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## Fixation patterns of individuals with and without Autism Spectrum disorder: Do they differ in shared zones and in zebra crossings? <sup>☆</sup>

Georgia Cowan<sup>a</sup>, Robyn Earl<sup>a</sup>, Torbjorn Falkmer<sup>d</sup>, Sonya Girdler<sup>a</sup>, Susan L. Morris<sup>c</sup>, Marita Falkmer<sup>a,b,\*</sup>

<sup>a</sup> School of Occupational Therapy, Social Work and Speech Pathology GPO Box U1987, Perth, WA 6845, Australia

<sup>b</sup> School of Education and Communication, CHILD programme, Institute of Disability Research, Jönköping University, Sweden

<sup>c</sup> School of Physiotherapy and Exercise Science, Faculty of Health Sciences, Curtin University, GPO Box U1987, Perth, WA 6845, Australia

<sup>d</sup> Rehabilitation Medicine, Department of Medicine and Health Sciences (IMH), Faculty of Health Sciences, Linköping University & Pain and Rehabilitation Centre, SE-581 85 Linköping, Sweden

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### ABSTRACT

Shared zones are a contemporary traffic zone that promotes equality between multiple road users and efficiently utilizes available space, while simultaneously maintaining safety and function. As this is a relatively new traffic zone, it is important to understand how pedestrians navigate a shared zone and any potential challenges this may pose to individuals with impairments. The aim of this study was to utilize eye-tracking technology to determine fixations and fixation duration on traffic relevant objects, non-traffic relevant objects, and eye contact, in 40 individuals with and without Autism Spectrum Disorder (ASD) in a shared zone and a zebra crossing. It was assumed that individuals with ASD would make less eye contact in the shared zone compared to the group of typically developing adults. A total of 3287 fixations across the shared zone and zebra crossing were analysed for areas of interest that were traffic relevant, non-traffic relevant, and eye contact, and for fixation duration. Individuals with ASD did not display any difference in terms of eye contact in the shared zone and the zebra crossing when compared to the controls. All pedestrians were more likely to look at traffic relevant objects at the zebra crossing compared to the shared zone. Individuals with ASD had an overall shorter fixation duration compared to the control group, indicating people with ASD either process information quickly, or they do not process it for long enough, although these findings require further investigation. While shared zones have many benefits for traffic movement and environmental quality, it appeared that pedestrians displayed safer road crossing behaviours at a zebra crossing than in a shared zone, indicating that more education and environmental adaptations are required to make shared zones safe for all pedestrians.

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\* Correspondence to: School of Occupational Therapy, Social Work and Speech Pathology, Faculty of Health Sciences, Curtin University of Technology, GPO Box U1987, Perth, WA, 6845, Australia.

E-mail address: [marita.falkmer@curtin.edu.au](mailto:marita.falkmer@curtin.edu.au) (M. Falkmer).

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## 1. Introduction

The primary aim of urban design is the promotion of accessibility and engagement between the environment and its many users (Hamilton-Baillie and Jones, 2005). Increases in population and traffic congestion pose immediate threats to the efficiency and quality of urban environments and highlights the need to integrate multiple road users within a single environment (Hamilton-Baillie and Jones, 2005). Designing an urban area that promotes inclusion and full engagement has been shown to have positive effects for traffic and pedestrian movement, safety, accessibility, comfort, and environmental quality (Hamilton-Baillie, 2008; Hamilton-Baillie and Jones, 2005; Kaparias et al., 2012). As a response to more efficiently utilize available space, while simultaneously maintaining safety and function, shared zones have emerged (Earl et al., 2016). Shared zones [Fig. 1] are designed to promote equality between multiple road users, including pedestrians, cyclists, and motorists, through reducing segregation (Hamilton-Baillie, 2004). As opposed to other traffic management fixtures, such as zebra crossings, shared zones are characterized by the removal of conventional roadway components, including signals, kerbs, barriers, and signs, that traditionally segregate roads and footpaths (Hamilton-Baillie and Jones, 2005). Zebra crossings are known for their distinct environmental cue, being the black and white “zebra” lines [Fig. 2]. This environmental cue gives pedestrians and drivers a recognizable prompt to acknowledge other road users, with the general rule in Australia being that drivers must give way to pedestrians.

Although there are basic traffic rules at shared zones, being pedestrians have right of way at all times, and low speed regulations for motor vehicles (Department of Transport, 2012), these are not commonly known due to the recent emergence of these traffic zones. Instead, a shared zone is based on a set of informal social protocols between users conveyed through human interactions (Hamilton-Baillie, 2008; Hamilton-Baillie and Jones, 2005). Traffic users are expected to communicate a significant amount of information regarding their action and intention via their gaze and eye contact (George and Conty, 2008; Itier and Batty, 2009). As a result, safe and successful negotiation of shared zones is based on the individual's ability to identify, perceive, and interpret social cues and factors in the environment, as well as being able to communicate their intended action to other traffic users. However, the ability to prioritise, interpret, and react to this information is dependent on a well-functioning theory of mind (Baron-Cohen et al., 1985). Theory of mind is defined as having the ability to attribute mental states not only to oneself, but to other people (Baron-Cohen et al., 1985). It allows for an individual to anticipate what others will do in a given situation (Baron-Cohen et al., 1985). This suggests that those with an impaired theory of mind may not be able to successfully or safely participate within a shared zone, as they may have difficulty understanding the intent of other road users, and struggle to communicate their own crossing intention. As road crossing is a dynamic activity requiring synchronized physical actions and behaviours (Lin et al., 2013), problem-solving abilities are also imperative when navigating a shared zone. Requirements for problem-solving include orientation, attention, memory, perception, and higher-level cognitive function (World Health Organization, 2001). A deficit in one or more of these areas may have significant impact on an individual's ability to safely and confidently participate in a shared zone, and by extension, their community.

Autism Spectrum Disorder (ASD) is a developmental disorder characterized by deficits in social interaction, non-verbal communication, and an impaired theory of mind (American Psychiatric Association, 2013). Restricted and repetitive patterns of behaviour, including fixated interests, and hyper- or hypo-reactivity to sensory stimuli are also common characteristics in individuals with ASD (American Psychiatric Association, 2013). Due to difficulties with social interaction and non-verbal communication, individuals

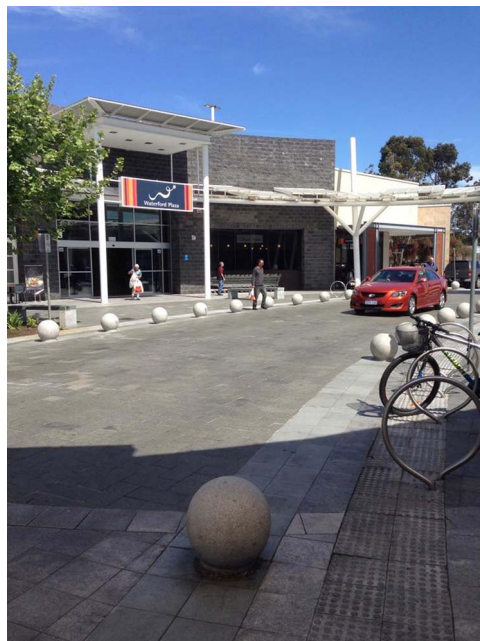


Fig. 1. Shared Zone.

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