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An experimental study using manipulated photographs to examine interactions between micro-scale environmental factors for children's cycling for transport

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ABSTRACT

Installing cycling infrastructure well-separated from motorized traffic is hypothesized to increase children's transportation cycling. However, in some streets it may not be possible to install such cycling paths (e.g. due to financial or space constraints). The current paper investigates which physical factors could increase parents' perceptions of environmental supportiveness for children's transportation cycling, across six different types of cycling infrastructure.

Parents completed a choice-based conjoint task by indicating which photographed street they preferred to let their child cycle along. The streets were experimentally manipulated on 7 physical factors (e.g. traffic speed, vegetation). Interactions between type of cycle path and the other environmental factors were identified.

When no or limited separation from motorized traffic is present, street characteristics increasing parents' safety perceptions (traffic density and speed) should be prioritized when aiming to improve the supportiveness of streets for children's transportation cycling. Comfort and aesthetics can further improve streets' environmental supportiveness when cycling paths are more separated from traffic.

1. Introduction

Obesity levels have never been so high as currently observed (Collaboration, N.R.F, 2016). Efforts are needed to stimulate the population to be active, especially at a young age, as children will be the next generation of adults. Increasing children's cycling levels might contribute to increasing children's physical activity levels (Cardon et al., 2012), which have shown a remarkable decrease during the last decades (Ortega et al., 2013). Children who cycle at a young age are also more likely to cycle as adolescents and adults (Cardon et al., 2012). Increasing cycling among children can enhance their health and induce a shift from extensive car use to active modes of transport that would also have ecological and economic benefits (Woodcock et al., 2009). Worldwide, researchers have observed large differences in cycling levels among children. For example, in Flanders, Belgium, boys and girls aged 10–12 years old cycle on average 25 and 27 min, respectively, to school (Brug et al., 2012). This is lower than European cycling countries such as Denmark and the Netherlands, but it is much higher than in the U.S. or Australia (Commission, E, 2013; McDonald, 2012). Increasing cycling levels should therefore considered as one of the key health strategies worldwide, as it can save many health cost, improve quality of life, lower CO_2 emission, and prevent further global warming (Mason et al., 2015). Before installing interventions aimed at increasing children's cycling for transport, it would help to learn what physical changes would likely affect cycling (Baranowski et al., 1998).

Socio-ecological models emphasize the importance of physical environmental factors next to individual and social environmental factors (Sallis and Owen, 2015). During the past decade, researchers have tried

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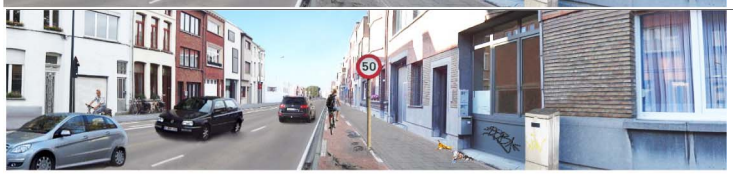
	Properties of the photographs		
	Cycle path: no Traffic density: high Maintenance: bad	Evenness: very uneven Vegetation: no trees	Traffic speed: 50km/h Speed bump: absent
	Cycle path: marked lines Traffic density: intermediate Maintenance: moderate	Evenness: even Vegetation: some trees	Traffic speed: 30km/h Speed bump: present
	Cycle path: curb Traffic density: low Maintenance: good	Evenness: moderately uneven Vegetation: no trees	Traffic speed : 50km/h Speed bump: absent
	Cycle path: curb + colour with pedestrians Traffic density: intermediate Maintenance: moderate	Evenness: very uneven Vegetation: no trees	Traffic speed: 50km/h Speed bump: absent
	Cycle path: hedge Traffic density: high Maintenance: bad	Evenness: moderately uneven Vegetation: some trees	Traffic speed: 30 km/h Speed bump: present
	Cycle path: hedge + colour with pedestrians Traffic density: low Maintenance: good	Evenness: even Vegetation: many trees	Traffic speed: 30 km/h Speed bump: present

Fig. 1. Six examples of the manipulated photographs, which differed in 7 environmental factors. Each photograph depicts a different type of cycle path and the different levels of the other environmental factors.

to obtain insights into the physical factors explaining cycling for transport among children (Panter et al., 2008; Davison et al., 2008; Ding et al., 2011). They have found macro-scale factors such as distance to destination, connectivity of the street network and mix in land-use positively associated with children's cycling for transport (Panter et al., 2008; Davison et al., 2008; Ding et al., 2011). They have also found traffic safety important for children's cycling, but it remains unclear about which traffic safety elements to employ, because perceived traffic safety can be influenced by many small, micro-scale environmental factors such as traffic speed, type of cycling infrastructure, traffic density and evenness of the cycling infrastructure (Ghekiere et al., 2014). Parents' perceptions of safety may even be more strongly associated with children's cycling for transport, given that parents often decide whether the child can cycle for transport without adult supervision (Schoeppe et al., 2015). However, findings regarding the associations between these micro-scale, easy-to-change environmental factors are mixed, which may be partly explained by methodological issues (Ding et al., 2011).

Previous studies examining associations between physical factors and cycling for transport often used self-report questionnaires, in which they asked participants to indicate the physical features in their neighborhood, and to link those features to their transport behavior. This method has at least two problems. First, participants' recall of features in their neighborhood may be inaccurate, as they are not observing their neighborhood when completing the questionnaire. Second, people may interpret their neighborhood differently, such that without a definition, the researchers cannot know what area they measured. To study which physical factors are most important for parents to create a cycling-friendly environment for children, an experimental study using manipulated photographs was set up recently (Ghekiere et al., 2015a). The use of manipulated photographs can overcome the aforementioned limitations, as they neither need a neighborhood definition nor do they need to have participants recall physical features of their neighborhood. Studies have tested the feasibility of this approach in several studies (Ghekiere et al., 2015a, 2015b; Mertens et al., 2014, 2015, 2016; Van Cauwenberg et al., 2014; Cauwenberg et al., 2016; Van Holle et al., 2014). Parents were repeatedly asked to choose one out of two hypothetical streets they prefer to let their children cycle along. These streets were created with the use of a standardized photograph manipulated on seven physical features previously found to be important to create a supportive environment (Ghekiere et al., 2014).

We identified that having cycling infrastructure which adequately separates cyclists from motorized traffic is by far the most important strategy for parents to create supportive environments for children's cycling for transport (Ghekiere et al., 2015a). A physical separation from traffic by a hedge was preferred over separation by a curb or a separation by line markings, which in turn were preferred over a shared path for cars and cyclists (Ghekiere et al., 2015a). Other environmental factors, such as traffic speed, maintenance and vegetation, were