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Can large cycling events promote active mobility? Expectations versus reality on the example of the 2018 UCI Cycling World Championship

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ABSTRACT

The Austrian province of Tyrol positions itself as a leading sport region in the Alps, which is reflected in the number of large sport events it holds. A prominent example is the 2018 UCI Cycling World Championship. The study investigates whether, besides promoting the host region as a cycling destination, a large cycling event can also leverage a positive change in residents' travel behavior towards active mobility. The analysis of panel data reveals that respondents have high expectations regarding the event's impact on cycling infrastructure and on their travel behavior, but their optimism decreases considerably after the event. They also cycle less frequently than before. These trends however are far less distinct in the group that spectated the event live. A large sport event, even if positively perceived by local populations, is not capable of leveraging a behavioral change towards active mobility only on its own and must be accompanied by complementary measures. It is recommended to involve residents in active participation in the event as spectators. Besides, an event of this size should result in substantial improvements in local cycling infrastructure. Otherwise, an opportunity to make the behavioral change happen can be missed easily.

1. Introduction

Located in the center of the Alps, the Austrian province of Tyrol positions itself as a sports region number one in the alpine area. The competition of the neighboring countries and regions is strong (Pechlaner, Demetz, & Scuttari, 2015) and hence local authorities and marketing managers are making endeavors to emphasize the sport image of Tyrol by staging major sport events. The recent marketing studies have defined cycling as a theme of great potential for tourism development in years, 2017–2020 (Tirol Werbung, 2016), followed by a cycling promotion campaign under the motto *"You like it? Bike it!"* In addition to the important role cycling plays in daily travel and its relevance for tourism industry, professional and amateur mountain biking and road cycling sport events have been held regularly in Tyrol for years, e.g. St. Johann Cycling World Cup, Ötztal Cycling Marathon, KitzAlp Bike. The 2018 UCI Cycling World Championship Innsbruck-Tyrol (further referred to as UCI) was aimed at further strengthening the reputation of Tyrol as a (tourist) cycling destination.

While the impacts of large sport events on tourism development, destination management and sport tourism have been deeply investigated by tourism researchers, the effects of such events on daily mobility from the transport planning perspective have been omitted in the literature so far. This gap should be filled since, due to size of the events, the repercussion for transportation systems can be substantial (road closures, blocked parking spaces, modified transit schedules, etc.). What is more, they may also have long-term effects on travel behavior of local residents of the host areas. Either indirectly, through changes in transportation systems with respect to the event, or directly, by inducing a behavioral change through participation in the event as a spectator.

Based on panel data collected from the period before and after the 2018 UCI Cycling World Championship in Tyrol, we analyzed whether this large cycling event triggered any change in travel behavior towards active mobility. Thereby, our research contributes to a paradigm change in modern policy-making in Austria and a strived-for goal of evidence-based transport planning (Davoudi, 2006; Faludi & Waterhout, 2006). Furthermore, bearing in mind the lack of quantitative data on the effects of cycling infrastructure investments on modal split in Austria, as highlighted by Hackl et al. (2019) and Raffler, Brezina, and Emberger (2019), we want to provide decision-makers with evidence on the perception of potential infrastructural benefits of large sport cycling events among local population of the Austrian province of Tyrol. We also inform whether large cycling events can serve as a trigger for travel

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behavior change towards active mobility.

The paper deals with the possible effects of large cycling events for travel behavior of local residents at tourist destinations and concentrates around the following three research questions:

1. What role does cycling play in the mobility behavior of local populations and how did that change after the UCI Cycling World Championship?
2. How do the residents perceive the potential impact of the UCI on their travel behavior? Did their perception change after the UCI?
3. How do the residents evaluate the infrastructural legacy of the UCI for cyclists? Did their perception change after the UCI?

The paper is organized as follows. Sections 2 provides a detailed overview of the current state of research, covering topics from transport planning to sport science and tourism management, and identifies the research gap. In Section 3, we describe the applied measurement methods and provide basic characteristics of the collected data. Section 4 of the paper demonstrates the outcomes of the study. We test the hypotheses and answer research questions posed in the introduction. We analyze responses of specific groups of individuals and compare subsamples of the dataset. Finally, in Section 5, we summarize our findings and discuss potential policy implications and recommendations for managerial practice.

2. State of research

2.1. Determinants of bicycle use in daily mobility

Cycling is a phenomenon with at least two major facets. Namely, it can be practiced as sport and recreation, i.e. for training, fitness and pleasure, and it can be a means of transport used for relocation and daily travel, or it can be treated as a combination thereof.

After over half a century of car domination in many European countries, cycling has gained in importance as a means of transportation in the last decades again. This is the case in particular in urban areas, where private car becomes very inefficient and space consuming given the high congestion levels, and where public transport cannot always overcome these difficulties. The trend can be also observed in Innsbruck, the capital city of the Austrian province of Tyrol (Pospischil & Mailer, 2014). By substituting car traffic, cycling makes daily mobility more sustainable since it reduces energy consumption and CO_2 emissions, promotes healthy lifestyle and physical activity, and is affordable. Thus, it is of interest for local governments to know what factors and conditions, and to what extent, influence the bicycle use in daily travel, and above all things, how to utilize this knowledge to make more people switch from motorized modes to cycling.

This interest is reflected in high number of scientific works devoted solely to this topic. In their review paper, Heinen, van Wee, and Maat (2010), synthesize factors found significant for commuting by bicycle. Their research proves travel time, distance and cost, built environment (incl. dwelling type, storage and parking facilities), bicycle infrastructure, natural environment (e.g. hilliness) and weather, safety as well as perceived values and attitudes to be influential on the share of cycling in the modal split among commuters. This is confirmed by the findings of Winters, Davidson, Kao, and Teschke (2011), however, they emphasize the type (separated) and location (away from noise and pollution; scenic routes) of bicycle infrastructure. Heinen and Buehler (2019) specifically investigate the effect of parking facilities, their supply and quality on travel behavior, they highlight however that the empirical evidence is somewhat limited. Not only physical infrastructure and built environment should be taken into account when forecasting bicycle use and designing policies. Willis, Manaugh, and El-Geneidy (2015) stress the significant role of social environment, habits, attitudes and perceptions, too.

Unfortunately, although the determining factors are largely known, the policy-making and implementation stage in Austria, unlike in northern Europe (Pucher & Buehler, 2008), is hindered by the lack of quantitative data on cycling, which makes it impossible to design bespoke policies and evaluate the impacts of infrastructure investments. Both national and regional travel surveys are being conducted in Austria. However, this is done irregularly and at large time intervals. The last two national travel surveys in Austria (Bundesministerium für Verkehr, Innovation und Technologie, 2016) were conducted in 1995 and 2013/2014. The most recent travel survey conducted in the province of Tyrol dates back to 2011 (Köll & Bader, 2011). These data have far too low temporal resolution to help make decisions on non-recurring events or those organized at short notice. As a result, decisions made are based on conjectures and are driven by political interests. Although arguments referring to benefits for cyclists are widely used by the authorities, neither are these promising scenarios founded on data collected before the event, nor are the real effects validated after the event, which is criticized by Hackl et al. (2019) who argue that *"In addition to the different levels of political commitment, […] the simple rationale of investing into any projects in order to boost non-motorized modal shares does not duly account for the complexity behind active mode choice and its driving forces."*

2.2. Leveraging sport participation and activity through large sport events

As mentioned before, cycling, apart from being a means of transportation, is also a popular sport art all over the world. Unfortunately, according to European Commission (2014) and European Commission (2018), the share of the EU population engaged in vigorous sport activities like cycling is continuously dropping. Between 2013 and 2017, Austria reported substantial decreases in the proportion of people that exercise and play sport regularly or with some regularity (45% ➔ 38%) or practice any physical activity (49% ➔ 42%). At the same time, the proportion of those who never exercise and play sport significantly increased (27% ➔ 40%) as did the proportion of those who never practice any other physical activity (15% ➔ 27%). In effect, diseases of affluence like obesity, diabetes, cardiovascular illnesses etc., resulting from the insufficient physical activity (or lack thereof) or bad eating habits, are increasing (in particular in western world countries) (Ezzati et al., 2005; World Health Organization, 2016). It has been therefore of interest for public health researchers to know whether the organization of a large sport event may results in an increase in participation and interest in sport and whether such events can be used (either as a main reason or as a side effect) to leverage physical activity in the host communities.

As synthesized by Chalip, Green, Taks, and Misener (2017), the findings on mass sport participation legacy are largely inconclusive, discipline-dependent, short-term and vary between countries. This is confirmed in the review paper of Murphy and Bauman (2007) as well as in the works by Weed et al. (2015) and Brown, Essex, Assaker, and Smith (2017), who claim that London 2012 Olympic Games failed in this respect.

Although studies concentrated on cycling are low in number, their findings are slightly more promising than of those focused on very large multi-discipline events like the Olympic Games. It is particularly important since the positive effects of both utilitarian and competitive cycling are unarguable (Götschi, Garrard, & Giles-Corti, 2016). In their qualitative study, Derom and VanWynsberghe (2015), analyze the potential of leveraging sport participation, based on the case of the *Tour of Flanders* road cycling race in Belgium. They conclude that whilst leveraging initiatives on different levels (government, municipality, city) were undertaken, their effectiveness was not measured and the health benefits of these endeavors is unknown. Crofts, Schofield, and Dickson (2012) have overcome this shortcoming by collecting data in form of a panel survey conducted in four time points before and after the event. However, they investigated the physical activity of the participants in a non-elite triathlon event held in New Zealand, not the

spectators of an elite event. The participation results in a high increase in physical activity before the event (preparation period) but also last up to three months after the event. Bowles, Rissel, and Bauman (2006) arrive at similar results when analyzing a mass cycling event in Australia, in particular regarding first-time participants.

This magnitude of effects is not observable in any spectator-oriented research. For example, Bakhsh and Potwarka (2020) describe the case study of 2015 Parapan American Games held in Toronto, Canada. They state that while the short-term positive effects are clearly observable, they fade away with time, and a mixture of leveraging strategies accompanying the event is needed to sustain the participation increase also in a long-term. King, Shipway, Lee, and Brown (2018) present the perspective of proximate sporting communities and local cyclists experiencing a large cycling race, on the example of *Tour Down Under* organized in Australia. They state that such events may result in higher place identity and self-esteem of local riders, but does not increase their (already high) sport activity and may even sharpen the conflict between drivers and cycling community.

2.3. Leveraging change in travel behavior through large sport events

In contrast to the effects on sport participation, the leveraging potential of large sport events for travel behavior change has not been, apart from few exceptions (London Olympic Games), investigated so far. The concern of the organizers has always been to decrease the travel demand of residents for the duration of the event and relieve the transport system so that it will not collapse when participants and visitors arrive or when parts of the network are shut. Analyzes of such Travel Demand Management (TDM) measures can be found in literature. A survey conducted by Hensher and Brewer (2001) before, during and after the 2000 Sydney Olympic Games revealed that good information and employers' flexibility allowed commuters to plan their travel effectively so that they did not experience negative effects of the event and found the transport situation better than expected. However, the authors found no significant shits between the transport modes before and after the event and hence no long-term behavioral changes that may have been induced by the event. The short-term behavioral changes (only for the duration of the event) are often effectively achieved through the use of "the big scare" and "underpromise and overdeliver" strategies (Currie & Delbosc, 2011; Jones & Woolley, 2019). Parkes, Jopson, and Marsden (2016) come to similar conclusions in their longitudinal study of the London 2012 Olympic Games. Although residents did change their travel (in most cases reduced or re-timed their trips, less often re-routed or re-moded) for the duration of the event, only 6% of them sustained this change after the event, and within this, only 1% was a change in transport mode. They criticize that it is often forgotten in promotion campaigns that different changes require different approaches and reducing travel might be far more attainable for certain cohorts than re-moding. Also Mulley and Moutou (2015) bring up this issue when analyzing learnings from the Sydney 2000 Olympics. The Sydney authorities failed in creating transport policies that could transfer the indeed positive short-term adaptations into long-term behavioral changes. So did the authorities of Bejing after the 2008 Olympics (Kangjing, 2012). Concentrating solely on the event period, not learning from the mistakes of predecessors and repeatedly downplaying the role of long-term strategies and proper post-event policy evaluation is a major charge raised in the literature.

2.4. Effects of large sport events for local economy and tourism

A relatively much research is dedicated to the legacy and outcomes of large sport events for residents and host communities (Garbacz, Cadima Ribeiro, & Mourão, 2017; Oshimi & Harada, 2019; Pfitzner & Koenigstorfer, 2016; Tang & Wang, 2020) or managerial effects, tourism development and destination image from the local authorities' perspective (Fyall & Shipway, 2012; Presenza & Sheehan, 2013; Schnitzer, Scheiber, Kornexl, & Thöni, 2017).

Humphreys and Prokopowicz (2007), on the example of 2012 EUFA Championships, warn that hosting the event generates more costs than direct potential revenue from tourist spending and the long-run benefits are vague and hard to estimate, which is then confirmed in an ex-post evaluation by Despiney and Karpa (2014). Also Baade and Matheson (2004) come to this conclusion, given the crowding-out effects and price increases in tourism. The net economic gains are often overstated due to erroneous assumptions in cost-benefit analyses (Mills & Rosentraub, 2013) or of very small scale compared to the total size of the economy (Li, Blake, & Thomas, 2013). Besides, the increased cost of housing and social services, and unequal distribution of economic profits must be taken into account when bidding for a large sport event (Tavakkoli, 2016).

Studies operating on cross-sectional data collected during or right after the event often report high satisfaction levels and decent support of local residents for the event. For example, Garbacz et al. (2017) found that the 2012 EUFA Championships, despite causing general increase in prices and providing economic benefits only for few selected economy sectors, may benefit pride levels and sense of identity with their city. Also subjective well-being is positively affected, as reported by Tang and Wang (2020). However, the positive perceptions often fade with time, which is clearly visible in longitudinal analyses (Kim, Gursoy, & Lee, 2006). Residents' expectations stimulated by politicians' pledges are at their highest short before and during the event, and may lower after the residents realize that the true cost of organizing an event exceed the actual benefits (Gursoy, Chi, Ai, & Chen, 2011). Besides the ambiguous effects on the economy, over-optimistic expectations are often associated with newly constructed sport infrastructure and venues, which then struggle with high maintenance costs and underutilization after the event (Alm, Solberg, Storm, & Jakobsen, 2016; Crompton, 1995).

The above-described findings pertain to mega-events such as Olympic Games or football championships. Economic impact of other large, but not mega, sport events, which are of lesser interest for national governments but are still important for regions and local economies, have not been researched that widely so far. According to the typology developed by Gratton, Dobson, and Shibli (2000), the 2018 UCI Cycling World Championship Innsbruck-Tyrol 2018 fall into the Type C events, which "is the most uncertain category in terms of economic impact".

2.5. Effects of large sport events on development of transport infrastructure

From the transport planning and mobility management perspective, it is interesting to know whether large sport events leave any infrastructural legacy that the general public can benefit from. In particular, whether large cycling events results in development of cycling infrastructure that would have not been built if the event had not been staged. Unfortunately, the literature on the cycling infrastructural legacy is non-existent. As far as public transport is concerned, Pereira (2018) highlights that, although organizing the 2014 World Cup and the 2016 Olympic Games in Rio de Janeiro (Brazil) did catalyze building new public transport infrastructure in the city, focusing on service provision in the areas close to sport venues and reorganization of transit lines resulted in higher transport inequality and lower accessibility on public transport and non-motorized means than before the events. His findings confirm what Malhado, Araujo, and Ladle (2013) already warned about before these events. Namely, the inefficient allocation of funding and detainment in construction may end up with underdeveloped urban infrastructure and economic and environmental problems, which they observed after the 2010 FIFA World Cup in South Africa. Also Kassens-Noor (2010) concludes that there is very limited evidence for long-term benefits of Olympic Games on transport. Although the physical changes do remain after the event, the institutional and behavioral changes do not stand the test of time. The major reason being lack of long-term planning being able to make use of the single

opportunity to create new transport strategies and permanently reorganize the responsible institutions and agencies.

2.6. Research gap – Effects of large sport events on mobility behavior of local residents

This literature review reveals how much we know on using sport event to promote tourism, shape the destination image and to leverage sport participation and physical activity of local residents. At the same time, there is a distinct gap in research addressing the topic from the travel behavior perspective, which results in an incomplete understanding of potential effects of such events on local populations. Also, the knowledge about infrastructural legacy is limited to mega-events organized on a national or international level (FIFA World Cup, UEFA European Championship, Olympic Games) and there is little known about investments driven by (medium-sized) events concentrating on a single discipline, in particular cycling, and their apprehension by the general public.

We argue that the leveraged sport participation among local residents, e.g. increase in cycling training, induced by a large sport event, does not necessarily have to mean an increase in using bicycle as a mean of transport. In other words, higher physical activity may or may not go together with higher active mobility. However, we hypothesize that, even though a large sport event might not induce a significant increase in utility cycling, it could play a mediating role in the behavioral change and act as a trigger by giving the last "push" to those who were already considering to start cycling on a daily basis (or cycle more) but still hesitated. That is to say, not only the infrastructural improvements but also picking up new leisure and fitness interests may be a turning point in one's propensity to cycle (Chatterjee, Sherwin, & Jain, 2013).

3. Data and methods

As highlighted in the previous section, a major flaw of many studies is their cross-sectional character and that the "before" and "after" states cannot be compared. Therefore, as requested in the literature (Yang, Sahlqvist, McMinn, Griffin, & Ogilvie, 2010), we designed our research in a form of a panel study that collects data from the same individuals at the time before and after the sport event.

The 2018 UCI Cycling World Championship took place on 22–30 September 2018 in the province of Tyrol in Austria. The pre-event survey was conducted between April and September 2018. The post-event survey was started in February 2019 and lasted until June 2019. Both surveys were implemented in SoSci Survey online system (Leiner, 2020). The pre-event survey was carried out in the field by trained interviewers in form of CAPI interviews with the use of tablet devices. The sample was collected in all administrative districts of the province of Tyrol, following a convenience sampling procedure, though attempting to achieve a sample structure proportional to the districts' population and gender distribution. Respondents willing to participate in the 2nd survey wave could provide their email addresses. After the UCI took place, they were contacted per email and received a link to the post-event survey. This survey was designed as a self-administered online questionnaire filled by the respondents on their own. It resulted in a considerably smaller sample compared to the CAPI interviews (Table 1).

The goal of the survey served was to collect data not only on mobility behavior of residents and on their perception of infrastructural legacy of the UCI but also on health and well-being, destination image and sport cycling preferences, which then served for other tourism- and health-focused studies. Thus, the contents of the questionnaire spanned questions regarding sociodemographic information, use frequency of different transport modes, transport infrastructure in respondent's municipality, support for tourism, perception of Tyrol as a cycling destination, perception of the UCI event, sport activity and one's quality of life and life satisfaction levels. The pre-event questionnaires were more extensive and included additional questions on i.a. participation and spectating sport events live, transport mode availability, motivations for transport mode choice and motivations for practicing sport, whereas the post-event surveys were substantially shorter, so as to keep the response burden low and avoid excess dropouts (which are unavoidable in panel studies). An analogous panel survey with identical content was carried out among tourist visitors to Tyrol before and after the UCI. These data are not presented in the current work.

Table 1
Descriptive statistics of the pre-event and post-event survey samples.

Variable	Value	Pre-event survey		Post-event survey	
		Number	%	Number	%
Age		Mean (SD): 39.8 (18.9)		Mean (SD): 40.1 (19.1)	
Gender	Female	1214	48.5	71	43.8
	Male	1287	51.5	91	56.2
Employment	Pupil	206	8.2	5	3.0
	Apprentice/trainee	64	2.5	3	1.8
	Student	420	16.6	46	27.9
	Employee	944	37.3	74	44.8
	Civil servant	172	6.8	14	8.5
	Self-employed/own business	236	9.3	9	5.5
	Unemployed/ looking for a job	56	2.2	0	0.0
	Retired	375	14.8	6	3.6
	Other	58	2.3	8	4.9
Education	No degree yet	97	3.8	2	1.2
	Compulsory school	327	13.0	8	4.8
	High school diploma/A-levels	789	31.3	60	36.4
	University degree	638	25.3	59	35.8
	Apprenticeship training	600	23.8	20	12.1
	Other	71	2.8	16	9.7
Monthly net income in EUR	<1000	672	28.7	52	32.9
	1000–2000	701	30.0	49	31.0
	2001–3000	444	19.0	36	22.8
	3001–4000	142	6.1	10	6.3
	4001–5000	42	1.8	4	2.6
	5001–6000	29	1.2	1	0.6
	6001–7000	12	0.5	0	0.0
	7001–8000	11	0.5	0	0.0
	8001–9000	3	0.1	0	0.0
	9001–10,000	2	0.1	0	0.0
	>10,000	10	0.4	0	0.0
	Refused to answer	271	11.6	6	3.8

Questions regarding transport mode use operated with a five-point scale: 4–7 days/week, 1–3 days/week, 1–3 days/month, rarely, never, which has been widely applied in mobility-related surveys (e.g. "Fahrrad Monitor Deutschland" or "Mobilität in Deutschland" by the German Federal Ministry of Transport, travel surveys by Transport for London) and respondents are in general familiar with it. Thanks to the range-based formulation, it allows for a more qualitative estimation of one's mobility. The respondents' answers were treated as ordinal, not interval, since the distances between points in the scale cannot be assumed equal. Collecting exact numeric frequencies from respondents would not bring much benefit due to the inherent impreciseness in estimating one's own mobility rates when not operating with the activity-based approach. Alternatively, it would require conducting a diary-based travel-activity survey, which was not possible in the current project.

Respondents were asked to describe their level of agreement with various statements (Tables 5–11) using the following five-point scale: 5 = strongly agree, 4 = rather agree, 3 = neither agree or disagree, 2 = rather disagree, 1 = strongly disagree. Given that this scale was presented to the respondents in a graphical form on a diagram with equal distances between the points, we decided to handle it as interval and use the rank-based tests for the analysis.

In the 1st survey wave, we collected data from 2501 residents of Tyrol. However, not all respondents provided an email address to be

contacted about the follow-up study. Eventually, despite a relatively large size of the pre-event sample, only 165 people (6.6%) participated in the 2nd survey wave. Table 1 summarizes elementary descriptive statistics of both samples. It should be mentioned that no imputation was imposed on the missing data.

The statistical analysis of the collected data was carried out in software packages SPSS 25 (IBM Corp, 2017) and *R* 3.6.2 (R Core Team, 2019). Only non-parametric tests were used due to non-normal data distribution (according to the Shapiro-Wilk test). For the comparison of repeated measurements on a single sample (pre-event and post-event responses of the same individuals), the sign test (for ordinal variables) and Wilcoxon-signed-rank test (for interval variables) were chosen. For the comparison of measurements on two independent samples (responses of spectators and non-spectators), the Mann-Whitney *U* test was applied. The mean values of ordinal variables in tables and figures are given for orientation purposes only and should be treated with caution and only as supplementary information to the percent changes in frequencies.

4. Findings and discussion

4.1. Frequency of transport mode use before and after the UCI

4.1.1. Results for the entire sample

We analyzed answers of those individuals, who participated in both the pre- and post-event surveys. The group totals 165 persons, out of whom not all responded to all questions, which is visible in different *n* values in the tables.

In the first instance, we investigated the change in use frequency of various transport modes before and after the event. Where the changes were observed and how large they were is illustrated in Fig. 1.

As Table 2 shows, the change in use frequency before and after the UCI proves significant only in the case of public transport, which reports an increase. This requires a further comment since in the year preceding the start of the survey, the transit pricing scheme in Tyrol was redefined. The reform introduced a province-wide ticket valid on all public transportation modes (trains, buses, trams) at the price of 490 Euro, which turned to be a bestseller and resulted in an increase in transit use, new transit connections and higher frequency during the peak times. According to transit operators, the increase in transit ridership was not a temporary upturn but a continuous trend, which eventually overlapped with the survey waves in the current study. Thus, the survey outcomes regarding the public transport use can be distorted.

Table 2
Changes in use frequency of transport modes before and after the UCI.

How often do you travel with the following means of transport?	Before		After		*p*-value (sign test)
	n	Mean	*n*	Mean	
Walking	113	4.53	165	4.49	0.877
Cycling	114	4.16	164	3.61	0.583
E-bike	100	1.21	160	1.33	0.180
Public transportation	113	2.65	162	2.81	0.026
Private car as a driver	114	3.68	164	3.73	0.120
Private car as a passenger	110	3.00	163	2.77	0.396
Motorcycle	107	1.16	161	1.18	1.000
Scooter	106	1.28	162	1.17	0.302

4.1.2. Differences between the spectator and non-spectator group

The results above pertain to all respondents, who lived in Tyrol at the time when the UCI took place. We hypothesized however that direct participation in the event, as an active spectator watching the racers, might exert a stronger influence on behavior of respondents than simply being aware of the event taking place but not watching it live. Therefore, the sample was split into respondents who declared to have seen the (at least on one day) event live (81 people) and those who declared not (84 people).

Results presented in Fig. 2 provide an interesting perspective from which to consider the data in Fig. 1 and Table 2. One can observe that bicycle was the transport mode that over a half of respondents would like to use more in the future. Apparently, this was wishful thinking since eventually only 22% of those who declared to be willing to do so, actually started to use bicycle more often in their daily commute after the UCI. Out of them, those who watched the event live accounted for around 12%, and those who did not, for about 10%, which might give the impression that seeing the UCI world cup live slightly reinforced one's initial resolution to change travel behavior. However, due to a

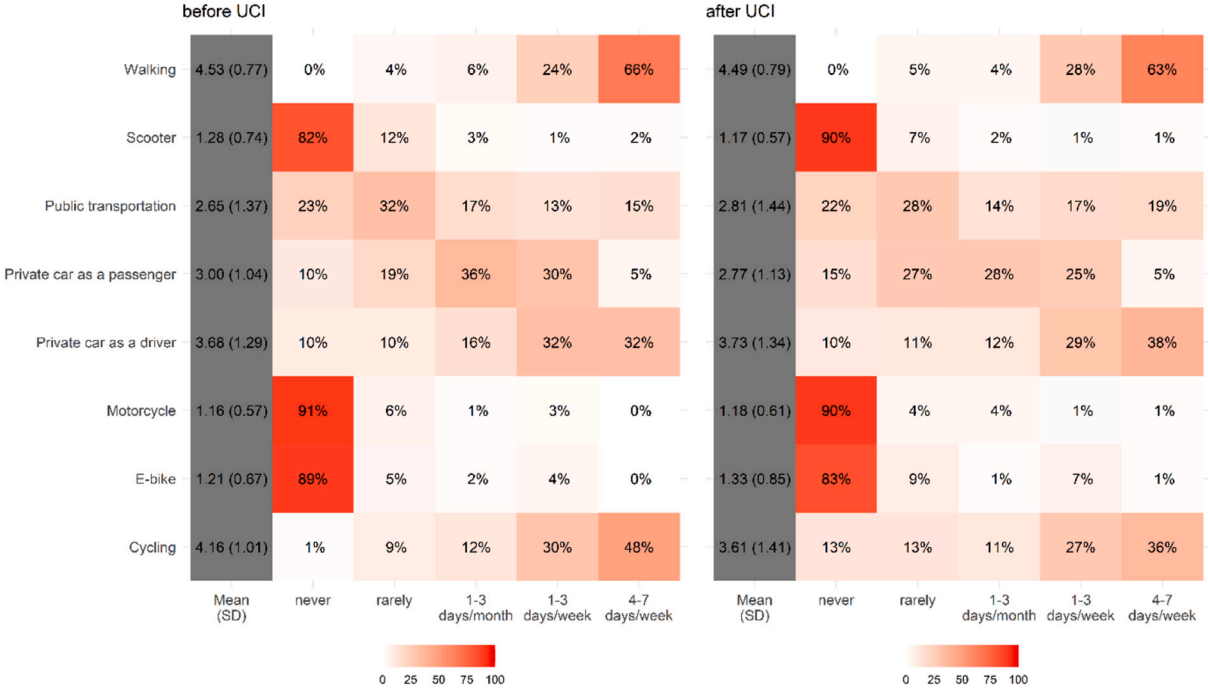

Fig. 1. Heat map of choice and use frequency of transport modes before and after the UCI.

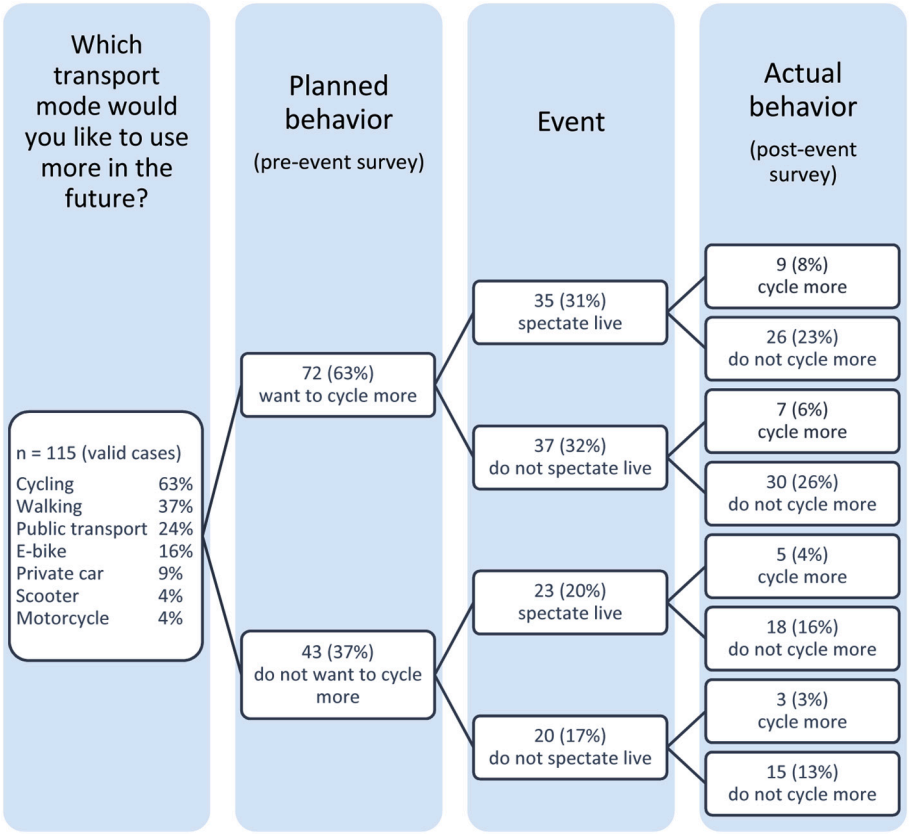

Fig. 2. Planned and actual change in active travel behavior among UCI spectators and non-spectators (% values with respect to the overall number of valid cases $n = 115$).

little difference and small sample size, this is no clear evidence. In total, those who were willing to cycle more and started doing so after the UCI constitute 14% of the entire sample surveyed after the event.

The analysis conducted for respondents who did not participate in the UCI as spectators reveals that their transport mode choice preferences did not change after the event in a significant way (Fig. 3, Table 3).

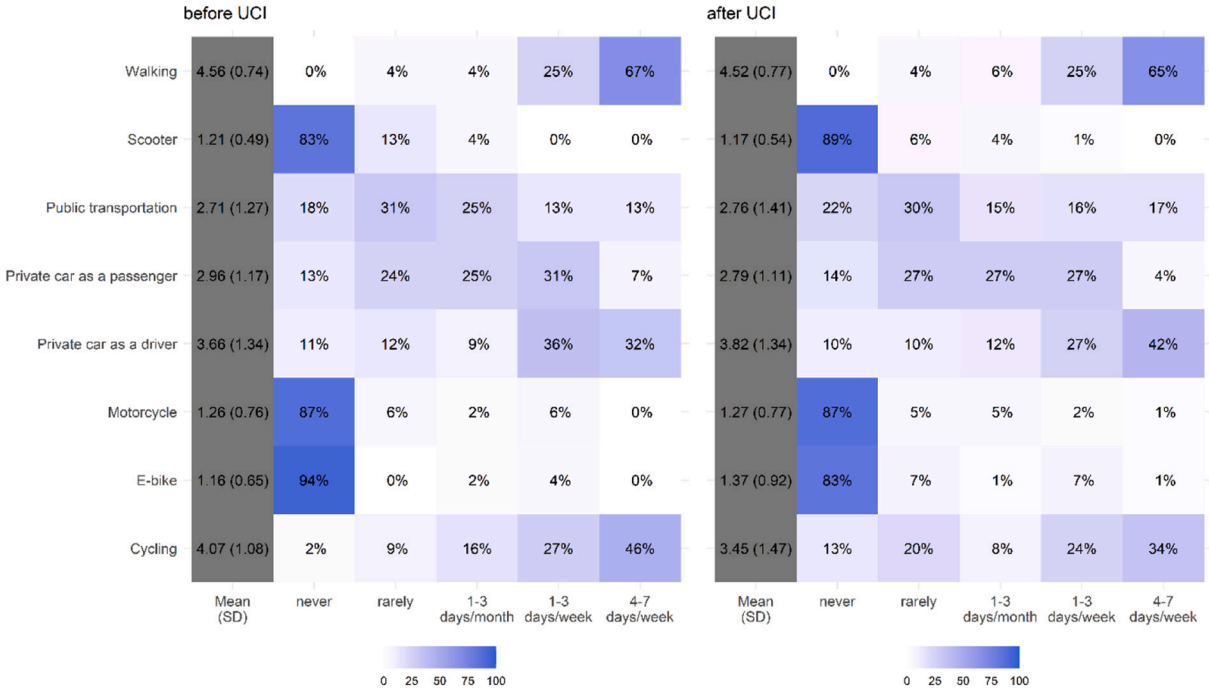

Fig. 3. Heat map of choice and use frequency of transport modes before and after the UCI among the respondents who did not participate in the event live as spectators.

Table 3
Use frequency of different transport modes before and after the UCI among the respondents who did not participate in the event live as spectators.

How often do you travel with the following means of transport?	Before		After		*p*-value (sign test)
	n	Mean	*n*	Mean	
Walking	55	4.56	84	4.52	1.000
Cycling	56	4.07	83	3.45	0.137
E-bike	50	1.16	82	1.37	0.070
Public transportation	55	2.71	82	2.76	0.361
Private car as a driver	56	3.66	83	3.82	0.678
Private car as a passenger	55	2.96	84	2.79	0.728
Motorcycle	53	1.26	82	1.27	1.000
Scooter	53	1.21	83	1.17	1.000

Table 4
Use frequency of different transport modes before and after the UCI among the respondents who participated in the event live as spectators.

How often do you travel with the following means of transport?	Before		After		*p*-value (sign test)
	n	Mean	*n*	Mean	
Walking	58	4.50	81	4.46	1.000
Cycling	58	4.24	81	3.78	0.541
E-bike	50	1.26	78	1.29	1.000
Public transportation	58	2.60	80	2.88	0.038
Private car as a driver	58	3.71	81	3.64	0.124
Private car as a passenger	55	3.04	79	2.76	0.499
Motorcycle	54	1.06	79	1.09	1.000
Scooter	53	1.36	79	1.16	0.180

The difference in cycling frequency is worth highlighting though. Although not significant according to the sign test, one can notice a substantial drop (3.45) compared to the period before the event (4.07). This can be interpreted in such a way that a large cycling event could potentially further deter from cycling those people who were already not very enthusiastic about the event (as they did not spectate it). On the other hand, it may simply reflect the gradually weakening interest into cycling, as exemplified by not attending a major sport event staged in one's own neighborhood as an audience. However, it is not possible to validate these claims since one cannot isolate the effect of the event as if it was a controlled experiment. Moreover, both interpretations do not seem very convincing and the observed decline could also be a result of other developments, such as more attractive public transport or reflect the shift to e-bikes. It might also be affected by different timings associated with the 1st and 2nd survey waves, as specified in Section 3. However, both survey waves cover the spring period of April, May and June, which are the months when cycling is typically practiced in our study area. That is, the possible bias is assumed to be low.

Against this background, it is interesting to see that among the respondents who did participate in the event live, no significant differences in use frequency, except for public transport, can be observed (Fig. 4, Table 4). Even though bike ridership is substantially lower after the UCI (4.24) than before (3.78), this difference is not statistically significant in this group. It could be hypothesized, although without clear evidence, that interest in cycling and attending the event counteracts the general trend towards less cycling.

4.2. Perception of the UCI effects on travel behavior and cycling infrastructure

4.2.1. Results for the entire sample

Furthermore, we examined the respondents' perception of the event's impact by looking at how they evaluated two statements concerning travel behavior and cycling infrastructure and five further statements related to their impressions from and support for staging such events in Tyrol (Fig. 5). After the UCI, the respondents appear to have become more skeptical about its potential positive impact. The share of respondents who do not believe that the event could result in better cycling infrastructure in Tyrol increased from 12% to 36%. In addition, after the event, 58% of respondents negated that it could influence their daily travel behavior, whereas before the event these people accounted for 41% of the same sample. Interestingly, statements concerning the event's image exhibit an opposite trend. Respondents evaluated them slightly more positively after than before the UCI. Nevertheless, the level of support for large events shifted by 7% towards more negative responses, with almost a third of all respondents being undecided. This might suggest that, whilst the residents did indeed like the image of the event, found it exciting and being a good fit for the

Fig. 4. Heat map of choice and use frequency of transport modes before and after the UCI among the respondents who participated in the event live as spectators.

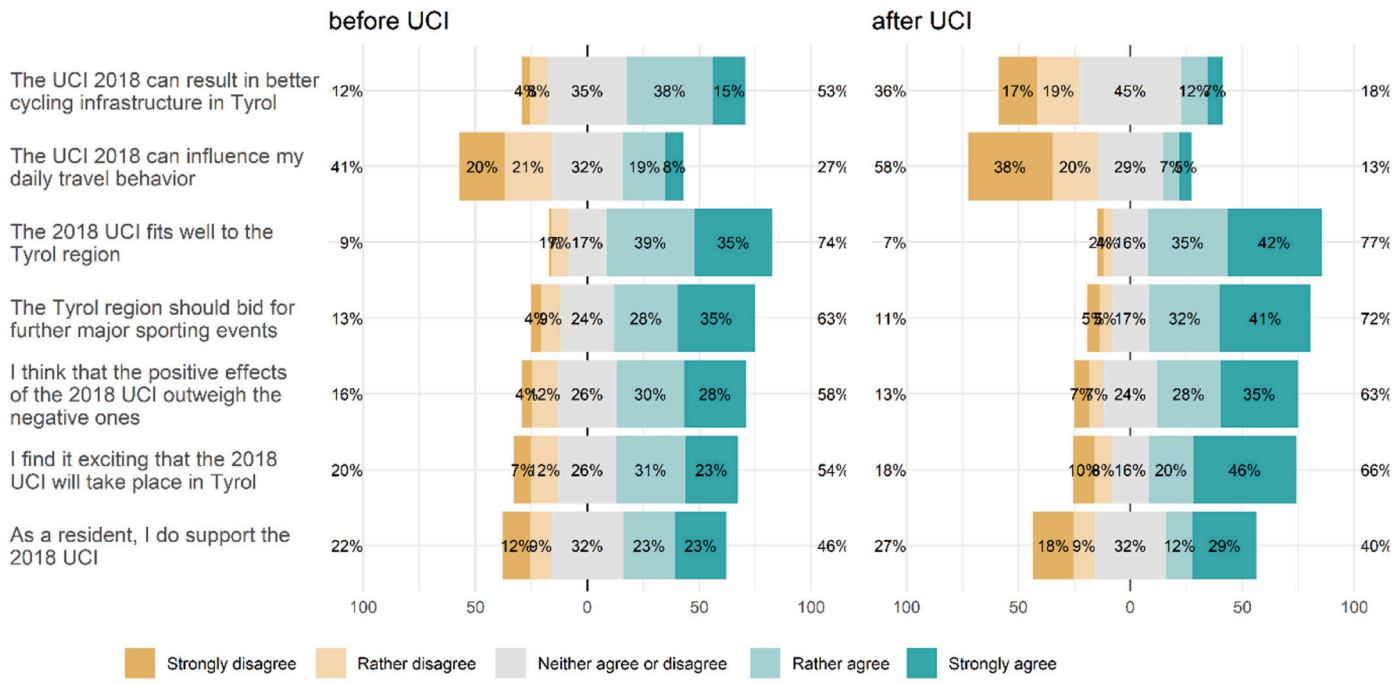

Fig. 5. Changes in evaluation of statements concerning cycling and staging the event before and after the UCI (% values to the left and right of the diagrams indicate the overall share of negative and positive statement evaluations).

region, they did not observe any concrete physical effects (such as infrastructure) that they could directly benefit from and so their support levels decreased. These observations are clearly reflected in the statistical test (Table 5).

4.2.2. Differences between the spectator and non-spectator group

In order to get more insight into potential effects of the participation in the UCI world cup, we further compared answers to questions concerning travel behavior and cycling infrastructure given by those who saw the event live and those who did not.

Evidently, the belief that staging the UCI world cup in Tyrol can result in better infrastructure for cyclists significantly lost in strength among those respondents who participated in the event (Table 6). It may indicate that the expectations they had had before the event were not met, i.e. the infrastructure had not improved or they did not notice it, and hence the lower grading. They also appear to be less convinced that the UCI may have an impact on their travel behavior compared to what they reported in the survey before the event. However, this difference is not significant according to the Wilcoxon test. Although the spectator group was significantly more doubtful about the infrastructural legacy of the UCI in Tyrol and their estimate of the behavioral impact stayed modest, their general impression of the event and the support for it was significantly more positive after the event, in all its aspects.

We report even larger drops in how respondents, who did not actively participate in the event, agree with the statements concerning cycling infrastructure and daily travel behavior. They respond significantly more negatively after the UCI than they did before (Table 7). In addition, their support towards the event decreases significantly and staging the event appear not to have generated any positive change in the attitude towards large sport events, as it was the case in the spectator group.

Not only is the post-event perception of the UCI impact on infrastructure and daily travel behavior among nonparticipants significantly more negative than before the event but it is also significantly more negative than the post-event perception observed among the spectating respondents (Table 8). Analogously, a comparison of responses related to the organization and image of the world cup in Tyrol reveals significantly more support and more positive impressions among those who watched the event live than among those who did not.

No significant differences between the two groups were found regarding these statements in the pre-event survey, which might imply that participation as a spectator and seeing the event live outdoors can contribute to less disappointment and less negative attitude after the event.

4.2.3. Differences between those who cycle more after the UCI and those who cycle less

To look deeper into the differences between those who started to cycle more in the period after the world cup and those who cycled less, we split the sample into two groups again and examined differences in statement evaluations. Out of the initial sample of 165 people, 24 started to cycle more after the event and 89 declared less frequent use of a bicycle in daily travel. In remaining cases, no answer was provided either in the pre- (51 NAs) or post-event survey (1 NA).

Although the respondents actually declare more frequent use of a bicycle in their daily travel after the UCI, they ascribe this increase to the event significantly less than before (Table 9). Besides, they are also significantly (at 10% level) less optimistic towards the event's infrastructural heritage for cyclists than they were before. Similar, though more meaningful, outcomes are delivered by the analysis of the respondents who reduced their cycling frequency after the UCI (Table 10). This group exhibits even larger decrease in the level of agreement with the two statements, highly significant in both cases.

A comparison of the agreement levels to the above statements signalizes that the group, which cycles less after the UCI, appraises the impact of the UCI on travel behavior and infrastructure more negatively than the other group, however these differences are not statistically significant according to the Mann-Whitney *U* test, as presented in Table 11.

Table 5
Evaluation of statements concerning cycling and staging the event before and after the UCI.

To what extent do you agree with the following statements?	Before		After		*p*-value (Wilcoxon test)
	n	Mean	*n*	Mean	
The UCI 2018 can result in better cycling infrastructure in Tyrol	164	3.52	163	2.72	0.000
The UCI 2018 can influence my daily travel behavior	163	2.74	164	2.23	0.000
The 2018 UCI fits well to the Tyrol region	163	3.99	164	4.10	0.187
I find it exciting that the 2018 UCI will take place in Tyrol	162	3.51	165	3.85	0.001
I think that the positive effects of the 2018 UCI outweigh the negative ones	163	3.65	165	3.78	0.192
As a resident, I do support the 2018 UCI	161	3.35	164	3.23	0.235
The Tyrol region should bid for further major sporting events	162	3.80	165	3.96	0.042

Table 6
Evaluation of statements concerning cycling and staging the event within the active spectator group.

To what extent do you agree with the following statements?	Before		After		*p*-value (Wilcoxon test)
	n	Mean	*n*	Mean	
The UCI 2018 can result in better cycling infrastructure in Tyrol	81	3.57	80	2.88	0.000
The UCI 2018 can influence my daily travel behavior	81	2.74	80	2.50	0.117
The 2018 UCI fits well to the Tyrol region	81	4.17	81	4.41	0.034
I find it exciting that the 2018 UCI will take place in Tyrol	81	3.74	81	4.47	0.000
I think that the positive effects of the 2018 UCI outweigh the negative ones	81	3.91	81	4.26	0.014
As a resident, I do support the 2018 UCI	81	3.62	81	4.00	0.007
The Tyrol region should bid for further major sporting events	80	4.04	81	4.33	0.013

Table 7
Evaluation of statements concerning cycling and staging the event within the non-spectator group.

To what extent do you agree with the following statements?	Before		After		*p*-value (Wilcoxon test)
	n	Mean	*n*	Mean	
The UCI 2018 can result in better cycling infrastructure in Tyrol	83	3.48	83	2.57	0.000
The UCI 2018 can influence my daily travel behavior	82	2.73	84	1.96	0.000
The 2018 UCI fits well to the Tyrol region	82	3.82	83	3.81	0.842
I find it exciting that the 2018 UCI will take place in Tyrol	81	3.27	84	3.25	0.847
I think that the positive effects of the 2018 UCI outweigh the negative ones	82	3.39	84	3.31	0.451
As a resident, I do support the 2018 UCI	80	3.08	83	2.48	0.000
The Tyrol region should bid for further major sporting events	82	3.57	84	3.61	0.634

Table 8
Post-event statement evaluation concerning cycling and staging the event in the spectator and non-spectator group.

To what extent do you agree with the following statements?	Spectator		Non-spectator		*p*-value (Mann-Whitney U test)
	n	Mean rank	*n*	Mean rank	
The UCI 2018 can result in better cycling infrastructure in Tyrol	80	86.85	83	77.33	0.173
The UCI 2018 has influenced my daily travel behavior	80	92.44	84	73.03	0.006
The 2018 UCI fits well to the Tyrol region	81	97.27	83	68.09	0.000
I find it exciting that the 2018 UCI took place in Tyrol	81	105.44	84	61.36	0.000
I think that the positive effects of the 2018 UCI outweigh the negative ones	81	102.60	84	64.10	0.000
As a resident, I do support the 2018 UCI	81	107.38	83	58.22	0.000
The Tyrol region should bid for further major sporting events	81	99.10	84	67.48	0.000

Table 9
Evaluation of statements concerning cycling within the group that cycles more after the UCI.

To what extent do you agree with the following statements?	Before		After		*p*-value (Wilcoxon test)
	n	Mean	*n*	Mean	
The UCI 2018 can result in better cycling infrastructure in Tyrol	23	3.26	23	2.74	0.074
The UCI 2018 can influence my daily travel behavior	23	2.83	23	2.30	0.032

Table 10
Evaluation of statements concerning cycling within the group that cycles less after the UCI.

To what extent do you agree with the following statements?	Before		After		*p*-value (Wilcoxon test)
	n	Mean	*n*	Mean	
The UCI 2018 can result in better cycling infrastructure in Tyrol	89	3.60	88	2.57	0.000
The UCI 2018 can influence my daily travel behavior	88	2.78	89	2.11	0.000

Table 11
Post-event statement evaluation concerning cycling within the more- and less-cycling group.

To what extent do you agree with the following statements?	Group cycling more		Group cycling less		*p*-value (Mann-Whitney *U* test)
	n	Mean rank	*n*	Mean rank	
The UCI 2018 can result in better cycling infrastructure in Tyrol	23	61.89	88	54.46	0.299
The UCI 2018 can influence my daily travel behavior	23	63.85	89	54.60	0.201

5. Conclusion

The research aims at investigating the leveraging effects of large cycling events on active mobility of residents as well as their perception of the infrastructural legacy for cyclists left after staging the event. However, the results of a panel study, in which data were collected from the same individuals at the time before and after the sport event, do not show an increase in bicycle use after the event, but do show a significant increase in public transport. This might be attributed to an improvement in the service quality, mainly by a massive price reduction of season tickets introduced in the preceding year. Even though 63% of the survey participants wished before the event that they cycled more in their daily travel in future, only 22% did increase the frequency of bicycle use after the event. A closer look at the sample, which distinguishes between people who actually spectated the event live and those who did not, shows that the bicycle ridership among the non-spectators dropped more than among the spectators. The fact that the group spectating the event reported a lower decrease in the frequency of cycling than the non-spectating group can be actually interpreted as a positive effect on their daily travel behavior. However, this effect could not be proved at a significant level. Therefore, we must claim that even a large cycling event such as the UCI World Championship in Tyrol could not leverage a change in travel behavior towards active mobility. However, it can be also argued that at least the negative trend of a declining bicycle use frequency was slowed down, if one compares the responses of spectators and non-spectators.

The findings contradict the expectations that the respondents had before the event. They believed that staging the UCI in Tyrol can influence their travel behavior and anticipated that it would result in better infrastructure for cyclists. Both statement significantly lost in strength after the event, which means that the perceived changes fall short of the respondents' expectations. But again, the respondents who participated in the event reported a significantly less negative change than the non-spectators. It must be born in mind that two prerequisites are necessary to facilitate a behavioral change – motivation (Markvica, Millonig, Haufe, & Leodolter, 2020) and adequate offers on the supply side – and both must be provided to make the change happen. Since mobility behavior is strongly based on routines, extraordinary impulses are a special opportunity for a change. The literature shows that e.g. residential relocation (Thronicker & Klinger, 2019) or holiday experiences (e.g. in health-oriented tourism, cf. Schlemmer, Blank, Bursa, Mailer, and Schnitzer (2019)) can induce a change in behavior. Accordingly, large events could also be a trigger. Thus, the UCI could have acted as a stimulus for a change (as it was perceived significantly more positively in the post-event survey), but apparently no offer has been made on the supply side that could effectively attract people to cycling. The feedback of the respondents proves that not enough new infrastructure was built on time (which is reflected in significantly more negative statement evaluations) and so the change did not occur. It is an example of a missed opportunity and a wasted potential.

Nevertheless, unlike the small and ambiguous effect of UCI on daily travel behavior, the effect on the perception of the event is very clear. Respondents who watched the race live outdoors exhibit a significantly more positive attitude towards the event and would support bids for further major events. This is a clear message for tourist regions and destination managers, which confirms that marketing campaigns focused on engaging local communities into the event worked well. However, it still does not inform on whether the host region of Tyrol and its residents did actually benefit from the event, be it from the perspective of local economy, tourism industry, sport or health, since such research has not been published so far. Certainly, they did not benefit from the perspective of the modal split as the propensity to cycle does not correlate positively with staging the event. The outcomes are in line with the literature, e.g. the findings of Bondarik, Pilatti, and Horst (2020), who claim that "expenditures were underestimated and the magnitude of benefits of the expected legacy was overestimated."

The promotion of the image of cycling in Tyrol corresponds to the state's objectives in the area of transport planning. With the creation of a cycling concept for 2015–2020 (Amt der Tiroler Landesregierung, 2014) and mobility program for 2013–2020 (Amt der Tiroler Landesregierung, 2012), the state of Tyrol was planning to make cycling in Tyrol more attractive and increase its share in the modal split on all routes by 3% over eight years. This is intended to meet the growing importance of cycling and the requirements of cyclists and follows the recommendations of experts and guidelines that aim at increasing the use of active means of transport. The current share in Tyrol oscillates around 11% (with strong regional variations between urban and rural areas) (Köll & Bader, 2011), which is noticeably more than the Austrian average of 6% but still less than scored by the Netherlands (28%) or Denmark (15%) (Bundesministerium für Verkehr, Innovation und Technologie, 2017). The results of the program shall be evaluated through the comparison of 2011 and 2020 (not conducted yet) travel behavior surveys.

In this regard, it is still recommended to make use of cycling events not only to advertise the destination among tourist visitors but also to improve the image of cycling among the population and ultimately promote the use of bicycles in the everyday commute and leisure traffic. However, the organizers and authorities should not overestimate the impact on infrastructure improvement or behavioral change to avoid disappointment and negative reviews after the event. Overenthusiasm at the event preparation stage, not followed by a comprehensive cost-benefit analysis, may results in misinformation and erroneous impression of reality, which has already been observed in case studies of mega sport events (cf. Section 2).

Nonetheless, the less negative perception of the UCI impact among people who have experienced the event live, highlight that the involvement of local population is an essential factor to achieve a positive impetus for cycling and produce a driving force for a behavioral change.

The study makes clear that people hope and expect that large cycling events will contribute to cycling infrastructures and general conditions for bicycle use in their area. Thus, the findings extend the evidence for planning and thinking of sport events and their aftereffects at the level of host municipalities. The typical process of juxtaposing benefits for tourism, hospitality and leisure industry with organizational and marketing costs should be extended by taking also transport planning perspective into account.

Declaration of Competing Interest

None.

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