


Knowledge, Attitude and Risk Perceptions of People Towards Climate Change: Predicting Pro-Environmental Behaviours for Mitigation and Adaptation

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Abstract

This study was carried out to find the predictors of pro-environmental behaviours (PEBs) to mitigate Climate change (CC) and to assess its association with knowledge about CC, attitude (beliefs and intentions) towards CC, personal experience with extreme weather events, holistic effect of CC, risk perception and individual willingness to reduce CC. The study used a correlational research design and a convenient sampling strategy to recruit 200 (N=200) young adults from Lahore. The results revealed that risk perception was a mediator between positive beliefs about climate change and negative affective evaluation of CC and PEBs. People with positive beliefs and negative feelings towards climate change had higher risk perceptions, leading them to act pro-environmentally. Moreover, personal willingness was also a significant positive predictor of PEBs. The findings illustrated that education positively correlated with PEBs, and women were likelier to engage in PEBs than men. The study has significant implications as it highlighted the crucial role beliefs, feelings, risk perception, and personal willingness can play in mitigating CC. Interventions should be designed to educate people about CC, strengthen their beliefs, stimulate negative affect towards CC, and increase risk perception and willingness. It can also help Pakistan's policymakers to improve the public's engagement with PEBs.

Keywords: Pro-environmental behaviours, Risk perception, Personal willingness, Holistic effect, climate change, extreme weather events

1 Introduction

Climate change is this century's most significant global issue (Mikhaylov et al., [2020](#)). Pakistan's

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additional secretary for climate change, Joudat Ayaz, revealed that 128,000 deaths occur every year in Pakistan directly or indirectly because of climate change. According to the 2020 report by think-tank Germanwatch, Pakistan is ranked fifth in the list of countries considered most vulnerable to climate change (Abu Bakar, [2020](#)). Psychology can also influence people's behavioural response towards climate change (Whitmarsh et al., [2021](#)). This study assessed people's knowledge about climate change, their attitude towards climate change, their feelings and personal experience of climate change, their risk perceptions, and their personal willingness and pro-environmental behaviours to reduce and tackle the issue of climate change.

Knowledge about Climate Change refers to people's knowledge regarding the causes/contributing factors and impacts of climate change and the actions individuals can take to reduce climate change (Bradley et al., [2020](#); Tobler et al., [2012](#)). A significant factor contributing to this issue may be not educating people or providing limited knowledge regarding the climate in their educational institutes. Furthermore, attitude towards climate change is defined as the degree of acceptance or denial of climate change, referred to as attitude towards climate change. Despite this, many individuals deny the magnitude of climate change and the need for behavioural change (Brosch, [2021](#); Clayton, [2020](#); Leiserowitz et al., [2018](#)). Individuals who believe the earth's deteriorating climate have significantly higher risk perceptions than others.

Moreover, van der Linden et al. ([2015](#)) emphasised that strengthening the belief that climate change is occurring owing to human activities will lead towards a higher risk perception of climate change, which will, in turn, encourage support for pro-environmental behaviours to reduce climate change (Cianconi et al., [2020](#); Ebi et al., [2021](#)). Therefore, beliefs significantly predict concern for the climate, which, in turn, predicts pro-environmental behaviour (Smith & Kingston, [2021](#)).

Fear and worry are assumed to motivate people to act pro-environmentally; these emotions are also linked with risk perception regarding climate change (Lu & Schuldt & Roh, [2014](#)). Van der Linden ([2015](#)) revealed that personal experience of extreme weather incidents and climate change risk perception are positively associated. Furthermore, people are more likely to donate to save the climate after acknowledging the rise in local temperature as global warming (Joireman et al., [2010](#)). Moreover, people who personally experienced the floods of 2013 and 2014 in the UK demonstrated high-risk perception and intense negative emotions and perceived themselves as more vulnerable to climate change (Mahdavian et al., [2020](#); Walkling & Haworth, [2020](#)).

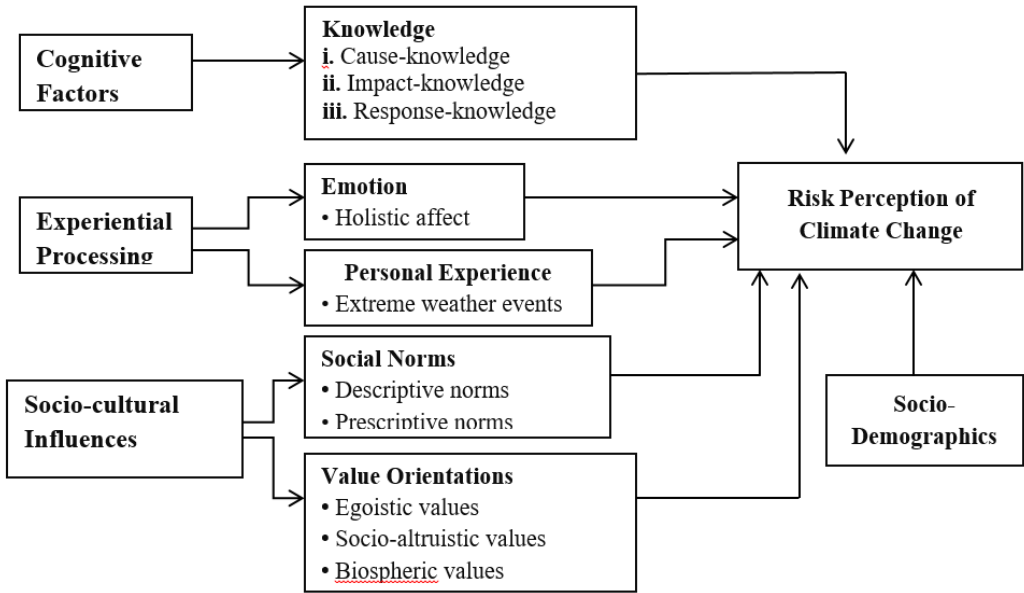
Climate change risk perception indicates that a person acknowledges the adverse impacts climate change can have on the earth. It assesses the negative impacts of a specific hazard (Cianconi et al., [2020](#)). Risk perception stimulates them to act responsibly to protect the climate and behave pro-environmentally (Lin et al., [2021](#)). People with high-risk perceptions may adjust their behavioural practices and lifestyle to tackle climate change.

Climate change risk perception significantly influences and predicts different pro-environmental practices (Li et al., [2018](#); Smith et al., [2021](#)). People with high-risk perceptions are likelier to engage in pro-environmental activities than those with low climate change risk (Xue & Zhao, [2015](#)). Personal willingness to reduce climate change can include readiness to switch from individual to public transport, willingness to pay more for energy and consume less of it, to buy green products even if they are expensive, to reduce air travel, acceptance of environmentally friendly policies (Chen & Zheng, [2016](#); Nielsen et al., [2021](#)). Pro-environmental behaviours (PEBs) are the actions of an individual that are taken to protect the climate from damage, for its welfare, or to harm it as little as possible (Kesenheimer & Greitemeyer, [2020](#); Rampedi & Ifegbesan, [2022](#)). Hence, this study assessed the self-reported frequency of various pro-environmental behaviours.

1.1 Theoretical Framework

1.2.1 Risk Perception Model/Theory of Risk

This model was introduced by van der Linden (2015) and is based on three factors, i.e., cognitive, experiential, and sociocultural influences. This study focused on this model's cognitive and experiential factors. Cognitive factors consist of three categories of knowledge regarding climate change. The experiential factor consists of affect and personal experience with extreme weather events. An individual who evaluates climate change as an unpleasant, unfavourable and harmful phenomenon is more likely to view climate change as threatening.



1.2.2 Theory of Planned Behaviour

According to the theory of planned behaviour (Kim et al., 2020), beliefs indicate an individual's intention to perform a specific behaviour. Behavioural intentions refer to a person's willingness to engage in a particular behaviour. These intentions are based upon a person's beliefs and perceived behavioural control. Behavioural intentions are presumed essential antecedents to behaviour; intentions/willingness drive behaviour (Hwang et al., 2020). Several researches have indicated a strong link between attitudes, behavioural intentions and behaviour (ElHaffar et al., 2020). This study will use beliefs, intentions and willingness to assess pro-environmental behaviour.

2 Literature Review

Climate change is a complex problem affecting people in various settings, including their homes, workplaces, and schools (Swinburn et al., 2022). Most of the research on pro-environmental behaviours has been carried out in developed countries; there is not much literature on the drivers of pro-environmental behaviour in developing countries. Van der Linden (2015) authenticated that higher climate risk perceptions were more common in women and politically liberal people (Shao & Hao, 2020). Accurate knowledge also positively predicts risk perceptions. The most significant and impactful predictors of risk perceptions were negative affective evaluation and personal experience with extreme weather conditions.

Similarly, Lee et al. (2018) proposed that episodic future thinking (EFT) leads to higher risk perception in people about climate change, predicting pro-environmental actions. Climate change risk perception mediated the association between EFT and pro-environmental behaviours.

Moreover, Zander (2018) also found that risk perception positively predicts pro-environmental behaviours. Personal concern had a more significant relationship with pro-environmental behaviours (PEB) than general concern for climate change (Maartensson & Loi, 2022; Zeng et al., 2020). Behavioural intentions partially mediated the link between personal concern and PEB. The study provided insight into the drivers of pro-environmental behaviours.

Van Eck et al. (2020) extended The Climate Change Risk Perception Model (CCRPM, van der Linden, 2015) and showed that effect was the most significant predictor of risk perceptions. In contrast, the impact of sociocultural factors was relatively low. Another research study showed that knowledge had a substantial, direct effect on beliefs and attitudes and had an indirect, significant impact on climate change risk perceptions. Beliefs about climate change and attitude acted as a mediator between climate change knowledge and perception of risk. Positive beliefs (beliefs that climate is changing) and attitudes regarding environmental issues were significant predictors of risk perception of climate change. The proposed model explained a 49 per cent variation in risk perceptions (Zobeidi et al., 2020).

Duchi et al. (2020) also confirmed that individuals with a growth mindset (the idea that an individual can influence and improve the world) had more accepting and positive attitudes regarding climate change; they were more likely to believe in the effectiveness of mitigation and were more inclined to engage in pro-environmental behaviours. Bradley et al. (2020) proposed that climate change risk perceptions result in high response effectiveness, psychological adaptation, and pro-environmental behaviours.

According to Bradley et al. (2020), many researchers have proven climate change to be a crucial component and predictor of pro-environmental behaviour and for supporting and accepting climate-friendly policies (Stoutenborough and Vedlitz, 2014). Although people who hold misconceptions concerning climate change can still help and accept environment-friendly policies. Still, they may support policies that fail to address the most pressing issues regarding climate change (Moxnes & Saysel, 2009). Insufficient knowledge should encourage individuals to improve their understanding of climate change phenomena. Consequently, denying one's knowledge gap is a matter of concern, making acquiring knowledge unnecessary (Hattie, 2013).

Rode et al. (2021) assessed that high efficacy beliefs regarding mitigation, in turn, influenced the participation of people in climate change-related discussions. Knowledge about climate change and efficacy beliefs to address climate change accelerates public engagement. These studies reflect a shift in environmental and climate change strategies to bring a change in people's behaviour that has generally promoted stimulating negative emotions like guilt to encourage pro-environmental action (Rishi, 2022; Schneider et al., 2017; Wang et al., 2021).

A study by Elshirbiny and Abrahmse (2020) indicated that people's negative feelings towards climate change were most prevalent when they discussed their experience with extreme weather incidents due to climate change, especially floods. Although people seemed concerned about the climate, they tended to have several misconceptions regarding its cause (hole in the ozone layer). Most people had inefficient knowledge and were unaware of human behaviour contributing to climate change.

Another study explored people's perceptions of climate change, pro-environmental behaviour, and mitigation and adaptation policies in China. The participant's perceptions towards mitigation and adaptation policies indicated inconsistencies between policies and relevant behaviour (Chen et al., 2020a; Xue et al., 2021). Furthermore, although most participants acknowledged that specific policies were highly significant to combat climate change, they were also worried about economic growth. There are discrepancies in the perceptions and behaviour of health workers concerning

climate change (Chen et al., [2020b](#)).

2.1 Rationale

Pakistan's Climate Change Additional Secretary, Joudat Ayaz, revealed that 128,000 deaths occur every year in Pakistan directly or indirectly because of climate change. Due to climate change, the average life expectancy can decline by 2 to 5 years. The ability of children to fight organ diseases is deteriorating. It also increases the risk of cardiovascular disease (Junaidi, [2019](#)). According to the 2020 report by think-tank Germanwatch, Pakistan is ranked fifth in the list of countries considered most vulnerable to climate change (Abu Bakar, [2020](#)). This study assessed people's knowledge, attitude, holistic affect, personal experience, risk perception towards climate change, and personal willingness to contribute to climate change financially and to find predictors of people's pro-environmental behaviour from different educational levels and fields. Interventions can be designed and implemented only after assessing climate change's cognitive, experiential and behavioural aspects. Climate change should be an immediate concern, given its magnitude and consequences. We are running out of time. We must start working to improve the climate to save future generations.

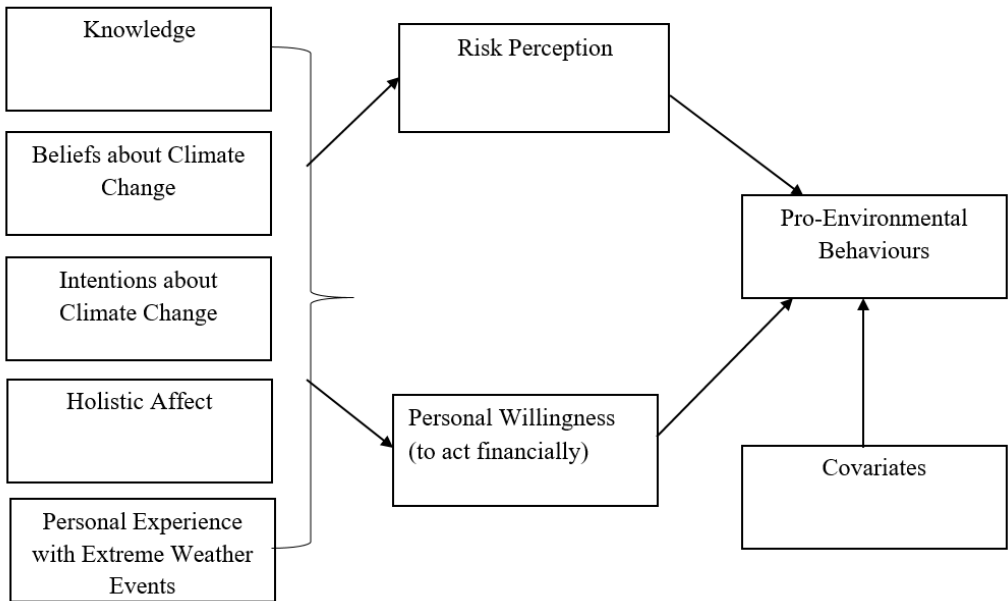
2.2 Objectives/Aims

- To assess people's knowledge, attitude, and risk perception regarding climate change. The study assesses knowledge regarding causes, impacts and actions related to climate change.
- To explore the predictors (knowledge, positive attitude, personal experience, negative affect, high-risk perception, personal willingness, gender, education) of pro-environmental behaviour.

2.3 Hypotheses

- Knowledge, positive attitude (beliefs and intentions), personal experience with extreme weather events, negative affective evaluation, high-risk perception, high personal willingness to reduce climate change and pro-environmental behaviours are likely positively correlated.
- High-risk perception and high personal willingness will likely mediate the relationship between knowledge, beliefs, intentions, personal experience, negative affective evaluation and pro-environmental behaviour.
- The educational level is likely to predict pro-environmental behaviour positively.
- There are likely to be gender differences in pro-environmental behaviour.

2.1 Hypothesised Model



3 Methodology

3.1 Research Design

A correlational research design was used in this study.

3.2 Sample and Sampling Strategy

The data was collected from 258 young adults, of which 58 responses were discarded. The final sample comprised 200 (N= 200) young adults aged 18-35 (M=23.61, SD= 2.67). The sample consisted of 93 men and 107 women. The sample size was estimated using G power. Non-probability convenience sampling was employed in this study.

3.2.1 Inclusion criteria.

- The data was collected from both men and women.
- The participants were recruited from both private and public sectors.
- Working and non-working individuals were recruited.
- Data was collected from individuals belonging to different educational fields.

3.2.2 Exclusion criteria.

- People with an education level below matric were not recruited.

Table 1: Demographic Characteristics of Sample (N=200)

Characteristics	f(%)	M(SD)	Median
Age		23.61(2.68)	
Gender			
Men	93(46.5)		

Women	107(53.5)	
No. of siblings		3.00
Education		
Matric	1(0.5)	
Intermediate	11(5.5)	
Undergraduate	104(52)	
Masters	46(23)	
Postgraduate	38(19)	
Major		
Business Education	35(17.5)	
Arts, Humanities and Social Sciences	88(44)	
Life Sciences	7(3.5)	
Medical and Biological Sciences	21(10.5)	
Engineering and Natural Sciences	16(8)	
Computer Sciences and IT	33(16)	
Institute		
Private	97(48.5)	
Public	103(51.5)	
Profession		
Working	122(61)	
Non-working	78(39)	
Residential area		
Urban	182(91)	
Rural	18(9)	
Family system		
Joint	59(29.5)	
Nuclear	141(70.5)	
Socioeconomic status		
Lower class	0(0)	
Lower middle class	5(2.5)	
Middle class	130(65)	
Upper middle class	61(30.5)	
Upper class	4(2)	
Religion		
Islam	198(99)	
Agnosticism	2(1)	
Father education		
Uneducated	3(1.5)	
School	37(18.5)	
College	34(17)	
University	126(63)	
Mother education		
Uneducated	12(6)	
School	41(20.5)	
College	57(28.5)	
University	90(45)	
Father occupation		
Employed	94(47)	
Self-employed	87(43.5)	
Retired	19(9.5)	
Mother Occupation		

Working	34(17)
Homemaker	166(83)
Ideology	
Liberal	145(72.5)
Conservative	55(27.5)

Note: M= Mean, S= Standard Deviation, f= Frequency, %= Percentage

3.3 Assessment Measures

3.3.1 Knowledge about Climate Change (van der Linden, 2015)

Van der Linden (2015) developed this scale. It comprised three subscales, i.e. impact-knowledge ($\alpha = 0.90$), cause-knowledge ($\alpha = 0.88$) and response-behaviour knowledge ($\alpha = 0.94$). Each subscale consisted of 13 items. Participants' answers were dichotomous as correct (1) or incorrect (0). Factor analysis was utilised for construct validity, and high factor loadings were demonstrated.

3.3.2 The Climate Change Attitude Survey (Christensen & Knezek, 2015)

It refers to people's beliefs about climate change and their intentions towards the climate (Christensen & Knezek, 2015). It consisted of 15 items. It had two subscales, i.e. beliefs about climate change (10 items, $\alpha = .90$) and intentions towards the climate (5 items, $\alpha = .78$). It comprised of 5 points Likert scale: "strongly disagree= 1, strongly agree=5". The scale was highly reliable ($\alpha = .89$). Factor analysis was employed to analyse construct validity (Christensen & Knezek, 2015).

3.3.3 Holistic Affect (van der Linden, 2015)

Holistic/generalised effect refers to people's feelings towards climate change and their evaluation of it, e.g., favourable or unfavourable, pleasant or unpleasant (van der Linden, 2015). It consisted of 3 items and was assessed using bi-polar adjective categories with 7 points, e.g. "I feel that climate change is (negative-positive; very unpleasant-pleasant; unfavourable-favourable)". The reliability of the holistic effect is ($\alpha = 0.85$).

3.3.4 Personal Experience with Extreme Weather (van der Linden, 2015)

It is the first-hand experience of an individual with climate change events, i.e. extreme weather conditions, flooding, etc. (van der Linden, 2015). It included two items and was analysed using a 5-point Likert scale. The items assessed whether they experienced extreme weather events, "e.g. severe heat waves, droughts, floods, freak storms, etc." and how often they experienced extreme weather events in the previous five years. The answers were dichotomised as (0 = no experience, 1 = experience) and summed.

3.3.5 Risk Perception (van der Linden, 2015)

It consisted of 8 items and was measured using 7 point Likert scale. It has two subscales: personal risk perception and global/societal risk perception. The overall reliability of the scale is ($\alpha = 0.96$). The construct validity indicated high factor loadings (van der Linden, 2015).

3.3.6 Personal Willingness (Xie, Brewer, Hayes, McDonald & Newell, 2019)

This scale consisted of 6 items. It was a 4-point Likert scale: "1 = Not at all willing to 4 = very willing". This scale asked individuals to rate how much they would be willing to act like "Pay more for and use less electricity". This scale had high reliability ($\alpha = 0.89$).

3.3.7 Pro-Environmental Behaviour Scale (Markle, 2013)

The original scale consisted of 19 items, but for this research, 11 items were used that were relevant

and applicable to Pakistan. It included three subscales, i.e. conservation, food, and transportation. The full scale had high reliability $\alpha = 0.76$. The reliability of the subscales ranged from 0.62 to 0.74. The scale's construct validity was determined through a strong correlation with the New Ecological Paradigm Scale, Environmental Regulations Attitude Scale and the Environment Identity Scale.

3.4 Ethical Considerations

Following ethical considerations were followed while conducting this study;

1. Permission was obtained from the Institute, Board Review, and authors of scales before starting this research.
2. The consent form was obtained from the respondents, and they were briefed about all their rights. They were allowed to withdraw from the study whenever they wished.
3. Privacy and confidentiality were maintained, and the data was only used for research.

3.5 Procedure

The data was collected online due to the COVID-19 situation in the country. Consent was obtained from all the individuals who participated in the study. They were informed about all their rights, i.e., privacy, confidentiality, right to withdraw, and the nature and purpose of the study. Approximately 10-15 minutes were consumed to fill out the questionnaire. At the end of the questionnaire, a debriefing form was presented to the participants, who were briefed about the actions they could take in their daily lives to reduce climate change.

4 Results

4.1 Reliability and Descriptive Statistics

The reliability coefficients of the scales, descriptive statistics, normality and actual and potential ranges of study variables are shown in Table 4.1.

Table 2: Reliability Coefficients of the Scales Used in the Present Study (N=200)

Scales	<i>k</i>	Mdn	M	SD	α	Range		Skewness	Kurtosis
						Potential	Actual		
Knowledge Impact-knowledge	13	7	5.30	2.06	.59	0-13	0-10	-.78	.29
Response-behaviour knowledge	13	7	5.59	2.20	.64	0-13	0-10	-.34	-.31
Cause-knowledge The Climate Change Attitude Survey	10	5	4.36	1.67	.41	0-10	0-10	.09	1.07
Beliefs about climate change	10	25	45.78	5.69	.91	10-50	10-50	-3.27	15.33
Intentions about climate change	5	13	20.30	3.29	.59	5-25	12-25	-.59	-.14
Personal	2	1	1.82	.52	.79	0-2	0-2	-2.84	6.78

Experience with Extreme Weather Events									
Holistic Affect	3	11	17.89	3.58	.79	3-21	4-21	-1.47	2.12
Risk Perception	8	28	47.97	6.85	.88	7-56	19-56	-1.53	2.83
Personal Willingness	6	12	16.04	3.34	.65	6-24	6-24	-.19	.04
Pro-Environmental Behavioural Scale	11	28	38.36	6.46	.57	11-55	17-53	-.20	-.10

Note. *k* =Number of Items; α =Cronbach's Alpha; *Mdn*= Median; *M*=Mean; *SD*= Standard Deviation

All scales have acceptable to good reliability values except for cause-knowledge (.41). The cause-knowledge scale's responses were dichotomised into correct and incorrect answers, initially a 4-point Likert scale. As the knowledge was measured objectively, the low reliability indicates that most people gave inconsistent responses and had incorrect knowledge about the causes of climate change. It can also be observed by the mean of cause-knowledge, i.e. 4.36. The mean value of all knowledge scales is low, indicating people's incorrect knowledge regarding climate change. Analysis assessing the normality of data revealed that almost all study variables fall into acceptable ranges of skewness and kurtosis. According to Field (2013), the normality assumption does not matter much in large samples. It is suggested that normality tests should not be used for a large sample size (Field, 2013).

4.2 Correlation Analysis

It was hypothesised that high knowledge, positive attitude (beliefs and intentions), personal experience with extreme weather events, the negative holistic effect of climate change, high-risk perception and individual willingness to reduce climate change would have a positive relationship with pro-environmental behaviours. All the assumptions of correlation analysis were fulfilled.

Table 3: Correlation of Demographics with Study Variables (N=200)

Variables	Impact-knowledge	Response-behaviour knowledge	Cause-knowledge	Beliefs	Intentions	Personal Experience	Holistic Affect	Risk Perception	Personal Willingness	Pro-environmental Behaviours
1 Gender	-.01	.01	-.07	.11	.17*	-.01	.06	.17*	.05	.16*
2 Age	-.08	.09	.08	-.03	-.05	.07	-.13	.05	-.05	.10
3 Education	-.07	.02	.07	.06	.03	-.08	-.05	.14	.04	.16*
4 Institute	.06	.11	.00	.09	.09	.07	.05	.12	.03	.10
5 Profession	.04	.10	-.15*	.03	.10	-.02	.01	.02	.06	-.03
6 Residential area	-.08	.05	-.10	.02	-.06	-.06	-.05	.05	.09	.12
7 Family system	.10	.06	.05	.05	-.01	-.03	.19**	.14	.13	.10
8 Socioeconomic status	-.01	.05	-.02	-.04	.07	.04	-.02	-.03	-.03	.07
9 Religion	-.04	.02	-.02	.00	.05	.04	.09	.01	.11	.09
10 Father education	.20**	.05	.04	.14	.12	.02	.06	.11	-.07	-.03
11 Mother education	.17*	.01	.05	.11	.13	-.02	.13	.01	-.06	-.13
12 Mother occupation	-.13	-.06	-.15*	-.03	-.05	-.00	.01	-.08	-.12	-.12
13 No. of siblings	-.00	.08	-.10	.02	-.06	.09	-.13	-.03	.07	.12
14 Ideology	-.03	-.08	-.03	-.06	-.12	-.07	-.07	-.13	-.13	-.03

Note. * $p < .05$, ** $p < .01$, *** $p < .00$; gender (1=men, 2=women); education (1=matric, 2=intermediate, 3=undergraduate, 4=masters, 5=postgraduate); institute (1=private, 2=public); profession(1=working, 2=non-working); residential area(1=urban, 2=rural); family system(1=joint, 2=nuclear); socioeconomic status(1=lower class, 2=lower middle

class,3= middle class,4=upper middle class,5=upper class); religion(1=Islam, 2=agnosticism); father education(1=uneducated, 2=school, 3=college, 4=university);mother education(1=uneducated, 2=school, 3=college, 4=university); mother occupation(1=working, 2=homemaker); ideology (1=liberal, 2=conservative)

Correlation analysis between demographics and study variables revealed that gender had a positive significant relationship with intentions about the climate, risk perception and pro-environmental behaviours, which implies that women were more likely to have positive intentions towards the environment and perceive climate change as a risky phenomenon and show pro-environmental behaviours than men. Education also had a positive significant relationship with pro-environmental behaviours.

Furthermore, working participants had more knowledge regarding the causes of climate change. Participants with a nuclear family system evaluated climate change more negatively than participants with a joint family system. The results also highlighted that those whose parents were more educated had higher knowledge regarding the impacts of climate change. It was also revealed that participants whose mothers were working women had a higher understanding of the causes of climate change than participants whose mothers were homemakers.

Table 4: Correlation between Study Variables (N=200)

No.	Variables	1	2	3	4	5	6	7	8	9	10
1	Impact-knowledge	1	.14*	.23**	.20**	.26***	.09	.19**	.20**	-.05	-.03
2	Response-behaviour knowledge		1	.39***	.33***	.36***	.12	.23**	.33***	.14*	.20**
3	Cause-knowledge			1	.24**	.29***	.09	.17*	.24**	.11	.18*
4	Beliefs				1	.30***	.23**	.57***	.64***	.08	.13
5	Intentions					1	.19**	.27***	.32***	.11	.04
6	Personal Experience						1	.14	.20**	-.01	.09
7	Holistic Affect							1	.54***	.13	.08
8	Risk Perception								1	.20**	.31***
9	Personal Willingness									1	.27***
10	Pro-environmental Behaviours										1

Note. * $p < .05$, ** $p < .01$, *** $p < .00$

According to the results of Table 4.3, participants with higher knowledge regarding causes of climate change and response behaviours were more likely to engage in pro-environmental behaviours. Similarly, participants who perceived climate change as a more risky phenomenon were more probable to act pro-environmentally. Moreover, participants who were more willing to take action to reduce climate change were more likely actually to engage in pro-environmental behaviours as well.

The results also revealed that the three types of knowledge, i.e. impact knowledge, response behaviour knowledge and cause-knowledge, were significantly positively correlated. The knowledge subscales had a positive significant relationship with beliefs and intentions about climate change. All subscales of knowledge also shared a positive significant relationship with holistic effect and risk perception. Furthermore, people with higher knowledge regarding response behaviours to reduce climate change were more willing to take action at a personal level to mitigate climate change.

The subscales of attitude, i.e., beliefs and intentions about climate change, also had a significant positive relationship with each other and personal experience of extreme weather events. Beliefs and intentions also had a positive significant relationship with holistic and risk perception of climate change. Personal experience with extreme weather events also had a significant positive relationship with risk perception, which revealed that participants who had consciously experienced extreme weather had higher risk perception. Holistic effect also shared a significant positive relationship with risk perception, implying that participants who perceived climate change as an unpleasant and unfavourable process were likelier to have higher risk perception scores.

4.3 Mediation Analysis

PROCESS was used to test the mediation hypothesis. All the regression analysis assumptions were tested and fulfilled before running the analysis.

Table 5: Process Analysis to Asses Path (a) of Mediation. Knowledge, Beliefs and Intentions, Personal experience with Extreme Weather events and Affect Predicting Risk Perception and Personal Willingness in Young Adults (N=200)

Predictors	Risk Perception		Personal Willingness	
	β	SE	β	SE
Gender	.03	.75	.03	.51
Age	.07	.16	-.08	.11
Education	.08	.47	.04	.32
Socio-economic status	-.04	.65	-.02	.44
Father education	.12	.51	-.03	.35
Mother education	-.15*	.48	-.11	.32
Father occupation	-.05	1.22	.06	.82
Mother Occupation	-.10	.99	-.14	.67
Impact-knowledge	.03	.18	-.10	.12
Response-behaviour knowledge	.08	.19	.10	.13
Cause-knowledge	.02	.24	.05	.16
Beliefs about climate change	.39***	.08	-.03	.06
Intentions about climate change	.06	.12	.07	.08
Personal experience	.05	.71	-.05	.48
Holistic affect	.28***	.12	.13	.08
Total R ²	.53***		.08	

Note. * $p < .05$; ** $p < .01$; *** $p < .001$; β = Standardized Coefficient; SE= Standard Error of B (unstandardized coefficient); R2= R Square

The assumption of Baron and Kenny's model for path (a), IV predicting mediator was fulfilled for beliefs and affect when risk perception was a mediator. For the first mediator risk perception, the model explained a 53% variance in risk perception, $F(15,184) = 13.56, p < .001$. Beliefs about climate change and negative affective evaluation of climate change were positive significant predictors, and mother education was a negative significant predictor of risk perception, implying that less education of mothers, positive beliefs about climate change and negative effect of climate change lead towards higher risk perception of climate change. Path (a) was only significant for beliefs about climate change and its impact. For the second mediator, personal willingness, the overall model explained an 8% variation in personal willingness $F(15,184) = 1.13, p > .05$. There were no significant predictors of personal willingness. Path (a) was non-significant for the second mediator.

Table 6: Process Analysis to Asses Path (c) of Mediation. Knowledge, Beliefs and Intentions, Personal experience with Extreme Weather events and Affect Predicting Pro-Environmental Behaviour in Young Adults (N=200)

Predictors	Pro-Environmental Behaviour	
	β	SE
Path (c)		
Gender	.15*	.92
Age	.05	.20
Education	.10	.58
Socio-economic status	.04	.81

Father education	.08	.63
Mother education	-.20*	.59
Father occupation	-.17*	1.50
Predictors	β	SE
Mother Occupation	-.16*	1.22
Impact-knowledge	-.08	.23
Response-behaviour knowledge	.13	.23
Cause-knowledge	.15	.30
Beliefs about climate change	.03	.10
Intentions about climate change	-.08	.15
Personal experience	.10	.88
Holistic affect	.05	.15
Total R ²	.18**	

Note. * $p < .05$; ** $p < .01$; *** $p < .001$; β = Standardized Coefficient; SE= Standard Error of B (unstandardized coefficient); R²= R Square

The assumption of Baron and Kenny's model for path (c), IV predicting DV without a mediator was not fulfilled.

Table 7: Process Analysis to Asses Path (b) and (c') of Mediation. Knowledge, Beliefs and Intentions, Personal experience with Extreme Weather events, Affect, Risk Perception and Personal Willingness Predicting Pro-Environmental Behaviour in Young Adults (N=200)

Predictors	Pro-Environmental Behaviour	
	β	SE
Path (b) and (c')		
Gender	.12	.89
Age	.04	.19
Education	.07	.56
Socio-economic status	.05	.77
Father education	.05	.61
Mother education	-.14	.57
Father occupation	-.17**	1.44
Mother Occupation	-.11	1.19
Predictors	β	SE
Impact-knowledge	-.07	.22
Response-behaviour knowledge	.08	.22
Cause-knowledge	.13	.28
Beliefs about climate change	-.07	.10
Intentions about climate change	-.11	.15
Personal experience	.09	.85
Holistic affect	-.05	.15
Risk perception	.26**	.09
Personal willingness	.20**	.13
Total R ²	.26***	

Note. * $p < .05$; ** $p < .01$; *** $p < .001$; β = Standardized Coefficient; SE= Standard Error of B (unstandardized coefficient); R²= R Square

The assumptions of Baron and Kenny's model for path (b) mediator predicting DV and path (c') IV not predicting DV in the presence of mediator were fulfilled. The overall model explained 26% variance in pro-environmental behaviours, $F(17,182) = 3.81$, $p < .001$. Risk perception and personal willingness were significant positive predictors, whereas the father's occupation was the significant negative predictor of pro-environmental behaviour. Father occupation indicated that

fathers' employment status (compared to retired) leads to pro-environmental behaviour. The results also implied that high-risk perception about climate change and high personal willingness to reduce climate change at a personal level lead towards pro-environmental behaviours in your daily life.

The indirect effect of positive beliefs about climate change (Effect=.12, SE=.06, LL-UL=.03 - .27) and negative affective evaluation of climate change (Effect=.13, SE=.06, LL-UL=.04 - .28) on pro-environmental through risk perception was positive and significant, as there was no zero between the lower limit and upper limit of bootstrap (Preacher & Hayes, 2004). Sobel z test also indicated a significant positive indirect effect of positive beliefs about climate change ($z = 2.52$, SE=0.05, $p=.02$) and negative affective evaluation of climate change ($z = 2.57$, SE=0.05, $p=.01$) on pro-environmental behaviour through risk perception.

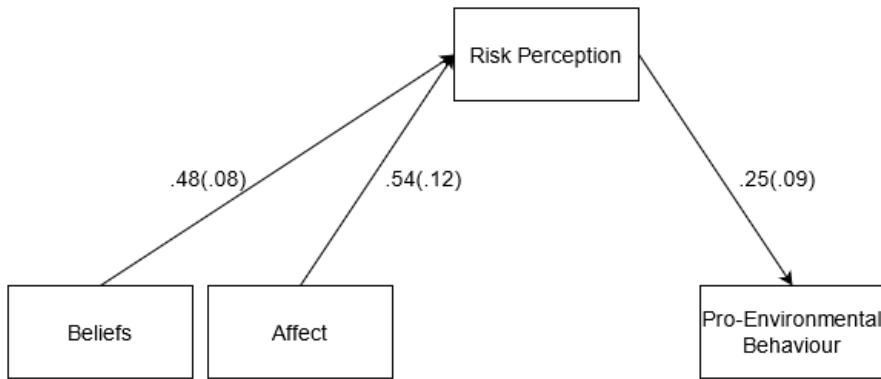


Figure 2: Beliefs and affect (IVs) had a positive indirect effect on pro-environmental behaviours (DV) through risk perception (mediator). Path (c) and (c') were non-significant regarding beliefs and affect. Unstandardised path coefficients are shown with standard errors in parenthesis.

4.4 Independent Sample T-test Analysis

Table 8: Independent Sample t-test Comparing Pro-Environmental Behaviours, Knowledge, Beliefs, Intentions, Personal Experience, Holistic Affect, Risk Perception and Personal Willingness in Men and Women (N=200).

Variables	Men		Women		t(df)	p	Cohen's d
	M	SD	M	SD			
Pro-environmental behaviours	37.29	6.60	39.29	6.21	-2.21(198)	.03	0.31
Impact-knowledge	5.32	2.23	5.28	1.90	.14(181.91)	.89	0.02
Response-behaviour knowledge	5.57	2.16	5.60	2.25	-.09(198)	.93	0.01
Cause-knowledge	4.47	1.74	4.25	1.60	.94(198)	.35	0.17
Beliefs about CC	45.12	6.83	46.36	4.42	-1.54(198)	.13	0.22
Intentions about CC	19.70	3.48	20.82	3.04	-2.44(198)	.02	0.34
Personal experience	1.83	.48	1.81	.55	.20(198)	.84	0.04
Holistic affect	17.65	4.03	18.10	3.15	-.90(198)	.37	0.12
Risk perception	46.75	7.73	49.02	5.82	-	.02	0.33
Personal willingness	15.86	3.27	16.19	3.41	2.31(169.46)	.49	0.10

Note: M= Mean; SD= Standard Deviation; $p < .05$; $**p < .01$; $***p < .001$; Men (n=93), Women

($n=107$); *CC= climate change*

According to the results in Table 4.5, there were significant gender differences in pro-environmental behaviours, intentions about climate change and risk perception. Women were more likely to engage in pro-environmental behaviours than men; hence, the hypothesis regarding gender differences was accepted. Women also had higher intentions about climate change, implying that their actions could make a difference in reducing climate change. Moreover, women also had higher risk perceptions than men, indicating that women perceive climate change as more risky and threatening than men.

5 Discussion

The present study was carried out to assess the association between knowledge of people regarding climate change, attitude (beliefs and intentions) towards climate change, affective evaluation of climate change, personal experience with extreme weather events, risk perceptions about climate change, individual willingness to sacrifice for climate change and pro-environmental behaviours financially.

The literature can support the impact of beliefs on risk perception; people who believe that the earth's climate is deteriorating have significantly higher risk perception than others (Zobeidi et al., 2020). Risk perception was a significant mediator for pro-environmental behaviour (Zeng et al., 2020). Beliefs and risk perception also had a positive significant correlation. They are concerned about climate change. Risk perception of climate change makes people perceive the issue of climate change as more severe and essential and increases their sense of urgency. Risk perception stimulates them to act responsibly to protect the climate, leading them to pro-environmental behaviour (Lin et al., 2021). This finding is consistent with the literature; strengthening the beliefs about climate change leads to a higher risk perception of climate change, increasing support for pro-environmental behaviours to reduce climate change (van der Linden et al., 2015). The value-belief-norm theory can also validate this finding (Shao & Hao, 2020).

If people process climate change as an unpleasant, unfavourable phenomenon and hold negative feelings towards it, they are more likely to perceive it as risky. Consequently, they are more likely to act pro-environmentally. It can be validated through The Climate Change Risk Perception Model (CCRPM); a negative, practical evaluation of climate change can increase the risk perception of people towards climate change (van der Linden, 2015). It is also consistent with the research evidence; many recent studies claimed that emotions and affect contribute significantly to forming risk perceptions (Gustafson et al., 2020; Jovarauskaite & Böhm, 2020). Negative affect was the most potent predictor of climate change risk perceptions (van Eck et al., 2020; Xie et al., 2019). Risk perception, in turn, significantly predicts pro-environmental behaviour (Lin et al., 2021). Literature evidence supports this finding and claims that risk perception is critical to engaging people in pro-environmental behaviour; it predicts different types of pro-environmental practice (Graham-Rowe et al., 2015; Zander, 2018).

The majority of the people had a negative generalised effect towards climate change. 82% perceived it as unfavourable, 88.5% considered it unpleasant, and 85.5% reported climate change as unfavourable. Moreover, our sample reported high-risk perceptions of climate change. Most people perceived climate change as a personal as well as societal or global risk. 90.5% of people perceived climate change as risky at an individual level, 92% perceived it as a worldwide threat, and 92% perceived climate change to severely impact Pakistan. 46% of people reported frequently worrying about the issue of climate change.

Suppose people are willing to sacrifice financially for the climate. In that case, if they are willing to pay more for electricity and use less electricity, pay a higher fuel price and reduce the use of personal vehicles, increase the use of public transport, cycle or walk, to buy environmentally

friendly products even if their prices are high, pay to offset to reduce carbon emissions in case they travel by air, they are more likely to engage in actual pro-environmental behaviour. The Theory of Planned Behaviour (TPB) also validates these findings; it emphasises that intentions/willingness are essential antecedents to behaviour, and intentions/willingness drive behaviour (Demir et al., 2021). Willingness can determine whether or not the public would act pro-environmentally (Chen & Zheng, 2016).

This finding can be supported by the evidence from the literature, which claims that a person's willingness to sacrifice for climate protection is a significant positive predictor of climate-friendly behaviour (Octavia et al., 2021). However, personal willingness did not act as a mediator; no study variable significantly predicted personal willingness. Tobler et al. (2012) suggested that perceived costs and benefits are critical determinants of willingness in people. In our sample, the willingness of people to financially contribute to reduce climate change was not that high. 34.5% of people were unwilling to pay higher fuel prices and facilitate the use of personal cars, and only 5.5% were utterly willing to do so. However, most people were willing to purchase environmentally friendly products (81.5%) from green companies (88%) even at a higher price.

Knowledge about climate change did not significantly impact risk perception, personal willingness or pro-environmental behaviours. Many studies found no significant link between pro-environmental actions and knowledge, risk perception and willingness (Xie et al., 2019). Moreover, inaccurate information does not influence willingness of people (Butt et al., 2019). These misconceptions can hinder accepting climate change and adopting pro-environmental behaviours (Graves & Roelich, 2021).

Intentions about climate change did not significantly influence people's pro-environmental behaviours, risk perception or personal willingness. Researchers reported discrepancies between intentions and actions (Zhang et al., 2019). Mixed findings were found regarding intentions in the sample. Only 39.5% of people believed that they could help tackle climate change. Personal experience with extreme weather events also had no significant impact on risk perception, personal willingness or pro-environmental behaviours. Several studies found no significant link between individual experience of extreme weather incidents and climate change risk perception (Bergquist et al., 2019).

In the sample, 88.5% of people reported experience with extreme weather events, whereas 11.5% reported no experience. Despite experience with extreme weather events, people may not form risk perception or act pro-environmentally, especially if the intensity of the extreme events is not that severe and does not occur that often. People believe a catastrophic event will not likely happen again soon after its last incidence (Wachinger et al., 2013).

Generally, the engagement of people in pro-environmental behaviours in Lahore was moderate. Most people were actively involved in energy conservation behaviour. The motivation behind the energy conservation behaviour could be monetary. However, they were not much engaged in water conservation. Only 23.5% of people reported consistently using public transportation, carpooling, cycling, or walking, and most reported never or rarely using public transit.

Moreover, the majority of the people (65%) did not decrease their consumption of poultry. On the contrary, 58.5% of people reduced their beef consumption, but they had other reasons behind this. They either did not prefer consuming it or avoided it due to health issues. This low level of engagement can be attributed to a lack of knowledge, resources, opportunities and infrastructure (Butt et al., 2019; Shahid, 2015). To conclude, there's a dire need to increase people's pro-environmental behaviour practices.

Moreover, there were significant gender differences in pro-environmental behaviours, risk

perception and intentions about climate change. Women were more involved in pro-environmental practices than men (Gheorghiu et al., 2015). Women showed higher risk perception/concern for climate change than men and reported higher intentions than men (Christensen & Knezek, 2015).

As for the results of correlation analysis, knowledge about the causes of climate change and knowledge regarding the response behaviour had a positive significant relationship with pro-environmental behaviours; they can adopt that can significantly reduce climate change and are more likely to engage in pro-environmental behaviours (Hart et al., 2015). Knowledge also shared a significant positive relationship with holistic effect, indicating that participants with a higher understanding regarding climate change were more likely to evaluate the phenomenon of climate change negatively; they found it unpleasant and unfavourable (van Eck et al., 2020). Knowledge and risk perception were also significantly positively correlated, implying that participants with higher knowledge about climate change perceived climate change as more risky and threatening (van der Linden, 2015; van Eck et al., 2020; Xie et al., 2019). Furthermore, response-behaviours knowledge had a positive significant relationship with personal willingness, indicating that people with higher knowledge regarding behaviours to reduce climate change were more willing to take action at an individual level to mitigate climate change (Xie et al., 2019).

5.1 Conclusion

The study concludes that positive beliefs regarding climate change (the belief that climate is changing, human activities are the reason behind it, and actions of an individual can help tackle climate change) and negative affective evaluation (perceiving climate change as an unpleasant, unfavourable and harmful phenomenon) leads towards higher risk perception in people (perceiving climate change a significant threat at the personal and societal level and being concerned about it), which in turn, encourage people to engage in pro-environmental behaviours. Moreover, individual willingness to financially contribute to reducing climate change (pay higher prices for fuel, electricity, and environmentally friendly products) is the most significant predictor of pro-environmental behaviours.

5.2 Limitations and Suggestions

Additional variables, such as sociocultural influences, should be assessed to improve the variance in pro-environmental behaviours (van der Linden, 2015). Future studies should also evaluate the determinants of personal willingness as they significantly impact pro-environmental behaviours. A correlational research design is used in this study, which means causal inferences cannot be drawn. The low reliability of the knowledge scale should be catered for in future studies. This research does not study the barriers to acting pro-environmentally, which can impact pro-environmental behaviours.

5.3 Implications

This study identifies the crucial role that beliefs about climate change, adverse effects towards climate change, risk perception of climate change and personal willingness to sacrifice financially to reduce climate change play in leading society towards sustainability. Interventions should be designed to strengthen people's beliefs, and the interventions should appeal to and stimulate the affective component (van der Linden, 2015), as the effect is the strongest predictor of risk perceptions, which leads people towards pro-environmental behaviours. Current attempts to mitigate climate change are inadequate, and it has been proposed that radical and urgent action is required. We are running out of time. We must start working to improve the climate to save the environment and future generations.

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