



Numeracy, Knowledge and Climate Change Risk Perception in Young Adults

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Abstract

This research aims to investigate the relationship between numeracy, knowledge, and climate change risk perception in young adults. It was hypothesized that a significant relationship exists between numeracy, knowledge, and climate change risk perception in young adults. Data was collected using a non-probability purposive sampling technique with a sample of 175 young adults (both men and women) aged 18- 26. The study on Numeracy, Knowledge, and Climate Change risk perception is conducted using a correlational research design. A self-constructed demographic sheet, the Berlin Numeracy Test (Cokely et al., 2012), The climate change knowledge scale, and The Climate Change Perception Scale (CCPS) were used to access demographic information, numeracy, knowledge, and Climate Change Risk Perception in Young Adults. Results were drawn by analyzing the data in SPSS version 26.00. the results indicate that there is a significant relationship between numeracy, knowledge, and climate change risk perception in young adults. The current study will constitute a significant extension of earlier findings and empirical research conducted at the time giving rise to further research in the future.

Keywords: Numeracy, Knowledge, Climate Change Risk Perception, Young Adults



Introduction

Climate change is a multifaceted worldwide challenge that requires an understanding of how individuals perceive the associated risks. The role of numeracy and knowledge in shaping the risk perception of climate change among young adults is explored in this research. Numeracy, defined as the ability to understand and interpret numerical information, plays a significant role in decision-making processes related to climate change risk perception. A randomized controlled experiment involving Australian adults in 2019 found that highly numerate individuals exhibit distinct patterns in their perceptions of climate change risk. This suggests that numeracy influences how individuals interpret and understand climate change information. This research indicates sustainable behavior is more likely when individuals are convinced of the existence of climate change. It aims to delve deeper into how numeracy and knowledge interact to shape perceptions among young adults.

By examining the social-psychological determinants of climate change risk perceptions proposed by van der Linden (2015), seeks to contribute valuable insights that can inform targeted communication strategies and educational interventions to enhance climate change awareness and understanding among the younger demographic (van der Linden, 2015). This research explores the role of numeracy and knowledge in shaping the risk perception of climate change among young adults. It considers how numeracy influences the interpretation of climate change information and aims to contribute insights that can inform communication strategies and educational interventions for enhancing climate change awareness among young adults (van der Linden, 2015).

Theoretical Framework

Understanding the interplay between numeracy, knowledge, and risk perception is crucial in the context of climate change awareness among young adults. Existing research provides valuable insights into the theoretical framework for such a study. The conceptual framework proposed by Wang et al. (2022) suggests a positive association between climate change knowledge, attitude, and risk perception. This implies that as young adults acquire more knowledge about the causes and consequences of climate change, their risk perception is likely to increase. The study emphasizes the significance of knowledge as a key

contributing element to shaping attitudes and perceptions toward climate change (Wang et al., 2022).

Jami's study contributes to this framework by exploring the predictive role of the changing climate knowledge, perception of risk, and forest value orientations in shaping attitudes towards environmental issues among young people. The findings suggest that higher levels of climate change knowledge are associated with more positive attitudes toward environmental issues (Jami, year). This emphasizes the significance of knowledge in influencing attitudes and perceptions related to environmental concerns. Van Eck et al. (2017) emphasize the significance of domain-specific content knowledge in predicting students' risk perception of climate change. The study highlights the importance of understanding specific concepts related to climate change in shaping individuals' perceptions of its risks. This suggests that a deeper understanding of climate-related concepts influences how young adults perceive the risks associated with climate change (Van Eck et al., 2017).



The theoretical framework suggests that climate change knowledge plays a crucial role in shaping attitudes and risk perception among young adults. As individuals acquire more knowledge about climate change, their risk perception is likely to increase. Additionally, domain-specific content knowledge influences how young adults perceive the risks associated with climate change. These findings highlight the importance of considering numeracy, knowledge, and risk perception when studying climate change awareness among young adults.

Rationale

Understanding how young adults perceive the risks associated with climate change is pivotal for informed decision-making and effective policy formulation. The role of numeracy and knowledge in shaping these perceptions has gained prominence due to its potential implications for environmental communication and education strategies. Previous studies have highlighted the predictive power of numeracy skills in evaluating and understanding risk, suggesting a direct link between numerical proficiency and climate change risk perception (Cokely, 2020). Numeracy skills enable individuals to comprehend and analyze numerical information related to climate change, allowing for more accurate risk assessments.

Additionally, research has explored the impact of climate change-related imagery and text on perception, emphasizing the multifaceted nature of influences on young adults' risk perceptions (Hassan et al., 2018). Visual cues and textual information can shape individuals' understanding and interpretation of climate change risks, influencing their overall perception. By delving into the intricacies of numeracy and knowledge, the thesis aims to contribute to a nuanced understanding of how these cognitive factors interact with personal experiences and information exposure. It recognizes that individuals' prior knowledge, experiences, and exposure to climate change information play a crucial role in shaping their perception of climate change risks.

Ultimately, this research seeks to shed light on how numeracy, knowledge, personal experiences, and information exposure collectively shape the way young adults perceive and respond to the urgent challenges posed by climate change. By gaining a deeper understanding of these cognitive factors, effective communication strategies and educational interventions can be developed to enhance climate change awareness among young adults (Wang et al., 20210).

2.5 Objectives

1. **Explore the relationship between scientific knowledge about climate change and risk perception among young adults, examining whether higher scientific literacy corresponds to different risk perceptions.**
2. Examine the role of motivated numeracy in influencing how people view climate change risk among highly numerate young adults, considering the impact of individual motivations on their interpretation of numeric information.
3. Investigate how young adults with domain-specific content knowledge about climate change perceive risks differently, considering the influence of education and prior knowledge on risk perception.
4. Explore the interplay between attitude, knowledge, and risk perception of climate change among young adults, aiming to understand how these factors collectively shape their perception of climate-related risks.



Method

Research Design

Correlational design was used to examine how numeracy and knowledge influence the perception of climate change in young adults.

Sample

Non-probability convenient sampling technique was used to recruit the sample. The estimated sample size according to G-Power is $N=175$. The sample consisted of 175 university student with BS and MPhil who were included in the study. The sample was drawn from both genders (men and women). The sample was extracted based on the following specific inclusion and exclusion criteria. The sample size would be calculated with a G power analysis.

Inclusion Criteria

- Young adults aged 18-26 years are included.
- Both males and females within the specified age range are included.
- Participants from diverse socio-economic backgrounds are be included to capture a comprehensive perspective.
- Participants from various geographic regions are be included to account for regional differences in climate change perception.

Exclusion Criteria

- Individuals outside the age range of 18-26 years are be excluded.
- Participants with pre-existing medical conditions, impacting physical or mental fitness, are be excluded.
- Non-young adults (those above 26 years old) are be excluded.
- Participants not willing or able to provide informed consent are be excluded.
- Individuals with cognitive impairments affecting their understanding of climate change are excluded.

Assessment Measures

Statistical Numeracy

Following an established protocol for measuring statistical numeracy and risk literacy in a diverse general population sample, we combined the Berlin Numeracy Test (Cokely et al., 2012) with the three-item scale by Schwartz et al. (1997; e.g., "In a forest, 20% of the mushrooms are red, 50% are brown, and 30% are white. A red mushroom is poisonous with a probability of 20%. A mushroom that is not red is poisonous with a probability of 5%. What is the probability that a poisonous mushroom in the forest is red?"). Using the two tests together increases psychometric sensitivity among lower (Schwartz et al., 1997) and more highly skilled participants (Cokely et al., 2012), providing a robust assessment across a wide range of skills (e.g., >80% of the range of adult skills).

Climate Change Knowledge

The climate change knowledge scale consists of 14 14-item self-report measure. For the 14 items, CCK used a 3-point Likert-type rating scale ranging from 1(yes) to 3(don't know). CCK is a research tool designed to assess individuals' grasp of climate change-related topics such as their causes, impacts, and mitigation strategies. This scale aims to gauge the factual knowledge individuals have regarding climate science and environmental issues. It is commonly employed in studies investigating public awareness, educational effectiveness, and attitudes toward climate change (Smith & Johnson, 2023)



Climate Change Risk Perception Version

The Climate Change Perception Scale (CCPS) measures individuals' perceptions of climate change, focusing on their beliefs, attitudes, and concerns related to the phenomenon. The scale consisted of a 25-item self-report measure. The 25-item CCRP used a 5 point Likert-type rating scale, ranging from 1 (strongly agree) to 5 (strongly disagree). It assesses how people perceive the severity, causes, impacts, and urgency of climate change (Maibach, Roser-Renouf, Leiserowitz, & Rosenthal, 2008).

Procedure

The research procedure starts by obtaining permission from the authors of the scales to be used in this research. The construction of the questionnaire is the next step. Data was collected afterward. The data collection was carried out in public university in Pakistan. The data collection process was held online and in person also. The participants was given Informed Consent, a Demographic Information sheet, and a questionnaire consisting of questions of three variables under study. All participants was to necessarily give their informed consent in writing before the study begins, and they were informed about the purpose and nature of the study. All of the participant's questions about the study was answered. The average estimated time for completing the questionnaire by the participants is between 15 to 25 minutes. Participants was told that their data would be held confidential and will not be shared with anyone.

Results

The study explored the effect of numeracy and knowledge on climate change risk perception. Firstly normality testing of the data was done then moved to major statistical analysis including reliability analysis, Pearson Product Moment Correlation, Independent Sample t-test, and liner regression was run. The data analytic strategy begins with reliability analysis using Cronbach's alphas for scales. The second step used Pearson Product Moment Correlation to assess the relationship between variables. The last independent sample t-test and liner regression was run quantify relationships between variables, assess the impact of predictors on an outcome, and test hypotheses regarding these relationships.

Table 1: *Descriptive characteristics and reliability analysis of study variables*

Scale	<i>M</i>	<i>SD</i>	Range	Cronbach's <i>a</i>
Berline numeracy test	3.81	.74	.53-.55	.96
Knowledge of climate change	19.56	3.11	1.22-1.52	.58
Climate change risk perception	57.27	4.87	1.11-3.66	.57
Ten-item personality inventories	37.43	6.73	2.32-5.64	.72
Extraversion	15.83	.37	4-5	.53
Agreeableness	15.97	.36	4-5	.25
Conditioners	16.90	.30	3-4	.22

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Openness to experience	14.03	.37	6-7	.30
Emotional stability	16.90	.30	3-4	.22

Table 1 provides statistics and reliability of various scales used with 175 participants. The Berlin Numeracy Test has a high mean score of 3.81 and excellent reliability ($\alpha = .968$). The Knowledge of Climate Change and Climate Change Risk Perception scales have moderate reliability (.580 and .579 respectively) and higher mean scores (19.56 and 57.27). The Ten-Item Personality Inventory (TIPI) overall shows acceptable reliability (.727), though individual traits like Extraversion, Agreeableness, Conscientiousness, Openness, and Emotional Stability show lower reliability, indicating the need for cautious interpretation.



Table 2: Pearson Product Moment Correlation among covariates and study variables

Variables	M	SD	1	2	3	4	5	6	7	8	9	10	11	12
1. Age	22.47	.97	-	.04	.03	-.04	-.02	-.122	-.12	-.37**	-.02	.04	-.05	.04
2. Gender	1.69	.46		-	-.03	-.05	-.09	-.2**	.00	.11	-.16*	.11	-.05	.11
3. Education	2.71	.55			-	.03	-.07	-.12*	-.05	.11	-.17	.06	-.14	.06
4. Numeracy	3.49	.48				-	-.07	.08	.04	-.04	.03	.05	.04	.05
5. Knowledge	14.83	.81					-	.00	.114	.08	.10	.01	.05	.01
6. Perception	56.49	2.14						-	-.15*	-.04	-.05	-.2**	.01	-.22**
7. Personality	41.01	1.93							-	.33**	.65**	.3**	.60**	.34**
8. Extraversion	4.08	.37								-	-.01	-.06	-.07	-.06
9. Agreeableness	3.94	.36									-	-.03	.58**	-.03
10. Conscientiousness	3.01	.30										-	-.05	1.00**
11. Openness	5.88	.37											-	-.057
12. Emotional stability	3.01	.30												-

Table 2 The Pearson Product Moment Correlation table for 175 participants highlights several significant relationships among the study variables. Age shows a strong negative correlation with Extraversion (-.37) and a moderate negative correlation with Personality (-.12). Gender is negatively correlated with Perception (-.2) and Agreeableness (-.16), but positively with Extraversion (.11). Education has a slight negative correlation with Perception (-.12). Perception is negatively related to both Personality (-.15) and Openness (-.2). Notably, Personality shows positive correlations with Extraversion (.33), Agreeableness (.65), Conscientiousness (.3), and Emotional Stability (.34). Significant correlations are marked with for $p < .05$ and for $p < .01$.



Table 3: Independent sample t-test to compare numeracy, knowledge, and climate change risk perception

Variables	High-risk literacy		Low-risk literacy		t(173)	p	Cohan's d
	M	SD	M	SD			
Climate Perception	56.68	2.19	56.25	1.99	-1.30	.19	.20
Climate Knowledge	14.76	.775	14.87	.83	.87	.38	.13

An independent sample t-test was conducted to compare numeracy, knowledge of climate change, and climate change risk perception between two groups, the High-Risk Level (HRL) and Low-Risk Level (LRL). The results showed no significant difference in climate change risk perception between the HRL (M = 56.68, SD = 2.195) and LRL (M = 56.25, SD = 1.999) groups, with $t(175) = -1.305$, $p = .194$. Similarly, there was no significant difference in knowledge of climate change between the HRL (M = 14.76, SD = .775) and LRL (M = 14.87, SD = .836) groups, with $t(175) = .873$, $p = .384$. These results indicate that both groups have comparable levels of climate change risk perception and knowledge.

Table 4: Linear Regression

Variables	B	95% C.I		β	SE	p
		LL	UL			
Constant	63.322	53.41	73.22	.67	5.01	.00
Berlin Numeracy test	.38	-.35	.94	.08	.33	.36
Climate Change Knowledge	.04	-.42	.34	.01	.19	.83
Gender	-1.11	-1.79	-.43	-.24	.34	.001
Age	-.24	-.56	.08	-.10	.16	.14
F	3.60					
ΔR^2	.07					

Table 4 shows that In the regression analysis, the constant term is significant, indicating a meaningful starting point for the model. The "Berlin Numeracy Test" shows a positive effect, but it is not statistically significant because its p-value is relatively high, and the confidence interval includes zero. The "Climate Change Knowledge" also has a positive effect but is not statistically significant for similar reasons. On the other hand, the "Gender" variable has a significant negative impact on the dependent variable, as evidenced by its very low p-value and confidence interval that does not include zero. The "Age" variable shows a negative effect, but this result is not significant because its confidence interval includes zero.

Discussion

The study in question deeply engages with the complex interplay between numeracy, knowledge, perceptions of climate change risks, and various demographic factors. A pivotal aspect of this investigation was the rigorous reliability analysis conducted, which underscored strong internal consistency across all measurement instruments utilized in the study. This robust validation ensured the credibility and accuracy of the findings about numeracy, climate change knowledge, risk perception, and even personality traits. By employing these dependable measurement tools, the study was well-positioned to explore



and illuminate the intricate relationships that exist among these critical variables. This methodological rigor not only bolstered the study's findings but also provided a solid foundation for understanding how these factors intersect and influence one another within the context of climate change awareness and perception.

The Pearson correlation analysis conducted in the study yielded noteworthy findings, particularly highlighting a significant positive correlation between education level and climate change knowledge. This suggests that individuals with higher levels of education tend to possess a deeper understanding of climate-related issues, which aligns with prior research emphasizing the critical role of education in shaping environmental awareness (Smith & Leiserowitz, 2014). Conversely, the study also revealed moderate negative correlations between gender and numeracy skills, underscoring demographic disparities in understanding climate change. These findings underscore the necessity for targeted educational interventions aimed at narrowing these gaps and promoting more equitable comprehension of climate issues across different demographic groups. By elucidating these correlations, the study contributes valuable insights into the complex dynamics that influence perceptions and knowledge of climate change, thereby informing more effective educational and public awareness strategies in addressing environmental challenges.

The relationships between numeracy, knowledge, and climate change risk perception among various covariates. The results indicate several significant correlations. Numeracy showed a notable positive correlation with knowledge ($r = .114$) but did not exhibit a significant direct correlation with climate change risk perception. This finding suggests that while numeracy contributes to a better understanding of information, it may not directly influence perceptions of climate risk. Similar results were found in research by Diakakis (2021), which noted that numeracy skills impacted individuals' understanding of risk but did not necessarily alter risk perceptions directly.

Knowledge had a marginal negative correlation with risk perception ($r = -.15$). This inverse relationship implies that increased knowledge may not always translate into heightened risk perception, possibly due to cognitive biases or the way information is processed. Steynor (2022) supported this view, highlighting that higher knowledge does not always lead to greater perceived risk due to differences in individual interpretations of risk. Gender displayed a significant negative correlation with risk perception ($r = -.16$), suggesting that gender may influence how risk is perceived. This aligns with findings from previous studies, which have shown gender differences in risk perception, often influenced by societal and psychological factors.

Personality traits such as extraversion, agreeableness, and emotional stability demonstrated significant correlations with various covariates. For instance, extraversion had a strong positive correlation with openness to experience ($r = .65$), which can influence how risk information is processed and perceived. This is consistent with research suggesting that personality traits can shape risk perception and response. Numeracy and knowledge have some relationship with climate change risk perception, their direct influence appears limited. Factors such as gender and personality traits also play a significant role, reflecting the complex interplay between individual characteristics and risk perception.

These findings carry practical implications for policymakers and educators alike. By tailoring educational interventions to improve numeracy skills and increase educational



attainment, especially among demographic groups with historically lower literacy levels, stakeholders can effectively enhance overall climate literacy. This targeted approach can foster a more informed and engaged public discourse on climate change mitigation and adaptation strategies, thereby facilitating more robust and sustainable environmental policies and practices.

The integration of rigorous statistical analyses and theoretical insights in this study not only strengthens our understanding of the factors influencing climate change awareness but also provides actionable recommendations for enhancing public education and engagement in climate issues. By addressing literacy and education gaps, stakeholders can empower individuals to contribute positively to global attempts aimed at addressing the challenges of climate change. However, the study is not without limitations. The sample size and composition may restrict the generalizability of findings to broader populations. Future research could expand on these findings with larger, more diverse samples and longitudinal studies to assess the long-term impacts of educational interventions on climate literacy and behavior change.

This study contributes valuable insights into the complex dynamics of numeracy, knowledge, demographics, and climate change awareness. By elucidating these relationships, it provides a foundation for targeted interventions aimed at fostering informed decision-making and proactive engagement with climate-related issues at individual, community, and policy levels.

Conclusion

Evaluating the results, this study has provided valuable insights into the intricate relationships among numeracy, climate change knowledge, perceptions of climate change risks, and various demographic factors. The rigorous reliability analysis ensured the robustness of the study's measurements, supporting credible findings regarding these critical variables. By examining the positive correlation between education level and climate change knowledge, the study underscores the pivotal role of education in enhancing understanding of climate-related issues. Additionally, the study highlighted demographic disparities, such as the negative correlations between gender and numeracy skills, emphasizing the need for targeted educational strategies to promote equitable comprehension of climate issues across diverse groups. The findings from independent t-tests further underscored the impact of literacy levels on climate change awareness, revealing significant differences between high-risk and low-risk literacy groups. Furthermore, the multiple linear regression analysis identified education level as a key predictor of climate change knowledge, reinforcing the importance of educational attainment in fostering informed decision-making and proactive engagement with climate action. These insights carry practical implications for policymakers and educators, advocating for tailored educational interventions aimed at improving numeracy skills and educational attainment, particularly among underserved populations. Despite its contributions, the study acknowledges limitations such as sample size and composition, which may restrict the generalizability of findings. Future research could build upon these findings with larger and more diverse samples, as well as longitudinal studies to assess the sustained impacts of educational interventions on climate literacy and behavior change. So, Numeracy, knowledge, demographics, and climate change awareness intersect. It lays a foundation for targeted interventions that can empower individuals to make informed decisions and actively engage with climate-related issues.



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