

2.35 **ASSESSING THE HUMAN EXPERIENCE OF CLIMATE: DEVELOPMENT OF THE CLIMATE ADJECTIVE RATING SCALE (CARS)**

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1. Introduction

A number of words in the English language can be used to describe weather conditions and climate. Meteorologists frequently use these terms in preparing and communicating weather forecasts while climatologists employ these terms in summarizing or characterizing the climates of different regions. The lay public also uses a variety of terms to communicate about the weather and climate. Such terms and the way people use them are significant because they can reflect the experiences and meanings that people attach to different climate conditions. Further it is possible that the use of particular weather or climate descriptors could shape or affect the perceptions people have of conditions or events (de Shazer, 1994).

Although many terms can be used to describe climate conditions, the research in this project investigated whether more basic, latent dimensions existed that could explain the fundamental ways people experienced and communicated about climate. Specifically, this project describes the development of the Climate Adjective Rating Scale (CARS), a psychological measure designed to examine how people use language to characterize their experience of the weather and climate. This instrument was developed to fulfill two purposes, the first of which was to begin building an understanding of the latent dimensions or constructs that underlie people's use of the variety of English words that describe climates. The second purpose, which is yet to be fulfilled, involves using the instrument to characterize the climate conditions of different geographical regions.

2. Development of the Climate Adjective Rating Scale (CARS)

The author searched multiple English language dictionaries to identify as many of the English words (most typically adjectives) as possible that were used to describe weather and climate (or that could function in this capacity). Terms that were identified were then cross-referenced with several thesauri to ensure that an inclusive and comprehensive listing of terms was developed. Some adjectives obviously were weather- or climate-related (e. g., *rainy, blustery, sunny, cloudy*, etc.). Other adjectives were identified and included which were not exclusively related to weather or climate but that appeared, at least anecdotally, to be frequently used in an evaluative way to characterize climates (e. g., *good, bad, pleasant, peaceful*).

The search resulted in 153 terms descriptive of weather and climate. Of these terms, 53 seemed most relevant in describing temperature and humidity conditions, 30 related to atmospheric lighting and cloud-cover conditions, 26 pertained to precipitation and related conditions, and 47 were descriptive of particular weather events or pertained to general and evaluative ways in which climate could be described. Several terms were appropriate for describing two or more of the above events, hence the total of 156.

In organizing the terms for presentation to research participants, the list was alphabetized. Next to each term was a five point Likert-type rating scale that ranged from 1 = *Never describes my experience of the weather/climate of this place* to 5 = *Always describes my experience of the weather/climate of this place*. A set of instructions for responding the adjectives terms was devised and reads as follows: *Think for a moment about what the weather and climate generally is like where you now live (or if you just moved to your current location, think about what the climate and weather was like at your former residence). You may probably think about the current season of the year, other seasons, or particular weather events you experienced before. Then, read the terms below and rate the extent to which each term describes your experience of the weather and climate of the place were you live. There are no right or wrong answers. Use the following scale:* The five-point

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scale then appeared; each numerical point had a verbal anchor to characterize the degree of descriptiveness.

3. Participants & Methodology

The participants for this research project were 292 undergraduate students from the University of Georgia who voluntarily responded to the CARS in exchange for course credit. The participants were 162 women and 132 men whose ages ranged from 18 to 40 years ($M = 19.6$ years, $SD = 1.93$). The participants were primarily Caucasian American (89%), followed by African American (5%), Asian American (2%) and 4% Other. The CARS was administered online via the Internet along with several additional instruments that were part of a larger research project to explore how people experience weather and climate (see Stewart, 2004). The research participants also responded to questions regarding their demography, ownership and use of consumer weather instruments, their characterizations regarding their favorite and worst types of weather days, and about various severe or threatening weather events that resulted in either damage to their or their family's property or to injuries they or their family members sustained (e. g., thunderstorms, tornadoes, hurricanes, ice or snow storms, etc.).

Because the primary objective of this project was to identify the latent dimensions or constructs that might explain peoples' uses of the climate adjectives, responses to the CARS were factor analyzed. A maximum likelihood factor extraction method was used along with an oblimin factor rotation that allowed for the factor intercorrelation. After examining a number of different factor solutions and reviewing the coherence of the terms that comprised each one, a fourteen-factor solution was chosen and the corresponding factors were interpreted. These factors comprised 188 terms (some terms loaded on more than one factor). Given the number of factors and the likelihood of additional superordinate latent dimensions, a second-order factor analysis was also performed.

3. Results

Table 1 lists the names of the 14 factors, provides some illustrative adjectives that constitute the factor, and lists the eigenvalues of the factor.

All of the original 153 adjectives loaded onto at least one of the 14 factors and 35 terms loaded on two or more factors. This latter result was not surprising because the statistical analysis was conducted so that the factors could be correlated with each other. Table 2 shows the intercorrelations for the CARS first-order factors.

Table 1: Factors of the CARS

Factor	Sample Terms	Eigenvalue
1. Hot	Scorching, Sweltering	74.99
2. Cold & Snowy	Icy, Frozen	23.58
3. Good	Pleasing, Sunny	14.25
4. Severe	Raging, Squally	9.64
5. Drab, Dismal	Dreary, Gloomy	8.52
6. Drizzly & Showery	Drizzling, Drenching	7.37
7. Violent	Turbulent, Threatening	5.62
8. Sunny & Mild	Sunshiny, Warm	4.81
9. Blowing & Blustery	Bad, Breezy, Gusty	4.17
10. Flooding	Flood Prone, Monsoonal	4.12
11. Cool	Chilly, Nippy, Brisk	3.77
12. Somber & Melancholy	Somber, Sopping	3.59
13. Stable & Predictable	Predictable, Unchanging, Monotonous	3.16
14. Dry & Dusty	Dry, Stuffy, Messy	3.15

At least four factors pertained to temperature (i. e., Factors 1, 2, 8, and 11). Factor 2 included adjectives referring to frozen precipitation whereas Factor 11 seemed to encompass cool weather without reference to frozen precipitation. Factor 8 contained adjectives relating to lighting and cloud-cover (i. e., sunny) whereas Factor 1 referred singularly to hot weather. Two factors referred to

liquid precipitation (i. e., Factors 6 and 10), although these factors did not exhibit more than a weak degree of correlation with each other. Drizzly and showery precipitation (Factor 6) seemed more associated with blowing and blustery conditions (Factor 9) and with violent weather (Factor 7); these conditions could all occur during thunderstorm. Flooding conditions (Factor 10) were slightly correlated with severe weather (Factor 4). Drab and dismal conditions (Factor 5) exhibited slight correlations with violent (Factor 7) and flooding (Factor 10) descriptors whereas descriptors collected under the somber and melancholy factor (Factor 12) showed slight correlations with descriptors pertaining to severe (factor 4) and violent (factor 7) conditions. Good weather (factor 3) was slightly correlated with descriptors involving sunny and mild conditions (Factor 8). Overall, however, beyond these small or slight correlations between the first-order factors, no other relationships existed between the factors.

The factor intercorrelations in Table 2 were subjected to a second-order factor analysis to determine whether more basic or fundamental latent variables may exist that could explain the relationships between the factors. Somewhat expectedly, two factors emerged. The first factor pertained to good or fair weather and the second to bad or inclement weather. Thirteen of the 14 factors loaded onto one of these factors; the drizzly and showery factor (Factor 6) loaded onto both. The factor pertaining to stable and predictable climate conditions (Factor 13) did not load onto either of the superordinate factors. Figure 1 illustrates the relationships between the first- and second-order factors.

4. Discussion

The results of these analyses were promising given the initial objectives of the project to identify some of the more fundamental dimensions along which people experience and communicate about their climatic conditions. All of the terms identified in dictionaries and thesauri contributed to the 14 factors that were retained for interpretation. Although the factors, named on the basis of the adjectives that composed them, appeared similar in some instances by referring to precipitation or temperature, overall the factors generally were only slightly related. This implies that peoples' experiences of climate are multi-faceted and that the rich assortment of terms that people use to communicate about weather and climate could

be important for making subtle distinctions between conditions. At a much more general level, the 14 factors loaded onto second-order factors pertaining to bad/inclement or good/fair weather.

The compositions of the first- and second-order factors raise some interesting points for discussion. First, it was regularly observed in examining the factors that the purely weather- or climate-related terms co-occurred with more general evaluative terms that people have used to characterize the climate (e. g., good, pleasant, peaceful, dreary, gloomy, etc.). This result suggests that peoples' perceptions of climate conditions may be very closely related with their evaluations of such conditions. For instance, *cold*, *dark*, and *rainy* conditions or climates may give rise to evaluations of the climate at that time as *gloomy*.

A second noteworthy observation is that the English language contains far more terms that pertain to bad or inclement weather, in general, compared to the range of terms that can characterize what is typically construed as good or fair weather (e. g., the sunny and mild factor). The results of this analysis reflected the greater breadth of bad-weather adjectives in that more factors emerged to describe bad conditions than good ones. Both the greater number of bad-weather descriptors and underlying factors could have adaptive significance. That is, to the extent that being able to symbolize different climatic conditions and to communicate about them has survival value, the use of these more negatively toned descriptors may persist or proliferate over time.

The second purpose of this research, to use the CARS to obtain characterizations of the climates of different regions from the people who live in them, has yet to be fulfilled. The reason for this is that the development of the instrument and understanding how the descriptors relate to factors represents a necessary first step. As more people from diverse geographic regions respond to the CARS items more will be learned about the basic and higher-order dimensions along which people experience and communicate about their climates. This will remain as the primary purpose of the CARS. Some people may find it useful to characterize a particular area or climate region with the CARS. Any such uses of the climate terms or of the factors that underlie them will necessarily be relativistic rather than absolute in nature. Residents of North Carolina and North Dakota, for example, may each characterize their climates as *cold*. This term, however, is merely a convenient label for two regions possessing very different physical climatologies. The same could be said for other terms such as hot, rainy, dry, and so forth. This

does not imply that the terms are useless or that more basic experiential or semantic dimensions that underlie them cannot be explored. Instead, this means that the individual meanings of climate descriptors are contextually and geographically bound. It would be necessary to operationally define each term, much in the same way that cloud cover descriptors are used in summaries and forecasts, before they could be used in an absolute manner.

The relationships that exist between people and their climates, people's experiences of the weather and climate of different regions, and the ways that people communicate about climate each illustrate lines of research that could be pursued within a new field that the author refers to as Behavioral Climatology. Here, climatology remains the principal field because of its naturally integrative and multidisciplinary focus (Glanz, 2003).

Behavioral denotes the sub-fields of inquiry as these relate to the broad and reciprocal relationships between climate on one hand and peoples' cognitive, behavioral, attitudinal, and emotional processes on the other.

The present study is limited in that it used undergraduate students from a university in the southeastern United States to study weather salience. Further efforts are being made to include a more heterogeneous sample of respondents to the CARS throughout the North American continent and elsewhere so that this instrument may be revised or supplemented according to the diverse ways in which people may orient themselves toward the weather and climate. Collaboration in collecting this data and in furthering the study of Behavioral Climatology would be welcomed.

5. References

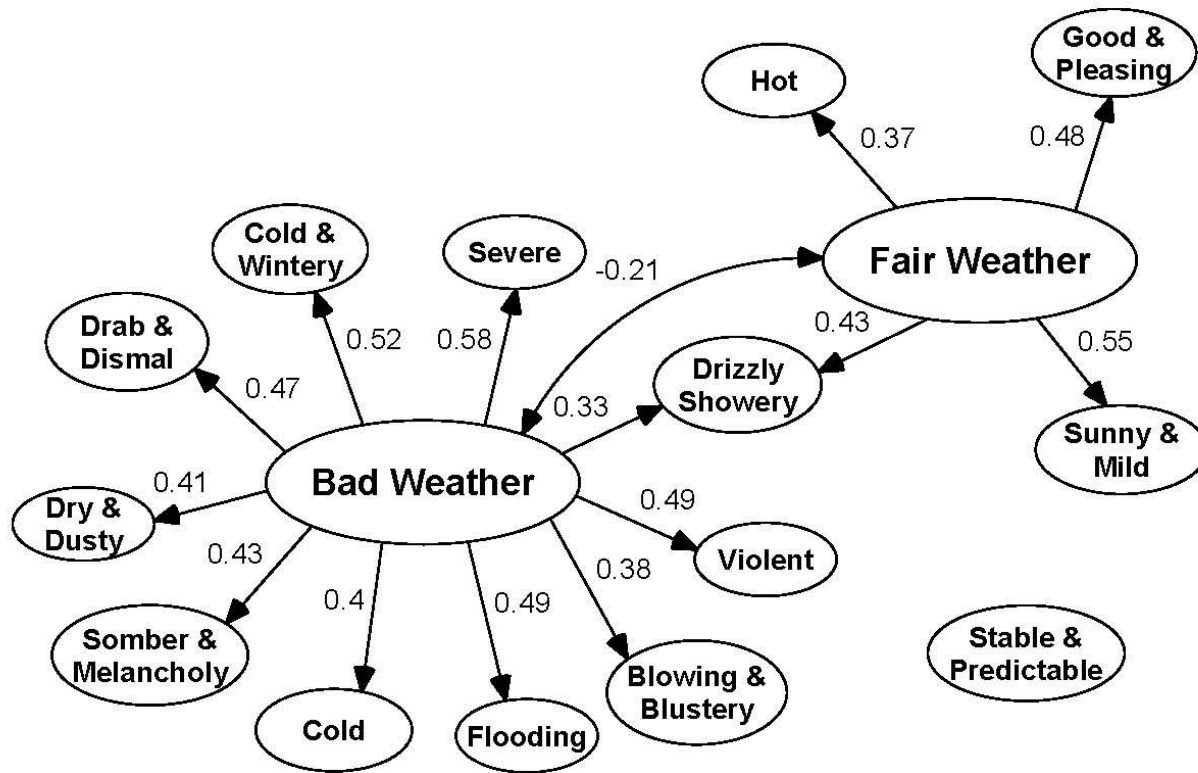
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Table 2: Intercorrelations for the CARS First-Order Factors

Factor	1	2	3	4	5	6	7	8	9	10	11	13	13	14
1. Hot	--													
2. Cold & Snowy	0.002	--												
3. Good	0.186	-0.025	--											
4. Severe	0.145	0.316	-0.038	--										
5. Drab & Dismal	0.127	0.211	-0.049	0.208	--									
6. Drizzly & Showery	0.217	0.147	0.134	0.158	0.093	--								
7. Violent	0.226	0.180	0.066	0.361	0.223	0.242	--							
8. Sunny & Mild	0.168	-0.068	0.302	-0.012	-0.009	0.202	0.092	--						
9. Blowing & Blustery	0.129	0.244	0.028	0.166	0.226	0.236	0.200	0.064	--					
10. Flooding	0.146	0.250	-0.100	0.293	0.290	0.144	0.182	-0.084	0.099	--				
11. Cool	-0.053	0.385	-0.004	0.185	0.204	0.162	0.140	-0.007	0.191	0.132	--			
12. Somber & Melancholy	0.127	0.215	0.112	0.294	0.172	0.152	0.289	0.050	0.156	0.191	0.168	--		
13. Stable & Predictable	0.007	0.027	0.125	0.025	0.111	-0.028	0.044	0.154	0.016	0.079	0.019	0.037	--	
14. Dry & Dusty	0.170	0.147	-0.076	0.261	0.263	0.130	0.185	0.012	0.133	0.246	0.126	0.128	0.044	--



**Figure 1: First & Second-Order Factors of the Climate Adjective Rating Scale (CARS)
(Coefficients Represent Inter-Factor Correlations)**