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ORIGINAL ARTICLE

The relative importance of subjective and structural factors for individual adaptation to climate change by forest owners in Sweden

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Abstract A growing body of literature argues that subjective factors can more accurately explain individual adaptation to climate change than objective measurers of adaptive capacity. Recent studies have shown that personal belief in climate change and affect are much better in explaining climate awareness and action than income, education or gender. This study focuses on the process of individual adaptation to climate change. It assesses and compares the influence of cognitive, experiential and structural factors on individuals' views and intentions regarding climate change adaptation. Data from this study comes from a survey with 836 forest owners in Sweden. Ordinal and binary logistic regression was used to test hypotheses about the different factors. Results show that cognitive factors—namely personal level of trust in climate science, belief in the salience of climate change and risk assessment—are the only statistically significant factors that can directly explain individuals' intention to adapt to climate change and their sense of urgency. Findings also suggest that structural or socio-demographic factors do not have a statistically significant influence on adaptation decision-making among Swedish forest owners. The study also offers valuable insights for communication interventions to promote adaptation. Findings strongly suggest that communication interventions should focus more strongly on building trust and addressing stakeholders' individual needs and experiences.

Keywords Climate change · Adaptation · Decision-making · Forestry · Communication

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Introduction

As the impacts of climate change become more tangible and severe, interest in how and why individuals adapt to them is growing (Tam and McDaniels 2013). In the case of forest owners, evidence exists that some of them in both Europe and elsewhere are starting to consider adaptive actions (Keskitalo et al. 2011b; Blennow 2012). The scientific understanding about favourable conditions of individual engagement with adaptation, however, remains obscure as research points in different directions.

Much of the contemporary scientific literature about climate change adaptation focuses on structural factors that determine the capacity of society and its institutions to adapt to climate change impacts (Brooks et al. 2005; Füssel and Klein 2006; Tinch et al. 2015). These studies examine the availability and accessibility of certain economic and political resources to explain whether, how and why adaptation takes place. By following this structural approach, individual adaptation can be understood as part of 'local or community-based adjustments to deal with changing conditions within the constraints of the broader economic–social– political arrangements' (Smit and Wandel 2006: 289). This suggests that individuals are more likely to adapt to climate change if they have the ability and access to resources to anticipate and respond to climatic risk and if socio-economic conditions are favourable.

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A growing field of research, however, has argued that the structural approach is limited in its ability to explain adaptive capacity and action by individuals (Adger et al. 2009; Kuruppu and Liverman 2011; Narayan 2005). This literature focusses instead on subjective factors that explain individuals' perceptions, intentions and actions for climate change adaptation (Grothmann and Patt 2005; Lorenzoni et al. 2007; O'Brien and Wolf 2010). In its last assessment report, the IPCC acknowledges that how individuals adapt to climate change is contingent on their perception of climatic risks as well as their values and objectives (Field et al. 2014). This suggests that the process of individual adaptation is shaped by cognitive, affective and behavioural factors (Lorenzoni et al. 2007).

In this study, we aim to develop an empirically grounded understanding of individual adaptation to climate change by assessing and comparing the influence of structural and subjective factors on individuals' intention to adapt to climate change and their sense of urgency. In the next section, we will review the contemporary literature on the factors behind individual adaptation and develop assumptions about their relevance and effect. In the following section, we describe the case study and how we operationalised, collected and analysed our empirical data. We then present results from a national survey with forest owners in Sweden. The final section will discuss the findings and draw conclusions for climate change communication.

Factors shaping individual adaption to climate change adaptation

Over the last two decades, several approaches to individual adaptation to climate change have been developed, drawing from diverse disciplines including behavioural science, psychology, sociology and anthropology (Fazey et al. 2007; Pelling and High 2005). A significant amount of empirical knowledge now exists that shows that socio-cultural, cognitive and experiential factors can explain how individuals perceive and respond to climate change (Wolf and Moser 2011; Frank et al. 2011; O'Brien 2009; Patt and Schroter 2008). These factors influence the different stages of the adaptation process, starting with the assessment of climate change risks, followed by the appraisal of adaptation options and leading to the implementation, monitoring and improvement of adaptive measures (Moser and Ekstrom 2010). One of the key challenges of research has been to account for the interplay between structural and subjective factors for individual adaptation (O'Brien and Wolf 2010).

Grothmann and Patt (2005) propose an analytical model that includes cognitive, experiential and structural factors to explain why and how individuals adapt to climate change. The model builds on the protection and motivation theory (Rogers 1983; Milne et al. 2000) and suggests that the process of individual adaptation to climate change relies on how individuals perceive climate change risks and how they appraise adaptation actions. The model also acknowledges that individual risk and adaptation judgements are shaped by an individual's objective adaptive capacity and the social discourse surrounding climate change (see Fig. 1).

The literature suggests that an individual's objective capacity can be measured in terms of personal access to relevant resources (Keskitalo et al. 2011a). To appropriately understand adaptive capacity, one must also consider an individual's exposure and vulnerability to climatic risks (Smit and Wandel 2006). Applied to the context of Swedish forestry, we can expect that forest owners with a higher income, larger forest property and dependency on income from forestry are more likely to consider climate change adaptation as an urgent issue and plan to take risk-mitigating measurers.

The literature also provides evidence that cognitive factors such as personal beliefs about climate change are another set of important factors to understand individual adaptation (O'Brien and Wolf 2010; Wolf et al. 2013). First, trust in climate science has been found to have considerable mediating influence on how people make sense of, and act on, scientific information about climate change (Moser 2010). Second, personal belief in the salience of climate change—the level of conviction that climate change is real—has been found to be one of the strongest drivers behind individual adaptation (Blennow et al. 2012). Trust in climate science and belief in the salience of climate change have also been shown to be the subject to social discourse about the topic which is shaped by social norms, political ideology and value-based group identities (Kahan et al. 2011).

Individual adaptation to climate change can also be explained by cognitive risk judgements. Climatic risks may be perceived as greater if they threaten something that is highly valued (Grothmann and Patt 2005), implying that people's values are crucial in shaping their perception of climate risks and adaptation needs (Wolf et al. 2013). Furthermore, the perceived proximity of climate risks is another important factor. A recent study by Brügger et al. (2015) has shown that the likelihood of individuals taking action is higher if they think that climate change poses an immediate risk to something that is important to them.

The same study by Brügger et al. (2015) also highlights that another necessary condition for individuals to actions on climate change is their conviction that these actions are possible, feasible and effective. This is what Grothmann and Patt (2005) call adaptation appraisal. Perceived self-efficacy is a particularly important factor, as it directly affects a person's motivation to change behaviour (Zimmerman 2000). It also shapes personal behaviour and resilience, as individuals with a stronger sense of self-efficacy are likelier to evaluate and adjust their behaviour in response to changing conditions (Bandura 2001).

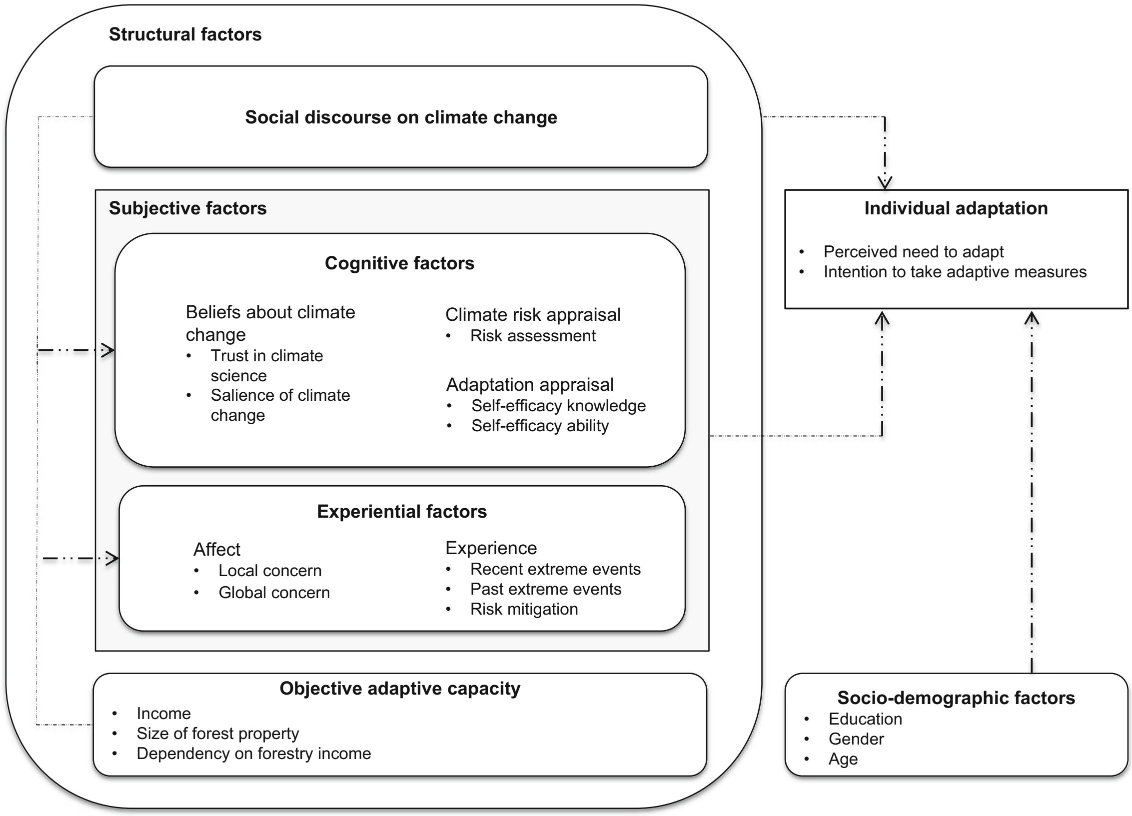

Fig. 1 Conceptual and analytical model of individual adaptation to climate change (based on Grothmann and Patt 2005 and van der Linder 2015)

Experiences with extreme events may also play an important, albeit indirect role for individual engagement with adaptation. Studies have suggested that people who experienced flooding show greater awareness about climate change (Spence et al. 2011) and are better prepared for future flooding events (Kreibich et al. 2011). However, the effect of personal experiences with extreme events on climate awareness and action is contingent on personal beliefs about the salience of climate change (Akerlof et al. 2013). It has also been found that this influence fades over time (Kreibich et al. 2011). Taking this into consideration, we assume that personal experience with extreme events will have no significant effect on individual adaptation.

Apart from personal experience with extreme events, affect is another type of experiential factor that can enhance climate awareness (van der Linden 2015). Its effect on individual engagement with climate change adaptation, however, is not well understood yet. Following Slovic et al. (2007) definition, affect is an evaluative feeling towards external stimuli. Amid some disagreement about the difference between affect and emotion (Sjöberg 2006), a recent study found that affect is the single most important predictor of personal climate risk perception (van der Linden 2015). In light of developing knowledge about the importance of affect, we assume that concern about climate change can help explain individual adaptation to climate change. We also expect that concern about local impacts of climate change are more important for individual adaptation than concern about its global consequences.

Lastly, there are several socio-demographic factors including education and gender which effect on individual adaptation is unclear. In the case of education, some research has suggested that high level of educational attainment at least in developing countries improves climate awareness (Lee et al. 2015). Research in developed countries, however, has pointed out that the more educated individuals are, the more they prefer to rely on their own interpretation and political worldviews rather than established climate science to form their opinion about climate change (Stoknes 2014). The effect of gender also seems to be in dispute with some studies showing that females tend to have higher risk perception (Brody et al. 2007) while others have shown no such effect (van der Linden 2015). In this study, we do not assume that either education or gender has an influence on individual engagement with adaptation.

Taken together, this study will test the overarching hypothesis that subjective factors are better in explaining individual adaptation than structural factors. To proof this general hypothesis, we out forward several detailed hypotheses that test the influence of individual factors (see also Fig. 1). Forest owners will have a stronger sense of need to adapt and are more likely to have the intention to take adaptive action if:

1. They have a high income, own large forest property or are dependent on forestry income (Hypothesis 1: Objective adaptive capacity).
2. They have a strong belief in the salience of climate change or have a high level of trust in climate science (Hypothesis 2: Beliefs about climate change).
3. They consider the risk of climate change on their forest property as high (Hypothesis 3: Climate risk appraisal).
4. They have a strong sense of self-efficacy to take adaptive actions (Hypothesis 4: Adaptation appraisal).
5. They have personal experience with recent extreme events (Hypothesis 5: Experience).
6. They are concerned about the local or the global impacts of climate change (Hypothesis 6: Affect).
7. They are highly educated or a female (Hypothesis 7: Socio-demographic factors)

Case study and research design

Case study

This study focuses on private, non-industrial forest owners in Sweden who own around 50% of the country's 28.2 million ha of forests (Swedish Forest Agency 2014). Sweden, the most forest-rich country in Europe (Forest Europe et al. 2011), is among the top three exporters of paper, pulp and sawn wood products in the world (Skogsindustrierna 2014). Climate change is expected to lead to increasing temperatures and changes in precipitation levels, although the extent of these changes varies between different emission pathways (SMHI 2014). In general, climate change is expected to have considerable implications for the forestry sector and will likely increase risk from pests and pathogens—but also to improve growing conditions (Swedish Commission on Climate and Vulnerability 2007). Although storms are not projected to increase in frequency or intensity (Nikulin et al. 2011), vulnerability to storms will increase under a changing climate due to inferior ground frost conditions during winters and generally wetter conditions (SMHI 2014).

Despite growing scientific knowledge, uncertainty about the impacts of climate change persists. For example, scientific understanding of future climate impact on spruce bark beetle is constrained by uncertainties in regional climate models (Jönsson and Bärring 2011). Uncertainties stemming from climate models also limit findings about appropriate adaptation measures (Jönsson et al. 2013). Nevertheless, climate-related risk and adaptation has become a concern for at least some Swedish forest owners (Keskitalo et al. 2011b). There is also evidence that Swedish forest owners are starting to take adaptive action (Blennow et al. 2012).

Operationalisation of dependent and independent variables

The conceptual and analytical model of this study (Fig. 1) includes all structural and subjective factors of individual adaptation that were discussed in the previous section. These factors were turned into measurable dependent and independent variables and included in the survey (Table 1). This list of variables was based on a review of previous studies about individual adaptation to climate change or risk-based decision-making by forest owners (Blennow et al. 2012; Lidskog and Sjödin 2014).

This study examines two different dependent variables to measure individual adaptation to climate change—personal sense of need to adapt forest property to climate change and stated intention to take risk-mitigating actions in the coming 5 years. Personal sense of need to adapt is measured in responses to the statement 'I think I need to take climate change into greater consideration' from strongly disagree to strongly agree on a 5-point Likert scale. Intention to take risk-mitigating actions in the coming 5 years—the second dependent variable of individual adaptation—is measured in binary responses to the statement 'I plan to take risk mitigating measures to address climate change in the coming 5 years'. Unlike the first dependent variable, the second dependent variable is a categorical variable.

Independent variables in this study were measured on categorical, ordinal and continuous scale. Variables to measure objective adaptive capacity include income (ordinal), dependency on forestry income (ordinal) and size of forest property (continuous). Cognitive factors behind individual adaptation are split into individual belief that extreme events in the past in Sweden have at least partly been caused by climate change (ordinal) and trust in climate science (ordinal). Variables to measure cognitive factors of individual adaptation also include climate risk appraisal in terms of individuals' assessment of climate change risks (ordinal). Data on adaptation appraisal are responses by forest owners to the statement that they have sufficient knowledge to adapt their forests to climate change (ordinal) and that they are capable of adapting their forest property to climate change (ordinal). Variables related to experiential factors include concern about local and global impacts of climate change (ordinal) and experiences with extreme events and risk mitigation (categorical). In addition, information about socio-economic variables—education, gender and age—is also part of the empirical data.

Table 1 Forest owners' views on climate change risks, adaptation and their socio-economic properties

Number of forest owners	836
Share of forest owners in percent that:[a]	
(a) are concerned about climate change in relation to their forest (*local concern*)	27.33
(b) are concerned about climate change globally (*global concern*)	44.73
(c) consider risk of climate change for their forest as serious (*risk assessment*)	27.23
(d) have taken risk-mitigating measures in the past (*experiences risk mitigation*)	84.57
(e) think that they have sufficient knowledge to adapt their forest property to climate change (*self-efficacy knowledge*)	20.81
(f) think that they are capable of adapting their forest property to climate change (*self-efficacy ability*)	20.06
(g) have experienced extreme events in the past 10 years (*past extreme events*)	45.10
(h) have experienced extreme events in 2013–2014 (*recent extreme events*)	29.03
(i) believe that extreme events in the past in Sweden have at least partly been caused by climate change (*salience of climate change*)	41.01
(j) consider climate science to be trustworthy (*trust in climate science*)	38.97
(k) think that they need to take climate change into greater consideration (*sense of need to adapt*)	21.53
(l) plan to take risk-mitigating measures to address climate change in the coming 5 years (*intention to adapt*)	38.75
Share of forest owners that are dependent on income from their forestry in percent (*dependency on forestry income*)	12.40
Average size of owned forest in hectare (*size forest property*)	61.69
Share of forest owners with higher income in percent (*income*)[b]	24.45
Share of forest owners with higher education in percent (*education*)[c]	36.89
Average age (*age*)	61.54
Share of men among forest owners in percent (*gender*)	79.07

[a] In the case of variables (a) to (g), respondents were asked to reply to each of these variables on a scale from 1 to 5. Percentages shown here represent the share of forest owners that responded with 4 or 5

[b] > 40.000 SEK per month and household

[c] University education

Data collection and analysis

Data for this study was collected with a survey of forest owners in Sweden which was conducted in the first half of 2014. The questions of the survey were developed and tested in two different pilot studies. The first pilot study consisted of a qualitative focus group interviews with forest owners in Southern Sweden. The second pilot study was a quantitative survey with 100 randomly selected forest owners. After the results of the two pilots were analysed, the final version of the survey was distributed to 3000 randomly selected forest owners. Contact information of forest owners that participated in this study was collected from a database of land owners in Sweden of the Swedish mapping, cadastral and land registration authority (Lantmäteriet) and the Swedish Forest Agency (Skogsstyrelsen). All 3000 forest owners received a postal invitation letter to take part in the survey a week before they received a copy of the survey by mail. Owners were also given access to a web-based version of the survey. Three weeks after the first sent out of the survey, owners received a reminder via mail. Another 3 weeks later, forest owners who so far had not responded received a paper-based version of the survey, as well as access to a web-based version. The collection of surveys was closed 3 months after owners had received the invitation letter.

The final version of the survey consisted of a total of 55 open-ended and closed questions of which 15 were used in this study.[1] The response rate was 28% resulting in 836 valid responses. Data about the total size of forest property for respondents and non-respondents came from the database of the Swedish mapping, cadastral and land registration authority. A Welch two-sample test showed that the mean property sizes of the two groups differed significantly (t test, t = 3.5003, df = 1529.338, p value = 0.0004782). The average size of forest property was 60.74 ha for respondents and 48.66 ha for non-respondents, which implies that forest owners with a larger total forest property are overrepresented in study.

As outlined above, the two dependent variables—perceived need to adapt and intention to take risk-mitigating measures to

[1] Other studies that are based on other or the same questions from this survey include André et al. (2017) and Blanco et al. (2017)

address climate change—were collected on an ordinal and binary scale, respectively. Thus, data analysis was limited to frequency analysis, ordinal and binary logistic regressions. To perform these regression analyses, ordinal scaled independent variables, which were all on a 5-point scale, had to be recoded into binary variables. The statistical software R was used for the data analysis (R Core Team 2015).

Results

Results are presented in two different sections. The first section gives an overview about the key structural and subjective factors of individual adaption to climate change. The second section presents the results of two logistic regression models to test assumptions about the influence of the different cognitive, experiential and structural factors on individual adaptation among forest owners.

Forest owners' views on climate change risks and adaptation

Table 1 summarises findings about forest owners' views and experiences with climate change risks, adaptation and their socio-economic properties. What stands out is that forest owners are more concerned about the global consequences of climate change than its impacts on their own forest property. The data also suggests that a large majority of forest owners have experiences with risk-mitigating measurers and that almost half of them have experienced extreme events in the past 10 years. In addition, almost a third of them had experienced extreme weather shortly before the survey was conducted. Notably, results from the survey also suggest that salience of climate change is considerable with more than two fifths of forest owners believing that extreme events in Sweden can at least in part be linked to climate change. However, most of forest owners considered climate science not to be trustworthy.

At large, results show that individual adaptation to climate change is still limited to a minority of forest owners. Only around a fifth of them have a strong sense of need to take climate change into greater consideration. However, almost 40% of them stated that they have the intention to take measures to mitigate risk related to climate change in the coming 5 years. Given that most forest owners in this study do not think that they have sufficient knowledge or ability to adapt to climate change, those risk-mitigating measures could be considered autonomous rather than planned adaptation (cp. Smit and Wandel 2006).

Assessing factors of individual adaptation

Individual adaptation was measured in this study by using two different dependent variables. The first of these variables is personal sense of the need to adapt personal forest property to climate change. Table 2 shows results of an ordinal logistic regression model, including the level of significance and odds ratio of the different independent variables. Results show that risk assessment, belief in the salience of climate change in relation to extreme events, and trust in climate science are significant factors explaining to what degree forest owners considered it necessary to adapt to climate change.

Thus, results support hypotheses two and three by showing that if forest owners considered the risk of climate change to their forest property as serious, the odds that these forest owners think that they need to adapt to climate change versus them thinking that they do not need to adapt, or that they are undecided, are combined 3.4 times greater, given that all other independent variables are held constant. The odds ratio for salience of climate change and trust in climate science are around half of that, suggesting that the two factors have a lesser, albeit still statistically significant positive effect on individual sense of the need to adapt.

The second variable to measure individual adaptation was the stated intention to take measures to mitigate risks related to climate change in the coming 5 years. Table 3 shows the results of a binary logistic regression. The outcomes show that risk assessment, experience with risk mitigation, belief in self-efficacy related to knowledge and perceived salience of climate change are all statistically significant factors that explain forest owners' intention to take risk-mitigating measures.

These findings support hypotheses two, three and four. They also show that experience with risk mitigation is a strong factor behind individual adaptation. Results also suggest that how knowledgeable forest owners think they are about climate change helps explain their intention to change behaviour. This would imply that planned adaptation is more common that the findings in the previous section suggest (Table 1), assuming knowledge about climate change that forest owners think they have is adequate.

Taken together, findings from the two regression models suggest that personal risk appraisal and belief about the connection between personal experience and climate change can universally explain individual adaption. This supports hypothesis three that if climate impacts are perceived as close and threatening, individual engagement with climate change adaptation increases (Akerlof et al. 2013). Findings also support hypothesis two that personal belief in the veracity of climate change drives individual adaptation.

It is also important to note that affective, experiential, socio-economic factors and structural factors related to objective adaptive capacity do not seem to have any statistically verifiable immediate influence on individual adaptation among forest owners. This means that results from this study do not support hypotheses one, five, six and seven. In both

Table 2 Ordinal regression analysis of personal sense of need to adapt

Variable	Value	Std error	*t* value	*p* value	Odds ratio
Local concern	0.3582669110	0.2581719533	1.387706551	1.652e–01	1.4308475
Global concern	0.2945072792	0.2076592339	1.418223855	1.561e–01	1.3424647
Risk assessment	1.2168147545	0.2687932294	4.526954631	5.984e–06***	3.3764159
Experience risk mitigation	0.3488508396	0.2718512243	1.283241746	1.994e–01	1.4174377
Self-efficacy knowledge	0.0021494656	0.2973044178	0.007229848	9.942e–01	1.0021518
Self-efficacy ability	− 0.0165793692	0.3028735204	− 0.054740240	9.563e–01	0.9835573
Past extreme events	0.0273599422	0.1751966019	0.156167082	8.759e–01	1.0277377
Recent extreme events	− 0.1161146669	0.1816581004	− 0.639193445	5.227e–01	0.8903731
Salience climate change	0.6338235303	0.1929861220	3.284295906	1.022e–03**	1.8848034
Trust in climate science	0.4404124075	0.1938552093	2.271862639	2.309e–02*	1.5533477
Dependency on forestry income	0.1881458955	0.2716890433	0.692504538	4.886e–01	1.2070096
Size forest property	0.0005197959	0.0008688119	0.598283541	5.497e–01	1.0005199
Income	− 0.1216555974	0.2011333564	− 0.604850431	5.453e–01	0.8854533
Education	0.2170162000	0.1912228209	1.134886511	2.564e–01	1.2423642
Age	− 0.0082745372	0.0072022168	− 1.148887553	2.506e–01	0.9917596
Gender	0.2289676808	0.2168962847	1.055655154	2.911e–01	1.2573014

318 out of 836 observations missing, Residual deviance 1361.26; AIC 1401.26, Significance codes: 0 '***', 0.001 '**', 0.01 '*' and 0.05

regression models, experiences with extreme events and levels of concern about local or global climate change are not significant. The same is true for income, education, gender, age and even level of dependency on income from forest and size of forest property. Thus, findings of this study indicate that individual adaptation cannot be adequately explained by evaluative feelings about climate change, personal experience with extreme events or vulnerability to climate impacts.

Table 3 Binary logistic regression analysis of stated intention to take risk-mitigating measures related to climate change

Variable	Value	Std error	*Z* value	Pr (> |*z*|)	Odds ratio
Intercept	2.027347	0.704147	− 2.879	3.987e–03**	0.1316845
Local concern	− 0.242296	0.318864	− 0.760	4.473e–01	0.7848239
Global concern	0.100987	0.240253	0.420	6.742e–01	1.1062622
Risk assessment	0.918513	0.325461	2.822	4.770e–03**	2.5055621
Experience risk mitigation	1.502268	0.441401	3.403	6.662e–04***	4.4918636
Self-efficacy knowledge	0.786881	0.381576	2.062	3.919e–02*	2.1965357
Self-efficacy ability	− 0.201852	0.378597	− 0.533	5.939e–01	0.8172155
Past extreme events	0.125900	0.204845	0.615	5.388e–01	1.1341683
Recent extreme events	0.346506	0.211774	1.636	1.018e-01	1.4141176
Salience climate change	0.459856	0.223640	2.056	3.9760e–02*	1.5838467
Trust in climate science	0.381591	0.225451	1.693	9.054e-02	1.4646136
Dependency on forestry	0.523693	0.334748	1.564	1.177e–01	1.6882509
Size of forest property	0.001934	0.001060	1.825	6.802e–02	1.0019359
Income	0.009326	0.236191	0.039	9.685e–01	1.0093694
Education	0.115737	0.224996	0.514	6.070e–01	1.1227004
Age	− 0.011171	0.008343	− 1.339	1.806e–01	0.9888910
Gender	− 0.078911	0.258386	− 0.305	7.601e–01	0.9241220

316 of 836 observations missing, Residual deviance 618.22 on 503 degrees of freedom; AIC 652.22; Number of fisher scoring iterations 4, Significance codes: 0 '***', 0.001 '**', 0.01 '*' and 0.05

Discussion

The literature on climate change adaptation suggests that individual engagement with adaptation is determined by the reciprocal relationship between subjective and structural factors (Whitmarsh et al. 2013). Based on an integrated model of individual adaptation (Grotmann and Patt 2005; van der Lindner 2015), the aim of this study was to assess and compare the influence of different structural, cognitive and experiential factors on engagement with adaptation. The study was designed to test the hypothesis that subjective factors are more powerful in explaining individual adaptation than objective factors of adaptive capacity (Adger et al. 2009; Blennow et al. 2012).

Results from this study strongly support this hypothesis and show that cognitive factors are the only statistically significant variables that can directly explain individual adaptation to climate change by forest owners in Sweden. The data shows that personal levels of trust in climate science and belief in the salience of climate change, alongside climate risk appraisal, strongly and positively influence individuals' intention to adapt to climate change and their sense of urgency. As expected, findings of this study also show that among Swedish forest owners, variables related to objective adaptive capacity do not have a statistically significant influence on individual adaptation.

Unexpectedly, results did not show that affect has any direct influence on individual adaptation. Future research should look into how affect influences individuals' perception of climate change risks (cp. Leiserowitz 2006), as well as personal beliefs about climate change salience and self-efficacy to better understand the effectiveness of emotive appeals to promote individual adaptation (Tannenbaum et al. 2015).

Outcomes from this study offer valuable insights for communication efforts that aim to enhance public involvement in adaptation. Results of this study confirm earlier research that has shown that personal trust in climate science is a key lever for climate awareness and action (Malka et al. 2009; Kahan et al. 2012). This highlights the importance of communication interventions to improve public trust in climate science (Goodwin and Dahlstrom 2014) to enhance awareness and knowledge about climate change impacts and adaptation options (Moser 2014).

Furthermore, findings also provide scientists and communication practitioners with a better understanding of how to promote individual adaptation by raising awareness about the proximate consequences of climate change (Brügger et al. 2015). Data clearly shows that personal belief in climate change can lead to greater level of awareness and intention to change behaviour. The study confirms earlier research that argued that experiences with extreme events alone does not automatically lead to greater climate awareness or preparedness (Whitmarsh 2008). This is consistent with previous research that has argued that links between personal experience and climate change need to be made more salient in order to increase individual's climate awareness (van der Linden 2015).

Lastly, the study also offers clues how to overcome the climate awareness action gap (Moser 2010). Results suggest that personal sense of self-efficacy related to knowledge and personal experience with risk mitigation can explain individuals' level of intent to adapt to climate change and sense of urgency. These results should not be misunderstood to show that a lack of action is merely due to a lack of information. Rather, it suggests that forest owners have specific knowledge needs that need to be addressed. This supports earlier studies that have argued that communication for adaptation needs to be based on a comprehensive understanding of the needs and experiences of specific target audiences and address stakeholders objectives and decision-making process (Pidgeon and Fischhoff 2011; Vulturius and Gerger Swartling 2015).

In conclusion, this study provides further evidence that at least in developed countries, subjective factors—namely personal levels of trust in climate science, belief in the salience of climate change and risk assessment—are better in explaining individual engagement with adaptation than measurers of objective adaptive capacity. Furthermore, findings also strongly suggest that communication interventions that aim to promote adaptive action should focus more strongly on building trust and attending to stakeholders' individual needs and experiences.

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