

Pedestrian walking speed as a response to environmental properties

MAREK FRANĚK

Department of Management
University of Hradec Králové
Rokitanského 62, 500 03 Hradec Králové
CZECH REPUBLIC
marek.franek@uhk.cz

Abstract: - An effect of various environmental properties on pedestrian walking speed was investigated. In two experiments participants were asked to walk inside the city along tracks, which consisted of streets with various amounts of vegetation and various degrees of traffic intensity. The walking speed was measured in eight selected sections. The data showed that pedestrians tend to speed up in environments without greenery, with a busy traffic and a high noise level. Moreover, walkers also tend to speed up in spaces, which are characterized by a lack of visual openness. Practical applications are discussed.

Key-Words: - Walking speed, Pedestrians, Landscape urbanism

1 Introduction

Residents of cities suffer from various forms of stress load. One form of the urban stressor is a stimulation overload. Urban dwellers are in their everyday lives exposed to large amounts of intense and arousing acoustical and visual stimuli. Environmental psychologists Bornstein and Bornstein [1] proposed that this stimulatory or arousal overload results in a fast pace of life of urban dwellers, which elicits various healthy deceases including the greater likelihood of heart attack occurrence [8]. Kaplan and Kaplan [5] studied the phenomenon of the stress overload in an urban environment and looked for an ideal restorative environment. Their considerations were coined by formulation of the Attention Restoration Theory. They argue that the stress of urban inhabitants is associated mainly with their attention resources, which has a limited capacity. The theory proposes [5] that prolonged use of directed attention diminished a person's capacity toward distractions. The individual showed signs of directed attention fatigue. A stay in an environment that does not require reliance on directed attention allows the mentally fatigued individual to rest the inhibitory mechanism on which directed attention depends and so to recover capacity to direct attention. According the Attention Restoration Theory, natural environments provide relatively good opportunities for psychological restoration.

The theory and empirical research suggests that the tendency to prefer natural over urban environments has some connection to a restorative potential of natural environment [e.g. 4, 6]. The greenery may be particularly desired within the urban environment, since it has restorative properties that appear to combat stressors, such as noise and crowding [10]. However, there are only a few studies investigating those associations in more details - which kind of vegetations or which types of arrangement of natural elements in urban environment elicit particular reactions, etc.

Our research focused the attention on the pedestrian speed in an urban setting. It was found that pedestrian speed is related to overall pace of life and reflect a size of a city and moreover, various socio-economical factors [e.g. 1, 7]. In our previous study [3] we asked participants to walk inside the downtown area of the city Hradec Králové in along a track, which consisted of streets with various amounts of vegetation and various degrees of traffic intensity. We found that participants tended to walk slightly faster in sections without greenery and with a higher level of traffic than in sections with greenery and with a small level of traffic. Thus, the study documented the effect of particular types of urban greenery together with other environmental

factors on walking speed and emotional reactions of the pedestrians.

2 Goals

The goal of our study was to investigate an effect of particular environmental properties on a speed of the pedestrian walk. Two experiments were designed to further enhance the previous findings. In the first experiment we asked the participants to walk along a track in downtown area of the city, which consisted of streets with/without vegetation and with various degrees of traffic intensity and noise. In the second experiment the participant were invited to walk along the track which was located mainly in green areas of the city, with or without traffic.

3 Experiment 1

3.1 Method

Hundred-eight (mean age=20.4, 56 females) took part in Experiment 1. The experiment was conducted in April 2008. The walking track took place in a centre of the city Hradec Králové. The passing the track lasted about 30 minutes. The track was divided into eight sections with different environmental properties. Inside each section the shorter sector was selected, where participants' walking speed was measured (see below). The length of the sectors varied from 39 to 74 meters. The sections, when the vegetation prevailed (trees, grass) was labeled „green sections“ (sections 1, 2, 3, 4, and 5), whereas the sections with a minimal amount of greenery or totally without greenery was named „sections without greenery“ (sections 6, 7, and 8). Participants were asked to pass the track with their normal walking speed. The track was marked by arrows to make orientation easier. Two directions of the walk on the track was employed – direction 1 (from section 1 to section 8) and direction 2 (from section 8 to section 1). The pedestrian speed was measured by observers with stopwatches. The observer was staying on the opposite side of the street and measured time duration of a participants' walk from the beginning to the end of the measured sector.

3.2 Results

Average walking speeds in the particular sections (m/sec) are shown in Fig. 1. The repeated measures analysis of variance (ANOVA) was carried out. Gender and direction of the walk on the track were chosen as independent variables, average walking speed in particular sections was the dependent

variable. ANOVA revealed the significant within subjects main effect of the type of the section [$F(7,497) = 41.35, p = 0.000$]. Gender and the direction of the walk have not significant effects. There were significant interactions between section, gender and direction of the walk [$F(7,497) = 2.56, p = 0.01$].

Results showed the general tendency to walk faster in the sections without greenery and with high traffic and noise than in calm areas with greenery. The fastest walking speed was identified in the section 6 without greenery and with high traffic and noise. The significant interaction between section, gender and direction of the walk was manifested in slightly different patterns for females walking in direction 2. They walked very fast in the initial part of the track.

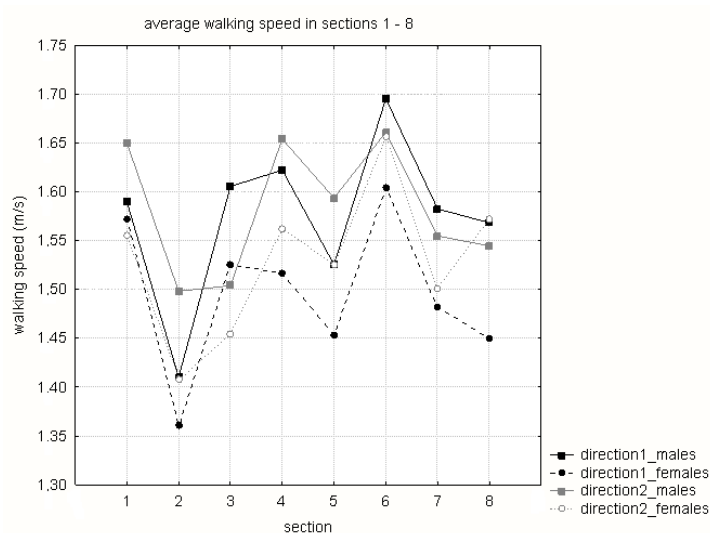


Fig.1 Average walking speeds (m/s) in particular sections in Experiment 1.

4 Experiment 2

4.1 Method

Ninety-one (mean age=20.1, 42 females) took part in experiment 2. The experiment was conducted in November 2008. The walking track took place in the city Hradec Králové. The passing the track lasted about 30 minutes. The track was divided into eight sections with different environmental properties. Inside each section the shorter sector was selected, where participants' walking speed was measured (see below). The length of the sectors varied from 30 to 77 meters. There was some amount of greenery in all sections. Sections 1 and 2 were located in a small park at the riverside,

sections 3 and 4 were in a narrow alley surrounded by high trees, sections 5 and 6 were located in the street with large trees and some traffic, sections 7 and 8 the streets with high traffic and small amount of greenery. The method of measurement was the same as in Experiment 1.

4.2 Results

Average walking speeds in the particular sections (m/sec) are shown in Fig. 2. The repeated measures ANOVA was carried out. Gender and direction of the walk on the track were chosen as independent variables, average walking speed in particular sections was the dependent variable. ANOVA revealed the significant within subjects main effect of the type of the section [$F(7,343) = 54.77, p = 0.000$] and the significant between subjects main effect of gender [$F(7,343) = 6.99, p = 0.01$]. Gender and the direction of the walk have not significant effects. There were significant interactions between the type of section and direction of the walk [$F(7,343) = 4.12, p = 0.000$] and gender and direction of the walk [$F(1,343) = 4.27, p = 0.05$].

Results showed the general tendency to walk faster in the sections with higher traffic (sections 1, 7) and in sections with less open space (sections 3 and 4). The results also revealed the effect of the contrast between the order of particular sections. The largest speeding up in the section 7 with high traffic and lesser amount of greenery was observed in direction 1, when participants were coming to this section from the relatively calm “green” section 6 than in direction 2, where the section 7 was preceded by relatively noisy section 8 with lesser amount of greenery. Females walked slower than males.

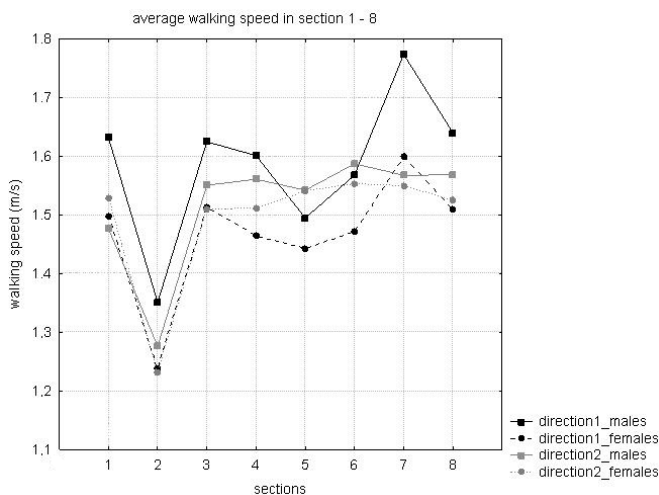


Fig.2 Average walking speeds (m/s) in particular

sections in Experiment 2.

4 Conclusion

The experiments documented effects of various environmental properties on speed of the pedestrian walk. Our data showed that pedestrians tend to speed up in environments without greenery, with a busy traffic and noise. Moreover, walkers also tend to speed up in spaces, which are characterized by a lack of visual openness. Such findings could be used in designing spaces, which reduce everyday stress of city dwellers. For example, White and Gatersleben [11] investigated perception of beauty and positive affectivity of “green” houses. The authors showed that houses with some types of integrated vegetation were significantly more preferred, beautiful, and restorative than those without.

Furthermore, there is a growing interest about the research in walking in order to promote it as an everyday important physical activity [2, 9]. The route walkability is in focus of interest, which typically involved numerous variables such as traffic safety, accessibility, pleasurability, density, diversity, etc. Unfortunately, walking speed in these investigations has not been registered. Thus, there is a challenge for future research to link these research approaches and also focus attention on temporal aspects of walking behavior. As we noted, temporal aspects of walking reflect pace of life, which in turn is associated with a level of stress and overstimulation.

References:

- [1] Bornstein, M. H. and Bornstein, H. G., *The pace of life*. Nature, Vol. 259, 1976, pp. 557-559.
- [2] Brown, B. B., Werner, C. M., Amburgey, J.W., and Szalay, C., Walkable route perceptions and physical features: Converging evidence for en route walking experiences. *Environment and Behavior*, Vol.39, 2007, pp.34-61.
- [3] Franěk, M., The effect of urban vegetation and traffic intensity on walking speed. In: *Urban planning and transportation (UPT'12): proceedings of the 5th WSEAS international conference, 25.-27.2. 2012, Cambridge (UK)*. Athens, World Scientific and Engineering Academy and Society, 2012, pp. 163-166.
- [4] Herzog, T. R. and Rector, A. E. , Perceived danger and judged likelihood of restoration. *Environment and Behavior*, Vol.41, 2009, pp. 387-401.

- [5] Kaplan, R. and Kaplan, S., *The experience of nature: A psychological perspective*. Cambridge (UK), Cambridge University Press, 1989.
- [6] Korpela, K. M., Hartig, T., Kaiser, F. G., and Fuhrer, U., Restorative experience and self-regulation in favorite places. *Environment and Behavior*, Vol.33, 2011, pp.572-589.
- [7] Levine, R. V. and Bartlett, K., Pace of life, punctuality, and coronary heart disease in 6 countries. *Journal of Cross-Cultural Psychology*, Vol.15, 1984, pp.233-255.
- [8] Levine, R.V., Lynch, K., Miyake, K., and Lucia, M., The type A city: Coronary heart disease and the pace of life. *Journal of Behavioral Medicine*, Vol. 12, No.6, 1989. pp. 509-524.
- [9] Napier, M. A, Brown, B. B., Werner, C. M, and Gallimore, J., Walking to school: Community design and child and parent barriers. *Journal of Environmental Psychology*, Vol. 31, 2011, pp.45-51.
- [10] Van den Berg, A. E., Koole, S. L., and van der Wulp, N., Y., Environmental preference and restoration: (How) are they related? *Journal of Environmental Psychology*, Vol. 23, 2003, pp.135-146.
- [11] White, E. V. and Gatersleben, B. (2011) Greenery on residential buildings: Does it affect preferences and perceptions of beauty? *Journal of Environmental Psychology*, Vol. 31,2011, pp.89-98.