

EXPERIENCE AS A FACTOR IN TORNADO AWARENESS  
AND RESPONSE LEVELS IN KANSAS

by

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## Chapter I

### INTRODUCTION

The environment reflects the interaction between human activity and the various natural systems. In part, these patterns of human activity reflected by the environment, are determined by the adjustments people make, either individually or collectively to a variety of phenomena which exist in nature, including those which pose a threat of danger to human life and property. Events such as floods, blizzards, earthquakes, and tornadoes are considered to be hazards when they occur in conjunction with human activities. Such hazards require human adjustments or change with respect to hazard response. To the inhabitants of the midwestern United States, the meteorological hazards of floods, drought, tornadoes, hail and windstorms present the greatest natural threat to both life and property. In the state of Kansas, the tornado has been the most frequent and consistent form of naturally occurring disaster throughout its history. This is the land where the skies are not cloudy all day and where a simple tapping of ruby slippers and a wish to return home reverses a young Kansas girl's dreams of yellow brick roads, Munchkins and the land of Oz back to the reality of the dangers involved with this awesome phenomenon. An interesting question arises from this historical association with actual and fictional tornadoes by the residents of Kansas. Because of past tornado experiences, are the citizens of Kansas communities more concerned and aware of this disaster and therefore respond differently? This study looks at three Kansas communities with varying degrees of tornado experience in an effort to investigate the influence of experience on human awareness and response behavior to the

tornado hazard. Awareness refers to a persons knowledge, realization or perception of the hazard. Response involves their reaction to the tornado hazard.

Past natural hazard studies suggest that the type of human response to the magnitude and frequency of tornadic activity is based generally upon levels of awareness of the damage potential, effectiveness of institutional actions such as warning systems and the types of adjustment options available to them.<sup>1</sup> The remaining sections in this part of chapter one will discuss the physical properties of tornadoes, their economic effects and the problems related to citizen awareness, as well as institutional responses and individual adjustment options.

#### Physical Properties of Tornadoes

A very important aspect of a citizens awareness- response level is the knowledge of the weather conditions which spawn tornadoes, the characteristic properties of the tornado itself and the type of damage it can cause. Hypothetically, a citizen who knows the basics of the tornado can respond in a more orderly fashion because of probable alertness to the weather conditions, recognition of warning signs and knowledge of the best places to seek safety. This section is concerned with a general discussion of the physical properties of tornadoes that are most important in understanding human response.

Several theories have been advanced as to the type of energy transformation necessary to generate a tornado. Although no single theory

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<sup>1</sup> Hazards research is generally concerned with investigating aspects of human behavior as influenced by a variety of factors relating to the threat or occurrence of hazardous events in nature, and how this behavior accounts for particular human activities at certain places and times,

has gained general acceptance, scientists seem to agree that tornadoes originate from the combined effects of thermal and mechanical forces, with one or the other force being the stronger generating agent. Regardless of the complicated energy transformations which produce the tornado, its formation requires the presence of layers of air which contrast in temperature, moisture, density, and wind flow characteristics. Once formed, the tornado becomes a visible vortex of rotating winds about a hollow cavity in which centrifugal forces produce a partial vacuum. The tornado or funnel cloud appears as condensation forms about the vortex. Near the ground it darkens as the air surrounding it fills with dust and debris.

An essential part of tornado safety is to recognize the differences between the appearance of tornadic systems and other comparatively harmless weather phenomena. In a March 24, 1977 television documentary on tornadoes, the National Severe Storms Center in Kansas City was quoted as saying "if it doesn't spin, don't call it in." Atmospheric conditions can produce a wide variety of ominous-looking cloud formations, some of which give mistaken impressions of being a funnel. A common error in citizen detection is viewing from a long distance a rain shower falling from a thunderhead. Although this shower appears as a dark solid column extending from the base of a large thunderstorm system, as a tornado does, it is harmless as compared to a funnel system,

Some tornadic storms fail to assume the more classical form of the funnel on the ground. This was the case in Manhattan, Kansas on June 8, 1966 when no funnel cloud was reported yet witnesses saw rather large "holes" in the base of the cloud with circulating debris as the storm system passed overhead. Because of the confusion with respect to atmospheric

conditions and the occasional twists in seemingly predictable patterns, shelter should be sought at the slightest indication of danger. This procedure, although ideal in theory, can be harmful in practice because of a tendency for individuals to become immune to the hazard situation treating it as a routine procedure. This will be discussed in more detail in the section dealing with problems related to citizen awareness.

Other important characteristics of the tornado include the direction of movement, the length and width of its path, its period of most frequent occurrence and the locations where this hazard is most likely to strike. Tornadoes occur in many parts of the world and in each of our fifty states, but no area is more favorable to their formation than the continental plains of the United States. This region reaches its peak in the number of tornadoes during May in the southern plains and June in the northern plains. This center of maximum frequency drifts northeastward with the increase in the penetration of warm, moist air while contrasting cool, dry air surges in from the north and northwest. It is the convergence of these contrasting air masses which generate the tornadoes which begin their increase in frequency over the Gulf States in February and move eastward during March and to the southeast Atlantic States in April.<sup>2</sup> As this region of maximum frequency drifts in a northeasterly direction so does the movement of the tornado itself. For the state of Kansas, data show the general direction of movement is from west to east with the greatest number moving from the southwest to the northeast.<sup>3</sup>

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<sup>2</sup>National Oceanic and Atmospheric Administration, Tornado (Washington, D.C., U.S. Government Printing Office, 1975) p. 7.

<sup>3</sup>Joe R. Eagleman, Vincent Muirhead and Nicholas Willems, Thunderstorms, Tornadoes and Building Damage (Lexington, Mass., Lexington Books, 1975) p. 59.

X The number and timing of tornadoes in the storm system present an additional threat to the potential victims of the storm. Because of the meteorological combinations which create them, tornadoes form most often during the warmest hours of the day in a variety of combinations. Multiple tornadoes, supported by the same thunderstorm are uncommon but do occur. Another possibility is that several tornado producing thunderstorms may occur at the same time within a radius of fifty miles or less. Frequently, a single thunderstorm produces several tornadoes, one originating as another dissipates.

The area covered by a single tornado may be as extensive as a path one mile (2 kilometers) wide and 300 miles (483 km) long, but on the average it is only a quarter of a mile (40 km) wide and up to sixteen miles (26 km) long. This path of destruction caused by the tornado leads to many disastrous economic situations for those individuals who fall victim to its fury.

Damages resulting from tornadoes are the result of the combined action of strong rotary winds, flying debris and the partial vacuum in the center of the vortex.<sup>4</sup> These damages are often compounded by the presence of associative disturbances such as heavy rain, hail and excessive winds. But by far the greatest monetary loss results from structural failures generated by the partial vacuum in the center of the vortex.

#### Economic Effects

Property losses resulting from tornadoes in the United States during the period from 1956-1965 exceeded \$5 million in each year while damage

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<sup>4</sup> Executive Office of the President, Office of Emergency Preparedness, Report to the Congress, Disaster Preparedness Vol. 3, (Washington, D.C.: U.S. Government Printing Office, 1972) p. 35.



exceeded \$50 million per each one year period during a nine year period from 1966-1974.<sup>5</sup> This increase in property losses in the United States can be attributed in part to the increase in property value, devaluation of the purchasing potential of the dollar and the concentration of the population. It is this increase in the number, size and population of urban areas that has made people and their property more vulnerable to the tornado hazard.

The need to immediately quote losses to determine if the region qualifies as a federal disaster area is one of the greatest problems following a major disaster. With little information available on the cost criteria used as a base in estimating damages it is very difficult to interpret how adequate the published figures are. Most estimates made since 1964 are based on the cost of restoration, however, some contradictions to this criteria in damage and expenditure estimates still exist.<sup>6</sup> Unfortunately, losses reported are used as the major means of assessing the severity of the disaster. These reported figures are assessed on public losses such as impaired utilities and damaged federal, state and local structures and roads, plus those losses in the private sector from damages to homes and businesses and the loss in revenue caused by the slack in business levels during the reconstruction period. Again, inconsistencies exist and figures on reported losses between various agencies fail to agree. Before any reasonable appraisal of these figures can be made, the numerous technical problems and the difficulty in

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<sup>5</sup> National Oceanic and Atmospheric Administration, Climatological Data National Summary, 1974 (Washington, D.C.: U.S. Government Printing Office) p. 66.

<sup>6</sup> Douglas Dacy and Howard Kunreuther, The Economics of Natural Disasters (New York: The Free Press, 1969) p. 123.

making viable estimates over a wide area in a short period of time must be taken into account.

The most destructive series of tornadoes reported in recent times occurred on Palm Sunday, April 11, 1965 when 37 tornadoes struck the midwest causing an estimated property damage of between \$200 million and \$500 million<sup>7</sup> (conflicting reports from two sources) killing 271 persons and injuring more than 5,000.<sup>8</sup>

Individual attitudes concerning tornadoes are often affected by reports made by the news media on the tragedy. These reports of the disaster, conveniently lumped into dollars and cents, deaths and injuries, add to a citizens awareness level whether they were a victim or not. The following section deals briefly with this and other problems related to citizen awareness.

#### Citizen Awareness

A person's hazard experience and attitude, or feelings and emotions, in combination with the physical factors related to the actual situation help to influence their level of awareness about actual or potential hazard situations. Not only is past experience a factor in determining human behavior but the actions taken by various governmental agencies in the form of precautionary measures and relief-rehabilitation programs as well as public reports and accounts of the disaster also act to affect how people view the particular hazard situation. Response to the tornado hazard is also dependent upon attitudes which in turn are affected by their awareness levels and their past experience with tornado situations.

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<sup>7</sup> Ibid., p. 8.

<sup>8</sup> Executive Office of the President, op. cit., footnote 3, p. 28.

An effort by various governmental agencies in conjunction with the news media to make the citizenry more aware or alert to the situation as probable conditions arise may tend to have adverse effects as persons who are continually subjected to tornado watches and warnings that upset their normal routine may develop an insensitivity to the potential of the possible hazard situation. This leads to a basic problem related to the effectiveness of warning systems. White and Haas ask "with current tornado forecasting skills, what modes of delivering the messages and what type of message content are most effective for the majority of the threatened population?"<sup>9</sup>

The degree to which a hazard experience influences an individual's level of awareness and response is determined by the amount of direct exposure to the hazard, the degree to which they are subjected to news reports and the variety of institutional responses made during the recovery process. The overall hazard experience is a combination of a variety of factors which relate to an individual's attitude towards tornadoes. How the actual physical event was observed and perceived is compounded by the actions taken by other individuals or groups before, during and after the occurrence of a tornado, as perceived by the individual. Therefore, the response of government agencies in an effort to aid the citizens of a community devastated by a tornado becomes an important aspect in the formation of awareness-response levels.

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<sup>9</sup> Gilbert F. White and J. Eugene Haas, Assessment of Research on Natural Hazards (Cambridge, Mass.: The MIT Press, 1975) p. 279.

### Institutional Responses

Proper precautionary steps by both the public and its officials becomes a critical necessity for tornado protection. The combination of a speedy onset, short duration, erratic path and low predictability of the tornado require the participation of all levels of government and the cooperation of citizens for the coordination of arrangements and communications between the responsible warning agency and the local county and state authorities and agencies which have the responsibility of instituting actions to insure public safety, rescue and relief. Since 1953 the National Oceanic and Atmospheric Administrations' National Weather Service is the agency responsible for providing alerting information and warnings to communities concerning the development of tornadoes.

A further involvement between the National Weather Service and any community is the development of a Tornado Preparedness Plan. This plan, initiated to ensure cooperative local action in the event that a tornado should occur, may include arrangements from the simple to the complex depending upon the size and diversity of the community. Among these arrangements made to ensure proper coordination of local actions are the following procedures common to all community plans as compiled by the National Weather Service.<sup>10</sup>

1. Indication of the National Weather Service office responsible for warnings.
2. A tornado and severe thunderstorm reporting network,

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<sup>10</sup> National Oceanic and Atmospheric Administration, National Weather Service, Tornado Preparedness Planning (Washington, D.C.: U.S. Governmental Printing Office, 1970) p. 5.

3. One or more warning centers.
4. Communications for dissemination of watch bulletins and warning bulletins and for alerting safety, rescue and relief agencies.
5. Provisions for alerting places where people normally congregate, to the need to activate a supplemental watch on threatening weather conditions for their own immediate benefit.
6. Provisions for alerting and warning people in outlying areas.
7. Specific, detailed provisions for action to be taken when a tornado or severe thunderstorm strikes.
8. Warnings lists, and rosters of key personnel and alternates.
9. Brief, clear reference information on steps that should be taken by the public to be prepared for tornado and severe thunderstorm strikes.
10. Information on actions to be taken after a disaster, and availability of food, shelter, medical supplies, water, fire prevention, sanitation and military assistance.

The citizens of a community which has instituted these arrangements into its emergency operations are assured of being adequately warned in the event of a tornado and provided with satisfactory relief and rehabilitation after a disaster. An orderly, timely and effective method of reaching all citizens in the event of a tornado is the most successful means of alleviating possible injury and death and reducing the damage potential. In any post-disaster situation it is important to provide the community with a safe, speedy and successful means of recovery. Proper allocation of duties and responsibilities to provide safety and relief to individuals stricken by the tornado is equally as important as an effective warning system in a pre-disaster situation.

The single most important aspect in a community's avoidance of costly damage and loss of life is a timely and effective warning system. To be ideally effective, a tornado warning system should have the following characteristics, as set forth by the Office of Emergency Preparedness in their 1972 Report to the Congress on Disaster Preparedness.<sup>11</sup>

1. The system must provide timely warning.
2. It must appeal to more than one human sense, such as sight and hearing.
3. It must be as mechanically foolproof as possible, with its human element having a similar degree of infallibility.
4. The warning must be understandable, convincing in language and tone, and issued by sources the public considers to be reliable.
5. It must reach every citizen in the affected area regardless of the hour.

No amount of public education, early detection, timely warning and execution of proper safety procedures will be effective without prompt human response to the threat. Even with proper response damage is unavoidable. If, therefore, a tornado does occur, necessary steps must be taken for the implementation of disaster relief and rehabilitation programs by all levels of the government. Today, the methods of providing relief at all levels are distributed through a variety of agencies and organizations. However, prior to the 1950's the American National Red Cross, established in 1905 as an official instrument of the Federal Government, was the major disaster relief agency in the United States.<sup>12</sup>

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<sup>11</sup>Executive Office of the President, op. cit., Vol. 1, p. 38.

<sup>12</sup>Dacy and Kunreuther, op. cit., footnote 5, p. 33.

Motivated initially by preparation and response to military attack in the 1950's, all states now have statutes dealing with a variety of disasters.<sup>13</sup> Red Cross activities are concerned mainly with mass care, while the federal government through its many programs provides assistance designed to aid the community as a whole or individuals separately.

In Kansas, relief operation procedures begin at the local level when a tornado threatens or occurs. Local authorities immediately take steps to warn citizens, alleviate suffering and protect life and property.<sup>14</sup> However, when damage is extensive and additional help is needed, local authorities may request assistance from the Governor who then has the option of committing various state agencies and resources as the conditions warrant. If the situation is of such severity and magnitude that effective response is beyond the capabilities of the State and the affected local governments, the Governor can request federal assistance.<sup>15</sup> This request must contain an accounting of reasonable expenditures of state and local funds for disaster relief in addition to an estimate of the extent and nature of federal assistance required for each of the affected counties and the state.<sup>16</sup> The govern-

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<sup>13</sup>Executive Office of the President, op. cit., footnote 3, Vol 3, p. 3.

<sup>14</sup>Division of Emergency Preparedness, Kansas Emergency Procedures Handbook (Office of the Adjutant General, Oct., 1976) p. vii.

<sup>15</sup>Ibid., p. vii.

<sup>16</sup>Ibid., p. vii.

mental responsibility in any post-disaster situation is to ensure continued protection, speedy relief and proper assistance to the citizens stricken by the disaster.

An individual's level of personal suffering can be alleviated in part through an effort to replace what was lost in the disaster. Although no price can be placed on human life or suffering, some compensations can be made to return the victim to a satisfactory level of living. This is what current governmental disaster policies attempt to do. The expenditures by government agencies could be lessened to some degree through the application of numerous adjustment options available to the individual citizen. The next section deals briefly with these options in regard to lessening the damage from tornadoes and their associative disturbances.

#### Individual Adjustment Options

Sound and aggressive forms of various precautionary measures can do more to reduce the severity of tornado damage than any other mitigative action. Awareness and proper incentives to motivate individual or community participation with respect to mitigative action are often affected by current federal policy such as low-interest Small Business Administration (SBA) loans - readily available and with extreme flexibility - to individuals, business concerns, partnerships, churches, charitable organizations and other non-profit organizations.<sup>17</sup> It is conceivable that the amount of aid available to the victims of a designated federal disaster area encourages individuals to continue

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<sup>17</sup> Dacy & Kunreuther, op. cit., footnote 5, p. 185.



to ignore various options available to protect themselves and reduce property damage against future catastrophes.<sup>18</sup> Those persons choosing to gamble may be left to rely upon more conventional forms of financing for rebuilding if their property is damaged in a region which fails to qualify as a designated disaster area.

A major form of protection for homeowners is the comprehensive homeowners insurance policies developed in the 1950's. It is standard practice today for financial institutions to require that a homeowner carry an EC or extended coverage endorsement in conjunction with fire insurance as a condition for obtaining a mortgage on a house.<sup>19</sup> This coverage for protection from wind damage caused by tornadoes began its popularity in the midwest and spread to include all states. As would be expected, the rates paid for this protection reflect the area's vulnerability, therefore being the highest in the central plains states.

For the more prudent individual who chooses to ignore the small mathematical probability of a tornado striking a specific location in any one year<sup>20</sup> and opt to rely on the ability of natural forces to reduce these probabilities to an almost meaningless form,<sup>21</sup> there are a variety

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<sup>18</sup> H. Kunreuther, "Economic Analysis of Natural Hazards An Ordered Choice Approach" Natural Hazards: Local, National, Global, ed. G. F. White, (New York: Oxford University Press, 1974) p. 213.

<sup>19</sup> Dacy & Kunreuther, op. cit., footnote 5, p. 231.

<sup>20</sup> According to the NOAA (see footnote 1) the probability of a tornado striking a given point in the area most frequently subject to tornadoes is 0.0363, or about once in 250 years.

<sup>21</sup> Some exceptions are; Oklahoma City-struck by tornadoes 26 times since 1892. Baldwin, Mississippi-struck twice by tornadoes during a 25 minute period on March 16, 1942. Irving, Kansas-struck by two tornadoes which occurred 45 minutes apart on May 30, 1879 and Codell, Kansas-struck three times, 1916, 1917 and 1918-all on May 20. (refer to footnote 1)

of actions that can be taken to alleviate the losses suffered by the tornado. Based on a review of previous tornado studies, they appear to be:

1. Institute a plan to be utilized by all members of the household upon receiving timely warning.
2. Increase the amount of insurance coverage.
3. Provide a form of shelter to house persons in the event a tornado does occur.
4. Provide proper ventilation for the roof of the home.
5. Anchor mobile homes firmly and abandon quickly at the onset of a tornado.

Although this list has been compiled from the findings of several studies on tornadoes, it is by no means inclusive. Any or all of these procedures will help alleviate both death and injury as well as property damage in the event of a tornado. However, the most important factor in surviving any disaster is to maintain a moderate to high level of awareness of the damage potential and a quick, effective mode of response. The quicker an individual recognizes the immediacy of the event and responds in a timely and orderly fashion, the more likely that person is to survive the tornado. Those individuals victimized by the tornado hazard, either actual or potential, would conceivably maintain a higher level of awareness and response to this hazard than those who have escaped its occurrence. However, the retentiveness of such an encounter on the part of an individual would seem to lessen as time elapsed.

# MAN-ENVIRONMENT STUDIES IN GEOGRAPHY

The study of the man-environment relationship is a rich tradition in geography. Throughout the discipline's history this approach has dealt with a variety of hypotheses and generalizations concerning the processes involved in man-environment interactions. These studies are characterized by a balanced view of both socio-cultural and ecological phenomena. One school of thought was introduced in 1922 by Harlan Barrows, who recommended studying geography as human ecology which involved the relationships that exist between natural environments and the distribution of man and his activities.<sup>22</sup> This approach, viewed from the standpoint of human adjustment to the environment rather than from that of environmental influence, was concerned with those adjustments made to landforms as an element of the natural environment. The view of people as agents in the modification of the surface of the earth is an old and honored theme among such noted geographers as Carl Sauer, C. Ritter, F. Ratzel and G.P. Marsh.<sup>23</sup> Previous geographers have either concentrated on the physical or the human element or have shown an unnecessary concern with the impact of one on the other.<sup>24</sup> G.P. Marsh felt that the study of what humans have done to the earth was the purpose of geography while C. Ritter and F. Ratzel supported the opposite view that human activity is defined in

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<sup>22</sup> Harlan Barrows, "Geography as Human Ecology," Annals of the Association of American Geographers, Vol. 13 (1923) p. 1.

<sup>23</sup> John Leighly "Carl Ortwin Sauer, 1889-1975" Annals Vol. 66, No. 3, p. 344.

<sup>24</sup> Roger Minshull, The Changing Nature of Geography (London: Hutchinson and Company LTD, 1972) p. 102.

terms of physical laws.<sup>25</sup> Individual or collective human adjustments are made not only to landforms but to a wide variety of phenomena in the natural environment. Among these adjustments are those made in response to a variety of meteorological and geophysical events which are termed hazards when human activity is involved.

The environmental orientation in geography, sometimes referred to as man-land relationships, is one of the three major themes of geography today. The initial division of studies in geography would fall under an environmental, regional or spatial theme.<sup>26</sup> The environmental perspective is comprised of numerous subdivisions which have produced a variety of accomplishments leading to a better understanding of how humans cope with the environment in terms of receiving the greatest benefit with minimum disruption to the natural environment. Among these various branches concerned with the interaction of man and the environment, the field of environmental perception has gained much recent interest.

#### Environmental Perception

Not until the early 1960's did the perception approach begin to have a significant impact on geographers. The economic geographer W. Kirk was among the first geographers to separate the perceived environment as a distinct subfield.<sup>27</sup> In the early 1950's he stressed the importance of examining the "behavioral environment", a field which

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<sup>25</sup> Ibid., p. 102.

<sup>26</sup> J. Lewis Robinson, "A New Look At the Four Traditions of Geography", Journal of Geography, Vol. 75, No. 9. pp. 520-530.

<sup>27</sup> Larry Grossman "Man-Environment Relationships in Anthropology and Geography" Annals, Vol. 67, No. 1, p. 139.

observed how sensed data acquire values and meaning, which leads to a decision-making process where behavior begins.<sup>28</sup> In another early study in environmental perception, D. Lowenthal dealt with the relationship between the real world and the perceived world and considered each person as an agent in the creating of order and organization of space and time according to their process of perceptions and preferences as derived from previous experience.<sup>29</sup> This approach parallels my study which views awareness-response levels to the tornado hazard as influenced by previous experiences within the constraints of various socio-economic phenomena such as age, education, and occupation.

The variety of individually derived images which are based on the perception and evaluation of the hazard event led to the determination of decision making processes and behavior modes that are in direct relation to the establishment of awareness and response levels. These decision-making processes are representative of varying levels of awareness to the tornado hazard as behavior is a direct parallel to response levels in relation to the perception and evaluation of the tornado hazard. Thomas Saarinen, whose work in environmental perception and behavior is representative of current trends in this growing field, views people as decision makers whose behavior is considered to be a function of their image of the real world.<sup>30</sup>

As a major subfield of environmental perception in geography, natural

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<sup>28</sup> Ibid., p. 139.

<sup>29</sup> David Lowenthal, "Geography, Experience and Imagination: Towards a Geographical Epistemology", Annals, Vol. 51, (1961), No. 3, p. 260.

<sup>30</sup> Thomas Saarinen, Environmental Planning: Perception and Behavior, (Boston: Houghton Mifflin Co., 1976) p. 10.

hazard studies deal with the economic, social and political aspects of adjustment to a variety of naturally occurring hazardous events. These studies initially supported by the National Science Foundation at Clark University, the University at Chicago and the University of Toronto, have been aimed at improving individual awareness and governmental assistance through appraisal of both physical and social factors related to the processes by which people adjust to the threat and occurrence of hazards in nature.

Under the leadership of Gilbert White, natural hazards research has attempted to analyze how people adapt to the risk and uncertainty during extreme natural events. Natural hazard issues investigated include: the determination of a range of actual and perceived adjustments, the decision-making processes as determined by individual or collective differences in perception and the existence of reasons for, the variations in the perception of hazards.<sup>31</sup> These basic issues focus on understanding the hazard itself, as opposed to earlier studies which viewed hazards in relation to the physical agents causing the hazard.

#### Perception in Hazards Research

The problem's of natural hazards cannot be expressed in geophysical terms as they always result from an interaction between a human activity and a destructive event in nature. Although the cause of the phenomena can be studied in a physical approach, the way people perceive, and respond to

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<sup>31</sup> Ian Burton and Robert Kates, "The Perception of Natural Hazards in Resource Management", Natural Resources Journal, Vol. 3, (1964), pp. 412-441.

the event must be studied in order to achieve the maximum benefit from research dealing with natural hazards. To alleviate damages caused by hazard events, an understanding of both the physical mechanisms involved and the variety of human adjustments and responses taken in light of this hazard threat or occurrence is vital. The perception of a natural hazard is a function of cultural, economic, political, and individual physiology and personality factors. Any or all of these factors act to condition individual and collective perception, response and adaption levels to extreme natural events.

Numerous hazard perception studies deal with a range of hazardous events including earthquakes, volcanoes, tsunamis, hurricanes, tornadoes, hail, snow, floods, lightning, and windstorms. All research investigations have a mutual concern toward collaborating the findings which may be common to a variety of specific hazards. Norman T. Moline, in a study involving the relationships between local planning and decision making governmental agencies and the attitudes of the citizens, found the residents of the floodplain to have: (1) a close attachment to their river locations; (2) a lack of knowledge about individual adjustment options; (3) a lack of awareness about the extent of governmental assistance to flood problems; (4) a perceived poor communications of government agencies with the residents; and (5) a low regard for the various units of the government.<sup>32</sup> These findings were helpful to the government agencies as they suggested a need for greater and more effective efforts at public education and

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<sup>32</sup> Norman T. Moline, "Perception Research and Local Planning: Floods on the Rock River, Illinois" Natural Hazards: Local, National, Global, ed. G. F. White, (New York: Oxford University Press, 1974) p. 58.

communication. The ability to determine a pattern of citizen attitudes toward possible hazard situations is a critical factor in effectuating an acceptable decision-making process to alleviate the possibilities of excessive damage. The findings were also useful for the student of natural hazards as parallels could be drawn between this study and other hazard studies. For example, attitudes between residents on a floodplain, in an earthquake zone, tornado belt or hurricane zone may conceivably show the same results in the close attachment to their location, lack of knowledge regarding adjustment options and a lack of awareness about the extent of governmental assistance to specific hazard problems.

#### Tornado Studies in Geography

To date, investigations dealing specifically with the tornado hazard have emphasized physical characteristics and are aimed at understanding the mechanisms of the tornado and at predicting its occurrence.<sup>33</sup> For example, a recent book by Eagleman, Muirhead and Willems, investigates several different aspects of tornadoes for the purpose of improving our understanding of tornadoes and our ability to decrease their impact on society.<sup>34</sup> The authors explore a model of wind flow patterns which provides insight into a concept such as the source of energy for the tornado.

Other physical studies have dealt with the regionalization and distributional patterns of the phenomena. A paper by Richard Skaggs from

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<sup>33</sup> White and Haas, op. cit., footnote 8, p. 280.

<sup>34</sup> Eagleman, op. cit., footnote 2, p. xix.



the University of Minnesota, describes the methods and results of an investigation of the degree and pattern of spatial variations in the diurnal distribution of tornadoes in the central and eastern United States.<sup>35</sup>

Studies dealing with the social, economic, and political aspects of tornadoes have not been as numerous as those dealing with flood erosion, earthquake and pollution hazards. To achieve consistency in methodology concerning tornado research, geographers need to look at the social ramifications of the tornado hazard in combination with continued physical efforts in future research. For example, in a study by John Sims and Duane Baumann, "The Tornado Threat: Coping Styles of the North and South", emphasis was placed on a concern with the differences in human response to the threat of tornadoes.<sup>36</sup> This study combines related physical investigations with the social aspect of human response to the tornado. Within the context of the tornado hazard, a very real problem is the ability to determine an awareness-response index based upon available adjustment options and factors influencing perception variations. If we view human action, from both the individual and collective perspective, as an agent in the creation of order and organization of space as influenced by the perception-preference process, it would be beneficial to determine how previous experiences with actual or potential tornado hazards affected the perception-preference process. This process is affected

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<sup>35</sup> R. Skaggs, "Analysis and Regionalization of the Diurnal Distribution of Tornadoes in the United States", Monthly Weather Review, Vol. 97, No. 2, p. 103.

<sup>36</sup> John Sims and Duane Baumann, "The Tornado Threat: Coping Styles of the North and South", Science, Vol. 176 (30 June, 1972) p. 1386.

also by numerous socio-economic characteristics of the individual and the community. The options for mitigative action are a combination of perceived behavior and individual preferences within a community context.

#### STATEMENT OF PROBLEM

In order for warning systems and tornado mitigation programs to be effective, an understanding of the levels of awareness for and responses to the hazard situation is needed. The major focus of this investigation will be to determine the influence of experience with tornadoes on human response to and awareness of the tornado hazard in Kansas. This study will examine how the magnitude and frequency of the tornado affect awareness and response. The variation of awareness and response will be examined for different socio-economic groups.

Three study areas have been chosen in Kansas on the basis of their different experiences with tornadoes but similarities in socio-economic characteristics. The cities of Clay Center and Manhattan were selected to compare the influence of time as Clay Center experienced a tornado in September 1973, Manhattan in June, 1966. Serving as a control, Junction City has had no occurrences of a tornado within the previous fifty years. It is assumed that the findings for these three cities would hold true for other cities of comparable size and character in the state of Kansas.

This study deals with numerous relationships between the real and perceived world. An individual's perceived environment is influenced by a variety of very real events including the threat of tornadoes. All of these occurrences lead to the behavioral environment of an individual in which this person functions on a day by day basis. An important part of people's decision-making process, where behavior begins, is how their

perceptions and preferences, as determined by previous experience  
affect the methods they utilized in creating order and organization  
of space and time.

## Chapter II

### THE STUDY: SITE, METHOD AND SAMPLE

The factors that influence individuals perception of the tornado hazard are often the result of distinctive characteristics within their community. These characteristics tend to act as constraints or boundaries within which people develop their attitudes and response behavior to the possible hazard situation. Before response based upon past experience can be dealt with effectively, a general understanding of the unique character of each city, as relevant to the study, should be examined. Consideration of physical, social, economic and institutional conditions for each community within the study area follows, along with a description of the techniques employed to gather data concerning individual conditions and attitudes of the citizens.

### THE STUDY AREA

For this study three sites were selected that were within a short driving distance of Kansas State University but that had differences in the degree of damage caused by past tornadoes as well as differences in the time of occurrence. The cities of Clay Center, Manhattan, and Junction City are all located within the area of the United States which has been termed "tornado-alley" because of its high frequency of tornadic activity. Each area also has a similar community character and population with a diversity in the degree of past experience. Hopefully the results of this study can be applied to other cities in Kansas with similar size and character. In terms of experience, the selection of these three sites was based upon the degree of damage and upon the season of

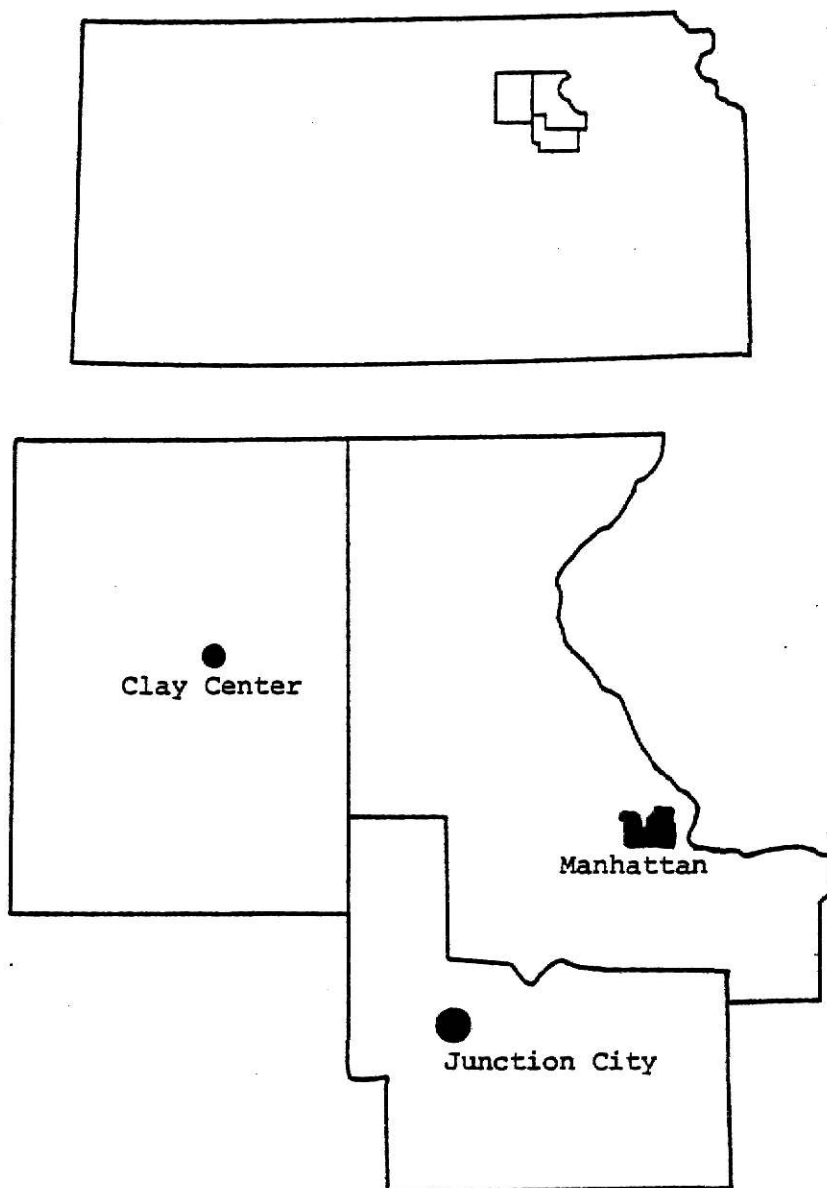
the year and amount of time elapsed since the tornado. Clay Center's tornado on the evening of September 25, 1973 accounted for more property damage than the tornado of June 8, 1966 which struck Manhattan. The time elapsed since both occurrences provides a means of examining the deterioration of individual awareness-response levels. Junction City was selected as a control city as it has had no occurrences of a tornado in the past fifty years, and is comparable in size and character to the other study sites. (Refer to Figure 1)

In the following section, each city will be described in terms of its character such as population, services and lifestyle. After this brief familiarization, the event of tornado experience shall be summarized. This will be followed by an account of the overall community response to the hazard from its warning system to the types and amount of relief provided by varying groups or agencies. Lastly, the adjustments made by each city in an effort to lessen future problems they may face in the event of a tornado shall be described and evaluated. For Junction City discussion will center around a description of the community's character and upon the Emergency Procedures and Post-Disaster Plan.

#### Clay Center

Located north of the Republican River and adjacent to Huntress Creek, the town of Clay Center, Kansas, the county seat of Clay County, was settled in May, 1862. This location allegedly prompted an old Indian to tell early settlers that a tornado would never enter the city limits, as it was the belief then that tornadoes would never cross a large body

FIGURE I  
CLAY CENTER, MANHATTAN AND JUNCTION CITY STUDY AREA



of water.<sup>1</sup> The city is surrounded by rich farm land planted mostly in wheat, corn, milo and alfalfa. Clay Center is distinctive from Manhattan and Junction City in that most of its 4,909 inhabitants are in some manner connected to or dependent upon the agricultural business. Two manufacturing facilities provide the single largest source of employment for the town labor force. These industries, Gilmore-Tatge and Hutchinson-Royal manufacture farm equipment.

The population is comprised largely of lifetime residents of the area. With few exceptions citizens have been exposed to this lifestyle and characteristics of the area most of their lives. The community settlement is fairly compact in nature consisting of homes constructed of wood or brick with a few stone houses and mobile home trailer parks. The age structure of the city is skewed to the upper-age bracket with twenty-three percent of the citizens belonging in the sixty-five and older category.<sup>2</sup> The mean age of forty years is almost twice that of the other two study areas. It is possible that awareness, response and adjustment would be greatest in this middle age group as opposed to the young and old because the responsibility for family and livelihood is more intense.

#### The Event

The events on the evening of September 25, 1973 provided an opportunity for the citizens of Clay Center to test the validity of the old Indian

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<sup>1</sup>Clay Center Dispatch, The Indian Was Wrong (Clay Center, Kansas: The Printery, 1973).

<sup>2</sup>U.S. Department of Commerce, Characteristics of the Population, Census of The Population, Vol. 1, part 18, Kansas (Bureau of the Census, 1970).

proverb as twenty-four tornadoes, recorded by the National Weather Service in Concordia thirty-two miles (52 Kilometers) northwest of Clay Center, were sighted in Clay County alone with eight of these funnels travelling a total of sixty miles (97 km) on or near the ground destroying farmsteads and crops. Shortly after 8 P.M. the citizens of Clay Center knew the legend was wrong, as a tornado entered the city from the southwest and followed Kansas Highway K-15 from one end of the town to the other destroying eighty homes and damaging 500 others. In the business district at least eighty offices, shops and stores were damaged with some being totally destroyed.<sup>3</sup>

September tornadoes are not rare in Kansas, however, they are not usually expected especially in the early evening hours. Prior to the twenty-four tornadoes on September 25, 1973, only fifty-nine have been reported for the month of September in the state since 1916. It might be thought that the citizens of Clay Center were unprepared for this tornado, but it was not the case as conditions were severe enough to cause concern by local authorities who took the necessary steps to institute the town's standard operating procedures for severe storm conditions. This procedure consisted mainly of deploying civil defense spotters to strategic elevated points around the city and deploying sheriff office vehicles to notify the small outlying farming communities in the area such as Longford and Oak Hill some eighteen miles (29 km) southwest of Clay Center.

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<sup>3</sup> Clay Center Dispatch, op. cit., footnote 1, p. 1.

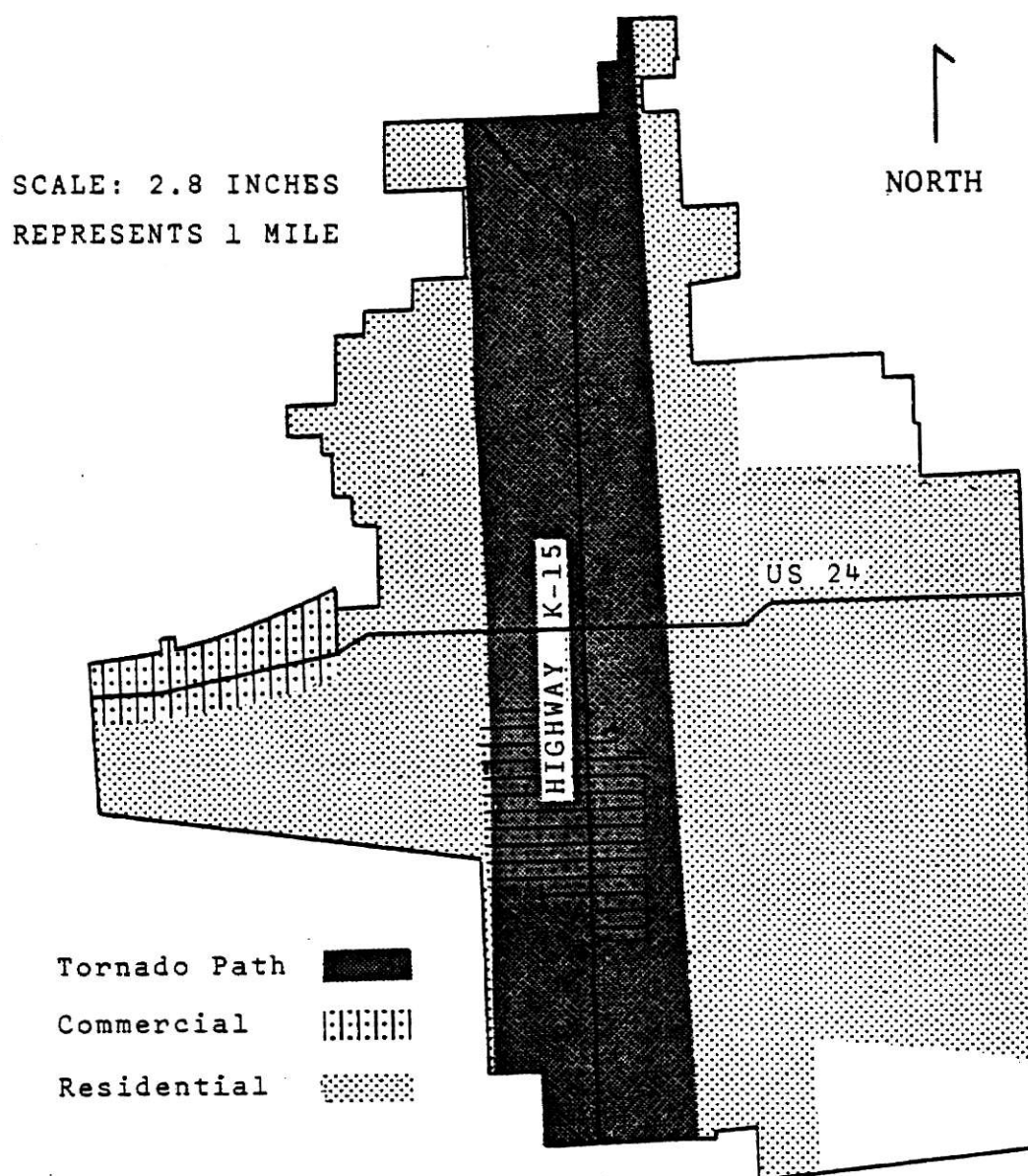


### The Response

The evening of September 25, 1973 was the most violent night caused by atmospheric conditions in recorded Kansas history, yet for some people in Clay Center it began as nothing more than another stormy evening as they went about with their nightly routine. Those who were just settling down to watch television or listen to the radio were interrupted with news that a tornado was headed for their city and were advised to take immediate cover. Meanwhile, the tornado warning system had gone into action as sirens and whistles were sounded and emergency vehicles drove up and down the streets with their sirens echoing into the ominous yellowish atmosphere. As the tornado dipped down it demolished businesses and churches for five blocks before continuing its northward surge striking buildings for two blocks on either side of its path. Before departing the town the tornado struck final blows to the east wing of the hospital and totally destroyed the new Medical Arts Building on the east. (Refer to Figure 2) The water tower antenna was also felled severing communications between the Law Enforcement Center and the world outside the city limits.

After the tornado had extended its destruction to farmsteads and smaller communities to the north, an eerie silence befell Clay Center interrupted only by the occasional final groans of buildings before collapsing into a pile of rubble. The event had taken only a few minutes, beginning at 8:07 P.M. and ending at approximately 8:10 P.M. No one was all that concerned with time, it was dark and raining heavily, and pieces of a once genteel life had to be collected. Those individuals who escaped the devastating path of the tornado were quick to respond to the needs of others as some helped restore communications and others worked on

FIGURE II  
PATH OF SEPTEMBER 25, 1973 TORNADO  
- CLAY CENTER, KANSAS -



clearing debris, felling once sturdy trees now twisted in a sculpturesque fashion and picking up the remains of a family home. Officials from surrounding towns offered their assistance as fourteen ambulances arrived from neighboring cities as far away as Mankato, seventy miles (113 km) northwest of Clay Center and Horton, some 115 miles (185 km) to the northeast. Five Army helicopters from nearby Fort Riley were sent in case evacuation of the hospital became necessary. Before sunrise the Red Cross disaster center was set up and the Salvation Army Canteen had arrived to provide relief. Assistance with clean-up duties was performed by city employees and the Kansas National Guard. A group of Mennonites from settlements in Reno and Harvey Counties approximately 120 miles (193 km) southwest of Clay Center, entered the scene to provide a range of services, and they worked throughout the day and night to assist individuals in any manner they could. Not only did these volunteers provide a much needed service, but they also came fully prepared to provide for all their own needs so as not to drain community resources.

By request of the Governor the event was designated a major disaster area by the federal government which subsequently supplied funds to local utilities and created facilities to offer low-cost loans to individuals for purposes of rebuilding homes or businesses through the FHA and Small Business Loan agencies. State agencies involved were the Highway Patrol, Emergency Preparedness Office and the Kansas National Guard. Law enforcement facilities were heavily damaged and funds were provided through an LEA grant for the replacement of those items lost. Because of the preparedness of city officials for tornado situations and the alert spotting on the part of the Civil Defense Director in conjunction with speedy and effective warning by city officials, injuries were kept to a

minimum and no deaths occurred. However, in the wake of this disaster, it became apparent that a means of providing a more orderly post-disaster plan was needed.

### Adjustments

Adjustments are made in a post-disaster situation in a variety of forms. Individual adjustments range from preparing a household action plan for future tornadoes to a complete rebuilding of their home. Aside from individual adjustments, collective adjustments may become necessary once emergency operations plans are subjected not to a test but to reality. Only in this situation are flaws to be found and corrected. For Clay Center facilities had been installed for civil defense warning some ten years prior in the form of fallout shelters, a siren and the previously discussed standard operating procedures for city officials. These measures survived the test but not to the satisfaction of city officials. A means of providing a more orderly and effective coordination and allocation of duties and responsibilities from some thirty-eight manpower organizations was deemed to be needed. The duties performed by these existing organizations were as varied as the organizations themselves. It was on the character of the organizations that duties and responsibilities were allocated. HAM radio operators were delegated to assist in communications and Boy and Girl Scouts to help in clean-up duties while churches and the Red Cross provided comfort and relief. The National Guard was assigned the more arduous clean-up duties and utility company's duties quickly restored power to the city.

Today, Clay Center is experiencing a trend towards residential and commercial expansion related in part to the stimuli provided by the

tornado. It cannot be discounted that the impetus afforded by the tornado provided an economic stimulus for the community. However, the inflow of external capital was not substantial, and the primary motive behind expansion is a need to rebuild coupled with the availability of low-cost loans to individuals who may have been in a situation prior to the disaster that made obtaining a loan for this purpose unfeasible.

Whether local capital would have been utilized for this purpose if the tornado had not occurred cannot be adequately determined, yet it is evident that the events due to the tornado were an incentive to local growth beyond the replacement state. A feeling of forward motion was instilled in the minds of the citizens of Clay Center as depicted on a sign in front of the Clay Center Court House which says . . . "Take a New Look. . . Walk Forward".

#### Manhattan

Manhattan, the tenth largest city in Kansas with a 1975 population of 31,540 is located at the junction of the Big Blue and Kansas (Kaw) Rivers fifty miles (81 km) west-northwest of Topeka, the State Capital, and thirty-five miles (56 km) southeast of Clay Center. This community, which experienced a unique tornado in June 1966, draws its character in part from Kansas State University, located in the city since the early days of settlement. Two other important factors concerning the socio-economic character of the city are its close proximity to the Fort Riley Military Reservation ten miles (16 km) to the southwest and Tuttle Creek Reservoir four miles (6 km) to the north. The issues which these three conditions bring about are concerned directly with the level of individual awareness-response. Because of the large number of students and military

personnel residing in Manhattan, the median age of the city is 23 years with only eight percent over sixty-five years of age. As a result of this short term diversified sector of the population, numerous mobile homes, apartment complexes and group quarters such as fraternities, sororities, scholarship houses and dormitories dot the landscape. An issue resulting from this sector of the overall population is the range of unfamiliarity with potential tornado situations. Although some students and military personnel are from areas with similar conditions prone to tornadic activity, there are those who have never been exposed to the threat of a tornado as they have resided in places outside of the high frequency area in the United States or outside of the country. The effectiveness of the warning system could feasibly be impaired by this lack of awareness. A similar problem is encountered by the numerous tourists that utilize Tuttle Creek Reservoir. Most individuals who may be located at Tuttle Creek are from Kansas and are aware of potential tornado situations but the problem arises in their types of shelter such as trailers and tents, which provide little if any protection against tornadoes.

Aside from this sector of the population, Manhattan is similar to Clay Center as the city has many long term residents who are little affected by the university or Fort Riley. This discussion of the character of Manhattan is simply meant as a means of familiarizing the reader with the lifestyle of the city and its inhabitants. Experience as an influence upon awareness-response levels is measured most accurately by obtaining cities similar in size, density and housing types while differing in the time elapsed since they experienced the tornado hazard as well as the difference in the severity of the event.

### The Event

On the evening of June 8, 1966 sightings of funnel clouds were first reported some 150 miles (242 km) southwest of Manhattan as a squall line moved eastward. Although there was no old Indian legend to lead citizens into a false sense of security, natural forces were at work to perform a similar task. There were many witnesses to the approaching storm, but few saw anything to forewarn them of the disaster which was about to happen. The tornado, as described by L. Dean Bark, Professor of Physics at Kansas State University, was not a classical one. In this case the energy of the tornado cyclone was not concentrated into a single vortex; instead, the energy was distributed among five or six small vortices within the tornado cyclone.<sup>4</sup> The tornado entered the city from the southwest across Wildcat Creek valley and struck a housing development in northwest Manhattan at approximately 6:00 P.M., causing extensive damage. The tornado proceeded northeastward to totally destroy the 424 foot self-supporting transmitting tower of KSAS radio station, designed to withstand straight winds of 120 m.p.h. As this tornado (Refer to Figure 3) was dealing out destruction, three other smaller tornadoes were simultaneously destroying housing developments, trailer courts, apartment complexes and married student housing in other sections of town.

This occurrence of a non-classical tornado in combination with communications failure resulted in little if any warning to the citizens of Manhattan. There were some observations of funnel shaped clouds by trained spotters, located at strategic elevated points around the city,

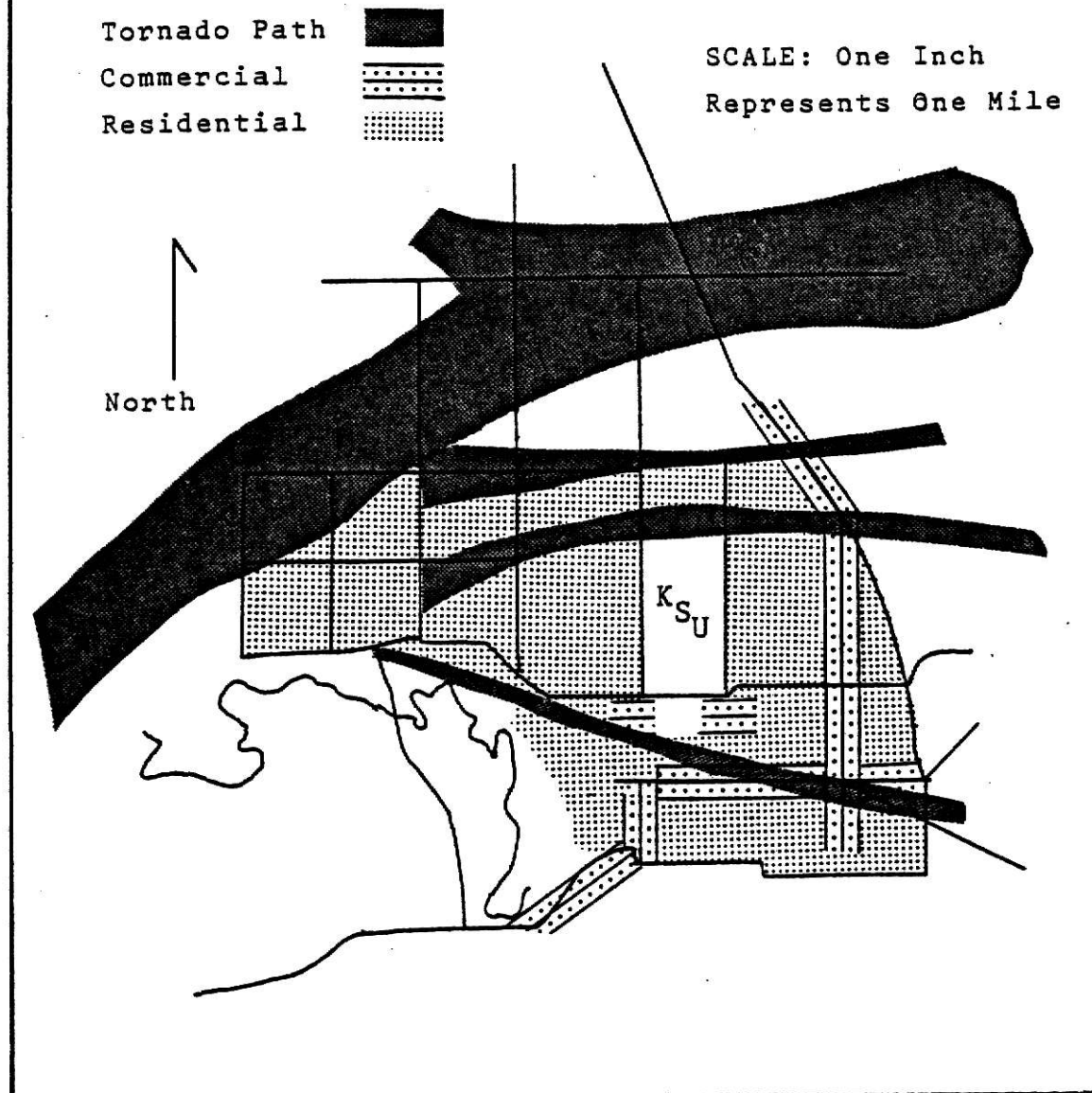
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<sup>4</sup>L. Dean Bark, "A Different Type Tornado On 8 June, 1966: Manhattan, Kansas", Weatherwise, Vol. 20, No. 2, April 1967, p. 71.



FIGURE III

PATHS OF JUNE 8, 1966 TORNADO  
- MANHATTAN, KANSAS -





who responded by notifying the senior police officer on duty by means of Citizens Band Radio. According to Dr. A. E. Levenson, the Civil Defense Communications Officer for Riley County, the message was never received due to atmospheric disturbance which blocked out the AM frequency of the energy spectrum of which Citizens Band Radios are a part. Despite this lack of warning, only fifty injuries with fourteen hospitalizations were reported by the Manhattan Red Cross. Damage was light in comparison to Clay Center as only eleven homes were destroyed in Manhattan, with 121 receiving major damage and another 207 with minor damages. In addition to this, twenty-eight mobile homes were destroyed and another 38 reported as damaged. An additional loss of \$1,850,000 was recorded by Kansas State University.

Within ten to twenty minutes after the storm had passed, the sky had completely cleared. Soon afterward the cold front passed bringing a sharp decline in the temperature. Rain was exceptionally light as only .13 of an inch fell, mostly during the storm. Little if any occurred after the center of the storm had passed. These conditions lead to a much more orderly and simple task of cleaning up the debris than was the case in Clay Center.

#### The Response

The evening of June 8, 1966 was to be a memorable one for many residents of northeast Kansas as a member of the same storm family which brought devastation to Manhattan was to roar through the capital city of Topeka one hour later killing 16 people, injuring 550 more and causing over \$100 million damages. In Manhattan the first notice of impending disaster was received over the local AM radio station KMAN. As the

case in all disaster situations, standard operating procedures which allowed for the orderly allocation of duties and responsibilities by numerous local agencies and civic groups, were in effect providing relief to the areas stricken. Because of the events which followed in Topeka, state resources were working at full capacity and the necessary steps for federal assistance were taken by the Governor. As with Clay Center, those individuals who were relatively unaffected by the tornado came to the aid of those left without homes or proper facilities.

#### Adjustments

As was the case in Clay Center, many adjustments were needed after the tornado had struck. Those taken on an individual basis will be dealt with in the following chapters. Collectively, the city officials found a variety of flaws in their emergency plan, mostly concerning the warning system. One major procedure that was never actually used in this event, as Citizen Band Radio communication was blocked out, was the delegation of authority for enactment of the warning system. The citizens of Manhattan on that fateful day would have been left without any sirens to warn them, communication failure or not, since the senior police officer on duty did not have the authority to sound the alarm and would not have done so unless permission had been obtained from either the Chief of Police or the City Manager. This was immediately rectified and was among the changes made in the overall emergency plan. Other adjustments made, which are relevant to this study, deal largely with the upgrading of the communication network and warning system. Effectiveness of any warning system relies upon timely alerting of

citizens, adequate shelter provisions, familiarity with the system and speedy response by those affected. The city has the responsibility of providing the most feasible warning system possible. One major drawback is, of course, economics. Manhattan, like most American cities, allocates funds in accordance to determined need. The probability of a tornado reoccurring in Manhattan is slight, therefore provisions were made to obtain an "adequate" warning system instead of the best available one.

The Riley County Civil Defense Communications Officer stressed that citizens should not rely upon the sirens as their only means of warning since mechanical failures and the numerous social distractions such as television, record players, machinery and other noise intruders all act to reduce the effectiveness of the warning system. Therefore, due to the weather conditions which prevail when tornadoes are a threat, individuals should provide themselves with a small transistorized battery operated radio and tune it in to a local radio station for word on the developments of the storm system.

Previous discussion of the events, response and community adjustment in Manhattan and Clay Center showed the basic similarity between city character, the diversity of the experience and the types of response and adjustments made by each community. While Manhattan's major flaw during the tornado was with communication, Clay Center's problem was in dealing with the post-disaster situation.

#### Junction City

Junction City has not had a tornado. Few cities can boast of this distinction in Kansas. Records for this city were checked as far back

as 1926 since it was felt that this was a period of time long enough to erase the mental "scars" or memories of the experience for those who had been involved in a tornado. The purpose of choosing a city to act as a control is mainly for comparison, to determine how awareness-response levels are actually influenced by experience and how the passing of time returns these levels back to that held before the tornado occurred. The discussion of Junction City deals with the familiarization to its character and a brief discussion of its Emergency Procedures and Post-Disaster Plan.

The distinct character of Junction City is derived in large part from its location at the confluence of the Smoky Hill and Republican Rivers sixteen miles (26 km) southwest of Manhattan, eight miles (13 km) southeast of Milford Reservoir and immediately adjacent to Fort Riley Military Reservation. The services provided by this community of 20,655 inhabitants are directed towards four activities: education, agriculture, recreation and military, with emphasis upon providing certain basic needs for military personnel in the form of housing, entertainment and commercial products,

With an estimated twenty-five percent of the city's population being composed of military personnel and their dependents, certain factors unique to their lifestyle play an important part in tornado awareness and response. As with Manhattan, a problem relevant to effective awareness-response levels is present in Junction City which is that of the individuals' unfamiliarization with the tornado hazard. The area of the United States which contributes the largest to in-migration of armed forces personnel to Kansas, the Pacific Region,<sup>5</sup> is the same region which

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<sup>5</sup> Cornelia Flora, Kansas Migration Streams: Where They Come From; Where They Go, (Agricultural Experiment Station, Kansas State University, Manhattan) Bulletin 601 September 1976, p. 6.

has the lowest occurrence of tornadic activity. The levels of awareness and response are determined by the individual's attitude toward the potential hazard situation caused by the threat of a tornado, which may be quite varied in this case.

In character the three study sites share similar traits and features. An individual foreign to this area might classify Manhattan a "college town", Junction City a "military town", and Clay Center a "farm town". Despite these dominant characteristics they are all similar. Military personnel, students and farmers reside in all three communities, and for the relevancy of this study, each sector has a chance of being sampled to measure awareness and response levels as influenced by experience.

#### The Plan

Because no tornado occurred in Junction City, the community response and adjustment to the event cannot be compared with Manhattan and Clay Center. However, the discussion of its Emergency Procedures and Post-Disaster Plan should show similarities to the initial and revised plans of the other cities.

The plan for Junction City was prepared by the City Manager's Office in March 1975. This recent date possibly reflects the continuing effort of city officials to improve the emergency operations in light of new information and technology compounded by the closeness of tornado disasters to their city in recent years. It conforms to the same basic outline as those in Manhattan and Clay Center with provisions for the delegation of lines of authority and areas of responsibility. Upon first notification of threatening "severe" weather (conditions are favorable for producing tornadoes, as issued via weather teletype by the National

Weather Service and received simultaneously by the Police Department and the local AM radio station KJCK , the senior police department official on duty is to immediately alert the on duty force and respective heads of the local REACT group<sup>6</sup> and Police Reserve Corps. If conditions worsen to the degree which constitutes a "close watch", spotters are to be sent to eight designated locations in various strategic elevated areas around the city.

If a tornado should be sighted on the ground and approaching the city, confirmed by either weather radar or observer sightings, the Chief of Police or his designated representative is to immediately sound a three-minute steady tone on the civil defense sirens and notify KJCK. Provisions are also made to interrupt programming on the cable television system. Final provisions are made for the designation of responsibilities, policies and procedures in a disaster of post-disaster situation.

The warning plan initially called for five civil defense sirens in Junction City and the city has applied for two additional sirens from the Emergency Preparedness Office in Topeka. Although there have been no major occurrences of tornadoes within the city limits, the plan has been tested either during tornado threats or during designated drills to assure the city officials of the continued effectiveness of the system.

It is apparent that these three cities, somewhat similar in character, size and quality are even more similar in their preparedness for tornadoes. In the following section, discussion will center upon the description of the data gathered and the methods used to collect it.

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<sup>6</sup> The REACT group consists of fifteen personnel and fifteen vehicles equipped with Citizen Band Radios.

### STUDY METHOD

The purpose for gathering data on individual socio-economic factors and measurements of respondent's awareness and response to tornadoes and their reoccurrences is to compare the levels of awareness and response for each of three study sites. From this comparison it could be determined if citizens are more alert and responsive immediately following the hazard only to return to pre-hazard levels after a given time span. Determination could be made also on the effects of certain socio-economic factors such as age, family size and occupation as related to the experience upon awareness-response indices. The data gathering procedure consisted of drawing a sample from each city to obtain individual measurements of socio-economic conditions and awareness-response information.

#### The Sample

A random sample was drawn from each city to insure a varied set of respondents from each age group, occupation, and educational level. Another important aspect was to obtain a variety of experience levels based upon the intensity of the damage received. For this purpose the areas to be sampled were determined by using a map of the city (Manhattan and Clay Center) in conjunction with one showing the path(s) of the tornado. The area was broadened for some four blocks on either side of the path in Clay Center. This resulted in almost equal coverage of the entire city as the path of the tornado bisected the town along its longest axis. However, for Manhattan, this procedure resulted in drawing a sample from that part of the city north of the University campus.

In order to further insure an unbiased population another step was taken before drawing the sample. As the city of Clay Center is the writers home town, certain deviations were introduced into the sampling procedure to achieve an unbiased response. Twenty close friends and relatives were removed from the sample pool because it was felt that these individuals would strive to answer questions as they believed the writer wanted them answered, thus reducing the usefulness of the survey. By chance, the potential respondents removed covered a wide range of socio-economic conditions which reduced any biasing of the sample that might have occurred from this procedure.

The final step taken in drawing the sample was the selection of respondents from telephone directories for all three cities, using a random numbers table. Each respondent was obtained by selecting a number from the random numbers table which was to indicate the page to be used. The second number selected corresponded to the number of names to be counted down the three columns on that page before arriving at the one to be used. For example, a random number of twenty-eight would refer to the 28th page of the directory while the second number, eighty-one would indicate that the 81st name would be selected. The current Junction City telephone directory was used for the selection of 100 persons. This sample size is larger than that drawn for Manhattan and Clay Center because of the number of military personnel selected who may no longer reside in the city and the anticipated low level of concern for this issue due to the lack of experience with tornadoes. For the selection of the sample from Manhattan and Clay Center, the telephone directory used during the time of the tornado was compared to the current directory to obtain present addresses of those individuals who were residing



in the previously discussed selection zone of each city. The sample size drawn was eighty from each city.

To achieve the best response possible under conditions of peak tornado awareness, the surveys were mailed, with a self-addressed stamped envelope for their return, on April 2, 1977, a date which marks the beginning of the period of highest frequency of tornadic activity in Kansas and the United States. Table 1 shows the surprisingly favorable response rate of the survey.

Table 1

SURVEY RESPONSE RATE

CITY	NUMBER SENT	NUMBER RECEIVED	PERCENTAGE
Junction City	100	40	40
Manhattan	80	50	62.5
Clay Center	80	57	71.3
Total	260	147	56.5

The Survey - A Brief Outline

The survey consists of two questionnaires of similar designs. One is used in eliciting information from individuals in the cities which had experienced a tornado, while the other was designed to obtain parallel information from the control site, Junction City, in which no actual tornado had occurred. The questions were intended to obtain information concerning individual socio-economic factors and measurements of the respondent's awareness and response to the event, probable reoccurrences of a similar event, or for Junction City the probable occurrence of a tornado disaster. In both forms of the questionnaire, the questions for eliciting socio-economic data were identical except

that all the information for Manhattan and Clay Center was asked to be given for the year the tornado occurred whereas for Junction City, present status was requested. Those questions pertaining to the hazard threat or hazard event were parallel in both styles. For Junction City individuals were asked what they would do in the event of a tornado whereas Manhattan and Clay Center's questions were worded in terms of what did happen on the day of the tornado. Other questions regarding the hazard pertained to personal feelings and attitudes about the tornado threat and evaluations of the community's warning system. This information was acquired by the use of both structured and unstructured questions.

The following information was obtained for the purpose of determining relationships between those variables peculiar to the hazard event and those pertaining to the socio-economic character of the individual. The variables selected for each category were:

#### Hazard-Specific Variables

1. Immediate response or action to first warnings of the tornado.
2. Perceived change in this response or action if event reoccurred.
3. Behavior at the time of the tornado.
4. Any perceived changes in this behavior if a similar event reoccurred.
5. Number of warnings received during the last ten years.
6. The type of warning received, or relied upon for tornadoes.
7. Location where respondent would choose to seek shelter.
8. Respondent's location at the time of the tornado.
9. Respondent's prediction of the future occurrence of a tornado in the city.
10. Change in attitude towards tornadoes as a result of the experience.
11. Respondent's age at the time of the first experience with tornadoes.

12. Type and amount of damage received.
13. Adjustments made or perceived as being made to alleviate similar damage in the event of another tornado.
14. A family plan of action to a tornado situation.
15. Respondent's evaluation of the city warning system.

#### Socio-Economic Variables

1. Age of the home at the time of the tornado.
2. Family size.
3. Marital status.
4. Type of structure of the home.
5. Ownership of home.
6. Number of years as a resident in the city.
7. Number of years as a resident in Kansas.
8. Occupation.
9. Education.
10. Sex.
11. Age group of respondent.

Provision was made for additional comments that the respondent may have concerning not only the subject or event but the questionnaire.

These variables were selected on the basis of those used in past hazard studies pertaining to different types of meteorological disasters other than tornadoes and on the writer's intuitiveness.

Tables were compiled to illustrate the type of relationship between these variables. The following chapter deals with a discussion of these relationships and their significance to this study.

## Chapter III

### SURVEY ANALYSIS

This chapter is divided into four general sections in an effort to systematically analyze the major topics of the survey data for purposes of showing the role of experience as a factor in human awareness and response to the tornado hazard. The first section is concerned with the cross-tabulation of the socio-economic and hazard-specific variables for purposes of illustrating the significance of those elements which prove to be related. The Chi-Square Test is employed using a .05 level of significance, in order to determine the importance of socio-economic conditions as opposed to experience-related variables as a component in the levels of awareness of and response to the tornado hazard. The second section deals with the cross-tabulation between hazard-specific variables in order to provide the data necessary for the comparison between socio-economic conditions and experience related variables. Those variables termed as hazard-specific are the ones which are directly related to the hazard threat or the actual disaster event.

The remaining two sections present tables illustrating the clustering of responses for each category among those variables directly related to experience. This clustering of survey responses into categories within each variable, related to either awareness or response, provides information relating to the importance of experience as a relevant factor in the determination of how individual citizens respond to or are aware of the threat of the tornado.

## ASSOCIATIONS BETWEEN SOCIO-ECONOMIC AND HAZARD-SPECIFIC VARIABLES

This section examines how socio-economic factors affect awareness and response to the tornado threat. This was done by using two methods. The first method crosstabulates the hazard-specific variables with the socio-economic variables for city or experience level while the second method provides a few of the aggregate relationships between these variables. Because of the small sample size of no more than forty respondents per city and a range of two to five categories for each variable, the number of responses per category in the crosstabulation of variables resulted in a vague impression of the importance of the relationship between socio-economic variables and the hazard-specific variables. The remaining part of this section deals with a brief discussion of the relationships of the socio-economic variables to the various hazard-specific variables as shown in tables 2 through 5. The tables indicate the relationships by crosstabulating the variables and illustrating the related ones by the use of a "+" and an "o" for those variables which are not related. When two variables are shown to be related it is helpful to indicate in which manner they interact or how one variable affects the other. This is done by viewing the relation between a cause and its effect or between regularly correlated events or phenomena. Each variable relationship is unique in that the causality factor varies among them. The relationships shown do not intend to indicate either positive or negative association.

Those associations shown between the socio-economic variables and hazard-specific variables for the three cities in the study area suggest that if we assume that the socio economic variables stand alone, unaffected by differences in the hazard experience, it can be inferred that the people of

Table 2

Significant Variable Relationships For Clay Center

SOCIO-ECONOMIC VARIABLES												HAZARD - SPECIFIC VARIABLES
Age of Home	Family Size	Marital Status	Structure	Ownership	Res. in City	Res. in State	Occupation	Education	Sex	Age	Response	
o	o	o	o	o	o	o	o	o	o	o	Procedure	
o	o	o	o	o	+	o	o	o	o	o	Warning Received	
o	o	o	+	+	o	o	o	o	+	o	Warning System	
o	o	o	o	+	o	o	o	o	o	+	Shelter	
o	+	+	o	o	o	o	o	o	o	o	Expectation	
+	o	o	o	o	o	+	o	o	o	o	Warning Evaluation	
o	o	+	o	o	o	+	o	o	o	o	Change in Procedure	
o	o	+	+	o	o	o	o	o	o	o	Procedure Followed	
o	o	o	o	o	o	o	o	+	o	o	Damage Adjustment	



Table 4

Significant Variable Relationship for Junction City

SOCIO-ECONOMIC VARIABLES											
Age of Home	Family Size	Marital Status	Structure	Ownership	Res. in City	Res. in State	Occupation	Education	Sex	Age	
o	o	o	o	o	o	o	o	o	o	o	Response
o	o	o	o	o	o	o	o	o	o	o	Procedure
o	+	o	o	o	+	o	o	o	o	o	Warning Received
o	o	o	o	o	o	o	o	o	o	o	Warning System
o	o	o	+	o	o	o	o	o	o	+	Shelter
o	o	o	+	o	o	o	+	o	o	+	Expectation
+	o	o	+	o	o	o	o	o	o	+	Warning Evaluation
o	o	o	o	o	o	o	o	o	o	o	Change in Procedure
o	o	o	o	o	o	o	o	o	o	o	Procedure Followed
o	o	o	o	o	o	o	o	o	o	o	Damage Admustment

HAZARD - SPECIFIC VARIABLES



Table 5

Significant Variable Relationships For The Aggregate  
Of All Three Communities

SOCIO-ECONOMIC VARIABLES											
Age of Home	Family Size	Marital Status	Structure	Ownership	Res. in City	Res. in State	Occupation	Education	Sex	Age	
o	o	o	o	o	o	o	o	o	o	o	Response
o	+	o	+	o	+	o	o	o	o	+	Procedure
o	o	o	o	o	o	o	+	+	+	+	Warning Received
o	o	o	o	o	o	+	o	+	+	+	Warning System
+	o	o	o	o	o	o	o	o	o	+	Shelter
o	o	+	o	o	o	o	+	o	o	o	Expectation
+	o	o	+	o	o	+	o	o	o	+	Warning Evaluation
o	o	o	+	o	o	o	+	o	+	o	Change in Procedure
o	o	o	o	o	o	o	o	o	o	o	Procedure Followed
o	o	o	o	o	o	o	o	o	o	o	Damage Adjustment

HAZARD - SPECIFIC VARIABLES

Clay Center, a farming community with close attachment to the weather conditions which affect its livelihood, have a much different awareness and response level with respect to every-day occurrences in the natural environment than the other cities in this study. Those relationships shown for the aggregate demonstrate that all socio-economic variables except the ownership of the home relate to a citizen's level of awareness or response to the threat of a tornado. Those variables which show the greatest number of relationships to the various hazard-specific variables are age and the type of structure of the home. This was expected, as the vulnerability of a person's home and its ability to provide shelter and protection in the event of a tornado were expected to be two of the main considerations of the homeowner when a tornado occurs.

Age is shown to be the most important variable relating to a person's level of awareness and response. It shows a strong relationship in the cities with past experience and no experience and also for the aggregate of all three cities. It seems evident that either maturity, immunity or old age apathy play an important role in determining the individual's attitude toward this hazard. The attitudes of persons under the age of twenty were not collected for this study, therefore it is assumed that the relationships shown stem from those age groups involving persons who are more sensitive to the value of life and property. In the writer's view, this could be due in part to the responsibilities incurred when raising a family or simply to a respect for a healthy and prosperous life. Although it is not always true, life and its numerous encounters tend to make the individual immune to those events which occur with continuing frequency such as tornadoes in Kansas. This immunity from the tornado hazard may advance to a state of apathy as a person reaches a

certain age. Although many social or psychological reasons may be postulated for this assumption, the major factor in this particular case is simply the probability of a tornado occurring at any given location within a person's lifetime. This indicates that the young may be more responsive than the elderly. This is not the case as both are responsive in a non-favorable fashion resulting from the peculiarities concerning their age. The elderly tend to be a fatalistic or apathetic while the young are more inclined to be adventuresome or curious. Those people who have reached advanced age may feel that this probability is so low that it is not really worth worrying about. This finding is consistent with previous works on a variety of natural hazards concerned not only with immediate response and overall awareness levels but with long-term effects related to the recovery and reconstruction processes involved in natural disasters.

It is important to realize that experience acts as a re-enforcing agent upon the behavior related to an individual's socio-economic character. As shown in tables 2 through 5, numerous variables play a role in determining at what level an individual is aware of this hazard or responds to it. In the following section, discussion will center on the role of experience alone in determining awareness and response behavior. It is necessary here to show the importance of each variable relationship instead of a brief overview as presented in this portion. Therefore the next subdivision follows tables 6 through 9 explaining the relationships found for each variable measured.

#### ASSOCIATIONS BETWEEN HAZARD-SPECIFIC VARIABLES

The following discussion centers upon the comparison of the variable

relationships within the three cities in the study area in order to relate not only the importance of each relationship but to illustrate the change in awareness and response which takes place over a given time span. Tables 6 through 9 illustrate those relationships which will be examined.

#### Variables Influencing Modes of Response

The first relationship is between response and the number of warnings received during the period ten years preceeding the tornado disaster, or for Junction City, those received in the last ten years. In the variable cross-tabulation, this relationship was shown only for the cities which had experienced a tornado. This suggests that those individuals who recalled receiving zero to two warnings responded to the tornado in various ways, most of which resulted in no shelter or safety being sought. This indicates that those people who are the least cognizant of warnings are those who have a low regard for the potentialities of the tornado hazard. On the other hand, it could be argued that this is an imprecise measurement as it relies upon memory of an unimportant event.

The relationship between response and people's age when they first experienced a tornado reflects the fact that those people who experienced their first tornado between the ages of 0-34 years all had pre-conceived plans for seeking safety in the event of a tornado. Those respondents who had never experienced a tornado before and were between the ages of 35 and 85 at the time of the tornado responded to the tornado event by seeking immediate shelter as opposed to following a well defined plan. Although seeking immediate shelter may be termed the best plan, preconceived

Table 6

Relationships Between Variables For Clay Center

HAZARD - SPECIFIC VARIABLES											
Response	Procedure	Wrn. Rc'vd.	Wrn. System	Shelter	Expectation	Age of First	Wrn. Eval.	Cng. in Proc.	Proc. Fl'wd.	Damage Adj.	
o	+	o	o	o	o	+	o	o	o	o	Response
	+	o	o	o	o	+	o	o	+	o	Procedure
		o	o	+	o	o	o	o	o	o	Warning Received
			o	o	o	o	+	+	o	o	Warning System
				o	o	o	o	o	o	o	Shelter
					o	o	o	o	+	o	Expectation
						o	o	o	o	o	Age of First
							o	o	o	o	Warning Evaluation
								o	o	o	Change in Procedure
									o	o	Procedure Followed
										o	Damage Adjustment

HAZARD - SPECIFIC VARIABLES											

HAZARD - SPECIFIC VARIABLES

Table 7

Relationships Between Hazard Variables For Junction City

HAZARD - SPECIFIC VARIABLES											
Response	Procedure	Wrn. Rc'vd.	Wrn. System	Shelter	Expectation	Age of First	Wrn. Eval.	Cng. in Proc.	Proc. Fl'wd.	Damage Adj.	
	o	o	o	o	o	o	o	o	o	o	Response
		o	o	o	o	o	o	o	o	o	Procedure
			o	+	o	o	o	o	o	o	Warning Received
				o	o	o	o	o	o	o	Warning System
					o	o	o	o	o	o	Shelter
						o	o	o	o	o	Expectation
							o	o	o	o	Age at First
								o	o	o	Warning Evaluation
									o	o	Change in Procedure
										o	Procedure Followed
											Damage Adjustment

HAZARD - SPECIFIC VARIABLES

Table 8

Relationships Between Hazard Variables For Manhattan

HAZARD - SPECIFIC VARIABLES											
Response	Procedure	Wrn. Rc'vd.	Wrn. System	Shelter	Expectation	Age of First	Wrn. Eval.	Chg. in Proc.	Proc. Fl'wd.	Damage Adj.	
	o	+	+	o	o	o	o	o	o	o	Response
		o	o	o	o	o	o	o	+	o	Procedure
			o	o	o	o	o	o	o	o	Warning Received
				o	o	o	o	o	o	o	Warning System
					o	o	o	+	o	o	Shelter
						o	o	o	o	o	Expectation
							o	o	o	o	Age of First
								o	o	o	Warning Evaluation
									+	o	Change in Procedure
										o	Procedure Followed
											Damage Adjustment

HAZARD - SPECIFIC VARIABLES

Table 9

## Aggregate Relationships Between Hazard Variables

HAZARD - SPECIFIC VARIABLES											
Response	Procedure	Wrn. Rc'vd.	Wrn. System	Shelter	Expectation	Age of First	Wrn. Eval.	Cng. in Proc.	Proc. Fl'wd.	Damage Adj.	
o	+	+	+	o	+	o	+	o	o	o	Response
	+	o	o	o	+	o	o	+	o	o	Procedure
		o	+	+	+	o	o	o	o	o	Warning Received
			o	o	o	+	+	+	+	o	Warning System
				o	o	o	+	+	+	o	Shelter
					o	o	+	o	o	o	Expectation
						o	o	o	o	o	Age of First
							o	+	o	o	Warning Evaluation
								o	+	o	Change in Procedure
									+		Procedure Followed
											Damage Adjustment

HAZARD - SPECIFIC VARIABLES



or not, for the tornado event, it reflects in this case a hurried and perhaps ill-judged form of safety. The case where individuals had a definite plan indicates that places of shelter were previously checked for their actual ability to provide safety for all possible effects resulting from this hazard. This again compares favorably to the statement made earlier in this chapter that age is a vital factor in tornado response. In his work "Perception of the Drought Hazard on the Great Plains" T. Saarinen found that perception of the hazard varied according to not only the amount of experience human's had with the drought hazard but also with the age of the respondent. Saarinen further stated that aged persons frequently displayed a deterioration in their ability to perceive the threat of the hazard, possibly resulting from an increased form of fatalism.<sup>1</sup> Because of their low perceptive ability, the aged could be expected to be the least responsive to the threat of a tornado.

A highly significant relationship for the city of Manhattan between the type of response and warning system used during the tornado again discloses the probability that most residents of the city did not receive any warnings of the impending disaster. Thirty-nine percent of the respondents said they received no warning while thirty-six percent had to rely upon visual recognition or receiving warning from a friend or family member. Although this does not relate directly to the time factor involving experience and its effects on awareness and response, it does give evidence to the importance of adequate warning as most

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<sup>1</sup>Thomas Saarinen, Perception of the Drought Hazard on the Great Plains (Chicago: University of Chicago, Department of Geography, Research Paper No. 106, 1966)

respondents in this case reacted in a variety of forms depending in part upon how, when and where they became aware that a tornado was actually occurring. It implies that if a warning had been heard the response of individuals would show an improvement over that taken when none was audible

#### Variables Influencing The Utilization of Pre-Conceived Procedures for Seeking Shelter

Those relationships shown between procedure and the number of warnings received as well as the age of the respondents when they experienced their first tornado again attempts to relate a high response level to the recent experience. However, due to the actual survey data which showed most respondents recalling as few as two tornado warnings in the past fourteen years, little significance can be related to whether the individual has a pre-planned procedure to follow or not, as the twenty-seven respondents were divided 13-14, between responding in accordance to a plan and responding with regard to immediate instinctive reactions. The relationship between procedure and age of the first experience indicates the high number of respondents who experienced a tornado for the first time while they were under the age of seventeen. The majority of these individuals stated having a pre-planned procedure to follow which gives added support to the postulation of experience leading to a high awareness and response level. However, the existence of a pre-planned procedure is ill-defined here, referring to the presence of a conceptualized notion of response in apprehension of possible danger. Therefore, those respondents who had an unconscious notion of the safest mode of response became grouped along with those who had a well-defined and thoughtout method for seeking safety when a tornado occurs. It is felt

that the majority of those respondents who stated having a pre-planned procedure had simply a general notion of the best procedure to take in seeking safety.

The relationship between an individual's pre-determined mode of seeking shelter and whether or not this procedure was followed simply infers that those citizens in each city with experience who had a pre-planned procedure to follow actually did utilize it. Again this after-the-fact assertion on the part of the respondent is supportive of the statement made previously that the term procedure was interpreted by the respondents to indicate a wide array of actions taken. This was surprising in the case of Manhattan where a substantial percentage of the respondents reported having received no warnings other than the actual occurrence of the tornado. It would be assumed that due to the lack of time, any pre-conceived plan could not be followed.

Those respondents in Manhattan who sought shelter in the basement of a home felt that there was no need to change the procedure for seeking shelter. This is seen by the relationship between shelter and change in procedure and reflects the prevalent notion that the safest place to be in the event of a tornado is the basement. Although basements have historically been thought of as the safest place of refuge during a tornado, certain questions were raised by Joe Eaglemen and associates at the University of Kansas which found numerous hazards involved in this shelter. Corners should be avoided as the foundation could give away, shifting the house and causing it to fall into the basement.<sup>2</sup>

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<sup>2</sup> J.R. Eaglemen, V. Muirhead and N. Willems, Thunderstorms, Tornadoes and Building Damage, (Lexington, Mass.: Lexington Books, 1975).

The best place to be is on an inside wall in the basement under a strong piece of furniture. This fact was not known to most respondents as they specified a particular corner of the basement, usually the southeast, as the safest place to be.

It is becoming evident that the tornado experience can be measured in numerous ways in order to determine its significance in affecting the individual citizen's level of awareness or response to the tornado hazard. Those factors relating to the actual occurrence from a few minutes before the strike to those hours following are the most important in how an individual perceives the disaster and in the length of time this perception maintains a significant level in regards to adequate awareness and response. This realization is consistent within most studies conducted on the variety of natural hazards which affect human settlements.

The discussion of those variables related to response was presented first in order to better realize the significance of those variables unique to awareness levels. Awareness is the stage on which the action or responses are carried out. In natural hazards literature it has been consistently cited that an individual's awareness of a hazard may be derived from socio-economic factors, physical impressionableness and/or experience to the hazard. In the following section concern will focus on the role of experience as related to the variables affecting an individual's perception of the probability of a recurring tornado event.

#### Variables Influencing Citizen Expectation of Future Tornadoes

An interesting relationship is shown between the number of warnings received ten years prior to the tornado and the respondent's expectation of

a similar event recurring. D. Baumann and J. Sims, in their article, "Human Response to the Hurricane", stated that individuals vary greatly in their perceived susceptibility to future occurrences of hurricanes.<sup>3</sup> Although numerous factors may act to influence the alertness of individuals to the tornado hazard, the number of times they were subjected to potential tornadoes through the receiving of warnings is one variable that is of particular concern. It has been postulated in previous natural hazards literature that repeated incidents of potential disasters through a variety of warning procedures act to condition a person's awareness to a level less than satisfactory for such hazards as tornadoes, which require immediate and effective response on the part of the individual. The response of those individuals answering this set of survey questions for Clay Center suggested that the fewer the number of warnings received the longer the span of time between the 1973 tornado and any expected ones in the future. The reverse of this could also be argued stating that those individuals who recalled three or more warnings during this period are more cognizant of the tornado and therefore more realistic in their predictions. No significant relationship was found for these variables for Manhattan or Junction City. Those respondents for Manhattan were asked to recall the total number of warnings received from 1956 to 1976; such recall meant a retention span of twenty-one years. Many felt that answering this question would be reflective only of a highly speculative guess, therefore they did not respond and consequently, with only a forty-nine percent answering to the question, no useful measurement

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<sup>3</sup> D. Baumann and J. Sims, "Human Response to the Hurricane", Natural Hazards: Local, National, Global, Ed. G. F. White, (New York: Oxford University Press, 1974) p. 25.

could be obtained between these two variables. Because of lack of experience, the findings for Junction City reflected a very diverse pattern of expectations regardless of the number of warnings they had recalled receiving in the past ten years.

For Clay Center the relationship between expectation and procedure followed implies that most respondents did not have a procedure outlined beforehand and of these people, two-thirds stated that they never expected another such event to occur during their lifetime. It could be assumed that these individuals, regardless of age, had and continue to have a low regard for the potential danger involved in this type of hazard. Most of the respondents commented on the returned survey that it is highly speculative to assume another tornado would strike Clay Center and that there are more important things which constitute the allotment of concern and money than does the threat of a tornado. This implies that the individually perceived frequencies resulting from actual experiences of a variety of intensities to the tornado hazard vary with the number of past occurrences, potential and actual, that occurred in a given area upon the landscape.

The perception of the tornado, independent of socio-economic indicators as measured through respondent's expectation rate, is influenced most heavily by the intensity, recency and frequency of past experiences. This assertion was made by R. W. Kates in his article "Natural Hazard in Human Ecological Perspective: Hypothesis and Models" in which he stated that "for personal experience, it is the recency, frequency and intensity of such an experience that appears most critical with intermediate frequency generating greatest variation in hazard interpreta-

tion and expectation".<sup>4</sup> It is this intermediate frequency of hazardous situations, actual or potential, that acts to continually re-enforce an individual's attitude toward the tornado.

#### Variables Influencing The Evaluation of Warning Systems

For the city of Clay Center, the relationship between the type of warning system used and the individual's evaluation of that system reflects both a recent experience and a good warning system. What the actual cross-tabulation showed was that only forty-seven percent of the respondents remembered being warned of the tornado by the civil defense system and that eighty-six percent felt this warning system was adequate. This reflects not only the forty-seven percent success of the community warning system but also the difference in disaster experience. Remember that Manhattan, for the most part, received no official warning that a tornado was approaching. Most of Manhattan's respondents used unreliable modes of warning while evaluating the city's present system as adequate. Moreover, eighty-eight percent of Junction City's respondents felt they would rely upon the civil defense sirens and/or warning by radio or television. Sixty-three percent of these thought the civil defense system was adequate while twenty percent stated that it was inadequate and ten percent thought it was given much too often. It becomes evident that in a community with no previous experiences with tornado events, its citizens seem to rely heavily upon the city civil defense system, feeling it is adequate. Through the continued procedure of testing and upgrading the civil defense system in

<sup>4</sup> R. W. Kates, "Natural Hazard in Human Ecological Perspective: Hypotheses and Models", Economic Geography, Vol. 47, No. 3, 1971.

Junction City the respondents became knowledgeable of its presence and perceived effectiveness to the point that many stated it as their only method of receiving warning of any approaching tornadoes. In the cities with experience, radio or television as a form of warning was consistently used in combination with other modes such as the civil defense system.

#### Variables Influencing a Change in Procedure

The recent experience of Clay Center indicates that reliance upon the civil defense warning system may lead to a subsequent change and/or continuance of individual tornado safety procedures. This is evidenced by the relationship found between the warning system used and whether or not they changed their safety procedure following the tornado event. The majority of citizens who had relied upon the community civil defense warning system felt no need to change their procedure for seeking safety in the future.

Those respondents who followed a pre-designed procedure at the time felt no need to change it as evidenced by the relationship shown between change in procedure and procedure followed. This is illustrative of the fact that no injuries resulted to those who sought shelter in accordance with a previously established method. This variable cross-tabulation could have had just the opposite result shown had some flaw been found in their procedure. Therefore, the physical intensity of the tornado and a pre-determined mode of response both play a vital role in the ability of an individual to escape injury.



### Summary

These relationships in their varied forms all enumerate one basic theme. The socio-economic variables which act to condition an individual's perceptive ability play a role in determining an individual's attitude toward the tornado hazard and the experience with this event acts as an alteration force or re-enforcing agent to the individual level of awareness and response. Some citizens became more cognizant of the disaster potential and changed their attitude to achieve a higher level of potential response to any future occurrences. Others continued to retain an already established high level of awareness and response but with greater concern than before.

The differences in the variables which were found to be associated possibly reflects the differences caused by the physical intensity of the storm system, the community character and the different levels of individual socio-economic characteristics. The variations in cause and effect relationships are explained in part by the diversity in the severity of the storm activities, the community warning facilities and the cultural character of the city. The strength of the hazard-specific variables was measured for the purpose of determining the effect that experience had. This was achieved by crosstabulating the hazard-specific variables for the aggregate of the three cities. The relationships shown for the aggregate of three cities provides the necessary data for determining which variables are the best indicators of the measurement of the role of experience in tornado behavior.

### Aggregate Cross-Tabulation

The cross-tabulation for the aggregate between the hazard-specific

variables as shown in table 9 exhibit twenty-one associations. The main point of note here is that the variables measuring the individuals mode of response, number of warnings received, procedure taken and the type of warning system used all show strong relationships to the other variables. The relationships emphasize those variables which are the strongest measurements for determining the effects that the actual tornado situation has upon human behavior. These four variables tend to be the best indicators for experience levels as shown in tables 6, 7, and 8. It is suggested that in determining the role of experience upon awareness and response to this hazard, these variables are useful in determining how accurate the retention level of the individual is regarding the disaster. This retention level or capacity to retain significant factors relating to the tornado experience is important because of the sudden onset of the tornado making quick instinctive responses necessary in most cases to avoid death and injury.

In the case of Clay Center and Manhattan, those individuals who responded to the survey questionnaire were asked to recall events surrounding the actual tornado. This meant drawing upon memories established three and one-half years earlier in the former case and ten in the latter. Depending upon the length of time since the disaster, the victims seem to remember most clearly those events surrounding the initial impact of the tornado. They recall more readily the type of warning they received, the mode of response taken and whether or not it corresponded to a previously established procedure for use in seeking shelter and safety.

With this established, the following two sections are concerned with the overview of awareness and response levels for the varying

degrees of experience. The hazard-specific variables were grouped into either awareness or response depending upon their type of measurement. The variables of warnings received, warning system, expectation and change in procedure showed to be the best indicators of a person's level of awareness, while response, procedure, damage adjustment, shelter taken, procedure followed and warning evaluation provided the most accurate form of measuring an individual's level of response.

#### AWARENESS LEVELS

In this section, concern is directed toward looking at awareness levels or the degree of knowledge, realization, or perception each respondent has with regard to the tornado hazard.

In looking at the categories for each level of experience under the variable of warnings received the percentage of individuals who recalled receiving from zero to two warnings was highest within the non-experience sector and lowest in the city with a recent experience. This indicates that those people with the most recent experience tend to have a greater awareness of events which took place prior to their own hazard experience, such as the remembrance of warnings sounded ten years prior to the disaster. Although this is a good reflection upon individual alertness relating more directly to social factors than experience, it also provides a general yet reliable measurement of the tendency for individuals to become less familiar with the physical aspects regarding tornadoes. It can be inferred that those individuals who have never experienced a tornado disaster and those who have been victimized in the more distant past seem to regard lightly or completely ignore the numerous warnings of tornadoes which become prevalent during the spring, summer and early fall

Table 10

## Awareness Levels

EXPERIENCE	Warnings Received				Warning System						Expectation				Change in Procedure	
	0-2	3-4	5-6	6-UP	D/R	C/D	R/TV	V/R	M/F	OTHER	0-5	6-10	11-20	N/L	Yes	No
NONE	Number 23	8	3	6	0	11	24	5	0	0	15	4	1	16	-	-
	Percent 57.5	20	7.5	15	0	27.5	60	12.5	0	0	41.5	11	3	44.5	-	-
PAST	Number 16	2	1	0	20	2	12	12	2	11	5	7	8	7	19	19
	Percent 41	5	2.5	0	51	5	31	31	5	28	18.5	26	29	26	50	50
RECENT	Number 17	4	0	4	20	9	25	1	9	2	3	3	6	25	21	24
	Percent 38	9	0	9	44	19.5	54	2	19	4	8	8	16	67	47	53

D/R - do not remember

C/D - civil defense

V/R - visual recognition

R/TV - radio or television

M/F - message from friend

or family

N/L - not in my lifetime

months. Those individuals who still have a clearly fixed image of the disaster in their minds are more cognizant of the conditions which surround the tornado and tend to recall more clearly those events relating to other tornado situations, actual or potential, that occurred in the past. Therefore, those respondents in Clay Center, having their memories recently stimulated, were able to remember the number of warnings received more clearly than those respondents in Manhattan.

Because of the structuring of the survey questionnaire, residents of Manhattan were asked to recall events over a twenty year span while those in Clay Center were taxed for only a thirteen year period. However, those citizens in Junction City, having no previous experiences, were asked to recall only a ten year period and many responded by stating that they simply couldn't remember. The purpose was to elicit information which would permit measurement of the general retention levels of individuals concerning this hazard. A high retention level is assumed to reflect a high level of awareness.

Perhaps the most important measure of awareness levels from both the conceptual and practical points of view is that of the reception and usage of warning systems for the disaster, or for Junction City, those relied upon in the event one should occur. Because of the immediacy of the event, most respondents do not remember the exact mode of warning they received. However, those individuals who are perhaps more perceptive, or possess the best memory, tended to rely most heavily upon either the civil defense system or warnings given by radio and television. This is found in Table 10 with one noted exception. Manhattan respondents, again due to their particular situation, were found to have relied upon visual recognition or some other more conventional means of warning. It

becomes apparent that individuals have a higher level of awareness to the tornado if they rely upon some form of official notification that a tornado is approaching. People resist seeking shelter until they are relatively sure that they are not wasting their time. They therefore respond to the more reliable sources of information when possible. From the data gathered, the most reliable sources are those which involve an official notification of a tornado sighting, either by civil defense sirens or announcements over radio or television.

The remaining variables which dealt with expectations and adjustments made in safety procedures showed no significant patterns other than one which supports the finding that the majority of citizens who have experienced a tornado feel that another tornado may never occur in their lifetime. Not only is it important to be aware of the possibilities of a tornado occurring and its potential danger, but proper acquaintance with the best mode of response or action to take when a split second could mean life or death is vital.

#### RESPONSE LEVELS

Table 11 portrays the varied types of responses or action taken in actual disaster situations compared to those perceived as being the best to use by the persons who have not yet experienced a tornado. It is apparent from the number of personal comments on the returned survey questionnaires that it is helpful to have a pre-planned procedure worked out for safety during a tornado. However, the best lifesaving technique is not only awareness of the damage potential of the storm, but also the weather conditions from which it spawns, the most reliable warning system for the area and the safest place to take cover. Response is

Table 11-1

## Response Levels

EXPERIENCE		RESPONSE					PROCEDURE		DAMAGE ADJUSTMENT			
		TAKE SHELTER	OPENING GATHERING	HELPING	PLAN	OTHER	YES	NO	STRUCT.	PROC.	INS.	NONE
NONE	NUMBER	13	0	9	14	4	25	5	- - -	- - -	- - -	- - -
	PERCENT	33	0	23	35	10	63	36	- - -	- - -	- - -	- - -
PAST	NUMBER	14	2	5	1	16	23	16	31	3	0	0
	PERCENT	37	5	13	3	42	59	41	91	9	0	0
RECENT	NUMBER	13	1	7	11	14	24	21	18	1	1	2
	PERCENT	28	2	15	24	30	53	47	82	5	5	8

Table 11-2

## Response Levels

EXPERIENCE		SHELTER TAKEN						PROCEDURE FOLLOWED		WARNING EVALUATION			
		BASEMENT	HALLWAY	CLOSET	UNDER SOMETHING	OTHER		YES	NO	GIVEN TO OFTEN	NOT GIVEN ENOUGH	IN-ADEQ.	ADEQ.
NONE	NUMBER	HOME	2	0	3	4		--	--	4	3	8	25
		WORK	4	5	3	8							
		DWNTN	2	6	3	10							
	PERCENT	HOME	5	0	8	10							
		WORK	11	14	9	23		--	--	10	7	20	63
		DWNTN	6	19	10	32							
PAST	NUMBER	HOME	3	0	2	9		17	5	3	0	5	29
		WORK	1	1	0	0							
		DWNTN	0	0	0	2							
	PERCENT	HOME	9	0	6	26							
		WORK	50	50	0	0		77	23	8	0	14	78
		DWNTN	0	0	0	100							
RECENT	NUMBER	HOME	1	0	0	0		16	1	1	2	9	34
		WORK	0	0	0	0							
		DWNTN	1	0	0	0							
	PERCENT	HOME	2	0	0	19							
		WORK	0	0	0	0		94	6	2	4	20	74
		DWNTN	100	0	0	0							



therefore a reflection of the level of awareness an individual has toward the tornado and their attitude toward the situation.

The term attitude refers to the feelings or emotions of individuals toward the tornado hazard. Although attitude is a difficult factor to discuss and measure it is a prime component of a person's level of response. Actions people take to various stimuli such as the tornado is often a reflection of their attitudes about the event. Because the questionnaires were confidential, it was not possible to relate each individual's attitude toward the tornado hazard. However, those citizens with the most recent experience held the most respect for the damage potential of the tornado and its associative disturbances. Those residents of Junction City, who have not experienced a tornado, were concerned about the possibility of one occurring and how effective the city's warning would be if actually needed in a true emergency. Manhattan's residents were also concerned enough to elaborate on their feelings toward future tornadoes. For the most part they felt very much at ease and not significantly concerned about any re-occurrences due largely to the improvements made in the community's civil defense system making it a very reliable one in most of the respondents minds.

The level of a person's response is best measured by looking at the attitude and awareness levels, as any response to this sporadically occurring phenomena can only be immediate, relying upon quick judgement and patterned behavior stemming from the victim's feelings and cognizance of the tornado hazard.

## Chapter IV

### CONCLUSIONS AND IMPLICATIONS

The focus of this study was to determine the influence of experience with tornadoes on human response and awareness to the tornado hazard in Kansas. It has been established that a person's level of awareness for the tornado differ with the magnitude, recency and frequency of previous personal experiences with the hazard, both actual and potential, in association with various socio-economic characteristics. Attitudes are influenced by numerous factors in which experience is the most portentous. The intensity of a person's attitude, or the feelings and emotions concerning the threat of a tornado, can be measured by first determining the corresponding level of awareness maintained by a particular individual. This awareness level is reflective of the citizen's overall attitude toward the tornado situation.

It was found that experience acts as a force which either alters or re-enforces a person's attitude toward the tornado hazard. The experience of actual and potential disaster situations resulting from the tornado acts to introduce to the victims the harsh realities of this hazard, therefore altering their attitude towards the tornado and their subsequent degree of awareness. Individuals who have never before experienced a tornado would be expected to change their feelings or attitude towards this hazard. However, with time attitudes and subsequent levels of awareness and response to the tornado lessen only to be re-enforced when a similar event recurs. If a substantial amount of time lapses from one experience to the next, an individual's response to the latter disaster would be reflective of that followed in the initial hazard experience. Through this

alteration or re-enforcement, awareness levels are derived. Those citizens who maintain an attitude of respect for the destructive capabilities of the tornado are seemingly the most cognizant of its characteristics and potential for damage. With this attitude and awareness level, their response to the immediacy of the disaster situation results in an orderly and safe procedure of seeking immediate shelter in the most reliable locations. Therefore, experience affects attitude by providing each victim with a conscious perception of reality through direct contact and participation in the events connected with the tornado phenomena. The majority of citizens in whose town a tornado has just occurred recognize better the damage potential of a tornadic storm. With an increased respect for and awareness of the tornado, the individual might be expected to respond instinctively and quickly to any similar events.

The main point discovered in this study is that time plays a very important role in determining the attitude and awareness levels of the citizens who have experienced a tornado. The individuals attitudinal level, from a high respect for the hazard to a state of indifference or apathy toward the tornado leads to an indication of how effective any warning system or other mitigative action will be. A tendency for attitudes to decrease to a pre-experience state was found just ten years after experiencing a tornado. Many reasons have been suggested for this occurrence. These include the proneness towards immunity to the sometimes over-zealous warnings that follow in the years after a tornado, the memory lapses on the part of the individual and the important age factor in conjunction with the probability rate of future tornado hazards. These points were expected and are consistent with previous hazard studies,

As discussed earlier, an individual's age is important not only in the person's perceptive ability due in part to a loss of mental faculties associated with advanced age but also in the form of old age apathy or fatalism. In addition to age influencing personal attitudes, the over-zealousness on the part of city officials to implement warning procedures has a tendency to make certain individuals immune to the very warnings meant to alert the citizenry in an attempt to save lives. On the other hand, it has been found that in the majority of cases, these warnings or potential hazard experiences act to re-enforce the attitudinal level established from the actual occurrence of a tornado. Depending upon the degree of intensity of the experience in terms of damages and losses suffered by each citizen, the attitudes and awareness levels will vary even with time, yet generally speaking, those citizens of a community which has recently experienced a tornado are going to be more cognizant and maintain a higher degree of respect for the tornado than those who have never experienced one. This is important because of the suddenness with which the tornado strikes, in which case the victim is unable to rely upon past and suppressed memories.

#### Comparison With Previous Literature in Natural Hazards Studies

The increasing volume of literature dealing with natural hazards, from floods to tornadoes, reveals several recurring themes. Among these themes are those dealing with the role of experience in affecting the individual's degree of awareness, or perception of the hazard. Although various topics were covered specifically within this general theme, the basic findings point to the importance of understanding which specific factors affect an individual's awareness of or attitude toward a hazard, and

what steps are necessary to mitigate action. Along these lines, two eminent scholars in the field of natural hazards have observed that "where disbelief in the possibility of an earthquake, a tornado, or a flood is strong, the resultant damages from the event are likely to be greater than where awareness of the danger leads to effective precautionary action".<sup>1</sup> This statement is consistent with my findings that a person's attitude toward the tornado is a vital ingredient in the process of understanding how people become aware of and respond to the threat of a tornado.

Those variables which influence this awareness and response concerning the tornado more often than not are related to the frequency of the event and the degree of personal experience with both actual and potential disaster situations. Another prominent scholar in this field, Thomas Saarinen, has also stated that there is a relationship between the frequency of the natural event and the perception of this hazard and that greater experience tends to lead to heightened hazard perception.<sup>2</sup> As in past hazard studies, the variables concerning the recency, frequency and intensity of the hazard experience which affects individual attitudes towards the hazard are those from which future research on tornadoes could benefit.

#### Implications For Future Research In Natural Hazards

As stated in the first chapter of this study, little has been done in the way of studying the human element involved with tornadoes. In the

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<sup>1</sup>Ian Burton and Robert Kates, "The Perception of Natural Hazards in Resource Management", Natural Resources Journal, Vol. 3, (1964), pp. 412-441.

<sup>2</sup>Thomas Saarinen, Environmental Planning: Perception and Behavior, (Boston: Houghton Mifflin Co., 1976)

future, much could be benefited from looking specifically at the factors involved in determining attitudinal levels toward the tornado as a result of the recency, frequency and intensity of the tornadic systems.

This study has dealt specifically with the state of Kansas in which tornadoes are a part of its character. However, other areas of the United States with varying degrees of intensity and frequency could reveal that the awareness of tornadoes is insignificant if not totally non-existent. Certain areas upon the landscape are more prone to a specific hazard than are others, and generally, a person's concern for hazardous events is directed toward one type of event, usually the one which occurs with the greatest frequency or severity. Studies directed at determining the need for educating the citizens in those areas of the less frequent occurring tornadoes could benefit not only the individual citizen but the civic leaders in their attempt to mitigate losses incurred in all major disasters.

Studies of this type can benefit government programs by providing information indicating the perceptions of people concerned with the tornado hazard and ways of adjusting to it. In short, by obtaining the knowledge of individual or group attitudes toward the tornado, mitigative actions can be tailored to best fit the requirements of each particular community.

#### Implications For Planning

Although numerous adjustments can be made in other natural hazards, those available for the tornado are limited because of a combination of physical and economic conditions. The physical mechanisms of the tornadic storm make it practically impossible to alter or lessen the severity of each

potential funnel cloud, and the frequency of the phenomena as it occurs within a given area on the earth surface makes it unfeasible to expend large amounts of money for sophisticated warning devices. Therefore, where adjustment in the form of alleviating the severity of the hazard is not a practical concern, individual awareness and response to the hazard are the most important aspects of mitigation programs designed to alleviate death and injury.

In those areas with characteristics similar to those of the cities used in this study, emergency preparedness planning can be improved by determining not only the socio-economic conditions of the community, such as age groups and occupations, but by also being familiar with the general attitudes and awareness levels of the citizens. With these levels known, warning systems and precautionary measures such as public education can be instituted by the civic leaders in order to increase the potential responses of the citizens who some day may be threatened by a tornado. Guidelines provided by this study may provide disaster preparedness researchers with helpful procedural information for preparing plans in the future.

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## APPENDICES

## APPENDIX A

## LETTER OF INTRODUCTION INCLUDED WITH THE MAIL QUESTIONNAIRE

April 2, 1977

Dear Respondent:

I am conducting research on tornadoes in Kansas for my masters degree in geography at Kansas State University. Your help in filling out this short questionnaire would be appreciated.

My research is concerned primarily with studying how human response to tornado hazards is influenced by experience. From the data elicited I also hope to see how effective our state and local policies are regarding warning and relief in the event of a tornado. Findings from this study will be sent to the Kansas Division of Emergency Preparedness in Topeka.

The questionnaire is to be filled out by the head of the household and all responses will be kept confidential. With the form you will find a stamped self-addressed envelope for your use in returning the completed questionnaire.

As I wish to evaluate the results in June, please return the questionnaire before May 15.

Sincerely,

Brian C. Logan

## APPENDIX B

SURVEY QUESTIONNAIRE USED IN THE  
STUDY OF AWARENESS AND RESPONSE TO THE TORNADO HAZARD

- - CLAY CENTER AND MANHATTAN KANSAS - -

This questionnaire is designed to determine your response to the (date of tornado) tornado in (city), Kansas. Please try to recall in as much detail as possible how the experience affected you.

1. To the best of your memory, when you received first warnings of the tornado on - - - - -, what was your immediate response or action?

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2. If a warning were to be given that a tornado is approaching, (this year) would you do anything different? yes no. If yes, what would you do differently?

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3. In 19\_\_, did your family have a pre-planned procedure to follow in the event that a tornado should occur? yes no. If yes, was this procedure followed as closely as possible? yes no.
4. Approximately how many times did you receive a tornado warning (official notice that a tornado has been sighted and that people should take cover) in the ten years preceeding the tornado of (date).  
0-2 3-4 5-6 more than 6 do not remember
5. If you received a warning on (date), what type was it?  
civil defense siren radio-television visual recognition  
message from a friend or family member other (specify)
- 
6. When you received warning of the tornado, where were you? home  
work downtown other (specify)
7. Where, on (date), did you seek safety?
- 
8. How soon do you expect that another tornado will occur in Manhattan?  
within 5 years 6-10 years 11-20 years not in my lifetime
9. Do you maintain the same attitude toward tornadoes now as you did during the twelve months following (date)? yes no. If no, how does your attitude differ?
10. At what age do you remember your first experience with tornadoes?
11. Did your home or property receive any damage? yes no. If yes, what kind of adjustments have you made to prevent this damage from recurring in the event of another tornado?

- 
- 
12. Does your family have a set plan of response now, if another tornado should occur? yes no.
13. With regard to (the city's) warning system, do you feel that warnings are:  
       given too often, when they are really not necessary.  
       not given frequently enough.  
       inadequate.  
       quite adequate.
14. What was the approximate age of your house in 19\_\_? (Year of the tornado)  
       new - 10 years           10-15 years           older than 25 years
15. What were the number and age of persons in the household on (date) ?
- | Number        | age     |
|---------------|---------|
| <u>      </u> | 0 - 5   |
| <u>      </u> | 6 - 18  |
| <u>      </u> | over 18 |
16. What was your marital status on (date) ? married single
17. What type of structure did you live in on (date) ?  
       mobile home           frame           brick           stone
18. Ownership of home. (at the time of the tornado)  
       owner owned           rental
19. Approximate years of residence in (city) on (date of tornado).
20. Approximate years of residence in Kansas on (date of tornado).
21. Occupation (date of tornado).
22. Education (date of tornado).  
       8th grade           high school           vocational or trade  
       some college           college graduate



23. Sex \_\_\_\_\_

24. Your age on (date of tornado).

\_\_\_\_ 18-30      \_\_\_\_ 31-50      \_\_\_\_ 51-64      \_\_\_\_ 65 or older

25. Additional comments that you may have are welcomed.

## APPENDIX C

SURVEY QUESTIONNAIRE USED IN THE  
STUDY OF AWARENESS AND RESPONSE TO THE TORNADO HAZARD

- - JUNCTION CITY - -

1. What would be your immediate response if a tornado should occur in Junction City?

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2. Does your family have a pre-planned procedure to follow in the event that a tornado should occur? ☐ yes ☐ no.

3. Approximately how many times did you receive a tornado warning (official notice that a tornado has been sighted and that people should take cover) in the last ten years. ☐ 0-2 ☐ 3-4 ☐ 5-6 ☐ more than 6

4. What type of a warning would you probably rely on if a tornado should occur in Junction City?

☐ civil defense siren ☐ radio-television ☐ visual recognition  
☐ message from a friend or family member ☐ other (specify) ☐

5. If a tornado were to occur, where would you seek safety if you were;

at home - ☐  
 at work - ☐  
 downtown - ☐

6. How soon do you believe that a tornado will occur in Junction City,

☐ within 5 years ☐ 6-10 years ☐ 11-20 years ☐ not in my lifetime

7. What is your attitude towards tornadoes,

\_\_\_ I worry about them all the time.

\_\_\_ I worry about them only during the period from March through September,

\_\_\_ I am afraid of them but do not worry much about when or if they will occur.

\_\_\_ I never think about them.

\_\_\_ other (specify) \_\_\_\_\_

8. Have you ever experienced a tornado? \_\_\_ Yes \_\_\_ no. If yes, how many

\_\_\_\_\_, when \_\_\_\_\_

where, \_\_\_\_\_

and what was the extent of the damage that you suffered? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

9. At what age do you remember your first experience with tornadoes? \_\_\_\_\_

\_\_\_\_\_

10. With regard to the warning system in Junction City, do you feel that warnings are;

\_\_\_ given too often, when they were really not necessary.

\_\_\_ not given frequently enough.

\_\_\_ inadequate.

\_\_\_ quite adequate.

11. What is the approximate age of your home.

\_\_\_ new - 10 years    \_\_\_ 10-15 years    \_\_\_ older than 25 years

12. Number and age of persons in the household.

number                  age

\_\_\_\_\_                  0 - 5

\_\_\_\_\_                  6 - 18

\_\_\_\_\_                  over 18

13. What is your present marital status? ☐ married ☐ single

14. What type of structure is your home?

☐ mobile home ☐ frame ☐ brick ☐ stone

15. Ownership of your home.

☐ owner-owned ☐ rental

16. Years of residence in Junction City. \_\_\_\_\_

17. Years of residence in Kansas. \_\_\_\_\_

18. Occupation. \_\_\_\_\_

19. Education.

☐ 8th grade ☐ high school ☐ vocational or trade

☐ some college ☐ college graduate

20. Sex \_\_\_\_\_

21. Age

☐ 18-30 ☐ 31-50 ☐ 51-64 ☐ 65 and older

EXPERIENCE AS A FACTOR IN TORNADO AWARENESS  
AND RESPONSE LEVELS IN KANSAS

by

BRIAN CHARLES LOGAN

B. S., Kansas State University, 1976

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AN ABSTRACT OF A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF ARTS  
Geography

Department of Geography

KANSAS STATE UNIVERSITY  
Manhattan, Kansas

1977

One of the basic problems which face community leaders in the state of Kansas is the adequate provision of emergency procedures aimed at mitigating losses from tornadoes. The effectiveness of emergency procedures such as warning systems can be augmented simply by knowing how citizens perceive this hazard. When the citizen perceptions are noted, warning procedures can be tailored to fit the requirements of each particular community. By realizing the human perceptions of the tornado we can seek to define behavioral patterns as they differ with respect to socio-economic and hazard related variables. In looking at and conceptualizing the relevant variables which interact to produce a definable mode of behavior we realize that within the framework of human adaptation to the tornado hazard, the level of awareness of, and response to, the tornado constitutes a significant view of how people perceive the actual hazard. The fact that in the past very little research was conducted pertaining to the human aspects of tornado hazards supports the need for this type of study.

In this study, the formulation of awareness and response levels was accomplished through the crosstabulation of eleven variables pertaining to the socio-economic character of each respondent and eleven variables related to the hazard experience itself as perceived by the respondent. This procedure was performed using the Chi-Square Test at .05 level of significance in order to relate the importance of experience as a factor in tornado awareness and response levels in Kansas. In order to study the effects of experience with tornadoes on hazard perception and the corresponding relationships to human awareness and response levels, three cities in the state of Kansas were selected for use in eliciting this information through the use of a survey questionnaire. Those cities

selected were Clay Center whose tornado experience occurred in 1973, Manhattan with a 1966 tornado and Junction City with no recent experiences for use as a control.

As problems encountered by individuals which influence their perception of the tornado hazard are often the result of certain distinctive characteristics common to their community, a concise discussion of the relevant physical, social, economic and institutional conditions for each city was employed, along with a description of the techniques used to gather data concerning individual conditions influencing the attitudes of the citizens.

By examining the significant relationships between such socio-economic variables as age, sex, occupation and time of residence in both the city and state, and the hazard-specific variables concerning either actual or perceived experiences with tornadoes, certain of the socio-economic variables are found to be effective in determining how a person is aware of and responds to a tornado. In addition, the crosstabulation or comparison between the hazard-specific variables provides insight into the cause and effect relationships which exist between experience factors and levels of awareness and response.

It has been postulated by other natural hazard researchers that people tend to become fatalistic when confronted with natural hazards as awesome as the tornado. If this is assumed true then city officials become faced with the task of devising proper warning procedures capable of reaching all citizens of their community in a timely and efficient manner in hopes that they will respond in an effective way, minimizing the amount of death and injuries incurred. Through obtaining a better understanding of the individual attitudes of citizens toward the tornado, decision-

makers can better realize the levels of awareness and subsequent response rates and take measures to tailor the emergency preparedness procedures to those conditions unique to their community. Through this, citizens may receive proper public education in order to increase their awareness to this hazard in addition to being able to rely upon timely, efficient and accurate warning in the event a tornado should occur.