Validity and reliability of a pc-based cycle test to measure higher order skills in 11 to 13 year olds

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1 INTRODUCTION

Cycling in dense traffic is a complex skill that probably will only reach expert levels after a considerable amount of practice. Aspects of cycling that are most demanding and therefore require most practice are higher order skills such as risk perception, perspective taking, and moral decision making. Today, in contrast to skill development for driving a car, little is known about skill development of young and novice cyclists. Traffic education is used to facilitate skill development, but these programmes are generally addressing simple skills such as the application of traffic rules and seldom the higher order skills. Unfortunately, these programmes are seldom evidence-based, meaning that their effects have seldom been assessed. To contribute to the development of evidence-based education programmes, the present study aims to develop a test method to assess the competencies of novice, young cyclists about 12 years of age. This test should be sufficiently reliable and valid to be used for: a) assessing skill level and monitoring changes in cycling competence over time; b) evaluating effects of traffic education programmes used in primary schools. Further, the test should resemble real life traffic situations and require an active response.

For this purpose, a previous study identified four domains of competence of young cyclists as essential for safe cycling: namely *hazard perception*, *decisions in complex situations*, *situations awareness*, and *moral and social actions* [1].:

1. *Hazard perception* aims to assess the speed by which cyclist can 'read' the road and anticipate forthcoming events. Participants watch short video clips from the perspective of a cyclist and have to imagine that they are cycling themselves. They had to press a button as soon as they detected a developing hazard.This task is time limited.
2. *Decisions in complex situations* aims to assess choices cyclists make when handling risky situations, when crossing the street or interacting with trucks. The *crossing the street task* presents the participant with video fragments from the cyclist's perspective, requiring the cyclist to decide whether a gap between two passing cars is sufficiently wide (yes/no) to cross the street. This task is time limited. The *interaction with trucks task* presents the participant with an interactive traffic situation, which enables participants to look around' and change views (birds eye, first person). The participant's task is to decide where to stand, wait or cross in the vicinity of a truck. This task is time unlimited.
3. *Situation awareness* aims to assess the extent to which participants perceive, understand and anticipate elements in traffic situations. The *perception* task presents the participants with video fragments from

the cyclist perspective. When the video stops, participants are asked to point out which element in the traffic situation requires most attention at that moment. This task is time unlimited. The *decisiveness* task also presents participants with video fragments from the cyclist perspective. The video stops at a point where the cyclist is about to interact with other road users. Participants then indicate which of the road users has right-of-way. The task is also time unlimited.

4. *Social and moral behaviour* aims to assess choices participants make when their own interests are in conflict with those of other road users or with road safety. The manner in which participants resolve these conflicts is an indication of their level of moral development. Participants are asked how many times out of ten they would show certain behavior, such as running a red light, cycling on the sidewalk or not giving space to other road users when they easily could have. Each situation and behavior is introduced by a short video or a picture.

This paper presents the results concerning the validity and reliability of the test. The following relationships were studied as indicators of validity: a) Experienced cyclists perform better than inexperienced ones, b) crash involved cyclists and cyclists who engage in risky behaviour perform worse than those who are not; c) cyclists who have received a lot of education perform better than those who have had only little education.

2 METHOD

Participants: 12 schools were recruited throughout the Netherlands, resulting in 335 students participating in the study (51% male, 49% female). All were in the last grade of primary school with ages between 11 and 13.

Test battery: The five subtests were installed on 24 laptops HP Probook 4730s, with i5 processor, 17,3" screen size, and a resolution of 1600X900 pixels. Table 1 presents on overview of the subtests in terms of sample items, items per test, and response and scorings methods. All tests were self-explaining using instruction video's. To control for potential order effects, the order of subtests were randomized over participants. Most participants completed the battery within an hour.

Participant Questionnaires: obtained information on student test motivation, cycle experience, and risk behavior.

School information: Teachers completed questionnaires on the amount and type of traffic education provided by the school to the students.

Procedure: Parents were informed and passively consented to children participating in the study. A research team visited the school and installed the laptops in a room dedicated for this experiment. Students were then instructed in their classrooms and in the presence of their teachers about the study, explaining its purpose. Next, participants were assigned to the laptops. Participating schools received a 50 euro voucher for their participation. The data were collected in January and February 2017.

Statistical analyses: Analyses were conducted with SPSS version 21[2]. Cronbach's alpha and factor analyses were used to assess consistency of scales, for discrimination xxx, for relationships between tests correlations, and for the relationships between test scores and respectively cycle experience, traffic education, and academic profile of schools multiple regressions.

3 RESULTS

The results are currently being analyzed and will be available at the end of March 2017. At the conference the results will be presented as well as a hands-on demonstration of the test battery.

Table 1: Overview of tests

Subtest	**# Items**	**Sample item**	**Instruction**	**Response**	**N**	**Min – max score**	**Coding key**
Complex situations	14						
Blind spot trucks	6	Truck waiting at a signalized intersection 	Use your mouse to click at the location where you can wait safely	Location of click	324	0-11	Location outside the driver's blind spot is correct (1) or incorrect (0)
Crossing streets and gap acceptance	24	Crossing 	Can you safely cross now?	Key board V: safe O: Unsafe	260	0-24	Correct element (1), incorrect (0)
Hazard perception							
	14	Potential hazard 	Press the spacebar when you have the feeling that a situation might become dangerous.	Reaction time space bar	313	0-14	A faster reaction time results in a higher score (max 1)
Situation awareness	12						
	6	Perception 	Click on the element in the picture that you should pay attention to right now	Mouse click in picture	283	0-6	Correct element = 1, incorrect (anywhere else in the picture) = 0
	6	Decisiveness 	What is the correct order of right-of-way? Click on the road users	Mouse clicks in picture	283	0-6	Correct order = 1, incorrect order = 0
Social and moral behaviour			in the correct order				
	10		Out of ten times that this occurs, how many times would you... [perform a certain undesirable behaviour]	Mouse click on number in scale from 0 to 10	287	0-100	Not part of test score, so no right or wrong. Score is sum of item scores

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