LETTER

Climate change, theory of planned behavior and values: a structural equation model with mediation analysis

A letter

Aysel Tikir · Bernard Lehmann

Abstract An online survey about climate change was conducted 2008/2009 among all university members (N = 3541). Using the Theory of Planned Behavior and Cultural Theory within a structural equation modeling approach, one main goal was to explain climate-friendly behavioral intentions and the underlying psychological processes comprehensively and to show the interdependencies between both approaches. The model explained 72% of the variance in Intentions to use public transport. Attitude towards public transport (beta = 0.67, p < .001) most strongly influenced Intentions followed by Subjective Norms (beta = 0.23, p < .001). In turn, Attitudes and Norm were explained by the value types Egalitarian, Individualist and Fatalist (24% and 14% respectively). These value types are mediated through Attitudes and Subjective Norms. Recommendations regarding the support of climate friendly behavior are formulated.

1 Rationale and goals of the study

Considering the historical development how societies have dealt with climate change three eras can be distinguished where in the first era (from the late 1980s to 2000) mainly scientists and national environmental policy makers were involved, whereas in the second era (from 2001 to 2006) a wider range of people became engaged such

A. Tikir (✉) · B. Lehmann
Institute for Environmental Decisions (IED),
Agricultural Economics—Agri-food & Agri-environmental Economics Group,
Swiss Federal Institute of Technology Zurich ETH,
Sonneggstrasse 33, 8092 Zurich, Switzerland
e-mail: atikir@ethz.ch

as NGOs and the development community. However, in the third era (up from 2006) a shift to individuals was proposed, indicating that every single person has to bear the responsibility to get involved with the climate change issue (Huq and Toulmin 2006). Liverani (2009) sees individual behavior as the root of the climate change challenge since individuals are the drivers of larger processes of change (e.g. public pressure) and as policy decisions are taken by individuals. Therefore, factors influencing individual behavior, beyond market mechanisms, are important for climate change and a focus on individual behavior in scientific research is needed, in particular to identify factors that determine climate-friendly behavior and to derive measures to change behavior. Leiserowitz (2007) and Anable et al. (2006) have criticized that most studies in this respect were more descriptive rather than theory-driven, not aiming to explain attitudes and behaviors in the climate change context. Stern (1993) emphasizes that driving forces of human behavior in the environmental domain are manifold and that they interact concluding that it is important to investigate not only these driving forces independently from each other but also to analyze the relationships between them. The climate change issue is rather complex as "*mitigation and adaptation behavior extends beyond adopting new technologies*" and that there is a "*complex interplay between perceptions, behavior, and communication*" (Whitmarsh and Lorenzoni 2010). To consider both, to be theory-driven and to cover the complexity in a comprehensive way we apply the Theory of Planned Behavior (ToPB, Ajzen 1985) and the Cultural Theory (Dake 1991) within a risk perception framework in the climate change context to identify influencing factors and explain behavioral intentions to use public transportation as means of climate-friendly behavior. Via Structural Equation Modeling and mediation analysis, we analyze not only the influence of the single factors on behavioral intentions but also the relationships between those factors.[1]

Regarding Cultural Theory Wildawsky (1987) and Dake (1991) state that people behave according to their values, also called world views or lifestyle. Values are general social, cultural and political attitudes towards the world and help people orienting in complex situations. In general, four different value types can be distinguished: Individualist, Egalitarian, Fatalist and Hierarchical. Each value type represents a different understanding about the ideal nature of society which leads each group to perceive different risks and prefer different responses.

Though ToPB is often used in different behavioral domains, the simultaneous test of ToPB and Cultural Theory within a Risk Perception framework is hardly done. Further, there are no studies which merge these theoretical approaches within a structural equation model and test for mediation to get a deeper insight into the underlying psychological processes of forming Attitudes, Norms and PBC. An essential benefit of using several approaches simultaneously might be that the complexity of the reality can be better described, understood and even explained. Furthermore, the interdependencies between the different theoretical

---

[1]ToPB considers Attitudes towards the behavior, Subjective Norms and Perceived Behavioral Control (PBC) as the antecedents of Intentions and Intentions influences Behavior. ToPB is valid for every kind of social behavior and since the introduction of PBC also sufficient for behaviors which are not under the volitional control of individuals (Ajzen 1985).

approaches can be better presented and may lead to a higher value-added for theory building.

1.1 Goals

The goals of this study are 1) to quantify the effect sizes of the Attitudes, Subjective Norms and PBC on Intentions to use public transport; 2) to determine the value types according to the Cultural Theory (Egalitarian, Individualist, Hierarchical and Fatalist) and quantify their effect sizes within the ToPB model; 3) to analyze the relation between the ToPB variables and the value types via mediation analysis; 4) to build a basic model with ToPB variables and value types for further extension with risk perception variables.

2 Theoretical background and hypotheses

2.1 Theory of planned behavior

Since its development ToPB is often used in several behavioral domains such as recycling behavior (Bamberg and Lüdemann 1996) and choice of travel mode (Bamberg and Schmidt 1997). Armitage and Conner (2001) concluded in their meta-analytic review that the ToPB is rather useful to predict intentions and behavior in several domains. Bamberg et al. (2003) have investigated students' bus use intentions and behavior and found support for the validity of the ToPB in the public transportation context.

The ToPB contains five central variables (see Fig. 1) which explain human behavior: a) Attitudes towards a certain behavior; b) Subjective Norm, as the perceived social pressure to conduct the behavior; c) PBC, which is the subjective
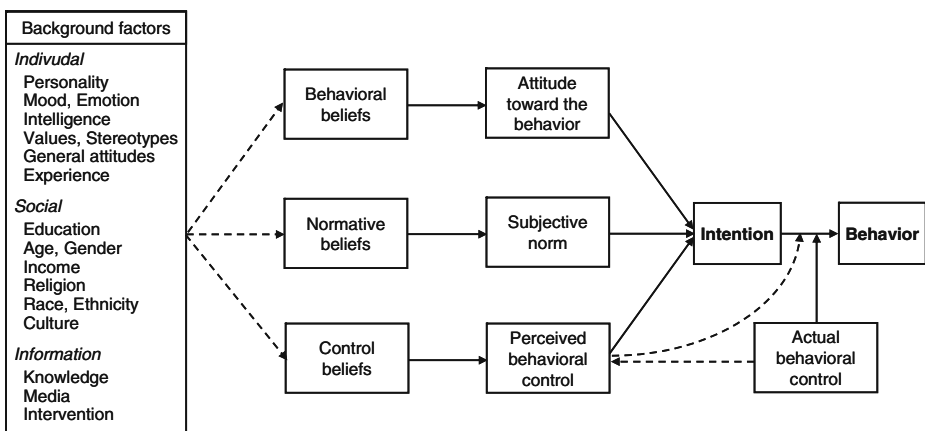

Fig. 1 Behavior model of the ToPB. Source: Ajzen and Fishbein (2005): 194

assessment about the own ability to control the performance of the behavior. These three
variables determine d) the Intention to perform the behavior. Intention in turn does directly affect e) Behavior (Ajzen 1985). Actual control is assumed to moderate the Intention–Behavior relation, i.e. the effect of Intention on Behavior is stronger when actual control is high. Also, PBC can serve as a proxy for actual control if it is perceived realistically (dotted arrows that connect actual control to PBC and PBC to the Intention–Behavior link) (Ajzen and Fishbein 2005).

From a psychological point of view the model variables are the result of a cognitive accounting of beliefs and their evaluations (Bamberg 1996). Beliefs represent the information a person has about a specific object and they connect the object with an attribute, e.g. a consequence of a behavior. Beliefs can be affected by cultural, personal, and situational factors (Ajzen and Fishbein 2005) such as personality and values. However, it remains unclear which of those background factors are affecting the beliefs in what way and if there are any interactions. Thus, a value-based approach is used as another theoretical basis to overcome this gap and provide deeper insights into the formation of the ToPB variables.

2.2 Values and cultural theory

There are several value-based approaches[2] commonly used in the general environmental context, e.g. the norm-activation theory of Schwartz (1977), the value-belief-norm (VBN) theory developed by Stern et al. (1993) whereas Cultural Theory is more common in the risk perception context. Every approach has its strengths and weaknesses. For instance, Harland et al. (2007) conclude that personal norm of the norm-activation theory is an important factor to behave pro-environmentally. However, Heath and Gifford (2002) who tested Schwartz's values as additional variables extending the ToPB with respect to use public transport reported non-significant results of those values. Kaiser et al. (2005) compared the ToPB with the VBN theory and found out that ToPB is more successful in explaining the variance in conservation behavior. With regard to West et al. (2010) Cultural Theory is a useful heuristic device informing opinions and behavior related to renewable energy in the climate change context. Leiserowitz (2006) suggest Cultural Theory to be considered investigating climate change issues as the values proved to be highly significant predictors for policy preferences regarding climate change in his study.

Cultural Theory assumes that each individual identifies risks depending on the value type he or she belongs to (Leiserowitz 2006). People perceive things which endanger their own lifestyle, i.e. world views or values, as risky (Oltedal et al. 2004).

Prototypical **Individualists** are individualistic and do not like social rules, which might limit their own initiative or restrict their individual freedom. They prefer self-regulation and market-based strategies; autonomy and opportunities for personal gain are important (Slovic and Peters 1998; Oltedal et al. 2004; Leiserowitz 2006). Individualists see nature as being in a global equilibrium and therefore stable (Steg and Sievers 2000).

---

[2]See O'Brien and Wolf (2010) for an overview.

Fig. 2 Path diagram of the hypotheses: intention to use public transport
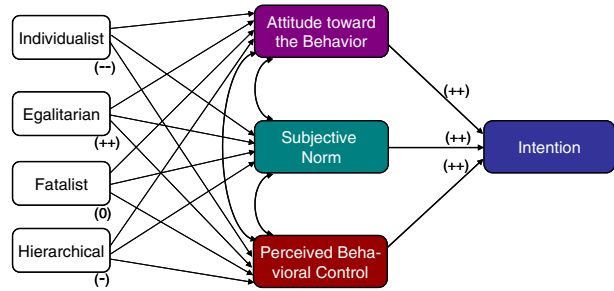
In contrast, **Egalitarians** are more group-oriented and are concerned about injustice in the distribution of costs and benefits of risks. They oppose inequality and are in favor of sharing the costs of risks. They promote social diversity and distrust in institutions and their experts (Slovic and Peters 1998; Oltedal et al. 2004; Leiserowitz 2006). For them nature is in a precarious balance (Steg and Sievers 2000).

Fatalists as being rather individual-oriented favor isolation and take little part in social life. They feel restricted in their behavior; even if they do not feel that they belong to any social group. Fatalists perceive the nature as capricious and uncontrollable. They do not believe in changes or that individuals can take influence (Peters and Slovic 1996; Slovic and Peters 1998; Oltedal et al. 2004).

Hierarchical support the existing systems and dislike changes. They are group-orientated but contrary to the Egalitarian and the Individualists authorities and their decisions are more important to them than individual freedom. They favor order and security and trust experts (Oltedal et al. 2004; Leiserowitz 2006).

2.3 Hypotheses

The hypotheses to be tested are shown in Fig. 1. It is assumed, that Attitudes, Subjective Norm and PBC towards the use of public transport are positively influencing the Intention to use public transport. According to Ajzen and Fishbein (2005) values are assumed to affect Attitudes, Norm and PBC as background factors (Fig. 2).

With respect to ToPB the antecedents of the Intention to use public transport are:

- Attitudes: The more positive the Attitudes towards the use of public transport the higher should be the Intention to use it.
- Subjective Norm: The stronger the Norm is the more higher the Intentions towards the use of public transport.
- PBC: The stronger people feel that they are able to control the performance of the behavior the stronger should be their Intentions to do so.
- In addition, the ToPB variables are expected to be correlated as stated by Ajzen and Fishbein (2005).
- All ToPB variables should have a medium to strong direct effect (++) on Intention. This is assumed as the ToPB variables are proven to be powerful predictors of behavioral intentions (Jonas and Doll 1996; Bamberg and Schmidt 1997).

Since the risk perception of climate change should differ depending on the value types, the antecedents of Attitudes, Norms and PBC towards the use of public transport as a response to climate change should also be affected differently:[3]

- Individualists are assumed to affect Attitudes negatively as travelling by public transport is perceived as less convenient (Root 1996) and might be seen as limiting individual freedom (e.g. timetables and non-accessibility of certain places). The effect on Subjective Norm is expected to be negative since Individualists are rather individual-oriented and prefer autonomy which is contrary to behave in accordance to the social network. The effect on PBC should also be negative, since the aspect of limiting individual freedom should be negatively perceived by Individualists which may prevent them to inform themselves about public transport and be therefore not in control of the behavior.

- Egalitarian should have a positive effect on the Attitudes towards the use of public transport as a means of sharing the costs and benefits of transportation by using public transport and reduce inequity. Subjective Norm should also be influenced positively as Egalitarian are more group-oriented and should be willing to behave according to the expectations of their social network. The PBC should be affected positively as Egalitarian think that needs and behavior are controllable (in contrast to resources) and that they should contribute to the solution of environmental problems (Steg and Sievers 2000). Thus, they are expected to be prepared and in control of the given behavior.

- Since Fatalists do not believe in change or that individuals can influence things, they should be indifferent regarding the use of public transport as a means of climate friendly behavior. However, favoring isolation could result in a negative effect on Attitudes since the use of public transport reduces isolation during transportation. As Fatalists feel restricted in their behavior even if they do not belong to any social group they could show negative effects on Subjective Norms or no effects at all. There should be also no effect on PBC or it should be negative because either the Fatalists feel isolated and take little part in social life or they are pessimistic regarding changes and individual influence. As Fatalists are not consistent in their thinking and acting (Steg and Sievers 2000), they could show negative effects or no effects at all.

- Hierarchical are hypothesized to affect the ToPB variables in a negative manner as they attribute the responsibility to solve problems to experts and authorities. Thus, they are expected not to favor public transport and therefore influence the ToPB variables negatively. Generally, as long as experts and authorities do not formulate prescriptions for certain environmental problems, which would lead them to perceive public transport positively in terms of a solution to climate change, Hierarchical will not see any necessity to act[4] (Steg and Sievers 2000). Thus, the effect on Attitude should be negative since they will not see the need to respond to climate change. Regarding Subjective Norm, the effect can be expected to be negative because the Subjective Norm indicators as we did assess

---

[3]Investigating ToPB and VNB theory, De Groot and Steg (2007) reported that values are directly related to the attitudes toward the use of a park-and-ride-facility, but not to the Intention.

[4]Unfortunately, within our study we cannot address this aspect since we did not differentiate between existing and non existing prescriptions.

them do not include experts and authorities. Also, PBC should be affected in a
negative way as Hierarchical believe that needs and therefore behavior cannot
be controlled.

- In addition, we assume that the effects of the four value types on the ToPB
  variables differ in their strength (++, −−, + and 0) as it is reported in several
  studies (e.g. Oltedal et al. 2004). For example Leiserowitz (2006) found out that
  the value types Individualist and Egalitarian have strong effects in predicting
  climate-friendly policy options compared to the effects of Hierarchical and
  Fatalist. Fatalists are not expected to be active in societal debates because they
  have a deterministic attitude. Thus, researchers tend to exclude them from their
  analysis (West et al. 2010). Therefore we assume that Fatalist will not have any
  effect in the model. However, the value type Hierarchical should show a less
  strong effect than the Individualist and the Egalitarian. Hierarchical should have
  a low risk perception as they do trust in experts also in terms of solving existing
  problems. For this reason they should have a smaller impact in our model.

3 Methods

3.1 Participants

Participants were all staff and students of a Swiss technical university, in total 23.568.
The response rate is about 15% (N = 3541), 51% male, 32% female, 17% not
reported. 45% of the respondents were students and 40% were staff members of
the university, 15% did not report their university status. The sample (N = 3541) was
divided into a sub-sample representing all respondents who have some intentions[5] to
use public transport, leaving a sample of N = 1563.

3.2 Procedure

This study was conducted as an online survey[6] in 2008/2009. The link for the survey
with a short introduction to the study was sent by e-mail to all university members.
Before conducting the main survey a qualitative test was carried out asking 6
individuals from the population (two students, two scientific members, and two
non-scientific members) about the understandability and the question wording to
improve the questionnaire.

3.3 Measures

All theoretical constructs (latent variables) were operationalized and assessed by
means of indicators, all rated on a five-point scale (e.g. 1 = do not agree at all,
5 = agree totally). Items regarding Attitudes covered the subjective evaluation of

---

[5]The question assessing Intentions had an additional response category (I am doing that already).
All respondents having chosen this category were excluded from the analysis as we do not have
more information about their intentions. We threatened these values as missing values.

[6]Within the course "Structural Equation Modeling in Market Research", the students Matthias Häni,
Katharine Tröger and Niklaus Lehmann have mainly elaborated the questionnaire.

the use of public transport (e.g. the use of public transport is good). Norm items were related to the expectations of people important to the respondents (e.g. people important to me would approve if I use public transport) and the PBC items were about the subjective assessment of control regarding the performance of the behavior in question.

The value type items were adapted from Leiserowitz (2006) to assess components of the Individualists (e.g. the society works best when it lets individuals take responsibility for their own lives without telling them what to do), Egalitarian (e.g. the world would be a more peaceful place if its wealth were divided more equally among nations), Fatalists (e.g. I feel that I have little value as an individual in society) and Hierarchical (e.g. the father of the family must be the master in his house).

3.4 Data analysis

To explain the Intention to use public transport, data was analyzed using Structural Equation Modeling (SEM) with AMOS 16 (Arbuckle 2006) and ML estimation. A SEM model includes directional (regression paths) and non-directional (correlations) linear relationships among a set of indicator and latent variables (Bollen 1989; Byrne 2001). Following the two-step approach (Backhaus et al. 2003) we first modeled the measurement models for Attitudes, Norm, PBC[7] and Intention and continued with the structural model.

The value types were extracted from 23 items via factor analysis. Item loadings of ≥.50 were considered to load on the respective factor contributing to its interpretation. This analysis produced four factors accounting for 49% of the variance in the items. Reliability analysis yielded Cronbach alpha values ranging from .55 to .82 (Individualist: .82, Egalitarian: .67, Fatalist: .71 and Hierarchical: .55[8]). The factor scores were saved as new variables and introduced to the basic ToPB model.

In addition, mediation test was conducted to test if value types are mediated via Attitudes, Norms and PBC. Mediation can be understood as a process that intervenes between input and output. "*Whereas moderator variables specify when certain effects will hold, mediators speak to how or why such effects occur*" (Baron and Kenny 1986). To test the conditions[9] for mediation (Baron and Kenny 1986), we conducted several analyses considering Holmbeck (1997) recommendations who adjusted the Baron and Kenny (1986) approach for path analysis and SEM.

4 Results

The results (see Table 1) indicate that respondents do have positive Attitudes towards the use of public transport. They perceive moderate Subjective Norm to use public transport and some 30% have strong intentions to use public transport.

---

[7]PBC failed to get a satisfactory measurement model, thus excluded from further modeling.

[8]Since Cronbach's Alpha for Hierarchical is unsatisfactory it was excluded from further modeling.

[9](a) X → M, (b) M → Y, (c) X → Y, and (d) X → Y and M → Y. Further, the indirect effect (X → M → Y) must be significant too. Where X: explanatory variables, i.e. values, M: mediator variables, i.e. Attitudes and Norms, and Y: variables to be explained, i.e. Intention.

Table 1 Frequencies—agreement in %, $n = 1,563$

Variables	Item wording	Low				High	m	sd
Attitude1	The use of public transport is pleasant to me	4.9	8.1	14.8	22.1	18.2	3.6	1.2
Attitude2	I think the use of public transport makes sense	0.9	0.8	4.7	16.4	45.1	4.5	0.80
Norm1	People important to me would approve if I mainly use public transport instead of a car	5.1	7.9	15.7	21.9	15.2	3.5	1.2
Norm2	People important to me travel almost exclusively with public transport	10.0	17.7	20.5	13.8	4.9	2.8	1.1
Intention1	I plan to solely use public transport for travelling	5.9	4.5	11.2	18.6	29.4	3.9	1.3
Intention2	I will try to use public transport also for business trips	5.7	4.8	10.0	20.5	28.5	3.9	1.2

Due to missing values the sum per row does not equal 100%

m mean, sd standard deviation

Model results (Fig. 3) show that Attitudes and Norms regarding public transport had positive effects on Intentions to use public transport. The standardized regression coefficients are .65 and .25 respectively, thereby explaining 70% of the variance in Intentions. All effects are significant at the .001% level and model fit indices[10] show rather good fit supporting the assumed relationships.

Incorporating value types (Fig. 4) to the basic ToPB model, the effects of Attitudes and Norms on Intention shifted slightly and the explained variance in Intentions increased from 70 to 72%. As expected, Individualists have negative effects on Attitudes and Norms meaning that higher scores in Individualism decrease positive Attitudes towards public transport. In contrast, Egalitarians have positive effects on Attitudes and Norms indicating that higher scores in Egalitarians increase positive Attitudes and Norms towards public transport. These results are in line with Leiserowitz (2006) who conducted multiple regression analysis where value types were used to explain support or opposition of political measures regarding climate change. He found out that Egalitarians are supporting and Individualists are opposing the same policy measures. As hypothesized, Fatalists have a negative effect on Attitudes. However there is no effect on Norms. In addition, a correlation path between Fatalists and Intention1 was introduced to improve model fit. Intention1 assesses respondents' opinion regarding the use of public transport for travelling for personal reasons. This positive relation may be since travelling for personal reasons is perhaps one part in the life where Fatalists have some degree of control and do not feel restricted.

---

[10]**Chi2 and its P value**: Chi2 Goodness of fit tests the null hypothesis that the implied covariance matrix is not different from the observed covariance matrix. **Chi2/DF**: is Chi2 divided by the degrees of freedom (DF) accounting for model complexity; less dependent on sample size than Chi2. **RMSEA**: Root Mean Square Error of Approximation, computes average lack of fit per DF. P-RMSEA, tests the null hypothesis that RMSEA is no greater than .05. **CFI**: Comparative Fit Index compares the existing model fit to a baseline model (Backhaus et al. 2003; Loehlin 2004).

Fig. 3 Basic ToPB model
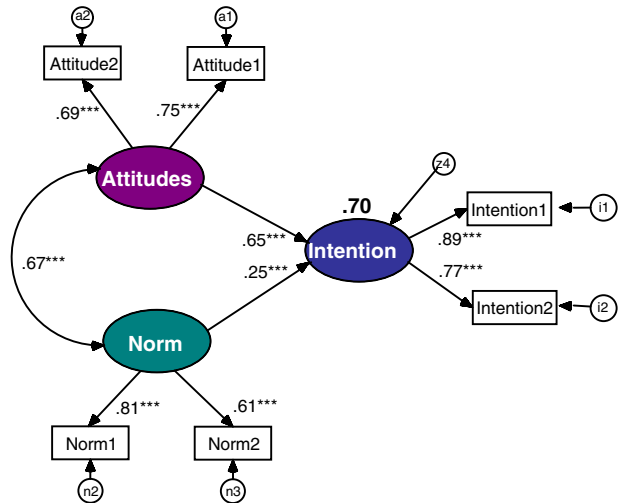
N=1563, Standardized Solution:
DF=6, Chi2=14.002, P -Chi2=.030, Chi2/DF=2.334,
RMSEA=.040, P -RMSEA=.688, CFI=.99 5

* p ≤ .05, ** p ≤ .01, *** p ≤ .001
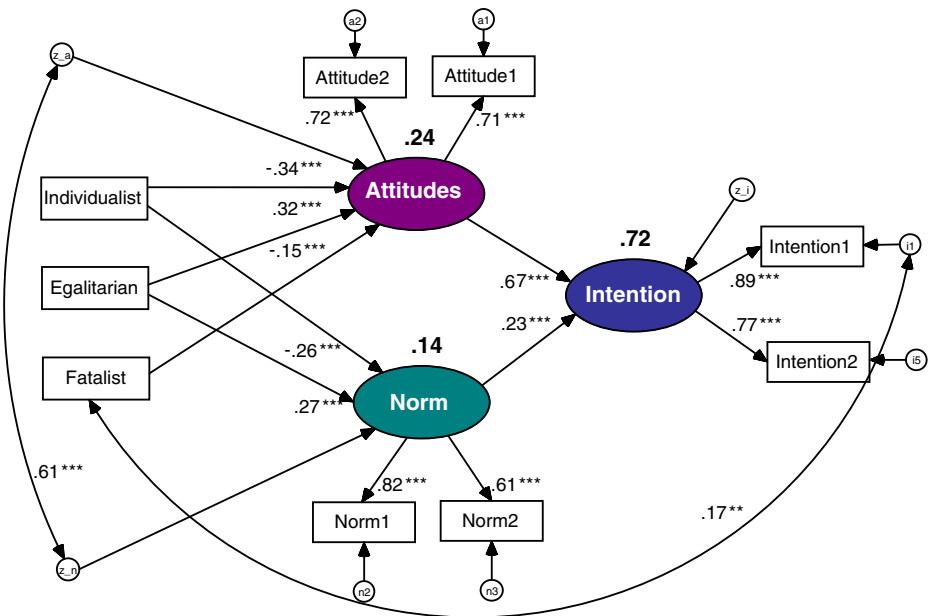
N=1563, Standardized Solution:
DF=21, Chi2=57.646, P-Chi2=.000, Chi2/DF=2.745,
RMSEA=.046, P-RMSEA=.668, CFI=.981

* p ≤ .05, ** p ≤ .01, *** p ≤ .001

Fig. 4 ToPB and values model

Table 2 Standardized total regression effects (direct and indirect effects)

	Norm	Attitudes	Individualist	Egalitarian	Fatalist
Norm	–	–	−0.26	0.27	0.00
Attitudes	–	–	−0.34	0.32	−0.15
Intention	0.23	0.67	**−0.29**	**0.28**	**−0.10**

Following Baron and Kenny (1986) and Holmbeck (1997) we tested whether Attitudes and Norms are functioning as mediators for the value types. Results of the mediation analysis showed that Individualist and Egalitarian were totally mediated through Attitudes and Norms because the direct effects of the values on Intention disappear when Attitudes and Norms are taken into account. In contrast, Fatalist had just a direct effect on Attitudes and an indirect effect on Intention but there is no mediation since there is no significant direct effect between Fatalist and Intention indicating that there is nothing to mediate. These mediation results indicate that Attitudes and Norms are formed depending on the values, i.e. being an Individualist in the sense of the Cultural Theory one will form negative Attitudes and Norms towards behaviors which are non-individualistic like the use of public transport. And being an Egalitarian will work the other way around. With other words, to affect the Intention the value types need to be processed via Attitudes and Norms.

In Table 2 total effects are given to show the importance of the value types. It is impressive that the effects of Individualists and Egalitarians on Intention, which are only indirect effects, are bigger than the effect of Norms on Intention. This finding is rather interesting as the value types like all the background factors are distal variables; in contrast the ToPB variables Attitudes, Subjective Norms and PBC are proximal variables meaning that they are closer to the Intention (Jonas and Doll 1996). Thus, the ToPB variables should have stronger effects on Intentions than the distal variables.

5 Conclusions

Using the ToPB it could be shown that Intentions to use public transport as means of climate-friendliness can be explained. Although not direct comparable, our models accounted for a much bigger amount in explained variance in Intentions than the results of Leiserowitz (2006), 70–72% versus 44%. The more positive the Attitudes towards public transport and the stronger the Subjective Norm the higher are respondents' Intentions to use public transport. This result is not surprising as the infrastructure for public transport in Switzerland is very well established and its use rather common. Additionally, this result is also in line with other results (e.g. Bamberg et al. 2003). However, the fact that PBC failed to get a satisfactory measurement model may be because there is already a rather high PBC and therefore the control aspect as operationalized can be neglected as being relevant in this specific context. But, the availability of parking facilities at the university may be an important limiting factor with respect to PBC which we unfortunately have not assessed. This aspect should be taken into account in further studies regarding the use of public transport.

Ajzen and Fishbein ([2005](#)) state that the relative importance of the ToPB variables may depend on the type of the behavior or it may depend on different samples. Thus, in other countries where public transport is not well established Attitudes and Norms may show different effects. Even PBC may show significant effects.

Given a high relation between intention and behavior it might be one possible strategy for motivating people to act climate-friendly by emphasizing the positive aspects of a certain behavior and connect it to climate change so people can associate the behavior with climate-friendliness. To work with peer groups may be another strategy to change peoples' behavior since Subjective Norms showed significant effects too. Liverani ([2009](#)) also recommended focusing on social norms, e.g. providing consumer-based incentives that reward positive behaviors rather than simply sanction bad ones.

The results regarding the Cultural Theory highlight that depending on the predominant value type the given behavior via Attitudes and Norms is perceived as positive or not. For example, if one has high scores in Egalitarian he or she will process the available information towards positive Attitudes regarding public transport. Probably, less effort is needed to convince them to act climate-friendly. In contrast, Individualists perceive public transport as more negative. Hence, it can be assumed that only institutional measures may motivate them to behave climate-friendly. It is important to make the benefits of certain behaviors visible for the Individualists. Institutional measures would also be necessary to motivate Fatalists. Even though, they do not believe in change and self-efficacy, they behave accordingly to institutional circumstances and go conform to given limitations. Therefore, certain measures which form social pressure could encourage Fatalists to behave in a climate-friendly way. Since the items for Hierarchical did not yield an acceptable scale our results do not provide any significant effects of this scale. However, strengthening the communication of experts and social authorities about the necessity of appropriate action might motivate them to be climate-friendly too.

In addition, results regarding the value types can help policy makers to identify an optimal policy mix which can be more cost efficient and minimize free-riding, e.g. giving the share of the value types present within a population may help to develop a policy mix. In climate change risk communication, more attention should be paid to the different value types. As Liverani ([2009](#)) suggested also, communication about climate change should be reader-centric rather than information-driven. Also, Anable et al. ([2006](#)) recommend a segmentation strategy regarding communication since different people are motivated by different factors they should be treated in different ways.

From a theoretical perspective, results support both theoretical approaches. Cultural Theory assuming that different value types influence the evaluation of a given object has significant contribution in explaining Attitudes and Norms. This indicates that values function as background factors in forming them.

Of course, there are also some limitations of this study as the PBC probably was not assessed accurately and the actual behavior could not be taken into account. Also, Intention as a dependent measure is less strong than a behavioral measure since Intention may not always result in Behavior. But, several studies have shown the Intention–Behavior relationship (Armitage and Conner [2001](#)). Thus, studying intentions and their antecedents can provide insights in research on public transport. Another shortcoming of this study is that the sample may be biased as the level of

education is rather high so results are not directly comparable to representative sample results. An additional limitation is that we could not use the whole sample for our analysis since there were respondents who were already using public transport. Those were excluded from the analysis as we did not have more information about their intentions. However, an analysis with those respondents may have yielded other results because it would be a different sample. But, given the validity of the theoretical approaches, it is also likely that the effects would have been bigger since those respondents should have more positive Attitudes, Subjective Norms and a high PBC than the respondents who were not already using public transport.

Nevertheless, our findings should be relevant for the scientific world as we could show the relation between the latent variables and could deepen the knowledge regarding the underlying psychological processes in forming Attitudes and Norms.

Further own research will incorporate climate change risk perception variables and socio-demographics such as gender, age and income to further extend the behavior model.

References

Ajzen I (1985) Attitudes, personality, and behavior. Open University, Milton Keynes (reprinted)

Ajzen I, Fishbein M (2005) The influence of attitudes on behavior. In: Albarracin D, Johnson BT, Zanna MP (eds) Handbook of attitudes and attitude change: basic principles. Lawrence Erlbaum, New York, pp 173–221

Anable J, Lane B, Kelay T (2006) Review of public attitudes to climate change and transport: summary report. The Department for Transport, UK

Arbuckle JL (2006) Amos™ 7.0 user's guide. Amos Development Corporation, USA

Armitage CJ, Conner M (2001) Efficacy of the theory of planned behaviour: a meta-analytic review. Br J Soc Psychol 40:471–499

Backhaus K, Erichson B, Plinke W, Weiber R (2003) Multivariate analysemethoden. Eine anwendungsorientierte Einführung. 10. Auflage. Springer, Berlin

Bamberg S (1996) Habitualisierte pkw-nutzung: integration des konstrukts habit in die theorie des geplanten verhaltens. Z Sozpsychol 27(4):295–310

Bamberg S, Lüdemann C (1996) Eine Überprüfung der Theorie des geplanten Verhaltens in zwei Wahlsituationen mit dichotomen Handlungsalternativen: Rad vs. PKW und Container vs. Hausmüll. Zeitschrift für Sozialpsychologie, Band 27, Heft 1, pp 32–46

Bamberg S, Schmidt P (1997) Theoriegeleitete Evaluation einer umweltpolitischen Maßnahme: Längsschnittliche Überprüfung der Wirksamkeit des Giessener Semestertickets mit Hilfe der Theorie des geplanten Verhaltens. In: Zeitschrift für Sozialpsychologie, Band 28, Heft 4, pp 280–297

Bamberg S, Ajzen I, Schmidt P (2003) Choice of travel mode in the theory of planned behavior: the roles of past behavior, habit, and reasoned action. Basic Appl Soc Psychol 25(3):175–187

Baron RM, Kenny DA (1986) The moderator–mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. J Pers Soc Psychol 51:1173–1182

Bollen K (1989) Structural equation models with latent variables. Wiley, New York

Byrne B (2001) Structural equation modeling with AMOS. Basic concept, applications, and programming. Lawrence Erlbaum Publishers, London

Dake K (1991) Orienting dispositions in the perception of risk. An analysis of contemporary worldviews and cultural biases. J Cross-Cult Psychol 22(1):61–82

De Groot J, Steg L (2007) General beliefs and the theory of planned behavior: the role of environmental concerns in the TPB. J Appl Soc Psychol 37(8):1817–1836

Harland P, Staats H, Wilke HAM (2007) Situational and personality factors as direct or personal norm mediated predictors of pro-environmental behavior: questions derived from norm-activation theory. Basic Appl Soc Psychol 29(4):323–334

Heath Y, Gifford R (2002) Extending the theory of planned behavior: predicting the use of public transportation. J Appl Soc Psychol 32:2154–2189

Holmbeck GN (1997) Toward terminological, conceptual, and statistical clarity in the study of mediators and moderators: examples from the child-clinical and pediatric psychology literatures. J Appl Soc Psychol 65:599–610

Huq S, Toulmin C (2006) Three eras of climate change. Sustainable development opinion. International Institute for Environment and Deveplopment (IIED), London

Jonas K, Doll J (1996) Eine kritische Bewertung der theorie des überlegten handelns und der theorie des geplanten verhaltens. In: Zeitschrift für sozialpsychologie, Band 27, Heft 1, pp 18–31

Kaiser FG, Hübner G, Bogner FX (2005) Contrasting the theory of planned behavior with the value-belief-norm model in explaining conservation behavior. J Appl Soc Psychol 35(10):2150–2170

Leiserowitz A (2006) Climate change risk perception and policy preferences: the role of affect, imagery and values. Clim Change 77:45–72

Leiserowitz A (2007) International public opinion, perception, and understanding of global climate change. Human Development Report Office, Occasional Paper, 2007:31

Liverani A (2009) Climate change and individual behavior. Considerations for policy. Policy Research Working Paper 5058, Background Paper to the 2010 World Development Report

Loehlin J (2004) Latent variable models: an introduction to factor, path, and structural equation models, 4th edn. Hillsdal: Lawrence Erlbaum Associates. Hillsdale, Lawrence Erlbaum Associates

O'Brien KL, Wolf J (2010) A values-based approach to vulnerability and adaptation to climate change. WIREs Clim Change 1:232–242

Oltedal S, Moen B-E, Klempe H, Rundmo T (2004) Explaining risk perception. An evaluation of cultural theory. Rotunde. 2004: 85. Norwegian University of Science and Technology, Department of Psychology, Trondheim, Norway

Peters E, Slovic P (1996) The role of affect and worldviews as orienting dispositions in the perception and acceptance of nuclear power. J Appl Soc Psychol 26:1427–1453

Root A (1996) Cultural and environmental aspects of transport regulation. Endeavour 20(3):126–129

Schwartz SH (1977) Normative influences on altruism. In: Berkowitz L (ed) Advances in experimental social psychology, vol. 10. Academic Press, New York, pp 221–279

Slovic P, Peters E (1998) The importance of worldviews in risk perception. Risk, Decision and Policy 3(2):165–170

Steg L, Sievers I (2000) Cultural theory and individual perceptions of environmental risks. Environ Behav 32(2):250–269

Stern PC (1993) A second environmental science: human–environment interactions. Science 260(5116):1897–1899

Stern PC, Dietz T, Kalof L (1993) Value orientations, gender, and environmental concerns. Environ Behav 25:322–348

West J, Bailey I, Winter M (2010) Renewable energy policy and public perceptions of renewable energy: a cultural theory approach. Energy Policy 38(10):5739–5748. doi:10.1016/j.enpol.2010.05.024

Wildawsky A (1987) Choosing preferences by constructing institutions: a cultural theory of preference formation. Am Polit Sci Rev 81(1):3–22

Whitmarsh L, Lorenzoni I (2010) Perceptions, behavior and communication of climate change. Editorial commentary. Wiley Interdisciplinary Reviews. Clim Change 1(2). doi:10.1002/wcc.7