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AGGRAVATED ASSAULT AND THE URBAN SYSTEM: DALLAS, 1980-81

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ABSTRACT

Prior research on the relationship between violence, heat stress, and the urban socioeconomic environment has suggested links between these three variables. Specifically, low-status neighborhoods appeared to exhibit a relatively exaggerated response to heat stress compared to higher status areas. This article uses prior work on the severe summer of 1980 as a point of departure for comparisons between 1980 and 1981 (a "normal" year). In the study period consisting of 609 days, some 9,994 assaults were recorded in Dallas. The underlying expectations were that 1) 1981 would, in general, show a diminished level of assault in the summer, owing, in part, to diminished heat stress, and 2) certain environmental relationships revealed in the analysis of 1980 data would be replicated with a substantially expanded data set. Initially, weather data for 1980 and 1981 were compared in order to establish that the summer of 1981 was indeed meteorologically different from that of 1980. Then a general model was developed, incorporating a Discomfort Index, day of the week, month, and selected interaction terms. Residuals were analyzed. Pairwise month-by-month comparisons of mean assault frequencies were made, by neighborhoods classified according to their socioeconomic status. In general, 1980-81 differences were less pronounced than expected, possibly due in part to population growth in the Dallas area. Other explanations lie in the so-called curvilinear effect, and the calendar effect.

Connections between thermal stress and violence have been made with increasing frequency and rigor in recent research. Various publications have shown relationships between temperature and violent behavior [1-4]. In general, however, the existing analyses have covered quite limited time periods, which has had the effect of reducing the amount of variability in weather conditions

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that could be encompassed by each study. In no case have identical time spans for consecutive years been compared in order to provide a framework of temporal control. In this article, we expand on earlier work in this series, adding another year of data in order to examine the effect of a "normal" year compared to one that was recognized as extremely severe. In addition, we analyze associations between significant elements of the urban environmental system, using the extended data base. This article is organized as follows. Initially, some background is provided with respect to the study of relationships between weather, climate, and violence. Then a rationale is developed for the study period, and it is shown that there is indeed a significant difference between 1980 and 1981 in terms of the atmospheric conditions experienced in Dallas. A general analysis of variance model is presented, replicating prior methodology with a substantially expanded data set. Next, inter-year differences in assault frequencies are examined by taking months paired by years, and administering t-tests in order to evaluate the hypothesis that mean assault frequencies between months differ by year; the *a priori* expectation would be that a cooler year would produce fewer assaults. Other significant components of the urban system that relate to the production of assault are also examined for the 1980-81 period.

WEATHER, CLIMATE, AND VIOLENCE

The specific notion that warm temperatures are associated with increases in criminal activity can be traced to the eighteenth century in scholarly literature, and much earlier in embryonic form [4]. However, investigations of relationships between temperature and crime generally have been limited in their perspective. If, at a given location, *weather* is defined as the instantaneous state of the atmosphere and *climate* is defined as the long-term characteristic state of the atmosphere, then studies of temperature and crime have not fully explored climate.

The most common approach has been to compare daily time series of temperatures with daily time series of crime frequencies. This approach is valid within the weather framework. Yet, climate overrides weather in that accumulated experience at a location has provided a notion of what weather types to expect at a particular time of year. To provide a rationale for the time period used in this research, it is necessary to examine the *climatic* viewpoint in some detail. This perspective can be categorized as having three avenues of expression. First, *thermal seasonality*; second, *place-to-place climatic difference*, and third, the concept of *deviations* from expected, or "normal" conditions.

Thermal Seasonality

Perhaps the strongest expression of the climatic viewpoint is embodied in the attention given to warm-season peaking of criminal activity. Researchers [3, 5-7] have unanimously concluded that summertime contains more crimes than any of the cooler seasons. Whether this is a direct thermal effect on behavior, or an indirect effect mediated by intervening variables (school vacation schedules, increased summer alcohol intake, etc.) has been vigorously debated. Yet, the fact remains that the seasonal march of temperature can be statistically associated with a seasonal rhythm in the frequency of crime.

Place-To-Place Differences

A second avenue of inquiry is geographic, and has involved the analysis of climatic differences. This perspective was implicitly included in the geographic strand of classical Greek environmental theory [8] and brought to modern "fruition" by the geographer Huntington [9]. Huntington's deterministic climatic approach was popular early in the century, but soon came under virulent attack. The sentiment against determinism was so pervasive that geographers dropped the investigation of relationships between climate and behavior, for fear of being tarred with the same brush of condemnation that had been used on Huntington. In the 1970s, geographers began to slowly emerge from the era of reaction. In 1978, Lewis and Alford investigated the relationship between seasonality and assult by comparing three years of monthly assault rates in each of fifty-six cities with the national average monthly assault rates. Examining maps of city locations, they found "little evidence that this crime migrates with season" [10]. Further work pronounced that temperature-crime relationships were non-existent [7], seemingly destroying what little credibility may have remained in the argument that climate and crime are related.

The Concept of Normality

Climatologists use thirty-year means, extremes, and variability to establish the climate of a location. A logical climatological approach to atmosphere-crime relationships would be to examine the climatic "normality" of study periods chosen to test hypothesized relationships. Yet this line of research has been left unexplored. Lack of consideration of the concept of normality (the climatic viewpoint) may limit the scope of research. Two works from the psychological literature illustrate this point. Baron and Ransberger studied temperature data relating to 102 riots and civil disturbances [11]. They found that when frequency of events was plotted against temperature, this type of violence peaked in the mid-80°s F (>26°C) and then sharply declined. Carlsmith and Anderson noted that the Baron and Ransberger findings were possibly an artifact of the climates involved [12]. In the United States, the most common maximum daytime summer temperature is in the mid-80s, so a researcher would, *a priori*, expect to find the greatest number of events occurring with temperatures in the mid-80 range. A second work in which consideration of the climatic viewpoint may have been beneficial was a paper by Anderson and Anderson that analyzed temperature and violent crime in Houston for the period October, 1980, through

September, 1982 [1]. An objective was to test whether the crime-temperature relationship was linear or curvilinear. But the study period omitted the summer of 1980—the hottest in half a century in much of Texas. The summers chosen by Anderson and Anderson were closer to long-term temperature normals than was the summer of 1980, which would have been ideal for the purpose of testing the crime-temperature hypothesis. This climatic approach, then, utilizing departures from expected, or "normal" temperatures, provides a perspective which cannot be replicated from time series of daily temperatures.

RATIONALE FOR THE STUDY PERIOD

We have used the concept of climatic normality as the guide to the choice of study period in this article. People are constantly acclimating to their thermal surroundings. In Dallas, Texas, for instance, an 80°F (27°C) day would be labeled warm if it occurred in February. However, a similar day in August would be perceived as cool; it would be some 19°F cooler than the normals for that time of year. Thus, in temperature-crime studies the departure from normal, or expected, might carry as much or more importance than the actual ambient temperature.

Extending this logic, the present work uses temperature and crime data from two years to provide a quasi-controlled experimental design through which to screen for a thermal effect. The reasoning was that if an abnormally hot year and a cooler year were compared, the differences in crime frequencies between years might be partially attributable to differences in temperature. The study period encompassed the summers of both 1980 and 1981. The use of only two warm seasons may be criticized in that a longer time series would be more useful. In this case, the use of 1980 and 1981 was expedient from a logistical point of view, and the addition of more years would have been questionable from a socioeconomic standpoint. As an important center for immigration to the Sunbelt, Dallas and environs have undergone rapid population growth and social change in the last decade. Thus, the most straightforward manner in which to "control" the social milieu is to minimize the number of years used. Nevertheless, the effect of growth on the incidence of assault between 1980 and 1981 is unknown and is a possible source of distortion in this study.

There is no question that 1981 provided a thermal contrast to 1980. In newspapers from the southern Great Plains and also in more scholarly literature (e.g., [13]) the warm season of 1980 was pronounced the most severe of the half century. Heat-related deaths in that summer were almost seven times those of an average year [14]. Dallas was particularly warm. Although its normal daily summertime maximum temperatures are in the upper 90°s F (>32°C), Dallas registered 100° (38°C) or above every day from June 23 through August 3, 1980. In all, the summer of 1980 had sixty-three days exceeding 100°F. This made 1980 the warmest summer on record in Dallas [15].

Table 1. Mean Temperatures and Deviations from Normal, Dallas, 1980-81

	Year			
	1980		*1981*	
Month	*Mean Temperature*	*Deviation*	*Mean Temperature*	*Deviation*
January	45.5	+0.7	44.6	−0.2
February	46.6	−2.1	48.9	+0.2
March	54.2	−0.8	55.7	+0.7
April	63.1	−2.1	69.2	+4.0
May	75.0	+2.5	70.5	−2.0
June	87.0	+6.5	80.3	−0.3
July	92.0	+7.2	85.9	+1.1
August	88.5	+3.6	83.4	−1.5
September	80.3	+2.6	76.2	−1.5
October	65.4	−2.2	66.1	−1.5
November	54.9	−0.9	57.5	+1.7
December	49.4	+1.5	48.1	−0.1

Source: National Climatic Data Center. Computations by authors.

The warm season of 1981 provides a suitable contrast to 1980. Whereas the warm season of 1980 was composed of months all with average temperatures above the long-term normals, none of the summer months of 1981 had mean daily *maximum* temperatures which departed more than +1°F from the long-term normals (see Table 1). In the period from the first to the last 100° day of 1980 (June 18 through September 16) the average daily departure from normal was +5.18°F; the same calendar days in 1981 averaged −2.40°F. Examination of the daily temperature records shows no heat waves in 1981 comparable to those of 1980. Indeed, 1981 contained only ten days above 100°F, and these were not concentrated in time.

The general impression of 1981 as a "normal" summer distinctly different from 1980 was reviewed via the use of a *t*-test. Temperatures from the hottest part of 1980 (June 18 through September 16) were converted to deviations from normal and paired with the deviations from normal for the same calendar days in 1981. The results suggested that 1981 was indeed significantly cooler than 1980 ($t = 11.17, p = 0.0001$). We may conclude, therefore, that our design includes an abnormally hot summer as well as one which was cooler than usual.

GENERAL MODEL

Data

The data base consisted of two elements: 9,994 aggravated assault records from the Dallas Police Department, and hourly weather data from the National Climatic Data Center, Asheville, N.C. Both data sets covered the period March 1, 1980 through October 31, 1981. The assault data were aggregated in order to provide daily counts of incidents. The climatic data were processed in order to extract a maximum daily Discomfort Index (*DI*), calculated as follows:

$$DI = 0.55\ T_d + 0.2\ T_{dew} + 17.5$$

where *DI* is the Discomfort Index value, T_d is the dry-bulb or ambient temperature, T_{dew} is the dewpoint temperature, and all readings are in degrees Fahrenheit.

This index incorporates temperature and humidity which, in combination, are the prime determinants of discomfort. The index has been tested extensively over a period of decades. A similar measure in use in the media is commonly referred to as the *humiture*. The *DI* was categorized into five levels, recognized in the literature, ranging from "severe heat stress" to "all comfortable."

For part of the analysis, Dallas police reporting areas were classified according to an Urban Pathology Index, into twelve high, medium, and low socioeconomic status neighborhoods. The methodology underlying this classification is developed in Harries, Stadler, and Zdorskowski [4], and will not be elaborated here. Data permitting this classification were provided by the City of Dallas Department of Housing and Urban Rehabilitation.

The Model

The study period was unbalanced in the sense that it did not include complete calendar years, thus precluding the use of "year" as an independent variable in the analysis. However, temporal variability was captured through the use of each of the twenty months of the study period as a discrete level in an analysis of variance framework. Another temporal variable with previously demonstrated importance was "day of the week." The daily frequency count of aggravated assaults constituted the dependent variable, while *DI*, day of the week, and month were the independents. Interactions between day and month, day and the *DI*, and month and the *DI* were also reviewed. In general, the model replicated that of Harries and Stadler, 1983, with the addition of twelve months of data, an increment of some 5,685 observations.

Results

The results of the analysis are presented in Table 2. The overall model was significant, with $F = 4.04$, $p = 0.0001$, and $R^2 = 0.67$. However, with the

Table 2. ANOVA Results for Main Effects and Selected Interactions, 1980-81 Data[a,b] (N = 609)

Source	*df*	*F*	*p*
Discomfort Index	4	2.05	0.09
Day of the Week	6	54.23	0.0001
Month	19	1.52	0.07
Day X Month	114	1.12	0.21
Discomfort Index X Day of Week	24	1.40	0.10
Discomfort Index X Month	39	1.45	0.04

[a] The F and p values apply to 'Type III' sums of squares, indicating that the other variables are controlled for.

[b] Durbin-Watson D = 1.88, suggesting lack of serial correlation among residuals.

significance level set at the conventional 0.05, only day of the week and the interaction term, *DI* X month, were significant, when all other variables were controlled for. The importance of day of the week is apparent in Table 2. The explanatory power of this variable is due to the pronounced peaking in assault frequencies observed on Fridays, Saturdays, and Sundays. Overall, Saturday night is the apex of assault production. In the earlier model, using a shorter study period, *DI*, day of the week, month, and (marginally) day of the week X month had all been significant.

In the longer time series used here, several months are characterized by *DI* at the lowest level, and relatively flat assault frequencies. In the summer of 1981, the *DI* failed to reach its highest level, except for very brief intervals, in contrast to 1980, when the highest *DI* was sustained for extended periods, and assault frequencies were strongly correlated with peaks in the *DI*. "Month" is clearly a surrogate for *DI* in the sense that seasonal variations in the *DI*, are, by definition, associated with specific months. Thus it is not surprising that the level of explanation provided by these variables is comparable. Furthermore, the interaction term, *DI* X month, would be expected to account for variation that neither variable could account for in isolation, hence its significance.

Residuals

Analysis of residuals indicated that they were normally distributed (skewness = 0.17) and random with respect to the classifications of the independent variables. Residuals were not serially correlated (Durbin-Watson D = 1.88), further confirming the relative success of the model in accounting for variations in the daily incidence of assault. A more detailed investigation of extreme residuals (those with a standardized value of at least +/− 2.00) cross tabulated with neighborhood socioeconomic status and day of the week also failed to reveal any striking relationships. One possibility for follow-up research would be the investigation of Dallas newspaper stories for insights relating to the reasons for substantially higher or lower-than-predicted assault frequencies on particular days. Major sporting events, local holidays, other special events, and weather phenomena apart from extreme heat, could constitute perterbations accounting for some large residuals.

PAIRED MONTHS AND ASSAULT DIFFERENCES

Comparable periods (March through October) from 1980 and 1981 were paired for the purpose of testing for significant differences in mean assault frequencies. Thus March of 1980 was paired with March of 1981, and so on. The paired months were then classified by neighborhood socioeconomic status. Theoretically, it would be expected that frequencies in high- and, perhaps, medium-status neighborhoods would not be significantly different between the two years, since their sensible climates are relatively controlled by air conditioning. In low-status areas, on the other hand, air conditioning is less prevalent [16], and the population is probably more prone to the direct effects of heat stress, at home and at work.

Expectations were not borne out (see Table 3). High-status neighobrhoods had three sets of months with significant differences (March, April, May); medium-status areas had none, and low-status areas only one (August). The pattern of above-normal months from May through September, 1980, suggests the possibility of a cumulative thermal stress effect in low-status neighborhoods, since June and July departed from normal substantially more than August. Three of the four significant differences were in the "right" direction, i.e., the mean for the month in 1980 exceeded that for 1981. However, testing differences on the basis of months failed to show any marked pattern of difference between the periods under review.

Table 3. Tests for Differences in Mean Assault Frequencies by Paired Months, by Neighborhood Status, 1980-81

Neighborhood Status	*Months with Significant Differences*	*t*	*p*
High	March	−3.86	0.0004
	April	2.22	0.0312
	May	2.51	0.0157
Medium	None	—	—
Low	August	2.63	0.0115

However, it is possible that the month by month pairwise comparison reported here is not the best mode of comparison. The periodicities in assault frequencies are, in reality, unlikely to conform to months, and another research approach could involve the detection of natural periodicities. Furthermore, there is no question that thermal stress is in any case a marginal determinant of violence, and its effects may be fuzzy, particularly when obscured by artifactual distortions due to measurement.

It should be noted that the totals of assaults for the comparable March through October periods were almost identical: 4,197 for 1980 and 4,148 for 1981. This is quite surprising in the context of the socioeconomic environment; the population of the City of Dallas grew 4.3 percent between 1980 and 1982 [17], and it is probably safe to assume that about half of that growth came in the 1980-81 period. Other things being equal, then, one would expect a corresponding growth in the incidence of aggravated assault, adjusted for the abbreviated comparable time period. Yet the data show a slight decline in frequency.

The explanation for this may have many roots, including demographic change, changes in police reporting procedures, changes in policing practices, and so forth. It is also possible that, if the summer of 1981 had been comparable in severity to that of 1980, the incidence of assaults may have been appreciably greater. Although only one month in low-status neighborhoods showed significant difference between 1980 and 1981, its absolute numerical contribution was substantial. For example, the paired means of daily frequencies (1980/1981) for the high-status areas were (March) 1.5, 3.0; (April) 2.6, 1.8; (May) 3.1, 2.2. But for August in the low-status neighborhoods, the means were 11.0 and 8.0, emphasizing both the relative role of the low-status neighborhoods, as well as the numerical importance of a difference attributable to only one month.

CONCLUSION

If the concept that ambient thermal discomfort influences crime incidence is a plausible one, then analysis must demonstrate the effects of those conditions. This is difficult in a real world setting, in which experimental conditions cannot be controlled directly. We chose to compare data from two years, one of which was recognized for its severe heat stress, while the other was climatically normal. However, our results are ambiguous, failing to clearly demonstrate the role of meteorological variables in the production of crime. This ambiguity may be, in part, an artifact of the research design, which utilizes a comparison between paired months to test the concept of differential assault frequencies by neighborhood types. Apart from being unnatural temporal divisions, months are also subject to "calendar" effects, whereby a month in a given year may have more or fewer Saturdays (high assault productivity days) than the same month in another year.

An issue about which little is known is how *expressive* and *instrumental* forms of assault interact with environmental conditions. Expressive assaults are those that are tied to emotional reactions, while instrumental assaults are related to accomplishing some end, such as robbery. Presumably, high-status neighborhoods will see few instrumental assaults committed by neighborhood residents. Low-status areas, on the other hand, are likely to experience many assaults of both types. Given the strong ties between alcohol consumption and violence of all kinds it may be argued that thermal stress, with its associated increase in alcohol consumption, will probably provoke increases in both types of assault, particularly in low-status neighborhoods, where air conditioning is less prevalent.

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