An Exploratory Factor Analysis of the Removing Carbon from the Atmosphere Domain of the Climate Change Action Inventory

Sisi Mai, Fred Vincent Margallo, Megan F. Lopez,
Maya Lopez Foresythe, and Kimberly A. Barchard
University of Nevada, Las Vegas

INTRODUCTION

- Carbon dioxide emissions are drastically contributing to climate change.
- Even if all Greenhouse Gas (GHG) emissions were to stop now, the planet would continue to warm due to the continued presence of GHG. Therefore, individuals, organizations, and governments need to remove the excess carbon that is already in the atmosphere.
- Methods of carbon removal include:
  - Direct Air Capture
  - Reforestation
  - Biochar
  - Changing ocean alkalinity
- The Climate Change Action Inventory (CCAI; Barchard et al., 2021) measures how often people take direct or indirect actions to reduce climate change.
- The CCAI has eight domains, including Removing Carbon from the Atmosphere.
- The purpose of our study is to determine if Removing Carbon from the Atmosphere is unidimensional as intended or if it contains multiple factors.

METHOD

Participants

- 500 CloudResearch approved participants living in the United States were recruited from Amazon's Mechanical Turk (Mturk).
- 15 climate change deniers and 36 multivariate outliers filtered out.
- We were left with 446 participants:
  - Gender: 257 male, 186 female, and 3 non-binary.
  - Age: 19 to 76 (M = 39.79, SD = 11.64).

Measures

- The Climate Change Action Inventory (CCAI; Barchard et al., 2021) measures how often people take actions that can reduce climate change.
  - The Removing Carbon from the Atmosphere Domain includes 9 items measuring how often people take direct or indirect actions that can remove carbon from the atmosphere.
  - Each item is rated on a 9-point frequency scale with response options ranging from 1 (*less than once a year*) to 9 (*at least 14 times a week*).

Procedures

- Participants completed a 15-minute online survey and were given $3 after completion.

Data Analysis

- To determine the number of factors underlying this domain, we considered five criteria: theory, the Kaiser-Guttman rule, the scree plot, parallel analysis, and the minimum average partial test.
- These criteria suggested one or two factors, so we extracted and interpreted both solutions. For the two-factor solution, we examined multiple orthogonal and oblique rotations.

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How individuals can remove carbon from the atmosphere

RESULTS

- For the one-factor solution, every item had a strong loading, strongly suggesting a one-factor solution was appropriate. See Table 1.
- For the two-factor solution, the direct oblimin rotation was the best rotation as it was the closest to the ideal of a simple structure. However, the factors had a high correlation (.66), no coherent interpretation of the factors was possible, and only a single item failed to load on the first factor. These results indicate the two-factor solution was not appropriate. See Table 2.

DISCUSSION

- We conclude that the CCAI Removing Carbon from the Atmosphere domain is unidimensional, as intended.
- Researchers can assess how much effort individuals are exerting to remove carbon from the atmosphere using the total score from all items.
- Future revisions of the CCAI could expand the range of actions listed in this domain to more fully capture individual efforts. For example, individuals can also use compost or biochar to improve soil health. Moreover, items that ask about contributions to organizations can be divided into specific strategies (e.g., organizations supporting biochar, organizations working to change ocean alkalinity, organizations supporting the use of wood vaults, etc.).

Table 1

One-factor Solution

Item	Pattern Matrix Coefficient
Item 1	.71
Item 2	.87
Item 3	.88
Item 4	.90
Item 5	.95
Item 6	.95
Item 7	.96
Item 8	.95
Item 9	.95

Table 2

Two-factor Solution: Uninterpretable

		Factor		
Item		1	2	h^2
Item 1	Plant or take care of trees	-.07	**.99**	.89
Item 2	Pay others to plant or take care of trees (e.g., landscapers, homeowners association)	**.76**	.15	.76
Item 3	Encourage others to plant or take care of trees	**.42**	**.59**	.86
Item 4	Problem solve how to plant or take care of trees	**.47**	**.56**	.88
Item 5	Give time or money to organizations that are planting or taking care of trees (e.g., rainforest preservation, forest restoration)	**.88**	.10	.91
Item 6	Buy carbon offsets (e.g., to fund environmental projects that reduce greenhouse gases)	**.99**	-.04	.94
Item 7	Encourage others to buy carbon offsets	**.99**	-.02	.96
Item 8	Problem solve how to improve carbon capture and removal	**.98**	-.01	.95
Item 9	Give time or money to organizations working on carbon capture and removal	**1.02**	-.07	.95
	Factor Intercorrelations	1	2	
	Factor 1	1		
	Factor 2	.66	1	

Note. h^2 = communality. Salient factor pattern matrix coefficients are in boldface.