From road shares to road sharing: Cyclist-motorists interactions and its effect on cyclists' perceptions and willingness to share the road

Ravid LURIA, Sigal KAPLAN

Abstract

In emerging cycling regions, cyclists are being forced to share the road with motorists because the development of cycling infrastructure is lagging behind. The road-sharing experience is associated with tension, anxiety and frustration leading to negative safety perceptions, which serve as barriers to the wide-scale cycling.

Israel is an emerging cycling country with growing numbers of cyclists and scarcity of dedicated cycling infrastructure. The authorities are keen at encouraging cycling, and some cycling infrastructure projects were recently developed, as the Tel-Aviv shared bicycle system, or underway as the Tel-Aviv cycling superhighways. Nevertheless, the number of cyclists is rapidly growing and the current cycling infrastructure is insufficient for accommodating the rapid growth, generating many road conflicts and cycling safety incidents. In such a context, encouraging an empathic and welcoming social environment is an important step towards maintaining the growing cycling rates.

This study focuses on understanding how cyclists' perceptions regarding driver's emotions, behavior and reactions to cyclists affect cyclist willingness to share the road. The behavioral approach is the Symbolic Interaction Theory, conceived by George Herbert Mead. The approach describe the nature of social interactions underlying behavior. In the process of social interaction, self-concepts, as behavioral motivators, develop through taking the "role of others" as a "looking-glass" of self-idea. Namely, individuals behave in social environments according to their perceptions of the self and others. Therefore cyclists define their self as a product of interactions with other road users, and the self-concept of cyclists could be shaped by the reactions of drivers through "role taking", as he/she interpret the reaction. Thus the self-concept of cyclists could be split into three components: (1) how the cyclist sees her/himself (2) how drivers actually see the cyclist, and (3) how the cyclist believes drivers sees him/her. Since the drivers actual perception of cyclist is mediated by cyclists' appraisal of drivers, the initial has not been measured. Alongside, the study measured the variable of how the cyclist sees drivers, assuming it has been affected by their interactions.

A web-based survey among 641 cyclists in Israel serves as the basis for data analysis, while 474 responses (74%) were entirely completed. The questionnaire refers to the three components mentioned above, used as the main independent variables, and to the willingness to share the road as the dependent variable. The latter was measured by 2 questions referring to the choice to cycle on shared infrastructure in urban environment: (a) choosing between a major mixed road, which is shorter, to a bicycle path through park, which is longer (b) choosing the perceived effectiveness level of 2 new laws relating cycling safety, which are an obligation to keep a space of one meter from cyclists, and putting traffic signs notifying presence of cyclists.

As for the independent variables, they were measured through the three levels of the conceptual framework: cyclists' self-concept, cyclists' appraisal of drivers and cyclists' perception of drivers appraisal. First, the cyclists' self-concept is measured by questions regarding his/her driving style in a shared road. By that an indication of marginality and sense of weakness are given, or alternatively sense of power. Second, the cyclists' perception of the driver is measured as inclusive or hostile by questions about the driving style of drivers from the respondents' perspective. Third, the cyclists' perception of drivers appraisal has been dealt by questions about the opinion of drivers as the cyclist sees it, assuming those perceptions impact their self-concept and accordingly the coping strategy of whether they willing to share the road, or they prefer to avoid it.

Each level include questions about positive and negative emotions of cyclists and drivers in various situations while sharing the road (e.g., anxiety, alertness, Attention). In addition, the questionnaire elicits socio-demographic information (e.g. gender, age, family status, cycling experience, and involvement in cycling safety incidents) and cycling habits (e.g. distance, frequency, purpose, time-of-day, bicycle type, location). Table 1 presents the distribution of each observed variable.

The data is analyzed by means of structural equation models (SEM) since they are the most suitable to combine observed socio-economic characteristics and latent constructs. Namely the need to model simultaneously endogenous latent constructs, their relationship with exogenous observed variables, and their correlation pattern. Specifically, in this study SEM allows to look at the influence of cycling conditions and characteristics on a range of cyclists' perceptions simultaneously, while controlling for socioeconomic characteristics and cycling habits and experience as important background variables.

A factor analysis led to a 10 factors model, each one representing different sort of perception of different level (see table 2). The self-concept factors are geared-up cyclist, distracted driving style, assertive driving style and anxious cyclist. The appraisal of drivers factors are distracted, dangerous and careful driving style and anxious driver. The perception of drivers appraisal factors are perception of risky cycling, vulnerable cyclists.

TABLE 1: Sample Characteristics

Variable	Categories (%)				
Gender	*Man*	*Woman*			
	80.6	19.4			
Age	*29- y.o.*	*30-39 y.o.*	*40-49 y.o.*	*50+ y.o.*	
	27.2	28.5	22.8	21.5	
Family	*In Relationship*	*Have Children*			
	75.9	57.6			
Price of owned bicycle	*Up to 275$*	*275-1390$*	*1390-2750$*	*2750-4145$*	*Over 4145$*
	14.6	32.1	17.1	17.1	19.2
Education	*School/ Technical*	*bachelor's degree*	*Master's or Doctoral degree*		
	26	45.2	28.8		
Region of residence	*South*	*Jerusalem*	*Center*	*North*	
	9.1	20.9	45.4	24.7	
Urban type/ city size	*Countryside/ Suburban*	*Small city*	*Medium city*	*Large city*	
	25	10	16	49	
Car usage frequency	*0-3times a month*	*1-3 times a week*	*4-7 times a week*		
	19.4	31.2	49.4		
Transit usage frequency	*0-1 times a month*	*2-4 times a month*	*2-7 times a week*		
	49.2	24.1	26.8		
Cycling alone frequency	*0-4 times a month*	*2-3 times a week*	*4-7 times a week*		
	28.3	30.6	41.1		
Group cycling frequency	Seldom or never	Often			
	51.3	48.7			

Cycling for Leisure activity	*0-3 times a month*	*1nce a week*	*2-7 times a week*		
	51.5	19	29.5		
Cycling for Sports	*0-3 times a month*	*1nce a week*	*2-3 times a week*	*4-7 times a week*	
	38.8	14.6	26.4	20.3	
Cycling for Work/study	*0-3 times a month*	*1-3 times a week*	*4-7 times a week*		
	49.2	22.5	28.3		
Cycling for Shopping or services	*0-3 times a month*	*1nce a week*	*2-3 times a week*	*4-7 times a week*	
	59.5	13.3	17.5	9.7	
Cycling With children	*Seldom or never*	Often			
	90.3	9.7			
Cycling for transfer	*Seldom or never*	Often			
	87.1	12.9			
Cycling hours	*Morning*	*Noon*	*Afternoon*	*Evening*	
Never	*1.9*	*36.5*	*21.7*	*28.7*	
Weekdays	*14.6*	*14.3*	*21.3*	*25.7*	
Weekends	*16.5*	*16.2*	*13.1*	*4.2*	
Both	*67.1*	*32.9*	*43.9*	*41.4*	
Cycling time (per cycling weekday)	*0-29* minutes	*30-59* minutes	*60-89* minutes	*Over 90* minutes	
	28.4	26.1	21.3	24.2	
Cycling distance (per cycling weekend)	*0-19 KM*	*20-39 KM*	*40-59 KM*	*60-99 KM*	*Over 100 KM*
	26.5	27.1	17.1	14.8	14.4
Cycling experience	*0-1 year*	*2-4 years*	*5-10 years*	*Over 10 years*	
	9.5	35.4	31	24.1	
Accident involvement	*Never*	*Once*	*2-4 times*	*Over 5 times*	
Saw on road	*36.2*	*17.4*	*27.1*	*19.3*	
Of someone familiar	*44.2*	*23.5*	*21.7*	*10.6*	
Directly involved	*29.8*	*27.1*	*28.9*	*14.2*	
Infrastructure for commuting	*Lack*	*Some*	*Junctions problem*	*All the way*	
	56.3	*35.4*	*4.4*	*3.8*	

TABLE 2: Measurement Equations of the Latent Constructs

Perceived drivers as dissociative (F1)	*est.*	*C.R.*
Drivers might misestimate my cycling speed	1.000	-
Drivers might misestimate the space between us	0.996	17.324
Drivers might deviate from the lane toward me when I cycle in the shoulders	1.180	18.559
When drivers park their car, it might hit me while driving backward	1.076	17.235
Drivers might heat me by opening the car door	1.082	16.418
Drivers might heat me mistakenly at the traffic light	1.190	19.510
Drivers might not notice me at a crosswalk	1.048	16.454
Drivers might hit me on a right turn	1.219	18.516

Perceived drivers as dangerous (F2)	*est.*	*C.R.*
Taking risks while driving next to cyclists	1.000	-
Enjoying the thrill of risky driving near cyclists	1.009	23.843
Enjoying the engine power and its acceleration near cyclists	1.029	25.053
Driving above speed limit near cyclists	0.939	19.951
Yelling and using aggressive word	0.987	24.541
Blowing the horn to cyclists	0.975	22.814
Flashing car lights to cyclists because they are going too slow	0.859	18.314
Shoving cyclists to the fringes when bypassing	1.111	28.233
Driving too close to cyclists	1.075	26.825
Perceived evaluation of cyclists as dangerous (F3)	*est.*	*C.R.*
Often running red lights	1.000	-
Not signaling before turning	0.926	16.732
making unexpected maneuvers, causing drivers to brake hard	0.990	17.937
Illegally cycling in contra-flow	0.980	18.598
Usually cyclists don't wear helmet and thus are vulnerable	0.509	8.551
Perceived self as a geared up cyclist (F4)	*est.*	*C.R.*
I use a helmet while cycling (R)	1.000	-
I use flashlights when I cycle (R)	0.914	9.297
I use reflectors when I cycle (R)	0.907	9.570
I use elbow-pads/knee-pads/gloves (R)	0.728	8.110
Perceived drivers as careful (F5)	*est.*	*C.R.*
Stopping for safe crossing of cyclists intending to cross the road (R)	1.000	-
slowing down until safe bypassing of a cyclist in the middle of the lane (R)	1.104	12.084
Usually attentive to cyclists (R)	1.469	12.778
Attentive to unexpected maneuvers of cyclists (R)	0.870	9.676
Perceived self as a dissociative cyclist (F6)	*est.*	*C.R.*
Misestimating the speed of a passing vehicle	1.000	-
Almost hitting a road object due to spatial distance misestimating	1.265	10.680
Cycling while distracted by other thoughts	1.609	11.718
Using my cell phone while cycling	0.559	5.076
Enjoying the view and not concentrating on cycling	1.109	10.031
Daydreaming while cycling	1.422	11.545
Perceived evaluation of cyclists as vulnerable (F7)	*est.*	*C.R.*
Cyclists on the road are susceptible to fatal injuries	1.000	-
Cyclists are fragile because of the mass difference between cars and bicycles	1.271	16.041
Cyclists can easily fall of the bike and get easily hit by a passing vehicle	1.229	15.515
Perceived self as an assertive cyclist (F8)	*est.*	*C.R.*
I use to maneuver between cars in a traffic jam	1.000	-
I enjoy high speed cycling	0.753	7.594
I enjoy cycling in the middle of the lane	0.848	7.822
I always ready for unexpected maneuvers caused by other road users	1.118	9.274
I confront drivers who 'cut me up' or fail to give me the right of way	0.676	6.424
When a driver try to bypass me, I assertively prevent it	0.867	8.284
Cyclists feelings relating drivers(F9)	*est.*	*C.R.*
Fear, Anxiety, Worry	1.000	-
Alertness, Attention, Vigilance	0.683	8.981
Frustration, Anger, Nervousness	1.059	14.885
Perceived Drivers feelings relating cyclists (F10)	*est.*	*C.R.*
Fear, Anxiety, Worry	1.000	-
Alertness, Attention, Vigilance (R)	2.463	3.215

Note: (R) – Reversed coding in the case of negatively-phrased items.

FIGURE 1: Structural model of the willingness to share the road

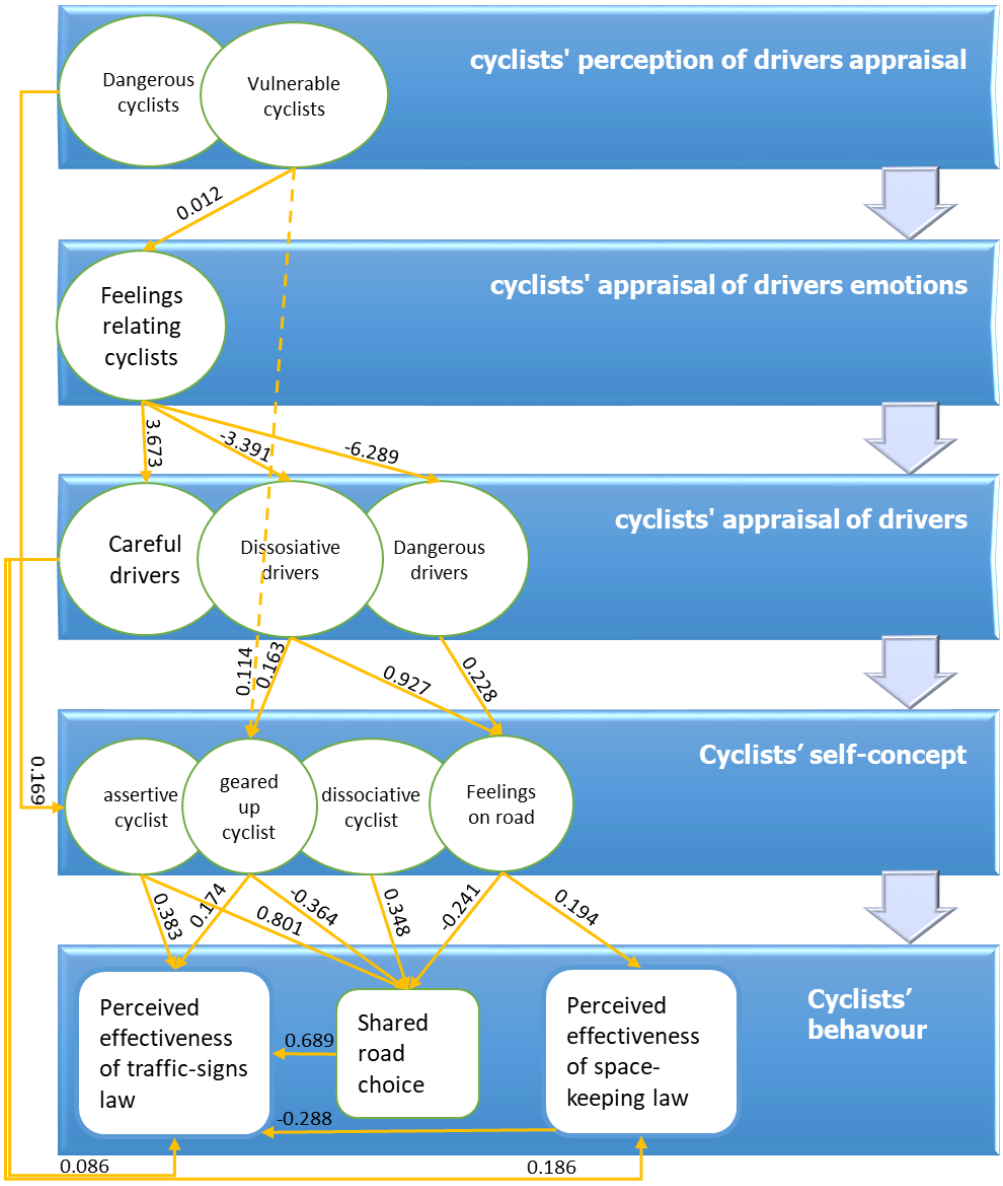

Figure 1 provides a visual representation of the final model with respect to the latent Symbolic Interaction Theory constructs, when looking at the willingness to share the road as a cyclist in mixed roads. SEM analysis revealed the effect of the cyclists' self-concepts' factors on the cyclists' behaviour dependent variables. It is noticeable that cyclists who perceive themselves as assertive and dissociative cyclists tend to use a shared road, whereas anxious, angry and geared-up cyclists tend to choose a separated non-motorized bicycle path. Furthermore, it has been shown that anxiety and carefulness among cyclists effect positively on the perceived effectiveness of space-keeping law, and in its turn, the effectiveness perception of the mentioned law effects negatively on the effectiveness perception of the traffic signs law. Alongside, the

latter law is being affected by assertiveness and geared-up self-concept, and by the shared road choice.

Regarding the cyclists' appraisal of drivers and the cyclists' perception of drivers appraisal, there are correlations between their factors and the self-concept factors: cyclists perception of drivers as dangerous and dissociative increase cyclists anxiety, anger and alertness, while the initial factors are strongly decreased by cyclists perception of drivers as anxious and alert. In addition, the latter strongly increase the extent to which cyclists perceive drivers as careful. Finally, the latent variables of perceived evaluation of cyclists as dangerous and vulnerable effect positively on the self-concept of assertive and geared-up cyclist respectively.

Moreover, results show a clear effect on the factors underlying road sharing intentions of gender, age, cycling habits, education, region of residence, infrastructures, cycling experience, accident involvement.

Results therefore show that the more powerful cyclists perceived themselves, and the more the perceived road environment is inclusive, the more they willing to share the road.

understanding the nature of social interactions and their inflictions on road user behaviors, provide insights that can be used by policy makers, transport and urban planners, to create a physical and social urban environments that promote cycling through decreasing social friction and encouraging empathic road behavior and conflict management.

***Key words*:** cycling; road sharing; Symbolic Interaction Theory, Structural equation Models.