J14.2 EDUCATING CITIZENS ABOUT SEVERE WEATHER AWARENESS FOLLOWING THE 22 MAY 2008 NORTHERN COLORADO TORNADO

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1. INTRODUCTION

A large tornado formed near the town of Gilcrest, Colorado at 11:26 AM MDT (1726 UTC) on 22 May 2008 and remained on the ground for 39 miles (62 km) while moving toward the northwest (Fig. 1). One fatality occurred at Missile Silo Park in west Greeley, and damage was especially concentrated within the town of Windsor. Storm survey teams found that the tornado attained a width of approximately one mile (1.6 km) and assigned it an EF-3 intensity rating (NWS 2009, SPC 2009). The tornado was quite unusual for Colorado in terms of its time of occurrence, speed and direction of movement, and intensity (NWS 2009, Schumacher et al. 2009). These factors indirectly caused challenges for the effective communication of severe weather warnings during the event and the emergency first response after the event (Schumacher et al. 2009). Given the growing need to integrate social sciences and meteorology (Demuth et al. 2007), this paper describes an outreach and weather education campaign that was developed in the aftermath of the tornado to aid survivors in their long-term physical and psychological recovery.

In the days following the storm, coordinated damage assessment surveys by local, state and federal agencies indicated that 858 residences were impacted, including 78 residences that were completely destroyed (FEMA 2008a). President Bush declared the event a Major Disaster on 26 May 2008, designated FEMA-1762-DR. This declaration activated latent federal recovery programs designed to assist individuals, businesses, and local government to recover from the storm. Federal disaster aid programs are categorized as *Individual Assistance*, *Public Assistance*, and *Hazard Mitigation* (FEMA 2009a). Funding for public assistance (e.g., infrastructure) was not included with this disaster declaration. Nevertheless, the town of Windsor, CO proceeded to form a committee of federal, state, and local representatives to coordinate municipal recovery by increasing the engagement of existing programs in areas such as transportation, energy, and homeland security (Jaeger 2009). The municipality also formed a Long Term Recovery Team (LTRT) to help coordinate nearly all aspects of individual assistance and hazard mitigation programs funded by the Federal Emergency Management Agency (FEMA) disaster declaration (Jaeger 2009). The LTRT was constituted out of a collaboration of volunteers, non-profit organizations, government and the private sector. The recovery process described for this event was guided by existing FEMA models that were tailored in real time to fit available local resources.

It is anticipated that the experiences reported herein could provide a generic model enabling meteorologists and crisis counselors to become co-involved with recovery programs for weather disasters affecting their home communities. In section 2 we define the commencement of the *Colorado Spirit* grant and describe their mode of operation. Section 3 describes the partnership formed between *Colorado Spirit* and undergraduate meteorology students from the University of Northern Colorado (UNC). The paper concludes with a summary of lessons learned about the importance of weather education as a part of individual storm survivors' recovery process.

2. COLORADO SPIRIT

2.1 Program Initiation

FEMA-funded individual assistance programs for presidential disaster declarations include the Crisis Counseling Assistance and Training Programs (CCP). These are grants awarded to state mental health authorities upon appropriate application and demonstration of response capacity. The CCP occur in two phases (FEMA 2009b): the Immediate Services Program (ISP) and the Regular Services Program (RSP). Both phases provide four core services focused on community recovery: outreach, assessment, education, crisis counseling and referral. The ISP for FEMA-1762-DR was awarded on 13 June 2008, wherein the Colorado Department of Human Services, Division of Behavioral Health (CDHS-DBH) and North Range Behavioral Health (NRBH) coordinated with FEMA, the town of Windsor and a host of volunteer organizations active in disaster to provide free crisis counseling to citizens of Weld and Larimer counties who were affected by the severe weather (Drennen 2008, FEMA 2008b, Jaeger 2009). This phase began by assembling a trained counseling staff to go door-to-door to make contact with every affected resident along the path of the tornado. Each contact included distribution of handout brochures describing available services and support systems (Fig. 2). Individuals who exhibited or discussed stress reactions were provided basic counseling support. Those with more extreme reactions or psychological symptoms were referred to NRBH and other existing community resources for counseling (Fig. 3). Thousands of contacts were made during the ISP

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involving door-to-door assessments, informational mailings, handout materials, individual crisis counseling, and group presentations (Jaeger 2009).

Many survivors of the tornado struggled to regain control of the physical, cognitive, emotional and behavioral aspects of their lives as the recovery process stretched beyond the ISP support period. Consequently, CDHS-DBH applied for and was awarded the grant-based RSP funding for nine months of extended crisis counseling services (Drennen 2008). NRBH was again designated as the local service provider on the basis of their work during the ISP (FEMA 2008b). The outreach group established for the ISP and RSP was called *Colorado Spirit,* which consisted of specialists having diverse areas of expertise who collectively sought to provide tornado survivors with information, case management, referrals, education, and crisis counseling.

2.2 Progression of Crisis Counseling Services

Colorado Spirit's ISP CCP began operating on 13 June 2008 guided by the mission statement: "provide, empower, assist, inspire", and continued with the RSP on 1 November 2008 (Gunderson and Drennen 2009). The program emphasis shifted from individual needs to community needs. Outreach activities were initiated and maintained by advertising using handouts, mailings, and public postings (Fig. 2). The initial surge in handouts during July 2008 was associated with the door-to-door contacts with survivors of the storm during the ISP. There was renewed vigor upon launch of the RSP as counseling services were refocused and expanded. Crisis counselors re-visited storm survivors throughout early spring 2009, and also distributed materials to local businesses to provide a steady presence within the community. The increase in distributed materials corresponds to the development of counseling sessions in public group settings such as churches, schools, civic groups and a Children's fair. Remaining materials were disturbed to resource lists for community reference as the program phased down with its scheduled end date. As the program concluded, nearly 27000 informative materials had been distributed throughout communities affected by the tornado.

The purpose of the ongoing advertising was to identify and attract storm survivors seeking crisis counseling services as needs evolved through stages of recovery described below. Continuous monitoring of the advertising content was crucial as survivors who initially declined services appeared for counseling later in the recovery process. A 0.73 correlation coefficient obtained from the overall tallies of distributed materials and counseling contacts (Figs. 2 and 3) indicates the success of the advertising campaign. Figure 3 reveals a general tendency of declining individual contacts attracted through door-to-door surveys, compared to increasing numbers of group contacts established as counseling needs evolved from individual to community recovery over the course of a year.

During the first quarter (Nov, Dec, Jan), *Colorado Spirit* counselors shared that many of their individual contacts involved normalizing people's concerns, worries, and frustrations, and individuals eagerly shared their stories. The two highest categories expressed during initial contacts were "witnessing destruction" and "experiencing home damage." Counselors addressed these concerns during the first quarter through community meetings where community members had a venue to voice their frustrations and seek assistance for various needs.

During the second quarter (Feb, Mar, Apr), the counselors continued their individual crisis counseling contacts while extending their service focus to groups. Initially, counselors had to work harder to seek out individuals, as people became more reserved about sharing their stories. Community members were not as likely to engage in individual crisis counseling services during the months of February and March (Fig. 3). As the quarter ended, and the spring thunderstorm season returned, the counselors experienced more individual crisis counseling contacts. Counselors reported more individuals were seeking assistance with triggering reactions related to severe weather, and the increase could also have been related to the upcoming anniversary date on 22 May 2009.

The majority of individuals contacted during the second quarter reported that "home damage," and "quick evacuation" had become the top concerns. The crisis counselors sought to address these experiences by promoting disaster preparation materials as a tool to help calm fears associated with thunderstorms and evacuation. The crisis counselors encouraged individuals to create a disaster plan and disaster kit to give them a sense of personal control of their situation in disaster situations such as evacuation. The counselors continued to provide individual crisis counseling on an individual level as the program phased down while maintaining their focus on supporting broader, community-wide outreach activities to build community resiliency and ensure survivors had continued access to resources when the program ended.

When spring thunderstorm weather conditions returned during the RSP, children's reactions to storm-like conditions were forefront for the team's attention. Specifically, the crisis counseling team sought to calm fears and normalize reactions for this high-risk population (Fig. 4). Accomplishing this objective required determined outreach throughout the school systems and creative approaches to engage children at different venues. Severe weather presentations in the schools by meteorology students (detailed below in section 3) helped alleviate fears and inform the children about established watch/warning services and precautions to take in the event of severe weather.

The *Colorado Spirit* team capitalized on their brief educational opportunities to share ongoing updates about their program and remind people about their continual community presence. As the team evolved their services to best meet the community's needs, they were able to share these updates quickly with individuals who may not have previously sought their services. Many of these brief educational contacts also led to follow up individual contacts when needed, or

oftentimes the brief contacts provided a reference for a future group presentation.

Referrals provided a vital tool for assisting the community members affected by the storms, as the counselors regularly referred individuals for emerging needs beyond the scope of crisis counseling services. The Colorado Spirit team provided 418 referrals during the program. The most referrals (130) went to individuals for other crisis counseling services such as support groups and educational presentations. The next most referrals (81) were those given to individuals seeking other needs such as insurance and physical rebuilding needs.

During the first quarter, communities in the southern portion of Weld County often resisted counselors' efforts to support in their recovery. Many individuals were hesitant to receive government assistance or were annoyed because they felt they were initially neglected. With persistence and innovation, the counselors created a space for the administrators to slowly welcome their presence and encourage their crisis counseling services. Offering their presentations about severe weather and reactions, the crisis counseling team and its services, stress management and self care, and disaster preparedness helped open the door as the administrators realized the value in these group presentations.

2.3 Highlights of Program Activities

Although the *Colorado Spirit* team included professionals having expertise in behavioral health and social services, the FEMA grant provided opportunities for additional training in disaster response and psychological recovery. Concentrated training sessions were held during the ISP to RSP transition, at mid-program, and prior to program phase down (Gunderson and Drennen 2009). Topics covered in each training session included goal setting, crisis counseling services (what it is and what it isn't), resilience, fatigue, at-risk populations, and cultural competency. Additional training focused on stress management and specialized services for children and adolescents. Lessons learned from prior CCP disaster recovery programs were reviewed and incorporated into the *Colorado Spirit* program. In addition to the requisite training, team meetings were held weekly to assure quality of counseling services by sharing insights and experiences from the past week. This combination of training and team sharing assured that *Colorado Spirit* adequately engaged faith-based groups, Spanish-speaking communities, school personnel, town administrators, elderly populations, and media partners.

Colorado Spirit developed four primary presentations: severe weather, self-care, disaster preparedness, and advocacy of program services. The *Severe Weather and Reactions* presentation involved undergraduate meteorology students from the University of Northern Colorado (UNC) to present information to seventeen schools and other organizations about severe weather formation, safety, and climatology. Using the educational presentation as a tool to open up dialogue, the counselors were able to talk with children and adults about emotional reactions related to severe weather. The presentation helped children understand why the tornadic storm formed and why they can feel comforted to know that meteorologists are always monitoring the weather. The content of this presentation is detailed in section three below as a means of emphasizing the role that meteorologists (or meteorology students) may play in helping their local community recover from weather disasters.

The *Self-Care and Stress Management* presentation provided groups and organizations with tools to cope with stress. *Colorado Spirit* counselors found while delivering this presentation that they were more openly received than when strictly talking about the tornado. Community members were apparently tired of talking about the weather and openly received the counselors' informative presentations on coping skills and self-care regarding stress and emotional reactions to issues related to the tornado.

As the season for severe thunderstorm returned, the counselors discovered that another creative way to gain interest was to offer presentations on disaster preparedness. The counselors also shared how creating a disaster plan bolsters emotional recovery as the citizens could actively take steps to prepare themselves. The counselors supplemented the concept of preparing the community members by giving them tools to control their environment amidst unpredictable weather conditions. These educational presentations sought to foster further community resiliency, as the attendees were encouraged to create disaster plans and share their education with community members and neighbors.

To continually update the community about their services, the *Colorado Spirit* team created a presentation to educate organizations and groups about their services and their history. Counselors shared this presentation with community organizations such as the Lion's Club and other groups that were interested in what's going on in the community. The presentations were valuable in gaining outside exposure and facilitating referrals for future presentations and contacts.

Several other activities were conducted over the course of the RSP, including holiday food box deliveries, the Children's Fair and the Community Resource Fair, and a balloon release on the tornado anniversary date (Gunderson and Drennen 2009). The Spirit Bowl fundraiser brought together two area semi-professional football teams – the *Wyoming Wranglers* and the *Broomfield Dawgs* – to compete and raise funds through the community's LTRT for disaster survivors still in need. *Colorado Spirit* also organized the tornado preparedness day at Windsor Charter Academy, which experienced a high level of exposure as it was directly in the path of the tornado.

3. OUTREACH THROUGH WEATHER EDUCATION

As *Colorado Spirit* counselors began to interact with storm survivors, they quickly recognized the need to calm fears about severe weather that beset citizens within their service area, especially among children.

Hence, they sought assistance from the undergraduate meteorology program at the University of Northern Colorado (UNC) to begin a weather education campaign. The background, content, and relevance of this partnership are described in the present section.

3.1 Partnership Initiation

The organizing theme of the UNC Student Chapter of the American Meteorological Society (UNC-AMS) is "scholarship, service, and camaraderie." While seeking to enhance community service, students constructed a tornado vortex model to provide a memorable conversation starter for school children. The tornado model was constructed by closely following plans posted online at the website for the NWS Forecast Office in Huntsville, Alabama (http://www.srh.noaa.gov/media/hun/TornadoMachinePlans.pdf). Funding for supplies was provided by a UNC Earth Sciences memorial fund. The project was initiated due to a rather serendipitous alignment of an ambitious student leader, access to large-diameter PVC pipe from a student's family farm, and painting services provided by a local auto-body shop where another student worked. Once the tornado model was constructed, students began arranging visits to local elementary schools where the curriculum includes a weather unit for second and sixth graders. Other simple experiments involving temperature, pressure, clouds and moisture were included in the presentation. Feedback from school teachers helped improve content to make the presentation more interactive and more closely aligned with curriculum objectives.

Given the pre-existing outreach program developed by UNC-AMS, the invitation to partner with *Colorado Spirit* was readily accepted. Students had wanted to contribute to the storm recovery effort, but did not have the means, connections, or understanding of how to become involved. *Colorado Spirit* counselors requested that the weather presentation emphasize lessons about the likelihood of occurrence for all kinds of severe weather in Northern Colorado, and that it provide recommendations about the response to, and preparation for such events. After one month of content development (described below), UNC-AMS students delivered a practice presentation to *Colorado Spirit* counselors and a few invited storm survivors. Feedback from the practice event yielded valuable improvements with regard to clarity and timing.

As *Colorado Spirit* counselors assumed control of scheduling presentations with area schools, UNC-AMS students were able to rotate through the busy schedule to balance the time commitments. The new partnership enabled the UNC-AMS chapter to gain a level of community exposure that they had been unable to achieve on their own. One lesson learned is that university meteorology clubs should exploit the narrative of section two above to help make their programs known to local emergency management as a resource for storm recovery well before an event occurs.

3.2 Program Content

The primary objective of the severe weather presentation was to help children, parents, and educators assuage fears and regain a sense of control associated with severe weather safety, preparation, and responses. To satisfy this objective, UNC-AMS students described the severe weather conditions of 22 May 2008, assessed the general climatology of severe and hazardous weather in northern Colorado, and discussed best practices for severe weather preparation and safety. A typical presentation included visual aids such as the tornado model, simple interactive experiments, a *PowerPoint* slide show, and open discussion (Fig. 5). Presentations primarily targeted elementary school children, but could be tailored to suit audiences including adult members of the general community.

While summarizing the events of 22 May 2008, students presented information similar to that shown by Schumacher et al. (2009), although in a more generalized context suited for non-scientific audiences. Specifically, a center of low pressure was shown over NE Colorado, along with attendant contrasting air masses and frontal boundaries. The storm path and its radar signature were shown (Fig. 1) to reveal the intensity, timing, and direction of motion of the tornado. The storm summary was delivered quickly to minimize the resurgence of negative memories, but was important to help citizens understand what happened. More importantly, its purpose was to show that meteorologists understand why the storm occurred (i.e., it was not a random, mystical event) while preparing the audience to consider its climatological significance.

Using data similar to that presented by Schumacher et al. (2009), UNC-AMS students demonstrated that the historical occurrence of tornadoes having similar intensity, direction of motion, and time of occurrence as the 22 May 2008 event are highly unusual for NE Colorado. The presentation stopped short of suggesting a similar event could never reoccur, but did indicate that citizens could safely let the professional meteorological community handle the watching and worrying. A NOAA weather radio was then brought out and played live to demonstrate that professionals are *always* watching. Citizens were encouraged to purchase a weather radio for home use, while being told about other means of communicating weather watches and warnings such as radio, television, internet, and mobile devices.

Other types of severe weather were also addressed in the presentation. Emphasis was placed on lightning, flash floods, and snow as conditions that residents of NE Colorado would be most likely to experience in the future. Safety lessons accompanied each of these topics, including the "30/30 rule" for lightning, "turn around, don't drown" for flash floods, and a list of things to have in the car for winter travel.

Children especially enjoyed playing a game called "Good Cloud, Bad Cloud", wherein a variety of cloud photographs were shown and children were asked to yell out whether they thought it was a "good" cloud or a "bad" cloud. If disagreement ensued, the UNC-AMS student presenters would engage a discussion to help the children understand what was the appropriate

answer. Cloud images for this game were provided by UNC-AMS students or downloaded from http://cloudppreciationsociety.org. Example of images included stratiform clouds colored red or orange (to show that colored clouds are not necessarily threatening), cumuloform clouds that depicted shapes (to help children learn joy in skywatching), and more threatening cumulonimbi and associated severe weather characteristics such as wall clouds, rain or hail streaks, and tornado funnels. One of the lessons learned from the northern Colorado tornado was that residents in its path initially thought the storm was simply an unusually heavy rain shaft and failed to acknowledge the wedge tornado until they observed debris. After the storm, residents (especially children) were much more likely to become critically fearful of any unusual cloud formations, especially if lightning, hail, or wind were being produced. Hence, the purpose of the "good cloud, bad cloud" game was to help citizens regain a sense of control by teaching them how to more thoughtfully observe their weather environment.

As time permitted, the severe weather presentations also included simple experiments to help teach participants about basic principles of meteorology. For example, a hand-operated vacuum pump was used to show how we measure pressure changes with a barometer. Children enthusiastically helped by working together to evacuate enough air to pop a balloon inside the sealed jar. At one presentation, a football player was invited to open the evacuated jar that had been filled with shaving cream. This required great effort, and yielded a messy result to the delight of the children in attendance! Other lessons involved reading thermometers and showing how water vapor causes cooling.

At every presentation, the tornado model engaged children as its operation was explained, and they were invited to approach the model to blow on it and to disrupt its motion by moving their hands through it. After using a hand-held anemometer to measure its rotation speed (about 3 ms^{-1}), the students competed with one another to see how fast they could blow the anemometer. This interaction enable UNC-AMS student presenters to make a connection with the unimaginable wind speeds associated with real tornadoes. The purpose was to help students know that we understand and can describe the basic rotation characteristics of a tornado for watch and warning purposes. When using the tornado model for inspiring discussion, a balanced approach was needed to ensure that tornadoes were not made to appear insignificant, while guarding against resurrecting fears by over-emphasizing the destructive potential of tornadoes.

3.3 Perspectives gained

After a year of activity, the weather education campaign evolved into a highly valued part of *Colorado Spirit's* emphasis on community recovery. What began as an initial experiment to alleviate fears blossomed into a force for sharing information about crisis counseling services that schools and other community groups eagerly wanted to learn more about. In return, the crisis counselors attained an in-depth knowledge about severe weather, and they were able to incorporate this knowledge into their crisis counseling services. Sharing the educational component opened dialogue to address the emotional concerns related to severe weather.

By participating in this project, UNC-AMS students learned to work as a team. They learned to independently conduct research, and then consolidate information into a coherent presentation that was meaningful and memorable for lay audiences. They learned to accept constructive critique from independent reviewers (*Colorado Spirit* counselors), and to learn from their initial experiences to improve the presentation. All of these skills are important for overall professional development, and could help the participating students gain employment in the discipline.

All meteorology students are fascinated with weather, but infrequently pause to consider the impact weather has on personal lives. Students that participated in these presentations will never forget the extent to which weather changes lives. They learned these perspectives by talking directly with those affected and by listening to feedback provided by the *Colorado Spirit* counselors. Meteorology students generally do not fear weather; therefore, it is enlightening for them to learn that so many members of the general public do fear weather. With this understanding, these students will become more effective weather communicators as they become professionals working in their discipline. It is widely recognized within the meteorological community that professional weather forecasters can fail to connect with their target audiences (Demuth et al. 2007, Fine 2007, Lazo et al. 2009, NCAR/SIP 2009).

4. DISCUSSION

This paper has sought to contribute information about how weather education can play a pivotal role in physical and psychological recovery in the aftermath of a devastating tornado. The outreach effort for severe weather education was established as a partnership between an activated FEMA counseling services program and the expertise of an undergraduate meteorology program existing within the affected community. It is expected that lessons learned from the *Colorado Spirit* program and their partnership with UNC meteorology will help improve other campaigns for severe weather education, including both preparation and long-term recovery.

Colorado Spirit counselors used their *Severe Weather and Reactions, Disaster Preparedness*, and *Self Care/Stress Management* presentations to educate individuals and establish dialogues regarding emotional reactions. The team discovered that presenting groups with their standard presentations helped open doors as group leaders saw the value in these presentations (Gunderson and Drennen 2009).

As the team recognized the evolving needs in the community with the return of the spring thunderstorm season, counselors began focusing on ways to foster understanding around weather and creating a sense of safety for children. The *Severe Weather* presentation was instrumental in educating the

community and providing the children with a sense of safety and knowledge of what to do in the event of severe weather. Furthermore, the children were more aware of clouds that produce severe weather and clouds that do not. Knowing the difference alleviated stress and anxiety related to the changing weather conditions.

The *Colorado Spirit* program benefited from the reports submitted following prior FEMA CCP programs for recovery following severe weather events. It is hoped that the additional component of weather education can provide new avenues for recovery from future events. In turn, local meteorological programs should make their services known to their local emergency management communities as a part of regular annual preparations. As the *Colorado Spirit* team discovered, it can be difficult to integrate all the various recovery organizations that emerge in the aftermath of an event, especially when multiple local municipalities become involved on behalf of communities having disparate cultural and economic backgrounds. Because weather is an everyday topic of interest in common to all, this case has shown how weather education helped open new dialogues and link together the efforts of several recovery and counseling organizations.

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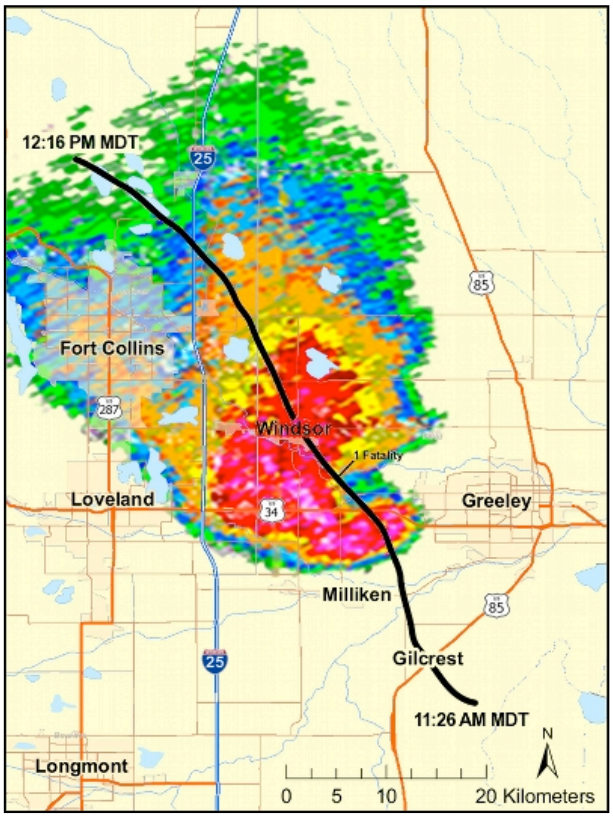

Figure. 1: Ground track of tornado passing through Weld and Larimer counties, Colorado, on 22 May 2008. Radar reflectivity image shows the storm size and position at 11:44 AM MDT (1744 UTC). Tornado track data and reflectivity image (cropped) were provided by the NWS (2009).

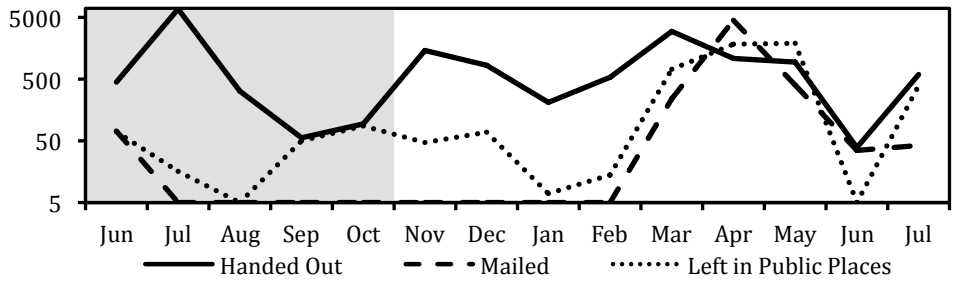

Figure 2: Number of materials distributed by *Colorado Spirit* crisis counselors to advertise their services and provide storm survivors with helpful information to aid in their physical and psychological recovery. The transition from the ISP (shaded portion of graph) to the FEMA-funded RSP occurred on 1 November 2008 (see text for details).

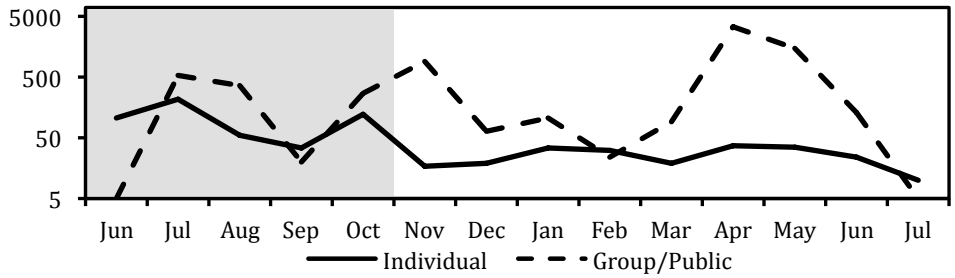

Figure 3: As in Fig. 2, except showing the number of individual and group crisis counseling contacts.

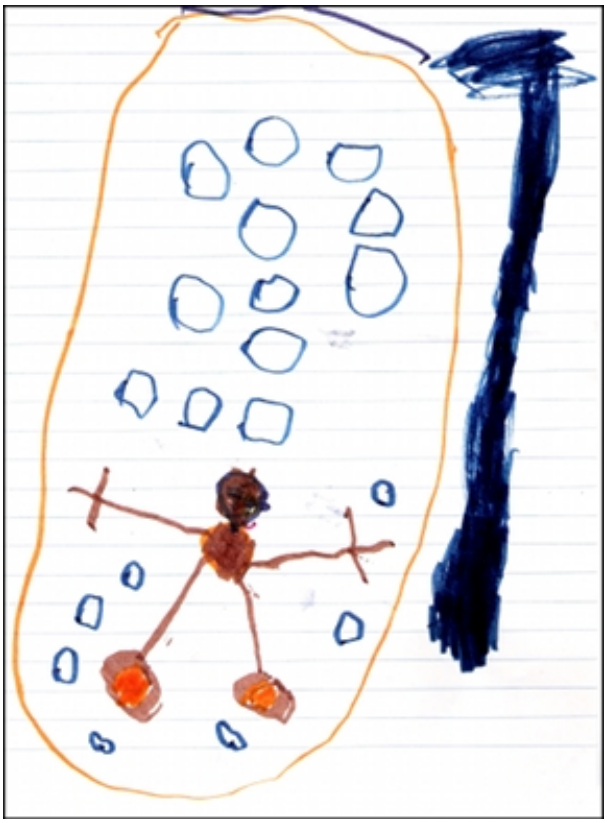

Figure 4: A child's drawing of flying glass experienced during the tornado reveals engrained fears of severe weather.

Figure 5: University of Northern Colorado meteorology majors teaching elementary school students about severe weather.