



Active school travel, attitudes and psychological well-being of children



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ABSTRACT

The decline in physical activity levels among children emphasizes a need for research on experiences related to children's active travel. The present study investigates the relationship between mode use on school trips and psychological well-being (PWB) of children. Data were collected from 152 primary school children in Lower Austria. The paper-and-pencil survey investigated transport-related attitudes, travel behavior, and children's emotional well-being depending on the travel mode used on their trip to school. Parents' perceptions of their child's travel mode on well-being were also collected in 31 in-depth interviews. Findings suggest that active school travel is positively associated with children's PWB, and that travel-related attitudes towards modes are significantly related to well-being. However, it is difficult to determine the causal direction between the two variables as causal feedback loops can be assumed. Clear results can be obtained for the parental survey: Parents reported strong positive associations between active travel modes and the well-being of their children. More research with bigger sample sizes and higher quality measures should be conducted, including about non-school trips and with longitudinal datasets, to further evaluate the interrelations between children's mode use, attitudes, and well-being and to determine the most successful strategies for increasing active mobility among children.

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1. Introduction

Changes in children's travel patterns and associated negative impacts to health and well-being have been a recent subject of research. Current developments show that children's levels of physical activity have decreased to alarming rates. According to the actual report on the situation of young people between 15 and 30 years old in Austria, only 57% fulfil the World Health Organization (WHO) recommendations on health-preserving physical activity (HEPA) (BMFJ, 2016). If only children and teenagers (aged 11–17) are considered, just 17% fulfil the WHO recommendations of one hour of physical activity per day (Ramelow, Teutsch, Hofmann, & Felder-Puig, 2015). In parallel, independent mobility of children has been declining with significant consequences for the physical, social and mental development of children (e.g. Frauendienst & Redecker, 2011; Shaw et al., 2013, 2015). Studies on health-related impacts of children's mobility mainly focus on physical well-being and

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health determinants such as cardiovascular fitness, cholesterol levels, and blood pressure (e.g. Lubans, Boreham, Kelly, & Foster, 2011; Panter, Jones, & van Sluijs, 2008; Schoeppe, Duncan, Badland, Oliver, & Curtis, 2013). Benefits of active travel modes for psychological and social well-being are assumed, but empirical studies measuring these effects for children are still scarce.

Understanding the links between children's active travel behavior and psychological well-being may provide important suggestions for policy-makers on how quality of life in cities can be improved. If a positive interrelation of children's well-being and active travel can be demonstrated, this may also help to sharpen the focus of travel awareness campaigns promoting walking and cycling among young people. In particular, if parents are aware that active travel contributes to the child's (and their own) well-being, it could serve as an efficient incentive for behavior change. Moreover, multiplier effects are to be expected as it is assumed that positive feedback loops exist whereby positive emotions reinforce actions, making people more likely to repeat those healthy behaviors (Ramanathan, O'Brien, Faulkner, & Stone, 2014). In addition to their policy relevance, measurements of well-being can possibly enhance behavioral models (Singleton, 2017).

This paper describes the results of a study of 152 children and 31 parents in Lower Austria, including a descriptive and exploratory analysis of relationships between children's mode use, modal attitudes, and well-being. The analysis—based on in-class surveys of children and interviews with parents—also served as a methodological experiment, which attempted to assess travel-related well-being of children based on self-reports. In this study, children reported their emotions after traveling to school. Thus, this paper focuses on the affective domain of subjective/psychological well-being pertaining a short time frame.

The paper is structured as follows: Section 2 gives a brief overview of different concepts of understanding and measuring well-being, as well as previous research in the field of children's well-being and mode use. Section 3 describes the survey approach and questionnaires. Section 4 presents the results of the descriptive-exploratory data analysis. The paper closes with a brief discussion and conclusions on the study methodology and results (Section 5).

2. Literature and research questions

2.1. Definitions and measurement of well-being

The broad concept of well-being is closely related to, encompasses, or is encompassed by the concepts of happiness, satisfaction, and (health-related) quality of life (QoL).¹ According to several definitions (Patrick & Erickson, 1988; Schumacher, Klaiberg, & Brähler, 2003), health-related QoL is a broad, multi-dimensional construct considering physical limitations, mental (and emotional, spiritual, etc.) states, functional abilities in everyday areas of life, and social interactions. Whereas this QoL concept has been mainly applied in the social sciences and medicine, the focus of this study is on the slightly narrower concept of psychological well-being.

Psychological well-being (PWB) is one of five domains of children's well-being identified in the literature (Pollard & Lee, 2003; Waygood, Friman, Olsson, & Taniguchi, 2017); the others are physical, economic, cognitive (learning-related), and social. Also known as subjective well-being, PWB deals with emotions, stress, affect, happiness, fulfillment, and life satisfaction. Although well-being can be classified in different ways (Nordbakke & Schwanen, 2014), this subjective version of well-being tends to be distinguished into *hedonic* and *eudaimonic* aspects. Following Becker (1994) and Diener (1984, 2000), hedonic well-being has two dimensions: (1) the *affective* component, characterized by a positive/negative emotional state or mood (more short-term), and (2) the *cognitive-evaluative* component, including a more self-aware assessment of general life satisfaction (more long-term). In contrast, eudaimonic well-being represents more high-level aspects such as personal growth, finding purpose or meaning, and self-actualization or achieving one's full potential (De Vos, Schwanen, Van Acker, & Witlox, 2013). Based on these classifications, this study looks at the affective component of hedonic subjective or psychological well-being.

Studies of the connections between transportation, travel, and well-being have become more common in recent years (e.g., De Vos et al., 2013; Delbosc, 2012; Nordbakke & Schwanen, 2014; Reardon & Abdallah, 2013). Many of these studies look at PWB associated with a particular mode or during or immediately after an individual trip; but, in line with multifold measures of well-being and quality of life,² different scales and questionnaires exist for measuring this travel-related PWB (Singleton & Mokhtarian, in preparation). One of the most common measures is the Satisfaction with Travel Scale (STS) (Ettema et al., 2011), a nine-item scale of hedonic well-being that reproduces the affective and cognitive-evaluative dimensions.³ Other more ad-hoc approaches have investigated overall satisfaction with or an affinity for travel in general, specific modes, and recent trips. The latter “travel liking” questions likely measure travel affect, while the former “travel satisfaction”

¹ Many studies exist in the field of health-related QoL of children and adolescents (e.g. Bullinger, 2009; Bullinger & Ravens-Sieberer, 1995; Drotar, 1998; Ravens-Sieberer, 2000).

² Examples include: WHOQOL (WHOQOL-Group, 1994), ILK Rating questionnaire (Mattejat et al., 1998); EuroQOL (Kind, 1996); EORTC-questionnaire (Aaronson, Cull, Kaasa, & Sprangers, 1996), Rosenberg Self-Esteem Scale (Rosenberg, 1965), Positive and Negative Affect Schedule (PANAS) (Watson, Clark, & Tellegen, 1988), Scale of Positive and Negative Experience (SPANE) (Diener et al., 2010), Swedish Core Affect Scale (SCAS) (Västfjäll, Friman, Gärling, & Kleiner, 2002), and others.

³ Westman, Olsson, Gärling, and Friman (2017) used an adapted version of the STS-scale for a survey with children.

questions appear to be more about cognitive than affective aspects of hedonic PWB (De Vos et al., 2013; Singleton & Clifton, 2017).

A challenge for the purposes of this study is that these measures of travel-related PWB have mostly been used to investigate the well-being of adults, and they may not be well-suited to the abilities and developmental conditions of children. Some children (depending on experiences and age) have short attention spans, a low capability in reading and an inability to fully understand certain complex questions (Henerson, Morris, & Fitz, 1987). Thus, visual scales are often used for children's self-assessment of well-being. Emoticons, in particular, can help children to understand what is expected of them while also making the task more enjoyable. For example, Andrews and Withey (1976) developed a scale with seven faces that express different moods and emotions; this instrument was suitable for self-reports of the general well-being of children in a recent study (Wydra, 2014). The present study also adopted emoticons to measure the current state of children's emotional PWB.

Despite the guiding principle behind PWB, that only a person her/himself can serve as an expert for her/his own well-being (Schwenkmezger, 1994), the particularities of children suggest that multiple methods may be appropriate for exploring a child's subjective perceptions. Third-party assessments of children's well-being—for example, assessments by parents and experts (e.g. medical doctors) (Mattejat et al., 1998)—can be used in a complementary way to supplement children's own self-assessments, thus helping to paint a fuller picture of PWB. This study utilizes both children's and parent's subjective assessments of children's well-being.

2.2. Children's psychological well-being and mode use

As mentioned above, there are only few studies examining relationships between children's well-being and travel. This is confirmed in reviews by Waygood, Friman, Olsson, and Taniguchi (2015), Waygood et al. (2017), who report that—apart from the relationship between transportation and the physical domain of child well-being—most well-being domains are poorly researched; although, more studies were found for psychological and social well-being than for economic well-being. In this section, our review focuses on the second of three “means of impact” of transport on children's well-being identified by Waygood et al. (2017): those intrinsic impacts during travel or as a direct result of traveling. Other authors (Singleton & Mokhtarian, in preparation) discuss these impacts as being related to the *experiences* of traveling by certain modes, routes, etc.

In their review, Waygood et al. (2017) present mainly positive relations with overall well-being for walking and cycling (respectively) and for active transport in general, and negative associations with car travel. (The results for public transport were more ambivalent.) When taking into account only the intrinsic influences on PWB, active modes appear to influence short-term well-being in the form of positive experiences, enjoyment, self-esteem and reduced stress (Waygood et al., 2017). For example, a large sample study in Canada found that parents and children who used active travel modes to school reported more positive emotions compared to passive mode travelers (Ramanathan, O'Brien, Faulkner, & Stone, 2014). In Austria, an evaluation of the “Schoolwalker” initiative demonstrated that parents and teachers reported an enhanced positive mood as well as improved concentration ability of children due to active mobility (Thaller, Schnabel, & Gollner, 2014); positive emotions were significantly related to well-being on school trips. A recent case study in Hong Kong revealed that primary school children engaging in active transport modes rated their journeys as happier than those using motorized transport (Leung & Loo, 2017). Westman et al. (2017) investigated whether travel mode (amongst other factors) affects children's satisfaction with their school journeys and their current mood immediately after arriving at school in the morning and later on in the afternoon. They found that travel mode was associated with children's satisfaction with their school travel; specifically, mean ratings of travel satisfaction were higher for active travel modes and school bus than for car, which might be explained by a greater opportunity for physical activity or social interactions. Assessments of current mood (ratings of valence and activation) were also higher for active travel mode users than for those traveling by car, although the differences were not statistically significant.

Despite these relatively consistent findings, in their integrated review, Waygood et al. (2017) concluded that “more effort is required to replicate findings” (p. 37) in the psychological domain, likely because there remain so few transport studies focusing on children's well-being.

The results of the studies concerning mode use and children's PWB are in line with findings concerning adults. Research using various measures of PWB—including the STS, as well as travel liking and satisfaction—consistently find that adults rate walking and bicycling more positively than they rate travelling by car. For example, Martin, Goryakin, and Suhrcke (2014) revealed that travelling by active modes to work positively influenced well-being, as operationalized by the WHO-5 Well-Being Index (Winther Topp, Ostergaard, & Sondergaard, 2015). Kemen (2016) also used the WHO-5 Well-Being questionnaire and found that cyclists had a 4–5 points higher well-being score than other traffic mode user groups. Singleton (2018) found that walk and bicycle commuters rated their experiences much higher than other commuters on both positive affect and overall hedonic well-being.

2.3. Attitudes, travel behavior, and psychological well-being

Although the literature review thus far has focused on travel behavior and its influences on PWB, another psychosocial concept is important to briefly discuss: attitudes. The theory of planned behavior (TPB) (Ajzen, 1991) suggests that attitudes

towards a behavior—along with other social-psychological factors like subjective norms and perceived behavioral control—influence that behavior. In our case, this would suggest that attitudes towards walking and bicycling may influence the choice to walk or cycle to school. However, the empirical evidence is more complex than this suggests. For example, [St-Louis, Manaugh, van Lierop, and El-Geneidy \(2014\)](#) revealed that the amount of satisfaction with the chosen travelling mode is highly influenced by attitudes towards the selected means of travel. However, [Ory and Mokhtarian \(2009\)](#) found little effect of attitudes on travel behavior; instead, their structural equation models found stronger evidence that affect (as measured by travel liking) influences modal perceptions. This supports statements by [Parkanay et al. \(2004\)](#), who suggest that a better representation of these linkages would be a circular process (or causal feedback loop) by which traveling generates (positive and negative) emotions related to mode/trip, which in turn affects perceptions and attitudes towards that mode or trip, thus eventually influencing future travel behavior choices. Similar findings were obtained by recent studies on bidirectional relationships from [Kroesen, Handy, and Chorus \(2017\)](#) and [De Vos and Witlox \(2017\)](#).

2.4. Present study & hypotheses

This article contributes to the literature by presenting the results of an analysis of survey data examining associations between mode use on school trips, travel-related attitudes and affective (emotional) indicators of psychological well-being among Austrian children in the province of Lower Austria. Perceptions of both children and parents were examined to analyze the interrelation of mode use and children's PWB and mode-specific attitudes. Based on the results of the literature review, our fundamental hypothesis was that active travel positively affects children's well-being, thus generating more positive attitudes towards active modes. Therefore, we expected that children's PWB, active travel mode use, and active mode attitudes would all be positively associated. Although we controlled for gender in our analyses, due to a lack of data we ignored household characteristics and other psychosocial attributes (e.g., the availability of vehicles in the household, parental behavior etc.), which are also important factors for mode choice.

3. Methods

3.1. Study design and participants

We conducted a two-stage survey at five primary schools in Lower Austria. These schools show comparable environments and are situated in villages with 1350–2550 inhabitants, with the exception of one school in a town of 16,150 inhabitants. All municipalities are located in rural areas in the west of Vienna, in relatively flat terrain and with typical ample gardens. Public transit for school children is provided. In the schools' catchment areas, the conditions for non-motorized modes are similar, as are the conditions for car use. The first survey-stage contained a paper-and-pencil survey investigating the children's preferences, their actual well-being and general mobility behavior. In the second stage, parents were invited to take part in an interview because children's mode choices are often mediated by their parents.

The surveys were conducted between May and October 2016 (except for July and August due to school holidays). In the analyses, we controlled for the different dates of the surveys to preclude the season (spring versus fall) or the timing within a school from influencing the results. It is important to note that the surveys of children were conducted on the day of a bicycle training for which the schools had registered. In the course of this, informed consent from parents on their child's and their own willingness to take part in interviews was requested at parents' evenings.

In total, 152 children (51% female) took part in the mobility and attitude survey. Children in the sample stem from the 3rd and 4th school grade (mean age 9.6). The paper-and-pencil survey was carried out in the first school lesson in the morning. Researchers and teachers supervised the children in completing the questionnaire. Although we used a child-oriented questionnaire, the children were quite used to fill-in worksheets and were looking forward to filling in the questionnaire; the supervisors went through the questionnaire point for point conjointly. Considerable importance was attached to instructions on the scales used in the questionnaire. A similar approach was used by [Waygood and Kitamura \(2009\)](#) who collected self-completion travel diaries from grade-five students in Japan.

In the second stage, interviews with parents were conducted ($N = 31$). The interviews with parents involved both face-to-face and telephone interviews. Except for one father, all of the participants were mothers (mean age 39.8). A tabular overview of key figures of the data sources is given in [Table 1](#).

3.2. Questionnaires

3.2.1. Children's questionnaire

The children's survey was partly designed based on self-completion questionnaires, which have been proven successful in previous interviews with children and youth ([Stark, Bartana, & Fritz, 2015](#)). It also contained examples on how to mark the answers correctly. The questionnaire utilized pictograms and emoticons plus very simple wording to ask questions about mode use on the reported day, individual preferences for school and leisure trips and the frequency of travel mode use.

First, children stated the transport mode used for their trip to school in the morning on the reporting date by encircling a pictogram plus mode name. Due to the bicycle training on the day of the survey, some children unusually used the bicycle or

Table 1

Key figures of the data sources.

Period of data collection		May–October 2016
Location		Lower Austria
Target group	Primary school children	Parents of primary school children
N (schools)	152 (5)	31 (5)
Mean age	9.6	39.8
Survey design	PAPI ^a	Telephone, face-to-face
<i>Content with regard to ... (excerpt)</i>		
...Mobility behavior	Mode use to school on reporting day, frequency of mode use (ST)	Frequency of mode use (parent + child)
...PWB	Subjective PWB dependent on mode use (ST)	Well-being dependent on mode use (child)
...Attitudes	Mode-specific attitudes, preferences (ST/LT)	mode-specific attitudes, attitudes regarding physical activity and active mobility
...Other	Self-assessment of cycling skills, satisfaction with activity level	Sociodemographics, activity level (child), health aspects, assessment of child's cycling skills

Abbreviations: PAPI – paper and pencil interview, PWB – psychological well-being, ST – school trip, LT– leisure trip.

^a Self-administered questionnaire with supervision.

were car passengers because parents brought bicycle and child by car. To consider this bias, children also reported the frequency of use on “normal” school trips [(nearly) always, frequently, sometimes, (nearly) never] for each given travel mode [car passenger, bus/train, scooter, bicycle, walking]. Further, their individual preferences of travel modes on school and leisure trips were surveyed, again, using pictograms to visualize travel modes. The children's attitudes with regard to the five travel modes were assessed using a 5-point scale with smileys and a keyword [really cool, good, average, bad, really uncool].

Subjective psychological well-being was addressed with two items. The first question was directly related to the mode use on children's school trips: “How do you feel in the first school lesson, when you have walked to school [went by bicycle/scooter/by bus or train/were taken by car to school]?” Children had to tick boxes using a 5-point scale with smileys (Fig. 1); no key words were used to describe the mood icons. If children never use one of the given modes on their trip to school, they were directed to cross out the respective row. This question was repeated by asking for the children's well-being during the last school lesson, following the assumption that children feel better during the day if they performed some physical activity in the morning.

Of course, these questions about PWB are very general and abstract; however, we assumed that children were able to give a valid answer as school trips are part of the children's daily routines. Ramanathan, O'Brien, Faulkner, and Stone (2014) had good experiences with similar concise questions about children's “usual feelings” on their ways to school. We also assumed that the display of faces expressing different emotions would elicit responses that were more about the affective than the cognitive aspects of PWB.

Other questions, not relevant in this paper, referred to cycling skills and physical activity: Smileys and a five-point scale were used for a self-assessment on cycling skills with two items: (i) “How good are you in cycling?” and (ii) “How comfortable/safe do you feel when you are cycling?” We asked if the children like to be physically active [yes/no] and if they would like to get more exercise [yes/no].

We do not have the addresses of children's homes or the distances of their ways to schools.

3.2.2. Parent's questionnaire

The parent's survey included questions about the household, the parent and the child. Topics covered in the in-depth interview included: mobility behavior (parent, child), availability of travel modes (parent, child), cycling skills (child), attitudes with regard to independent mobility and cycling (parent), physical activity levels (child), as well as physical and mental condition (child). As the overall topic was cycling skills, the sample might have been biased because parents with a high affinity for active lifestyles may have been more likely to volunteer to take part in the interviews. We were also unable to prevent social desirability bias from affecting answers by the parents.

In the following, only relevant questions for the analysis are briefly described. The impact of a child's everyday mobility on her/his well-being was analyzed using open-ended and closed questions. First, parents were asked open-ended questions about how everyday mobility affects a child's behavior and well-being on a day when the child mainly uses active travel modes versus usually traveling as a passenger in a car. Then, parents evaluated a set of well-being items on a 4-point Likert scale [fully agree – not agree] regarding a day when the child mainly uses bicycle/scooter (or bus/train, walks a lot, travels as car-passenger a lot). The following 14 items were selected from the ILK Rating questionnaire (Inventory for assessment of quality of life in children and adolescents, after Mattejat et al., 1998) and the “Questionnaire for general well-being, 1998” (Wydra, 2014): healthy, strong/powerful, physically challenged, self-confident, feels well in his/her body, fit/sportive, happy, balanced, unhappy, annoyed/angry, stressed/nervous, uncertain/anxious, tired, has physical complaints. Thus, these questions cover not just psychological but also physical well-being. In the questionnaire, the items were arranged to provide a mix between positive and negative associations.

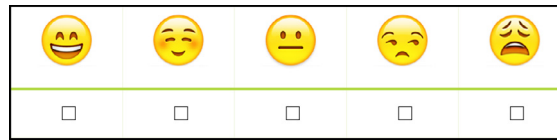


Fig. 1. Mood icons for children's self-report on well-being.

4. Results

These data were analyzed using bivariate measures of association to examine relationships between children's well-being (self-reported), mode use, and modal attitudes. Group comparisons between boys and girls were conducted. A descriptive analysis was conducted for the parental assessments on the interrelation of well-being of their children and mode use.

4.1. Mode use

The modal split in the sample based on the *children's survey* is given in Table 2. The high share of cycling on the reported day was likely due to the fact that some children unusually traveled by bicycle to take part in the cycling training. The share of car use is also a little higher, presumably, because some parents drove the bicycle (and child) to school. Therefore, the modal split on a "normal day" is also provided. The share of children using active modes (walking, bicycle, and scooter) was very high compared to public transport (PT) use, mainly because of the relatively lower PT-supply in Lower Austria. As the table shows, children preferred to use their bicycle or scooter as well as walking on their school trips. The high preference for active modes is a well-known pattern of children in this age group (e.g. Aschauer & Stark, 2016; Limbourg, Flade, & Schönharting, 2000; O'Brien, 2008; Zwerts, Allaert, Janssens, Wets, & Witlox, 2010). No significant differences in terms of gender were observed. We found also no significant differences in terms of school location and time of the survey (spring versus fall), except for the modal split on the reported date. At two schools (surveyed in May), bicycle use was much lower because the children were asked to take it to school the day before.

4.2. Mode use and well-being

Children's self-reports showed generally quite high levels of PWB which are expressed in values closer to five (Table 3). Well-being decreased slightly between first and last school lesson; however, the differences were not statistically significant. In addition, no effect of gender could be found.

But, well-being during the first lesson differed significantly between travel modes (Friedman-test: Chi-Quadrat(4) = 67.15, $p = .000$, $N = 98$). The post hoc Dunn-Bonferroni test showed significant differences to the advantage of active modes (mainly bicycle): Well-being after bicycle-use was rated higher than car ($z = 3.817$, $p_{adjusted} = .001$), public transport ($z = 6.844$, $p_{adjusted} = .000$) and walking ($z = -2.959$, $p_{adjusted} = .031$); PWB after scooter-use was rated higher than public transport ($z = -4.201$, $p_{adjusted} = .000$). These effect sizes according to Cohen (1992) were medium to high. An active mode (walking, bicycle, scooter) versus passive mode (car as a passenger, public transport) comparison—following Ramanathan, O'Brien, Faulkner, and Stone (2014)⁴—revealed that perceptions of well-being were significantly higher for active modes (Median = 4.5) than for passive modes (Median = 4.0; asymptotic Wilcoxon-test: $z = -5.849$, $p = .000$, $N = 151$). The effect size is $r = 0.48$ and corresponds to a large effect size.

4.3. Travel-related attitudes

Children had very positive attitudes towards active travel modes, especially regarding the use of bicycle (Table 4). Again, it should be noted that children may have been looking forward to the cycle training on the given day. In addition, this high rating might be explained by the fact that some children used their bicycle in the morning by way of exception, leading to euphoric responses. To consider this possibility, we conducted a sub-analysis by excluding children who used the bicycle on the reporting day but stated that they (nearly) never normally use the bicycle on their trip to school; this refers to 14% of the sample. Against expectations, children who cycled on the reporting day but who rarely do so on a normal day actually assessed the bicycle worse (Mann-Whitney- U -Test: $U = 1080.500$, $p = .039$; effect size $r = 0.17$); thus, we reject this possible explanation.

Significant differences in terms of gender were only found for bicycle use: Males assessed cycling to be "cooler" (Mann-Whitney- U -Test: $U = 2412.000$, $p = .022$; effect size $r = 0.19$). To control for the possibility of the date of the survey having an impact on the children's perceptions, we analyzed attitudes with regard to two groups (spring versus fall). No significant differences could be observed, except that the car mode was assessed more positively at schools which took part in the survey at the end of the school year than in September or October (Mann-Whitney- U -Test: $U = 1761.500$, $p = .000$;

⁴ It should be noted that the use of public transport is often combined with walking trip stages.

Table 2

Travel mode used by children on the way to school, N = 152.

Travel mode	Reported date	Normal day	Preference
Car use as a passenger	25.0%	23.5%	7.2%
Public transport	17.1%	19.1%	8.6%
Walking	19.7%	26.1%	13.2%
Bicycle	32.9%	15.1%	59.9%
Scooter	5.3%	16.2%	11.2%

Table 3

Means of indicators of subjective well-being in the first/last lesson, per travel mode, five-point scale (5 = high well-being, 1 = low well-being).

	Car passenger (N = 150)	Public transport (N = 131)	Walking (N = 145–146)	Bicycle (N = 143)	Scooter (N = 124)
First lesson	3.91	3.50	4.23	4.59	4.16
Last lesson	3.62	3.31	4.12	4.44	4.07

Table 4

Mean values of attitudes, five-point scale (5 = positive, 1 = negative), N = 152.

	Car passenger	Public transport	Walking	Bicycle ^a	Scooter
All (N = 152)	3.39	2.97	3.84	4.63 (4.38/4.67)	3.97
Female (N = 78)	3.32	3.06	3.87	4.49	3.94
Male (N = 74)	3.47	2.86	3.80	4.78	4.00

^a Value in brackets: children who used the bicycle only exceptionally on the reporting date (N = 21)/others (N = 131).

effect size $r = 0.32$). A detailed look at the school sites did not reveal any explanation. As no corresponding effect could be found for active travel modes, this issue remains unexplained.

4.4. Interrelation: attitudes, mode use and well-being

A Spearman's correlation analysis identified and tested the strengths of relationships between PWB and both attitudes as well as mobility behavior, using the children's self-reported general frequency of mode use to school. Based on their definitions in the data set, higher scores of the input variables stand for (i) a higher PWB-level in the morning after mode use, (ii) a more positive attitude towards a travel mode, and (iii) a higher frequency of mode use on trips to school.

Table 5 shows the correlation coefficients of the relations between (i) PWB and frequency of mode use and (ii) PWB and mode-specific attitude. There are medium positive bivariate correlations between well-being and frequency of mode use, which are statistically significant for car, public transport, walking and scooter modes ($r_s = 0.133$ – 0.386). The results indicate that higher levels of well-being after using a certain travel mode are related to a higher frequency of mode use on the way to school. Furthermore, children reporting higher levels of PWB after using a certain travel mode had a more positive attitude towards this travel mode ($r_s = 0.222$ – 0.482). This result is statistically significant for all travel modes.

Despite these results, we cannot necessarily conclude that children choose travel modes on the basis of travel-related PWB, nor that children's attitudes towards travel modes are the direct result of their well-being after using them. Due to the "reciprocal nature of psychological factors and behavior" (Bamberg & Schmidt, 1998), the fundamental cause-effects relationships are unclear. Repeated exposure can be sufficient to enhance the attitude towards a stimulus (mere exposure); in other words, well-being may be rated higher if the travel mode is used more often. The same issue applies for attitude, as attitude and behavior are normally highly correlated. In our case, attitude and behavior correlate significantly on medium to high level for public transport ($r_s = 0.516$, $p = .000$), walking ($r_s = 0.275$, $p = .001$) and scooter ($r_s = 0.426$, $p = .000$). For car and bicycle, no significant bivariate correlations can be observed, presumably because children have less freedom to choose, because they rely on their parents' mobility decisions and attitudes (Stark, Frühwirth, & Aschauer, 2018). This is not only the case for car use, but also for cycling, as children in Austria need a supervisor up to the age of 12 (children who have successfully passed the cycling proficiency test can travel without an adult from the age of 10).

4.5. Parent survey

As outlined above, parents were asked to assess the well-being of their child in relation to their child's mobility behavior. In response to the open-ended questions, parents gave mostly positive associations when children use primarily active travel modes on a given day: The most frequent answers were that children are "balanced, happy, and pleased" (Table 6). Parents also reported that children have a better good night sleep due to higher activity levels. In contrast, when children mainly travel as car-passenger, children are "bad-tempered, restless, and annoyed". However, occasionally, parents reported that their children are satisfied because of comfort when traveling by car.

Table 5

Correlation coefficients (Spearman's rho) of psychological well-being (PWB), by travel mode, N = 152.

Travel mode	PWB ~ Frequency of use	PWB ~ Mode-specific attitude
Car passenger	0.182 [*]	0.320 ^{**}
Public transport	0.386 ^{**}	0.377 ^{**}
Walking	0.292 ^{**}	0.439 ^{**}
Bicycle	0.133	0.222 ^{**}
Scooter	0.300 ^{**}	0.482 ^{**}

^{*} Correlation is significant at the 0.05 level (2-tailed).

^{**} Correlation is significant at the 0.01 level (2-tailed).

Table 6

Open answers of parents with regard to the well-being of their children dependent on the travel mode used on a given day (N = 31).

	When the child uses bicycle, scooter, or walks a lot	When the child is traveling as car-passenger a lot
Frequent answers	Pleased, balanced, quiet, happy, physically fit, mentally fit, "positively tired", allows for a better night's sleep, no behavioral problems	Restless, annoyed, irritable, bored, dissatisfied, unbalanced, bad-tempered, fidgety, less receptive
Occasional answers	More receptive, exhausted, partly physical complaints	Satisfied because of comfort, quiet, urge to move, slightly aggressive, nausea

The positive impacts of active travel on the children's well-being are also reflected in the quantitative evaluation of well-being indicators (Fig. 2). Parents' agreement rates on positive aspects of well-being were higher for walking and cycling compared to public transport and car use. Modal differences on the negative aspects were not as substantial, although there was a clear tendency that active travel modes do not lead to negative impacts on the child's psychological and physical well-being. The exception was tiredness; however, following the parents' open answers, tiredness can also be seen positively.

As outlined above, socially desirable answers cannot be excluded, and there is also a risk that parents who participated in the in-depth interviews had an affinity for active travel modes that affected their responses. To control for a possible bias, we investigated the general travel patterns of our sample. In doing so, we assigned a score from 0 [(nearly) never] to 4 [(nearly) daily] for the given frequency of mode use on the 5-part scale and calculated means for the sample. Fig. 3 shows the parents' responses with regard to their own and their child's travel behavior. We found that a high share of parents uses a bicycle

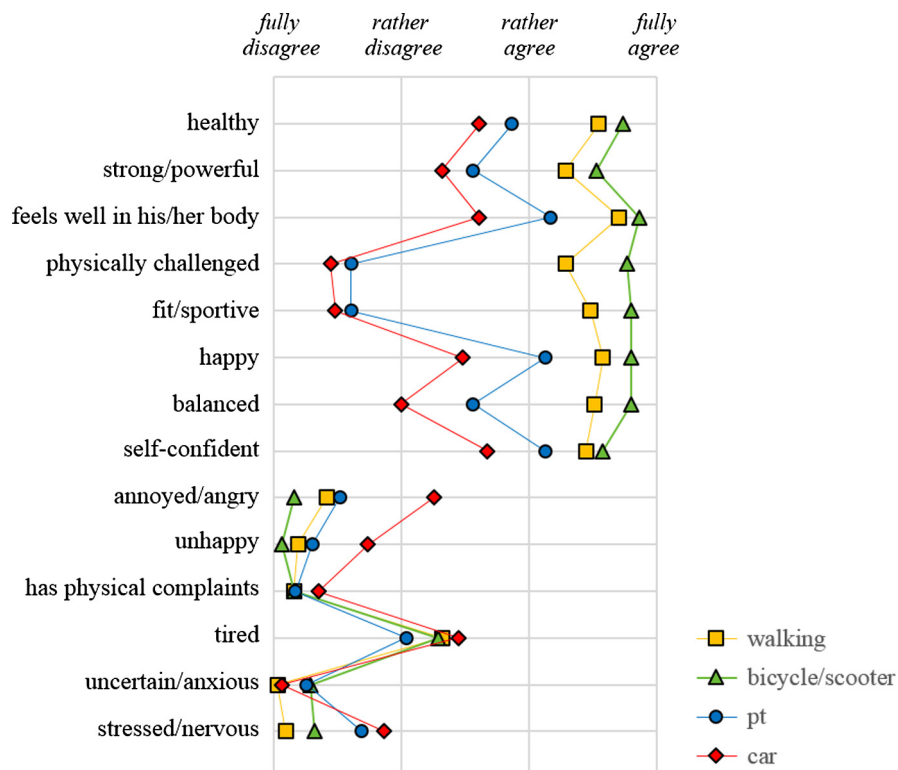


Fig. 2. Parents' assessments of well-being of their children, dependent on main transport mode used on a given day (N = 31).

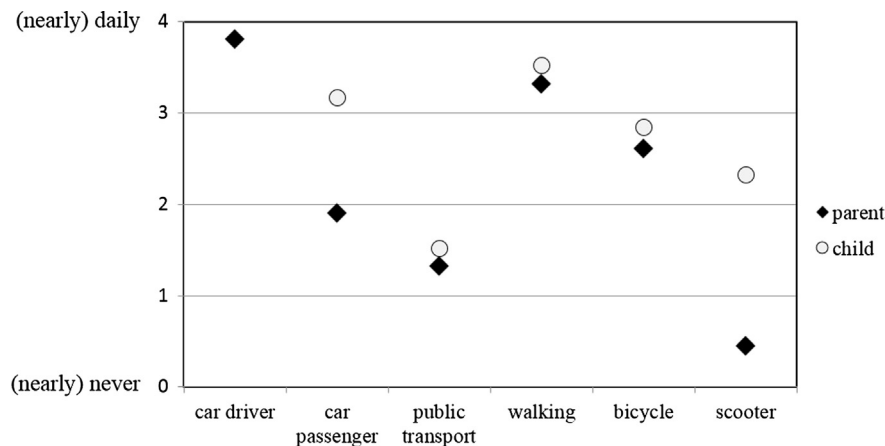


Fig. 3. Parents' responses on general travel patterns (frequency of mode use) for themselves and their child (motorcycle excluded) (N = 31).

(nearly) every day or 2–3 times a week (64%) which is also reflected in the children's frequency of bicycle use. However, as usual for rural areas in Lower Austria, car use is very popular in our sample: 97% of the parents use the car (nearly) daily or 2–3 times a week. These corresponding shares can be attributed to the fact that, at this age, most of the children's trips are accompanied and most decisions on mode choice are made by the parents (Stark et al., 2018).

In this context, parents presumably may want to justify their travel related decisions and thus might assess—for example—car use less negatively when they (and their child) travel by car very often. Therefore, we investigated the correlations between (parents' and children's) frequencies of general mode use and parents' assessments of children's well-being. Positive (or negative) correlations mean that higher frequencies of mode usage are associated with more positive (or more negative) assessments of well-being; thus, significant correlations might imply the presence of justification bias. The results show only a few significant relations, mostly for public transport (Table A1, Appendix). Parents who use active modes more frequently (or whose children use active modes more frequently) do not seem to rate their children's well-being more positively for active modes than do other parents. Thus, we conclude that substantial parental justification bias does not appear to have affected our data.

5. Discussion

This study sheds light on a relatively unexplored field of research concerning the relationships between psychological well-being (PWB), travel behavior, and travel-related attitudes of children. We analyzed person-based PWB-travel behavior relationships (and PWB-attitude relationships) using a data set from primary school children and their parents in rural areas of Lower Austria. Children's self-reported PWB was measured using a faces scale asking for their subjective feeling (emotion or affect) in the first (and last) school lesson.

Our fundamental hypothesis was that active travel has a positive effect on children's psychological well-being. The main finding suggests that mode use on the way to school is associated with children's PWB, whereby the use of active travel modes (walking, cycling, and scooter) is advantageous. Another key finding is that travel-related attitudes and well-being are connected in such a way that positive attitudes towards individual travel modes are significantly associated with higher ratings of PWB when the mode is used. These findings are consistent with our hypothesis and with previous literature on children's well-being.

However, given the limitations of our cross-sectional dataset, we are unable to conclude about the direction of causality in these relationships among PWB and both attitudes and mode use. Well-being (and attitude) may be rated higher if the travel mode is used more often, either because the child enjoys it (a causal feedback loop: attitude → mode use → PWB → attitude) or because of a lack of feasible alternatives. The former case would support our hypothesis, just over a longer time frame. In contrast, Festinger's (1957) dissonance theory suggests that attitudes change to fit the behavior, thus reducing discomfort and increasing psychological well-being. In this latter case, the associations we observed between attitude, mode use, and PWB may be spurious from a causal perspective. Longitudinal data collection focused on travel mode-related attitude formation in children could help to illuminate these issues. A further challenge to this research is that a clear empirical distinction between well-being and attitude is not always possible.

There are some additional limitations of this study. The approach of measuring a child's well-being only considers a single aspect of subjective well-being: that related to affect, emotion, or mood. Well-being cannot be comprehensively assessed by examining only whether a child exhibits a particular mood. Therefore, our study can be classified as a contribution to research on intrinsic travel-related influences on children's affective PWB, and not necessarily on other dimensions of well-being (cognitive, eudaimonic) or related but broader concepts (such as travel satisfaction). From a methodological point

of view, it should be noted that the PWB assessments used quite general questions, so there is a chance of memory distortion. We would have preferred to use mobility and activity data in connection with questions of children's well-being that are based on one-day or multi-day travel diaries. This would also allow analyzing the influence of trip distances. Due to the response burden and the different focus of the project in which this study was embedded, such surveys were not possible. It should also be considered that the survey was conducted on the day of a bicycle training program, which may have biased the favorable attitudes towards cycling.

Furthermore, the parent survey contained some inherent limitations. Foremost, the sample size was small ($N = 31$), so caution is warranted when attempting to generalize these results, especially those about modal differences in well-being. Parents also may have had a small incentive to report higher levels of children's well-being for modes that they or their children use more frequently, or for modes that they prefer or that they prefer for their children. However, as our analysis in the [Appendix](#) makes clear, this bias does not appear to have been substantial or systematic. According to the parents' responses, the car was the most frequently used mode for parents and the second most frequently used mode for children (see [Fig. 3](#)), yet the car mode was ranked worse on many well-being indicators in [Fig. 2](#). The fact that parents' modal ratings roughly matched children's modal ratings (higher for walking and bicycling, lower for public transport and car use) seems to validate parental responses.

As the overall topic was cycling skills, the sample might have been biased because parents with a high affinity for active lifestyles may have been more likely to volunteer to take part in the interviews; 64% of the parents reported using their bicycle (nearly) every day or 2–3 times a week. We were also unable to prevent social desirability bias from affecting answers by the parents.

Some limitations of this study could be addressed through further research. Qualitative research on the usability of faces scales for children's (different dimensions of) well-being and subjective interpretation of questions in this field would be very helpful for the design of survey instruments in the future. Independent variables with regard to the built environment, household characteristics (e.g., vehicle availability), and psychosocial factors—such as parental concerns and interrelations between parents' travel mode to work and parents' attitudes towards different travel modes—were not included in the analysis due to a lack of data. These factors may have an impact on the use of active travel modes (e.g. [De Vos et al., 2013](#); [Deka, 2013](#); [Flade, 1994](#); [Kalwitzki, 1994](#); [Lopes, Cordovil, & Neto, 2014](#); [Stark et al., 2018](#)), so they should be investigated in future studies. Additionally, further research with a large heterogeneous sample may provide more information on gender and also age-related impacts. We would also recommend including non-school trips in the focus of future research. [Westman, Johansson, Olsson, Mårtensson, and Friman \(2013\)](#) found that children's experiences of everyday travel varies depending on where they are going; specifically, experiences during the school journey elicited a lower degree of valence and alertness than for trips of other purposes.

Despite these limitations, our study contributes to an increased understanding of active travel-related psychological well-being among children, an underrepresented aspect within the larger context of research on benefits of active transport. Although our design does not allow for inferences of causality, it does provide evidence that there are positive associations between children's well-being, use of active travel modes, and attitudes towards these modes. The bidirectional relationships between attitudes and PWB (and between travel behavior and PWB) should be analyzed based on representative longitudinal data sets to derive an overall conceptual causal framework. In this context, additional research is required to gain a better understanding of the demarcation of attitudes and well-being. Further research can also help to indicate how well-being can be used in travel behavior models and in the evaluation of transport related projects, programs, and other interventions. When it comes to convincing adults of the benefits of active mobility, it would be interesting to also inform them of the cognitive performance of children.

Overall, we hope that the present analyses will encourage researchers in finding new pathways to understand travel behavior and well-being relationships among young age groups in general. In this context, a stronger cooperation between scholars in different disciplines (e.g. mobility, psychology, and health) might be advantageous.

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Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Appendix A

See [Table A1](#).

Table A1

Spearman's correlation between frequency of travel mode use (parent, child) and parents' assessments of well-being (WB) of their children, dependent on main transport mode used on a given day (N = 31).

	Correlation WB-assessment and parent's frequency of mode use				Correlation WB-assessment and child's frequency of mode use			
	Walking	Bicycle	pt	Car	Walking	Bicycle	pt	Car
Healthy	0.033	−0.008	0.061	0.251	0.141	0.186	−0.130	0.160
Strong/powerful	−0.174	−0.310	−0.098	0.138	0.059	−0.201	0.101	0.183
Feels well in his/her body	−0.167	0.272	0.406	−0.081	0.128	0.193	0.164	0.085
Physically challenged	0.089	−0.282	0.371	0.073	0.265	−0.110	0.209	−0.013
Fit/sportive	−0.100	−0.124	0.484 ⁺	−0.011	0.173	0.004	0.220	−0.075
Happy	−0.153	0.064	0.420 ⁺	−0.175	0.252	0.004	0.334	−0.119
Balanced	0.045	−0.105	0.507 ⁺	0.209	0.358 ⁺	0.105	0.070	−0.100
Self-confident	0.135	0.132	0.231	−0.119	−0.172	−0.094	0.046	−0.216
Annoyed/angry	0.135	−0.338	−0.469 ⁺	−0.152	−0.269	−0.234	0.151	−0.156
Unhappy	0.189	0.081	−0.454 ⁺	−0.172	−0.277	0.044	0.064	0.106
Has physical complaints	0.027	0.140	−0.191	0.197	0.358	0.105	0.070	−0.100
Tired	0.066	0.127	−0.008	0.107	0.325	0.161	0.039	0.022
Uncertain/anxious	−0.679 ^{***}	−0.383 ⁺	−0.531 ^{***}	0.108	−0.504 ^{***}	−0.192	−0.268	0.090
Stressed/nervous	−0.362 ⁺	−0.209	−0.742 ^{***}	−0.114	−0.305	−0.090	−0.051	0.111

Note: General frequency of travel mode use (5-point scale, the higher the more frequent) and assessments of children's well-being when using various travel modes (4-point scale, the higher the degree of agreement with statements about well-being).

⁺ p < 0.05.

⁺⁺ p < 0.01.

^{***} p < 0.001; two-tailed.

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