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The Relationship Between Weather and Children's Behavior: A Study of Teacher Perceptions

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THE RELATIONSHIP BETWEEN WEATHER AND CHILDREN'S BEHAVIOR: A STUDY OF TEACHER PERCEPTIONS

by

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ABSTRACT

The Relationship Between Weather and Children's Behavior:

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by

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The weather is an ever present and uncontrollable element in our lives. Only a handful of studies has addressed the relationship between weather and the behavior of children, although anecdotal and intuitive evidence of this relationship abounds. The purpose of this study was to observe the behavior of groups of elementary school-aged children in their classroom ecology during different phases of the weather cycle as observed by their teachers, observe any behavioral differences between girls and boys, and observe if any weather-related differences exist between the behavior of younger and older children. A model of the direct and indirect influence of the weather on children was introduced, and a comprehensive, systematic method of classifying weather data for analysis was presented. A significant relationship was found between day of week, grade, school, weather, and behavior.

(54 pages)

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Carrie Dabb

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CHAPTER 1

STATEMENT OF THE PROBLEM

Children grow and develop in a highly complex social and environmental system. Although the weather is inescapably part of a child's environment, research dealing with its effects on children and their behavior is scarce, almost to the point of nonexistence. This in itself points to the need for further research to provide a baseline of information from which to launch more systematic and detailed studies concerning the relation between weather and children's behavior. This thesis reviews the existing literature that addresses this relation and the literature dealing with the influence of weather on adults. It also reports on a study that will hopefully contribute positively to the meager information currently available in order to help parents, teachers, and others who work with children better understand children's sometimes seemingly unexplainable behavior.

The weather, which is defined as current atmospheric conditions such as air temperature, barometric pressure, and precipitation (Ashcroft, Jensen, & Brow, 1992), is an ever-present, ever-changing, and uncontrollable element of the human environment. It influences whre we like to live, what we wear, and many of our activities. Many local television stations across the country report on pain and respiratory indexes, as well as pollen counts, during weather forecasts (Murphy, 1986). The influence of weather has even been linked to the activity of the United States stock market, with stock indices advancing more on sunny days than on cloudy days (Saunders, 1993).

Those who work regularly with children, most notably teachers, have often associated, in anecdotal form, children's unusually restless and inattentive behavior as a

precedent to stormy weather (Landsberg, 1969, 1986). It is surprising then that empirical data to either support or discount these associations is so scarce.

The purpose of this study was to replicate and extend the information available that discusses the relation between weather and the behavior of school-age children, including observations concerning age and gender. It was not an attempt to explain the relation. A model of the direct and indirect influence of the weather on children is put forth, as well as a more systematic way of organizing weather data for analysis. In order to pin down the relation that apparently exists, and to minimize the demand on teachers' time, the study was of necessity more global than molecular in design. It dealt with groups of children and not the similarities and differences that most assuredly exist between individuals. The range of behaviors to be observed was intentionally not more precisely defined than from unusually quiet and/or attentive to unusually noisy, active, restless, and/or inattentive. When more empirical evidence shows that a general relation exists between children's behavior and weather, research can progress to examine the more specific behaviors of individual children that might be weather related.

CHAPTER II

REVIEW OF THE LITERATURE

Weather and Adults

People have associated human health and behavior with the weather since the Greek physician Hippocrates wrote about the relation in 400 B.C., and probably before (Landsberg, 1969, 1986). The primary focus of research conducted concerning weather and adults has been the relation between weather and health. The list of ailments correlated with specific weather patterns or changes includes migraines, strokes, heart attacks, embolisms, joints and scar pain, and respiratory problems such as asthma and allergies (Landsberg, 1969, 1986; Persinger, 1980).

Several studies have considered the relation between the weather and adult moods. Goldstein (1972) reported that positive moods were related to high barometric pressure and low humidity, and that those who have a belief in external control may be more reactive to the weather. Persinger (1975) found a 1- to 2-day lag time between cloudy days with high humidity and lower moods, and inversely, the same lag time between sunny days and high moods.

The results of a more recent study (Barnston, 1988) tend to support the relation between rising barometric pressure and good moods, with pressure change more than actual pressure being the key factor. Barnston (1988) also reported that the subjects found rapid within-day warming trends in combination with falling pressure to be depressing and irritating. Auliciems (1978) concluded that emotional disposition is the product of the total environment, which includes the weather component.

Cohn (1990), in the first comprehensive review of research on weather and crime, found that most violent crimes against people (i.e. assaults, burglary, collective violence, domestic violence, and rope) increase linearly with heat up to at least 85 degrees Fahrenheit. The relationship between other weather variables (cold, sunlight, wind, barometric pressure, rainfall) and crime is not as clear, possibly because most of this research has focused exclusively on heat. In a study of sexually abused adolescents, LaRoche (1994) identified seven distinct commonalities in the drawings of these victims, one of which was inclement weather. Cohn (1990) called for more and better research on the relationship between weather and crime in order to increase our understanding and ability to explain, predict, and prevent its occurrence.

Weather and Children

Few people doubt that weather has an impact on children and their behavior even though the number of research studies is small. It follows that if certain weather conditions make adults uncomfortable and irritable, the same would hold true for children. The detrimental effects of high heat, for example, led the American Academy of Pediatrics (AAP; "School can," 1985) to suggest that schools be closed or air-conditioned during very hot weather. The AAP concluded that excessive heat (defined as 95 degrees Fahrenheit or higher with 50% humidity) triggers behavior disturbances or lethargy among children.

Foust, Weidmann, and Wehner (1974) examined the influence of meteorological factors is Swiss infants and adolescents. The data on infants (2 years and younger) was obtained through caregiver reports, which could and probably do reflect the caregiver's

own sensitivity to weather as much as that of the infants. (This possibility was pointed out to the caregivers at the beginning of the interviews.) Caregivers reported increased incidence in discontented moods, restlessness, whining, quarrelsomeness, fatigue, dislike of play, sleep disturbances, and other physical ailments such as diarrhea, vomiting, and loss of appetite in the infants anywhere from several hours to three or more days before a storm.

The adolescents surveyed by Faust et al. (1974) were between the ages of 13 and 20 and the symptoms reported most often included fatigue, sad moods, headaches, irritability, restlessness, and inability to concentrate. Less reported complaints consisted of loss of appetite, inability to sleep, hypersensitive skin, aching joints or surgical scars, and vomiting and diarrhea. As with the infants, symptoms tended to occur form a few hours to one or more days before a change of weather. These authors also examined age and gender differences and found the older adolescents complained mote frequently of weather sensitivity than younger ones, and the girls were found to experience symptoms more often than the boys. Interestingly, those teens who claimed to be mot at all sensitive to changes in weather were also affected with the same symptoms, by at a rate of 3 to 10% less frequently than their counterparts (Faust et al., 1974).

Scagliotti (1980) examined the relation between barometric pressure and the behavior of boys (ages 9-13) with a history of school behavioral problems. Observations conducted through a one-way screen revealed increased restlessness, irritability, inattention, and impulsiveness when the barometric pressure was falling. No consideration was given to the time interval between when the barometer started falling and the onset of the negative behaviors, although the researcher worked under the

assumption that variations existed with each incident of falling pressure and with each individual child.

Essa, Hilton, and Murray (1990) studied the relation between weather and preschool children's behavior. A four-phase weather model was used to code the weather data instead of using the individual elements. Children were found to prefer playing with toys during stable, sunny weather, and when the weather was moving out of this phase. The children interacted mote with peers and adults during unstable, stormy weather, and when the weather was moving out of this phase. It was also reported that the girls were more weather sensitive, and the older preschoolers were more sensitive than the younger ones, supporting the conclusions of the previous studies discussed.

Vachon (1983) looked at children's behavior on the classroom level, with teachers filling out a 5-point Likert scale twice daily, The children were quieter when the barometer was high and the sky was sunny, and more active with an increase in humidity and precipitation. No analyses were done by age or gender, and therefore, no conclusions were drawn.

It is difficult to make direct comparisons between any of these studies because each one looks at different weather components rather than the weather system as a whole. It is possible and probable that more substantial and conclusive results could have been obtained if researchers defined the weather in the same way. Likewise, the different methods used to obtain human data varied widely (from self-reports to observations through one-way screen), and the individual behaviors studied varied as well, making it extremely difficult to make comparisons and draw conclusions. In order

to replicate and thereby substantiate or discount research findings, researchers should be looking at weather and behavior in the same or very similar ways.

Even though the number of studies is few, and some methodologies are stronger than others, there is evidence to support the existence of a relationship between the weather and children's behavior.

Conceptual Framework

Biometeorology

Biometeorology is the science dealing with the relationships between atmospheric and life processes (Landsberg, 1969). Scientific studies concerned with people and the weather have only emerged in the last few decades. Collecting weather data is relatively simple: Information on the weather elements, as well as their daily and seasonal changes, is measured with precision. Human beings are another matter altogether. In so many ways we are all alike, and at the some time we are so different. This is part of what complicates research and confuses and exasperates the researchers in this field (Landsberg, 1986).

Another factor that serves to further confuse conclusions and complicate comparisons between studies is the apparent lack of any shared ideology concerning which weather elements are best suited for examination. Some studies look at air temperature, some at humidity, some at precipitation and cloud cover, some at barometric pressure, and a few have considered combinations of weather elements. Only one study (Essa et al., 1990) attempted to incorporate all of the elements into a weather-phase model, with the children's behaviors associated with a specific phase and not one or two

individual weather components and linear time frame. Widespread use of such a model in research is needed to eliminate confusion so that the human response to weather can be seen with more clarity. The great variability in time between human reaction and storm (Faust et al., 1974; Persinger, 1975) would most likely be eliminated if symptoms and behaviors were analyzed according to weather phase and not the 24-hour clock. As discussed previously, Essa et al. (1990) found different behaviors occurred during weather phases, regardless of the actual time involved.

A comprehensive weather-phase model is available but has not been used. In this model, the weather cycle is classified into six phases that simplify the complexity of weather without sacrificing accuracy (Landsberg, 1969, 1986). These phases are not necessarily of equal length in one sequence, ot in the course of a year–the entire cycle can last from 3 days in the winter to several weeks in the summer. However, each phase is present and in sequential order, if only briefly, in each weather cycle. Landsberg (1969, 1986) defined the phases as follows:

Phase 1	Cool, high pressure, with a few clouds and moderate winds.
Phase 2	Clear, dry, high pressure and little wind.
Phase 3	Warming, steady or slightly falling pressure, and some high clouds.
Phase 4	Warm moist air in the lower atmosphere, clouds thicken, winds pick up, some precipitation, and pressure continues to fall.
Phase 5	Precipitation, cold gusty winds, rising pressure, and falling humidity.

Phase 6 Further rising pressure, diminishing clouds, temperatures reach low levels, and humidity continues to fall.

A schematic representation of the weather phases and associated weather elements can be seen in Figure 1.

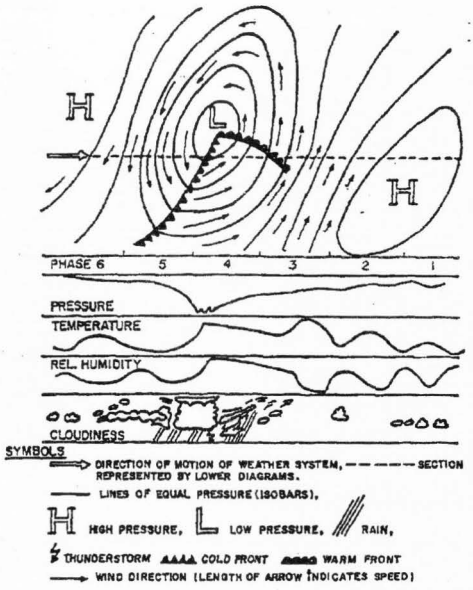

Figure 1. Schematic representation of weather phases that are related to biometeorological events.
Note. Each phase in the diagram spans 24 hours. In reality the phases may be shorter or longer.
Note. From *Weather and Health: An Introduction to Biometeorology* (p. 92), by H. E. Landsberg, 1969, Garden City, New York: Doubleday. Copyright 1969 by Doubleday & Company, Inc.
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Direct and Indirect Influences

In any study of the relation between the weather and behavior, it must be remembered that children and adults do not exist independently of one another or their environment, but are part of a complex system. Influence in adult-child relationships flows form adult to child, and from child to adult (Maccoby, 1980), with many external factors thrown in to complicate matters. Adult observations of changes in children's behavior are necessarily subjective and reflect some of their own responses to external stimuli. A model of the direct and indirect influence of the weather on children and adults reflects the reciprocal and interactive nature of the adult-child relationship (Figure 2).

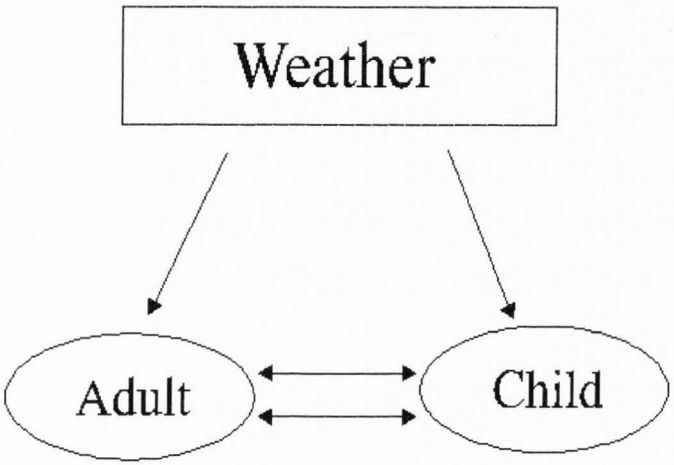

Figure 2. A model of the direct and indirect influence of weather on adults and children.

In summary, more substantial and conclusive results could be obtained if a comprehensive weather phase model were used in the study of weather and human behavior. Much of the confusion concerning the time frame in which weather-related behaviors occur would certainly be eliminated. More groundwork on the general level of behavior must be laid in order to identify the appropriate specific individual behaviors to be studied in the future. This study is an attempt to incorporate a comprehensive weather-phase model in the study of the relationship between weather and children's behavior, and to document the changes in the behavior of groups of children that have been observed by teachers for many years and attributed to changes in the weather.

Hypotheses

1. Children will be observed to be more restless, active, and inattentive preceding a storm (weather phases three and four).
2. Girls will be more sensitive to weather changes than boys.
3. Older children will be more sensitive to weather changes than younger children.

CHAPTER III

METHOD

Subjects

Children in 12 elementary school classrooms were observed by their teachers. These classrooms included grades one through five located in two schools within the Logan City School District in Logan, Utah. All teachers of grades one through five in each school were invited to participate. The resulting convenience sample consisted of one class from each grade in each school, with two first-grade and two fifth-grade classes from one school, and two teachers (the regular teacher and a student teacher) in one fifth-grade class in the other school. The 13 teachers who volunteered to participate gave informed consent. Eleven teachers were female, two were male, and all were Caucasian. The range of teaching experience at the elementary level was 0 to 29 years ($M = 8.76$, $SD = 7.70$).

The children in each classroom were observed as a group, with no individual child being singled out or identified (i.e., the class became the subject or unit of analysis). The two schools are located less than 2 miles apart, controlling for geographic proximity, which ensured all classrooms would experience similar atmospheric conditions. The schools had similar mixes of socioeconomic status with 54% and 56% of students involved in the free and reduced lunch program. Both schools served breakfast. The racial composition of both schools was also similar, with the principals reporting approximately 15% of the student population composed of minorities. Of these, the vast

majority were Hispanic, with African American, Pacific Islander, Native American, and Southeast Asian cultures represented at both schools. The lunch and recess schedules were similar (Principals S. Earl & P. Olsen, personal communication, May 2, 1997). However, these schools were also selected because of their architectural differences: one is over 100 years old, the other is less than 15. The older school has very high ceilings, and a range of zero to seven windows in each classroom (the average was four). The newer building has low ceilings and either zero, two, or four windows in each classroom. Both schools use standard fluorescent lighting.

Procedure

The teacher in each classroom served as the observer. Given that each class is an ecological unit existing apart from any single person's perception (Gump, 1975), the data needed to be collected as unobtrusively as possible, and from within the unit. This made the teacher in each unit the logical and necessary choice to make the observations. An outside observer would not be familiar with the personality of the class, and therefore not be able to rate class behavior as viewed by the teacher. An outside observer would also be an unnecessary and potentially disruptive factor influencing classroom behavior. The use of video equipment, while allowing for detailed coding of behaviors, was rejected for its strong potential to disrupt the classroom ecology. Further, the purpose of the study was to obtain subjective, within-system evaluation of classroom behavior.

Each teacher was given a classroom rating scale to be filled out at noon and again promptly at the end of the school day, immediately after the children left the room. Each

teacher was also given written instructions on how to use the form. These are both described in the instrument section of this thesis. Teachers were asked to give ratings for the girls, boys, and the class as a whole. The rating forms were collected and new ones distributed at the end of each week. Small incentives (free video rentals, etc.) were given to the teachers each time they returned the ratings form. All of the teachers completed the study. The teachers were blind to the weather component of the study, being told only they were participating in a study of classroom behavior. At the end of the 8-week observation period, each teacher completed a survey designed to gather additional information about the teacher and the physical classroom. This survey, which can be found in Appendix B, consisted of six items asking for the number of girls and boys in their class, the number of years they had been teaching, the number of windows in their classroom, and on a 3-point scale, how they felt weather affected them and their students. The results of this survey are presented in Table 1.

The study was conducted during the months of February and March, when the storm patterns in this area consist of broad frontal systems (Ashcroft et al., 1992). This controls for variability in weather elements across a large physical area. Data on weather conditions were recorded by the Utah Climate Center on the Utah State University campus. Three professionals at the Utah Climate Center separately classified the weather data into the six weather phases in the Landsburg weather-phase model presented earlier. The results were compared and any discrepancies resolved by referring to the raw weather data and arriving at a consensus. The classroom observations were then paired with the corresponding weather data for statistical analysis.

Table 1

Results of the Post-Study Teacher Survey

School	Grade	# of girls	# of boys	Years teaching	# of windows	Weather affects me	Weather affects students	Teacher gender
1	1	9	12	4	3	somewhat	quite a bit	female
	1	9	12	7	2	somewhat	quite a bit	female
	2	12	12	15	7	quite a bit	quite a bit	female
	3	12	13	10	7	somewhat	somewhat	female
	4	13	11	1	4	quite a bit	quite a bit	female
	5	9	13	29	0	quite a bit	quite a bit	male
	5	12	14	6	2	somewhat	quite a bit	female
2	1	10	13	1	0	somewhat	quite a bit	female
	2	10	11	7	4	somewhat	quite a bit	female
	3	16	9	12	2	somewhat	somewhat	female
	4	12	13	9	4	not at all[a]	somewhat	male
	5	17	15	13	2	quite a bit	somewhat	female
	5	17	15	0	2	quite a bit	quite a bit	female

[a]The mean scores of this teacher did not stastically differ from those who replied "somewhat" so this teacher was placed in that group for analysis.

Instrument

The classroom rating form used was a Likert scale that asked the teacher to rate the behavior of the girls, boys, and class as a whole on a scale of 1 to 5 (Appendix C). The teachers were instructed to give ratings of three for typical behavior or how their class usually behaves and what is normal for them without reference to any other class or how the teachers believe or wish their class should/would behave. Ratings of 1 or 2 were to be given when the class was quieter or more attentive than usual. Ratings of 4 or 5 were to be given when the class was more active, restless, or inattentive than normal for them. Likert scales are widely used and have been shown to be a reliable measure of the dependent variable when the scale consists of five or more points (Rasmussen, 1989).

A pilot study was conducted to test the rating form, which was intended to be very

quick and easy for the teacher to use. Ratings for each day took less than 10 seconds to complete. No part of that data was used in the current study. As a result of the pilot study and subsequent input from the teachers involved, the phrases "more attentive" and "less attentive" were added to the instructions on the rating form. A need for specific written instructions for the teachers instead of oral-only instructions was also identified. This resulted in the previously discussed written instruction sheet given to each teacher (Appendix D). One teacher in the pilot study reported very little variation in the behavior of her class. This particular class was located in a room with only two small windows, whereas the other classrooms in the pilot school had windows completely across one wall. This observation contributed to the final selection of the two architecturally different school buildings in the present study.

Ethical Considerations and Limitations

Each classroom was assigned an identification number to protect the privacy of the students and teacher. Teachers were instructed not to identify individual children in any way on the rating form. Letters of permission were received from the principal of each school (Appendix E), as well as each teacher involved (Appendix F). Approval for the study was obtained from the Institutional Review Board at Utah State University, as well as the Logan City School District.

CHAPTER IV

RESULTS

A series of *t* tests was used to determine if there were any statistically significant differences in behavior scores for girls or boys among teachers with regard to teacher gender, years teaching, teacher beliefs about how weather affects them, and beliefs about how weather affects their students. Polytomous logistic regression was used to test the importance of weather in the behavior model for girls and boys.

Teachers utilized the entire range on the 5-point Likert scale (Appendix G, Table 5). As can be seen in Appendix G, Table 6, school 1 had higher mean scores than school 2. Girls had a lower overall mean score than did the boys in this sample. Grades one and two received higher behavior scores than grades three, four, and five for both girls and boys. Highest mean scores for girls and boys were recorded during weather phase 2, followed by phase 3.

Analysis of the post-study teacher survey yielded very interesting results. As can be seen in Table 2, teacher gender was the only characteristic of the teacher that reached statistically significant levels, with female teachers giving higher behavior scores for both girls and boys. The correlation between number of windows in the classroom and behavior scores was not statistically significant. This correlation table can be found in Appendix G, Table 7.

To determine which factors seem to influence children's behavior scores in this sample, a polytomous logistic regression was used. Unlike logistic regression, which only allows the dependent variable to have two levels, the polytomous logistic regression

Table 2

Teacher Characteristics and Classroom Behavior Scores for Girls and Boys

Variable	*n*		*M*	*SD*	*t*
Teacher Gender					
Female	11	Girls	2.86	0.38	5.39*
Male	2		2.20	0.06	
Female	11	Boys	2.97	0.34	5.56*
Male	2		2.36	0.05	
Years Teaching					
<8	7	Girls	2.73	0.38	0.21
>8	6		2.78	0.51	
<8	7	Boys	2.88	0.36	0.03
>8	6		2.86	0.44	
Teacher beliefs about how weather affects self					
"somewhat"	8	Girls	2.74	0.40	0.23
"quite a bit"	5		2.78	0.52	
"somewhat"	8	Boys	2.88	0.36	0.06
"quite a bit"	5		2.87	0.46	
Teacher beliefs about how weather affects students					
"somewhat"	4	Girls	2.75	0.34	0.03
"quite a bit"	9		2.76	0.48	
		Boys			
"somewhat"	4		2.83	0.33	0.35
"quite a bit"	9		2.90	0.42	

*$p < .001$

allows the dependent variable to have three levels. The independent (explanatory) variables can be either categorical or continuous. The idea behind logistic regressions is to relate the probability of the dependent variable to explanatory factors, in other words, to predict whether something will happen or not (Vogt, 1993).

Because of the small sample size (a larger sample was unavailable), there were not enough observations to fully accommodate the structure of the polytomous logistic regression (too many empty cells), and to meet the chi-square assumptions. It was therefore necessary to reduce the number of low count and empty cells by collapsing the explanatory and dependent variables to smaller levels. The dependent (behavior) variables (girls and boys) were originally scaled from 1 to 5, with 1 being the best behavior. These were collapsed into the required three levels by combining levels 1 and 2, and levels 4 and 5. The five grades were collapsed into two levels by combining grades one and two, and grades three, four, and five. The six weather phases were collapsed into three by combining phases 6 and 1 (high pressure system), 2 and 3 (weakening high pressure system and transition to low pressure system), and 4 and 5 (low pressure system).

The polytomous logistic regression was used to identify the explanatory variables that adequately fit the model. From these, the model with weather, school, day of the week, and grade as main effects provided an adequate fit for girls' and boys' behavior scores (p = .21 and .22, respectively). Day of the week was an unexpected, but necessary variable in these models. As can be seen in Table 3, the models without the weather variable are not adequate, while the models with the weather variable as well as the other explanatory variables do fit the data for this sample. The chi-square of the difference between the two models was also statistically significant, which indicates that weather is indeed a very important explanatory variable for girls' and boys' behavior scores for this sample. The predicted behaviors by weather phase are presented in Table 4. As can be seen, teachers were more likely to give behavior scores of 4 and 5 (worst behavior)

Table 3

Fit Indices for the Polytomous Regression Models

Model	χ^2	*df*	χ^2_{diff}	df_{diff}
Dependent variable = girls				
Model w/o weather	191.73*	121		
Model w/ weather	82.57	79		
			119.54*	44
Dependent variable = boys				
Model w/o weather	211.42*	124		
Model w/ weather	89.68	80		
			121.74*	44

*$p < .001$

during the combined weather phase 2 (phases 2 and 3) than at any other time (when weather = 2 teachers gave behavior scores of 3 to girls 28% of the time, and to boys 30% of the time). Girls were most likely to be observed at their best behavior during the combined weather phase 1 (phases 6 and 1). As can be expected, the most likely behavior score for all weather phases was 2, which is normal or average behavior.

Ten complete cycles of the Landsburg weather phase model (phase 1 through 6) occurred during the 8 weeks of this study. The cycles ranged in length from 2 to 8 days with the mean being 5.50 days. No statistically significant difference was found between length of cycle and scores for girls or boys.

Table 4

Weather by Behavior Predicted Percentages

Weather category	Girls = 1 Best behavior	Girls = 2 Normal behavior	Girls = 3 Worst behavior	Boys = 1 Best behavior	Boys = 2 Normal behavior	Boys = 3 Worst behavior
Weather = 1 (Phases 6 and 1)	40%	41%	19%	34%	41%	25%
Weather = 2 (Phases 2 and 3)	34%	38%	28%	31%	39%	30%
Weather = 3 (Phases 4 and 5)	38%	46%	16%	35%	46%	19%

Note. Original behavior scores of 1 and 2 were assigned to level 1, scores of 3 were assigned to level 2, and scores of 4 and 5 were assigned to level 3.

CHAPTER V

DISCUSSION

In this sample, girls and boys were observed to be more active, restless, and/or inattentive during weather phases 2 and 3, as opposed to the hypothesized phases 3 and 4. It is difficult to state conclusively whether or not the second hypothesis, that girls would be more sensitive to weather changes than boys, was confirmed. The hypothesis that older children would be more sensitive to weather changes than younger children was not supported in this sample.

A somewhat surprising finding was the importance of which school was attended to the behavior model. The average number of windows per classrooms in each school was approximately the same (about three), so perhaps some other element of the architecture contributes to the difference, such as ceiling height or the age of the building. People who have visited both schools have commented on how different each school feels in an intangible way. The differences in behavior between schools underline the importance of context in any explanation of children's behavior. Although the mean behavior scores between schools were different, the trends within each school were the same.

It was surprising to find that day of the week played such an important role since it was not mentioned as a significant factor in any of the studies reviewed. This variable should be included in future studies. The higher behavior scores given to the children in the younger grades (one and two) were also surprising given the research results reviewed at the beginning of this thesis, which indicated the opposite should occur. One possible

explanation lies in the expectation of self-control in the school setting, which older children seem better able to accomplish.

It was expected that the teachers' beliefs about how weather affects them or their students would have had a significant impact on how they rated the behavior of their classes, but they did not. It would appear that in this sample, the teachers' observations transcended their beliefs. Another surprising result was that years of teaching experience at the elementary level did not significantly impact observational ratings either. In this sample, the only teacher characteristic that had any significant bearing on behavior scores was teacher gender. Female teachers consistently gave significantly higher ratings than the two male teachers who participated. This gender difference might also help explain the differences between schools: the school with the higher behavior scores has a female administrator. Of course, no sweeping generalizations can be made from this observation, but it poses an intriguing question for future studies.

Windows appear to have some impact on children's behavior, and although not statistically significant, the behavior of the children, especially the boys, worsened with the increase in windows in the classroom. It was interesting to note that one teacher who had no windows in this study indicated she preferred classrooms that had many windows.

It was gratifying to find that weather did play a part in explaining children's behavior because it validates what teachers have suspected for many years. Although weather was one of several contributing factors, it was nonetheless essential to the behavior model. The results of this study appear to support long-held teacher beliefs that their students are affected by weather, and seem to predict coming storms. Weather

phases 2 and 3 are classified by most people as "good" weather with sunny or mostly sunny skies, and the average person does not recognize the subtle changes that indicate a storm is on the way. This was when the children in this sample were observed to exhibit their worst behavior in the classroom. Many people do not see signs of a storm until phase four, when clouds begin to appear and thicken, and the temperature begins to rise in advance of the cold front. It was interesting to note that both extremes of behavior for girls occurred during so-called "good" weather. Their best behavior was recorded during phase 6, when a new high-pressure system is building.

Of course with any study there are concerns that arise. There were problems with how teachers reported the number of windows in their classrooms due to combinations of windows with areas of glass brick, and total window size. Each classroom had to be visited to determine how to code the number of windows for analysis. This sample was relatively small, in a specific geographic area, with a specific demographic make up. It may not be appropriate to generalize the results obtained in this study to other areas and populations. The ratings were not counterbalanced, so they may have been influenced by the order in which they were recorded (girls, boys, group) by the teachers each day, although there is no way to know in what order the teachers recorded their observations. This sample of teachers was also overwhelmingly female, with only two male teachers involved. A sample with more equal numbers of female and male teachers may or may not provide the same results.

In future studies it is suggested that the impact of windows be analyzed using the actual square footage of exposed glass in the classroom. This would give the most

accurate measure. It would be extremely helpful to have studies that cover a much longer time-span, such as one, or even several years. Studies in other geographic and demographic areas would also be helpful, as would the participation of more teachers in more schools in each study. It is also suggested that schools headed by female and male administrations be included in order to determine if gender of the principal is really a factor in the differences found between schools.

CHAPTER VI

EXECUTIVE SUMMARY

Those who work regularly with children, most notably teachers, have often associated, in anecdotal form, children's unusually restless and/or inattentive behavior preceding stormy weather. However, research dealing with weather's effects on children is scarce and comparison of these existing studies is difficult because each one looks at different weather components rather than the weather system as a whole. This study used the 6-phase weather cycle model presented by Landsberg in 1969.

Children in 12 elementary school classrooms in Logan, Utah, were observed by their teachers over an 8-week period in February and March 1996. Teachers recorded the children's behavior each day on a scale of 1 to 5, with 1 being the best behavior. The Utah Climate Center classified the weather during this period into the Landsberg weather phases. The behavior scores and weather phases were then paired for statistical analysis.

Worst behavior for both girls and boys was recorded during phases 2 and 3, as high-pressure systems weaken in advance of coming low pressure (and storms). Best behavior for girls was recorded during phase 6, as high pressure builds again. Younger children (grades one and two) received higher scores than older children. Which school was attended and day of the week were also important factors in explaining behavior (best days were on Tuesday, girls were worst on Wednesdays, and boys on Fridays).

Future studies need to be conducted over longer periods of time and in varying geographic locations with larger samples.

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APPENDICES

Appendix A. Copyright permission to reprint

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June 05, 1997

Carrie Dabb
#7 USU Mobile Home Park
Logan, UT 84341

RE: WEATHER AND HEALTH

Dear Sir or Madam:

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Yours sincerely,

Sincerely,

Carol Christiansen
Permissions Manager

-1-

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Appendix B. Post-study teacher survey

Please take a moment to answer the following questions about your classroom environment and return it to the envelope in the office by Friday, April 5. Your participation in this study has been greatly appreciated. **THANK YOU !!!**

Class ID _____

How many girls are in your classroom?

How many boys?

How many years have you been teaching at the elementary level?

How many windows are in your classroom?

Circle the answer that most applies to your class.

I feel the weather affects my attitudes and/or behavior

not at all somewhat quite a bit

I feel the weather affects the attitude and/or behavior of my students

not at all somewhat quite a bit

Appendix C. Classroom rating form

Class ID_____

Week of _____

Please rank the general or overall attitude of your class on a scale of 1 to 5; 1 being unusually quiet and/or attentive, 5 being unusually noisy, active, restless, and/or inattentive, and 3 being "normal" for your class.

Morning:	Girls	Boys	Entire class	(comments)
Monday	_____	_____	_____	_____
Tuesday	_____	_____	_____	_____
Wednesday	_____	_____	_____	_____
Thursday	_____	_____	_____	_____
Friday	_____	_____	_____	_____

Afternoon:	Girls	Boys	Entire class	(comments)
Monday	_____	_____	_____	_____
Tuesday	_____	_____	_____	_____
Wednesday	_____	_____	_____	_____
Thursday	_____	_____	_____	_____
Friday	_____	_____	_____	_____

Did anything unusual occur which could account for or influence a rating? (For example: first day of school, a special visitor, teacher having a bad day, etc.) If yes, please indicate what occurred, and on which day.

Please refrain from identifying a particular child.

Appendix D. Classroom rating form instructions

TEACHER'S INSTRUCTIONS

1. Remember to fill out the form each day just before you take your class to lunch, and after you dismiss them for the day. IF YOU FORGET TO COMPLETE THE FORM ON ANY GIVEN DAY, DO NOT GO BACK AND FILL IT IN. It is preferable to leave a day blank than to try and remember what your class was like.

2. Please do not be afraid to give ratings of 5 if you feel your class deserves it. A rating of 5 DOES NOT reflect negatively on you or your teaching methods.

3. If you are spending more time thinking about a rating than the time it takes to write a numeral you are taking too long. You should only be taking a few seconds twice a day to complete this form.

4. You are only rating the behavior of YOUR class, which is different from every other class in your school. You are the only one qualified to observe and rate the behavior of your class.

Appendix E. Letter of permission--principals

Dear Principal:

At Utah State University we are beginning a research project which will examine classroom dynamics through the elementary grade levels. We hope the results of this project will be useful to parents, teachers of the elementary grades, and researchers in the fields of child development and classroom management.

Your school has been chosen as one site for this research. As principal of this school, there are several important points we wish you to consider as a basis for granting permission for this study.

1. Under no circumstances will any individual child be the focus of this project. We are interested in the group dynamics of the classroom only.

2. No outside observers will be involved. Two teachers from each grade level will be recording information on his/her classroom before lunch and at the end of the school day. Each observation takes only a few seconds.

3. Teachers who wish to participate will be required to give written permission.

4. The study will begin in January 1996 and continue for eight school weeks.

5. Participants may withdraw from the study at any time without penalty.

We hope you will be willing to allow us to conduct this research in your school. Thank you for your interest and cooperation.

Sincerely,

Carrie Dabb
Graduate Student, USU
Under the direction of Dr. Ann Austin
Department of Family and Human Development
College of Family Life
Utah State University

I give permission for (school name)Elementary to participate in this study of classroom dynamics. I understand that I may withdraw my consent at any time without penalty.

I do not wish this school to participate.

Name _____ _____

Signature

Appendix F. Letter of permission--teachers

Dear Teacher:

At Utah State University we are beginning a research project which will examine classroom dynamics through the elementary grade levels. We hope the results of this project will be useful to parents, teachers of the elementary grades, and researchers in the fields of child development and classroom management.

With the permission of your principal and the Logan School District, your school has been chosen for this research. As a teacher at this school, there are several important points we wish you to consider as a basis for granting permission for this study.

1. Under no circumstances will any individual child be the focus of this project. We are interested in the group dynamics of the classroom only.

2. No outside observers will be involved. Two teachers from each grade level will be recording information on his/her classroom before lunch and at the end of the school day. Each observation takes only a few seconds.

3. Teachers who wish to participate will be required to give written permission.

4. The study will begin February 5, 1996, and continue for eight school weeks.

5. Participants may withdraw from the study at any time without penalty.

6. If you have any questions regarding this project please feel free to call me at 797-6724.

We hope you will be willing to allow us to conduct this research in your classroom. Thank you for your interest and cooperation.

Sincerely,

Carrie Dabb
Graduate Student, USU
Under the direction of Dr. Ann Austin
Department of Family and Human Development
College of Family Life
Utah State University

____ I am willing to participate in this study of classroom dynamics. I understand that I may withdraw at any time without penalty. I currently teach ___grade.
____ I do no wish to participate.

Name (print)_____ _____

Signature

Appendix G. Tables

Table 5

Frequency of Behavior Scores Given by Teachers

Behavior scores	Frequency	Percent
Girls		
1	79	10.80
2	196	26.70
3	306	41.70
4	124	16.90
5	29	4.00
Boys		
1	68	9.30
2	178	24.30
3	306	41.70
4	143	19.50
5	39	5.30
Group		
1	67	9.10
2	184	25.10
3	313	42.60
4	139	18.90
5	31	4.20

Table 6

Mean Behavior Scores by Gender

Variable	Girls	Boys
School		
1	2.92	3.02
2	2.55	2.67
Grade		
1	3.20	3.35
2	3.02	2.98
3	2.53	2.57
4	2.57	2.74
5	2.53	2.67
Weather Phase		
1	2.78	2.95
2	2.93	2.98
3	2.87	2.96
4	2.69	2.73
5	2.74	2.83
6	2.59	2.76
Day of Week		
Monday	2.65	2.78
Tuesday	2.55	2.62
Wednesday	2.98	3.06
Thursday	2.75	2.85
Friday	2.93	3.09

Note. The range of scores is 1to 5, with 5 being worst behavior.

Table 7

Correlation Between Behavior Scores and Windows in the Classroom

$n = 13$	Group	Girls	Boys	Windows
Group	--	0.95	0.97	0.43
$p =$		0.00	0.00	0.15
Girls		--	0.93	0.41
$p =$			0.00	0.16
Boys			--	0.46
$p =$				0.11