; boys 14-17yrs=955 mins/week) and girls accrued 757 (SD=484) mins/week (girls 5-11yrs=707 mins/week; girls 12-17yrs=805 mins/week). Within 1600m from home youth on

average had access to seven different types of destinations and 35 bus stops (Table 1). Within 400m from home, youth on average had access to one type of destination and two bus stops.

For the 1600m neighborhood activity space, the count of 'total', 'youth-related' and 'service' types of destinations was associated with screen time for all youth (Table 2). Youth with access to 12 or more types of neighborhood destinations, on average had 83 less minutes/week of screen time, compared with youth with access to only 0-3 neighborhood destinations ($p \leq .05$). Moreover, youth who had access to three or more types of service destinations had on average 52 less minutes/week of screen time, compared with youth with no access to service destinations ($p \leq .05$). The count of types of service destinations was also negatively related to screen time (trend p-values < .05). In stratified analyses these relationships were observed for girls but not boys, however the gender interaction p-values did not reach the 5% level of significance.

A significant gender interaction p-value was observed for the relationship between screen time and the count of types of youth-related destinations and number of bus stops. Girls with 12 or more youth-related types of destinations, on average undertook 109 less minutes/week of screen time, compared with girls with access to only 0-3 youth-related destinations ($p \leq .05$). Moreover, girls who had access to 41 or more bus stops undertook on average 102 less minutes/week of screen time, compared with girls who had access to 0-20 bus stops ($p \leq .05$). The count of types of youth-related destinations and bus stops was significantly related to girl's screen time in a dose response manner (trend p-values < .05).

No significant relationships between screen time and access to neighborhood destinations were observed for boys and no significant age interaction effects were observed for boys or

girls (results not shown). The count of types of youth-related destinations at the 400m sized neighborhood activity space was significantly related to girl's screen time in a dose response manner (trend p-value < .05) (results not shown). No other destination measures were significantly associated with youth screen time at the 400m sized neighborhood activity space.

Discussion

The number of different types of neighborhood destinations was associated with youth screen time for both the 1600m and 400m neighborhood activity spaces, although the association was only statistically significant for girls and notably did not vary with age. Girls with access to a high number of different types of youth-related neighborhood destinations participated in almost two hours less weekly screen time, compared with girls who had little or no access to different types of local destinations. Overall the findings highlight that neighborhoods that have poor access to a mix of local destinations are associated with increased screen time in girls.

This study offers a rare examination of the relationship between objectively measured neighborhood destinations and youth screen time and observes a possible gender difference. The association between access to different types of neighborhood destinations and screen time was evident for girls but not boys suggesting that having things to do and places to visit in the neighborhood is important for providing girls with opportunities for leaving the home (going outdoors) and reducing screen time. Other studies have shown that it is not the presence of certain types of land uses or even destinations that is important for children's active travel but rather the mix of destinations in a neighborhood that provide opportunities for children to be outside (Kemperman & Timmermans, 2014). Our findings also suggest that

boys use screens regardless of what places and destinations are present in their neighborhood. For boys, reinforcing factors in the home and family environment (e.g., TV in bedroom, lack of rules limiting screen time, high access to screens) (Granich, et al., 2011) as well as peers may outweigh any effect from the neighborhood environment. Our findings about girls are important, given girls tend to be less physically active than boys (ABS, 2013; Troiano, et al., 2008) and in younger children, are given fewer freedoms to be independently mobile (Alparone & Pacilli, 2012; Villanueva et al., 2014a). This gender difference in the relationship between screen time and access to local destinations warrants further investigation.

One explanation for our findings may be that the youth-related destination measure used in this study did not reflect differences in boys and girls preferences for what they do in and around their neighborhood. Future studies should examine other destinations (e.g., vacant blocks, alley/laneways, bush/nature, friend's houses, skate parks) as well as both the presence and quality of features of the built environment that are important for encouraging boys outside and away from screens. Another explanation is that the local neighborhood is of less importance to boys and young men if they are willing (and are permitted to) to travel greater distances than girls and young women.

The relationship between screen time and access to different local destination types observed for girls but not for boys could also be a reflection of the parent's (most likely the mother's) movement patterns and use of neighborhood destinations. Girls generally have lower independent mobility compared with boys (Alparone & Pacilli, 2012; Carver, Timperio, & Crawford, 2012; Prezza, et al., 2001). Thus, girls who live in a neighborhood with a variety of destinations may spend less time in screen-based activities because they are 'out and

366 about' doing things in their neighborhood with their parents and friends (Christian et al.,
367 2015). In support of this finding, we also observed that girls who had a large number of
368 neighborhood bus stops had less screen time than girls with access to only a few
369 neighborhood bus stops. It appears that for girls, a variety of neighborhood destinations as
370 well as a means of accessing these destinations (i.e., via public transit) correlates with less
371 screen time.
372
373 The opposite appears to be true for boys. Boys are granted more freedom to make
374 independent decisions about what they do and how they spend their time (Villanueva, et al.,
375 2013), including how much time they spend in front of screens. Moreover, boys and young
376 men may be less interested in being 'out and about' in their local community with their
377 parents particularly as they get older and once they are able to drive a motor vehicle. Future
378 research might consider whether the relationship between destination mix and screen time in
379 girls is dictated by their parents' preferences and use of local destinations and if independent
380 mobility mediates the relationship between the neighborhood environment and children's
381 sedentary behavior. Furthermore, even though our study did not observe significant age
382 interaction effects for boys or girls the change from primary to secondary school may be an
383 important time point to examine if and how changes to a child's neighborhood opportunities
384 around a school impact on health behaviors such as screen time and physical activity. Future
385 studies may wish to explore this.
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387 Our youth-related destination measure was associated with girl's screen time for both the
388 1600m and 400m neighborhood activity spaces and showed slightly greater effect sizes
389 compared with the total neighborhood destinations measure. This highlights the importance
390 of youth-related or context-specific measures (Giles-Corti & Salmon, 2007; Giles-Corti,

Timperio, Bull, & Pikora, 2005). However, overall, relationships between neighborhood destinations and youth screen time were more evident at the 1600m than at the 400m neighborhood activity space. This does not support our hypothesis that the association between youth screen time and destination mix would be stronger at the 400m than the 1600m neighborhood activity space. We posited that the 400m neighborhood activity space may be more relevant to younger children because of their lower mobility range. This study was undertaken in Perth which is a low density city characterized by urban sprawl. It is likely that the weaker associations observed at the 400m neighborhood activity space relates to the very low number of destination types (variation) observed within this smaller neighborhood activity space. Furthermore, the area reflects the screen time behavior for youth who in general reside in low density suburban areas. By their nature these environments may make the choice to spend leisure time engaged with screens a more comfortable and convenient one. In contrast, youth who live in urban environments characterized by higher residential density and a greater mix of other types of local destinations have on average less private indoor and outdoor space and thus the choice to spend leisure time indoors engaged in screens may be less preferable because of the confined space, reduced space for screen based equipment and competing uses of these spaces. This highlights the need for further studies in cities with greater variation in these and other built environment measures (Christian, et al., 2013) as well as further investigation of the interaction between the ecology of the home and neighborhood.

Study Limitations

This study includes a large representative sample as well as objective measures of neighborhood destinations at different geographic scales, however it was a data linkage study and thus we had no control over how the screen time data was collected and reported. This

study was limited by its use of parent and self-report screen time and lack of information about education-based screen time. This may have over-estimated the amount of leisure-based screen time reported. Furthermore, while the presence of destinations was objectively measured, this study was unable to determine the actual destinations visited and thus could not examine the relationship between youth's screen time and use (vs. presence) of local destinations. Future studies should examine the influence of the neighborhood and home physical environment on youth-report and objective measures of youth leisure and education-based sedentary behavior (e.g., TV viewing, computer use, electronic games, tablets, mobile phones, sitting time) and use of local destinations (via Global Positioning Systems (GPS)) via different modes of transport (car, walking, cycling) as well as the interaction between the physical and social environment (e.g., social cohesion, parent perception of neighborhood safety) on youth sedentary behavior. Future research may also consider an evidence-based weighting system for destination types measures so that the relative importance of individual destination types can be captured. Moreover, a greater understanding (via qualitative research) of both youth and parent preferences for neighborhood built environment features is needed as well as clarity on youth activity spaces and how pre-defined neighborhood activity spaces influence exposure to different types of neighborhood destinations.

Conclusions

The number of different types of destinations present in young people's neighborhoods was negatively associated with girls but not boy's screen time. Neighborhoods designed to support active living through increased access to local destinations appear to discourage the amount of time girls spend in sedentary screen based activities and may increase the time they spend (active) outdoors. Ensuring access to places for structured and unstructured physical activity may be important for providing alternatives to screen use. Future research

441 should consider children and adolescents preferences for destination types and how
442 independent mobility and parent's use of local destinations influences the relationship
443 between neighborhood destination mix and youth screen use.
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Table 1

Types of destinations within 1600m and 400m of young people' homes

	1600m service area			400m service area		
Count of:	**Range**	**Mean (SD)**	**N (%)**	**Range**	**Mean (SD)**	**N (%)**
Types of destinations[1]	0-17	6.7 (3.6)		0-9	1.12 (1.17)	
0-3			581 (20.8)	0		883 (31.6)
4-7			1112 (39.9)	1		1155 (41.4)
8-11			799 (28.6)	2+		752 (27.0)
12+			298 (10.7)			
Types of youth-related destinations[2]	0-21	7.3 (4.2)		0-11	1.19 (1.22)	
0-3			496 (17.8)	0		844 (30.3)
4-7			1140 (40.9)	1		1122 (40.2)
8-11			676 (24.2)	2+		824 (29.5)
12+			478 (17.1)			
Types of services[3]	0-5	1.9 (1.5)		0-4	.12 (.45)	
0			719 (25.8)	0		2560 (91.8)
1-2			1086 (38.9)	1+		230 (8.2)
3+			985 (35.3)			
Types of convenience goods[4]	0-7	2.2 (1.8)		0-4	.14 (.45)	
0			592 (21.2)	0		2496 (89.5)
1-2			1116 (40.0)	1+		294 (10.5)
3+			1082 (38.8)			
Types of public open space[5]	0-4	1.6 (0.8)		0-2	.28 (.49)	
0			255 (9.1)	0		2047 (73.4)
1-2			2213 (79.3)	1+		743 (26.6)
3+			322 (11.5)			
Number of bus stops	0-121	34.8 (20.8)		0-16	1.97 (2.34)	
0-20			731 (26.2)	0		1191 (42.7)
21-40			1125 (40.3)	1-3		919 (33.0)
41+			934 (33.5)	4+		980 (24.3)

[1]Sum of the Services, Convenience Goods, Public Open Space and transit stops (bus stops and train stations).

[2]All destination types (except pharmacy, post office and dry cleaner) plus toys and hobby shop, craft and art supply shop, library, bike shop, recreation centre, cinema, sport and recreation shops.

[3]Pharmacy, post office, dry cleaner, video store, CD/DVD store.

[4]Deli, general store, supermarket, green grocer, gas station shop, other food shop, shopping centre.

[5]Sport field, park, beach, school ground.

Table 2

Association between count of neighborhood destinations (1600m service area) and screen time (minutes/week) by gender

	All Youth		**Boys**		**Girls**	
Count of:	Adjusted mean (SE)[1]	*p*-value	Adjusted mean (SE)[2]	*p*-value	Adjusted mean (SE)[2]	*p*-value
Types of destinations						
0-3	859 (33)	ref	873 (44)	ref	826 (58)	ref
4-7	835 (30)	.352	884 (38)	.764	768 (54)	.102
8-11	833 (30)	.346	896 (39)	.560	754 (55)	.054
12+	776 (39)	**.020**	840 (51)	.511	694 (65)	**.010**
Trend p-value		.061		.917		**.011**
Gender interaction p-value		.096				
Types of youth-related destinations						
0-3	870 (34)	ref	882 (45)	ref	842 (60)	ref
4-7	840 (29)	.254	869 (38)	.732	796 (54)	.207
8-11	822 (32)	.098	918 (41)	.399	713 (56)	**.001**
12+	802 (35)	**.035**	858 (45)	.600	733 (59)	**.016**
Trend p-value		**.024**		.974		**.002**
Gender interaction p-value		**.029**				
Types of services						
0	863 (32)	ref	886 (41)	ref	820 (56)	ref
1-2	839 (30)	.318	887 (38)	.984	774 (54)	.169
3+	811 (30)	**.036**	873 (39)	.709	728 (54)	**.008**
Trend p-value		**.039**		.678		**.010**
Gender interaction p-value		.115				
Types of convenience goods						
0	847 (33)	ref	868 (44)	ref	805 (58)	ref
1-2	837 (29)	.692	882 (38)	.709	771 (54)	.331
3+	824 (30)	.376	868 (44)	.582	744 (54)	.083
Trend p-value		.127		.899		**.050**
Gender interaction p-value		.135				

Types of public open space						
0	820 (40)	ref	885 (54)	ref	722 (67)	ref
1-2	842 (28)	.509	883 (35)	.972	779 (52)	.214
3+	792 (38)	.501	870 (49)	.800	690 (64)	.599
Trend p-value		.678		.478		.229
Gender interaction p-value		.856				
Number of bus stops						
0-20	855 (32)	ref	866 (41)	ref	829 (57)	ref
21-40	836 (29)	.439	886 (38)	.547	771 (54)	.078
41+	816 (30)	.117	888 (39)	.531	727 (54)	**.003**
Trend p-value		.117		.673		**.007**
Gender interaction p-value		**.010**				

*$p \leq .05$; ref=Reference category; SE=standard error

[1]Models adjusted for gender, age, family structure, area-level socio-economic status and traffic exposure; [2]Models adjusted for age, family structure, area-level socio-economic status and traffic exposure.