Radar as a Speed Deterrent: An Evaluation

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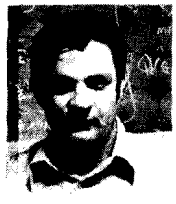

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Special recognition and thanks are due each of the North Carolina municipalities that participated in this evaluation. Both the police personnel and those at the broadcast media (newspapers, radio and television) cooperated throughout the study.

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ABSTRACT

Is the presence of radar, visibility of a patrol car, ticketing, and/or media publicity effective in eliminating (or substantially reducing) municipal speeding? This study addresses this question by examining speeds of vehicles collected over an eleven-day period in 43 North Carolina municipalities under varying experimental conditions (e.g., media publicity in one group of cities vs no publicity in a comparable group given baseline or "before" sppeds for both groups).

The evaluation provides convincing evidence that in the 35 mph speed zones studied a reduction in both the proportion of speeders (from 0.669 to 0.464) and the average speed of traffic (from 38.7 mph to 35.5 mph) can be accomplished by a combination of efforts (i.e., visibility of patrol vehicle, ticketing and media publicity). However, each of the factors considered alone reflect only marginal evidence of effectiveness.

INTRODUCTION AND BACKGROUND

Highway Safety Standard 4.4.15 requires evaluation (re cost and effectiveness) of programs undertaken in the area of Police Traffic Services. Why should program evaluation be required by the safety standard? After all, the evaluation itself costs money! If there were unlimited funds for the various competing areas of highway safety, evaluation would not be nearly as necessary. However, with the limited funds available and the many candidate programs competing for these funds, it is essential that the funds be allocated in those areas with the biggest payoff in the sense of reduction of highway accident costs. This can only be determined by well-designed and conducted field studies.

In this project in North Carolina, the endeavor is to include: (1) speed measuring equipment used in enforcement programs designed to eliminate excessive speeding; (2) breath testing equipment used in enforcement of drunk driving statutes; and (3) special selective enforcement programs. To date, efforts have been concentrated in the area of evaluating the use of speed measuring equipment.

The North Carolina investigation is a joint effort involving the North Carolina Governor's Highway Safety Program, the University of North Carolina Highway Safety Research Center (HSRC), and police agencies

in the various cities involved. Briefly, the Governor's Highway Safety Program is responsible for coordinating the various efforts, securing the necessary equipment, and aiding in the orientation efforts along with HSRC. HSRC is responsible for the planning of the evaluation, the preparation of sample publicity (when required by the evaluation procedure), the assembling and compiling of pertinent records from the police groups, the analysis of the records, and the preparation of a report (including findings and recommendations). The various police agencies are responsible for the field work involved in the study (e.g., recording of speeds and other information, coordination of local publicity efforts, etc.). Clearly, such a project is a cooperative investigation and, as such, depends upon the coordinated efforts of a number of people.

During the first year of this project, VASCAR speed measuring devices were distributed to ten North Carolina cities after an evaluation procedure had been established. The details of this phase of the overall project can be found in Council (1971). Two major recommendations grew out of this study which have helped considerably with the present study. These recommendations were: (1) supply convincing information to police agencies concerning the "why" of evaluation and the requirement for evaluation and (2) place stronger emphasis on the idea that the police agency itself is in effect conducting its own evaluation. Both of these recommendations resulted from the failure of certain of the cities that received the VASCAR units to submit the required eval-

uative data. Of the ten cities involved in the study, only four submitted usable data with the resulting analyses being based on very limited information.

Benefiting from the experience of the earlier study, the present effort received excellent cooperation from the various police agencies.

PROCEDURE

As in the first year of this project, most of the effort was directed toward the evaluation of the use of special speed measuring equipment primarily by a number of city police departments in the state. Specifically, the Governor's Highway Safety Program secured 90 radar units through this project and allocated them as follows: 47 North Carolina municipalities received a total of 61 units, the State Highway Patrol received 27 units, and the Department of Community Colleges and the Security Division of North Carolina State University each received one unit. The results reported herein were obtained from a study of the use of the radar units by the various municipalities, primarily to allow for comparability of results and also for administrative convenience.

The analysis was primarily directed at the immediate effects of the presence of newly-acquired radar units on vehicular speed in various cities across the state. In addition, the study design incorporated procedures for investigating the effect of publicity (both

by the news media and word-of-mouth following arrests using the radar unit) and/or the visibility of a police car in reducing vehicular speeds.

It was anticipated that the immediate effect of the device would be a lowering of the average speed to a speed under the posted limit if previously above it, and a reduction in the proportion of vehicles traveling at speeds above the posted limit (especially those exceeding the posted limit by more than 15 miles per hour).

This investigation included the following efforts:

1. Planning of evaluation procedure. The initial impact of the use of the radar units was investigated by the use of "before and after" type data. The 47 towns were divided into five regions (or groups) according to their location (see Table 1). Each radar operator was to obtain the speed of the first 25 vehicles at the same location and time each day for 11 consecutive days. The four cities that received more than one unit were to collect data for each radar unit.

Although speeds were collected for days 4 and 8, such data were not used in the analysis, as these were transition days between stages. Thus, in each group, there were three stages lasting three days each (i.e., stage 1: days 1-3; stage 2: days 5-7; stage 3: days 9-11).

Baseline data on vehicular speeds at the particular time and location chosen for the study were provided by the first three days of the study, the "before" stage.

Table 1. Study design by city within region

Region	City *	Population**	Experimental Conditions Phase 1 (Days 1-3)	Phase 2 (Days 4-7)	Phase 3 (Days 9-11)
I	Lenoir	10,800	Car Concealed	Car Visible	Car Visible
	Hickory	20,000	Radar Concealed	Radar Visible	Radar Visible
	Belmont	5,007			
	Hudson	1,536	No Ticketing	Ticketing	Ticketing
	Morganton	2,943	No Publicity	No Publicity	No Publicity
	Marion	3,345			
	Spindale	4,082			
	Hazelwood	1,925			
	Fairmont	2,286			
II	High Point	65,000	Car Concealed	Car Visible	Car Visible
	Randleman	2,232	Radar Concealed	Radar Visible	Radar Visible
	Mebane	2,364			
	Durham	81,000	No Ticketing	Ticketing	Ticketing
	Lowell	2,784	No Publicity	No Publicity	Publicity
	Reidsville	14,800			
	Burlington	35,500			
	Stoneville	951			
	Mt. Airy	7,055			
	Raleigh	104,000			
	Garner	4,300			
	Ellerbe	843			
III	Smithfield	6,117	Car Visible	Car Visible	Car Visible
	Chapel Hill	18,000	Radar Concealed	Radar Visible	Radar Visible
	Magnolia	629			
	Ranlo	2,067	No Ticketing	Ticketing	Ticketing
	Zebulon	1,534	No Publicity	No Publicity	Publicity
	Clayton	3,302			
	Ramseur	1,258			
IV	Hope Mills	1,109	Car Visible	Car Visible	Car Visible
	Maxton	1,755	Radar Concealed	Radar Visible	Radar Visible
	Hamlet	4,460			
	Elizabethtown	1,625	No Ticketing	Ticketing	Ticketing
	Tabor City	2,338	No Publicity	No Publicity	No Publicity
	Raeford	3,058			
	Lawndale	723			
V	Wilson	31,000	Car Visible	Car Visible	Car Visible
	Bethel	1,578	Radar Concealed	Radar Concealed	Radar Visible
	Washington	10,000			
	Aulander	1,083	No Ticketing	No Ticketing	Ticketing
	Princeville	797	No Publicity	Publicity	Publicity
	Murfreesboro	2,643			
	Plymouth	4,666			
	Havelock	2,433			

* Four additional cities provided data that was not usable.
** Based on 1960 census information.

For Group I, the radar unit and clocking vehicle were concealed during the first stage; there was no ticketing (unless a violation was flagrant) and no publicity. In the second and third stages, the police car and radar unit were visible; there was still no media publicity but, since speeders were ticketed, word-of-mouth publicity from ticketed drivers would be expected. By comparing stage one with stages two and three, the combined effect of the visibility of the radar unit and the police vehicle was investigated.

The procedure in Group IV was similar to that of Group I, the only difference being that the police car was visible in stage one. Differences in traffic speeds between the first stage and the latter two in Group IV gave a measure of the effectiveness of the visibility of the radar unit along with the effectiveness of ticketing.

The first and second stages for Group II were the same as the first two stages for Group I. However, during the last three days in Group II, publicity was used in addition to the ticketing with both the radar unit and police car visible. A comparison of the data of the last three days in Groups I and II yielded an indication of the effectiveness of newspaper and radio publicity.

The first and second stages of Group III were identical to those of Group IV. For the third stage of Group III, media publicity was instituted. Therefore, a measure of the effectiveness of media publicity was examined by comparing the last three days of Groups III

and IV.

Group V utilized a three stage procedure, which was somewhat different than that of Groups I-IV. The data for the first stage were obtained with the police car visible, radar unit concealed, no ticketing and no publicity. In the second stage, the only change was that there was media publicity. By comparing stages one and two, the effectiveness of the publicity alone was examined. Stage three differed from stage two only in that ticketing began and the radar unit was visible. Any differences in stage two and stage three speeds were then a result of the visibility of the radar unit and ticketing, and not the effect of media publicity. See Table 2 for the summarized study design.

All of the towns were also asked to obtain, when possible, supplementary data on approximate age, sex and race of the driver. (See Figure 1 for a sample data sheet). These supplementary data were requested in order to examine the relationships of speed and/or speed reduction with driver characteristics.

2. Orientation of the police in study procedures. Initially, the cities participating in the study were notified of the requirement for an evaluation and its importance through a memorandum from the office of the Governor's Highway Safety Program (see Appendix A). Included in this memorandum was a schedule of dates and locations for the initial round of orientation sessions (one in each region).

Table 2. Summarized study design

Region	Stage	Vehicle Visible	Radar Unit Visible	Ticketing	Publicity
I	1	-*	-	-	-
	2	+**	+	+	-
	3	+	+	+	-
II	1	-	-	-	-
	2	+	+	+	-
	3	+	+	+	+
III	1	+	-	-	-
	2	+	+	+	-
	3	+	+	+	+
IV	1	+	-	-	-
	2	+	+	+	-
	3	+	+	+	-
V	1	+	-	-	-
	2	+	-	-	+
	3	+	+	+	+

* - corresponds to 'no'
** + corresponds to 'yes'

Figure 1. RADAR EVALUATION DATA SHEET

Form 005

City ANYTOWN Date FEBRUARY 14, 1971

Operator's name JOHN W. PUBLIC

Street name or highway number W. MAIN ST. AT COLUMBIA ST.

Why was this location chosen? HIGH ACCIDENT LOCATION

Posted speed limit 35 m.p.h.

Description of test situation:
Vehicle description (circle one) (1 Marked) 2 Unmarked
Vehicle position (circle one) 1 Clearly visible (2 Hidden)

Describe POLICE CAR PARKED OFF W. MAIN ON COLUMBIA (NOT VISIBLE TO TRAFFIC)

Weather (circle one) (1 Clear) 2 Cloudy 3 Raining 4 Snowing 5 Fog 6 Sleet or Hail

Beginning time 4:05 AM (PM) (circle one)

When possible, check appropriate column for sex, age, and race of driver

	SPEED (m.p.h.)	SEX M	SEX F	AGE 16-25	AGE 26-50	AGE over 50	RACE W	RACE NW	COMMENTS
1	37	✓			✓		✓		
2	40	✓			✓		✓		
3	32	✓				✓		✓	
4	34		✓			✓	✓		
5	40	✓			✓			✓	
6	42	✓		✓			✓		
7	62			✓					CAR FULL OF TEEN-AGERS
8	33		✓		✓		✓		
9	35	✓			✓		✓		MOTORCYCLE
10	37	✓				✓	✓		
11	38	✓			✓		✓		
12	35		✓	✓				✓	
13	20	✓			✓			✓	DELIVERY TRUCK
14	38	✓			✓		✓		
15	25	✓			✓		✓		TRUCK
16	34								
17	34		✓			✓	✓		
18	45								AMBULANCE
19	30		✓		✓			✓	
20	38	✓		✓			✓		
21	36	✓		✓			✓		
22	35	✓			✓		✓		
23	28	✓				✓	✓		
24	40	?		✓				✓	
25	35		✓		✓		✓		

Ending time 4:50 AM (PM) (circle one)

At the orientation sessions, the radar operators from the participating cities were trained jointly by HSRC personnel and by representatives of the Governor's Highway Safety Program and the North Carolina Department of Community Colleges.

HSRC developed detailed instruction packets which were distributed to the representatives from each city at the first orientation session held during the month of December, 1970. (See Appendix B for a copy of the instructions given to those cities in Group III). Summarized instructions were distributed at the second orientation session held in late February and early March, 1971. It was anticipated that the radar operators might be able to follow the abbreviated instructions more easily.

At the first orientation session, the operators received the following information: origin of radar, description of the particular unit they would be using (the Decatur Model 99) as well as "how to use it", typical questions asked the operator when testifying in court, etc. In addition, the instructions for the evaluation were discussed point by point. At the follow-up orientation session, the radar units were distributed and examined and the instructions reviewed. At this time, packets of data sheets were distributed to the radar operators.

To reinforce the idea that the cities were primarily responsible for conducting the evaluation along with HSRC an attempt was made to contact each of the city representatives by telephone during the data

collection period. A number of operational problems were taken care of "on the spot" by this mechanism in addition to stressing the need for city cooperation.

3. Public information. A well-informed public should increase the effectiveness of any enforcement program. The study design for this evaluation included a mechanism for examining the effect of massive publicity efforts on vehicular speeds. Basically, the speeds for those regions having massive publicity campaigns (the "experimental" group) were compared with those regions with no special publicity efforts (the "control" group). Differences in mean speeds and/or proportion speeding for the two groups became the mechanism for examining the effect of publicity efforts.

For those cities in the "experimental" group, the following procedure was used: at the first orientation session, each city representative supplied HSRC with a list of the daily and weekly newspapers most commonly read in that city as well as the radio and television stations most commonly listened to. Then HSRC sent packets of sample publicity (i.e., news releases and public service spot announcements) along with a cover letter to these news media (See Appendix C). The letter stressed the importance of the timing of the release of the information, particularly by the weekly newspapers, and gave the name of the police representative who would be cooperating with them. Since the police representative also had a packet of sample publicity, it was

anticipated that the two groups (police and news media personnel) would cooperate in generating interesting and informative publicity. Immediately following the data collection phase, each city was expected to submit to HSRC samples of newspaper publicity actually used (see Appendix D). This latter device was instituted primarily to encourage and strengthen the publicity efforts.

At the end of the data collection period, those cities in the "control" group were sent packets of sample publicity and encouraged to use publicity in their continuing enforcement program.

4. Records assembly and evaluation. When a city completed the data collection phase of the study, it forwarded to HSRC the 11 data sheets per radar unit and other information requested. With a minimum of follow-up effort by HSRC, the required information was submitted by all 47 participating cities. This impressive cooperation by the municipal police departments is credited largely to: (1) the emphasis made on the need for an evaluation of enforcement efforts; (2) stressing the fact that the individual cities were conducting the evaluation; and (3) the close contact between the Governor's Highway Safety Program, HSRC, and the cities, including the telephone survey conducted during the data collection phase.

The data for the five regions representing the 47 cities were edited for failure to comply with instructions. As a result, four cities were eliminated from the final analyses. The data for the

resulting 43 cities were then coded and key-punched for subsequent computer analysis.

Since certain cities (Raleigh, Durham, High Point and Reidsville) received more than one radar unit and since certain other cities (Spindale, Lowell and Zebulon) submitted data for more than one location and time period, there was information on a total of 63 sites. Thus the study is based on 14,175 vehicular speeds (i.e., 63 (sites) × 9 (days) × 25 (observations/day)).

RESULTS

The major criteria for judging the impact of use of radar as a mechanism for speed control in the communities participating in this study are the reduction in proportion of speeders and the reduction in average speed. Also of interest is the proportion speeding recklessly where speeding recklessly is defined to be those speeding by 15 miles per hour or more. The results discussed below focus mainly on Groups I through IV of cities (or regions) described in the procedure section. Because of the study design, less obvious comparisons were available for Group V. Results within communities are given in the tables in Appendix F for those interested in particular locations.

Discussion of the results focuses on all cities within a region with the different population sizes considered only when particularly

appropriate. It should be emphasized that the different cities presented different results and that overall trends may not apply in every case. The reader interested in these interacting effects is referred to the tables for details.

For each of the five study groups described in the previous section, the results are classified according to the population of the participating communities within each group; i.e.

i) small populations ($\leq$ 2500 inhabitants as of the 1960 census)

ii) medium populations (2501-9999 inhabitants)

iii) large populations ($\geq$ 10,000 inhabitants)

and according to period of study; i.e.,

i) days 1-3 (stage 1)

ii) days 5-7 (stage 2)

iii) days 9-11 (stage 3)

As mentioned earlier, data collected on days 4 and 8 were omitted in order to provide a transitional period for changing the conditions under which the radar was used; e.g., car concealed, radar concealed, no ticketing, publicity, etc.

Proportion of Group Speeding. The results based on the proportion of the group speeding in 35 mph speed zones are presented in Table 3. Chi-square and p values are given to indicate the statistical significance of the differences among the proportions during the three stages of study.

Table 3. Proportion of group speeding (35 mph posted speed limit) by population group within region

Proportion of Group Speeding						
Region	Population	Days 1-3	Days 5-7	Days 9-11	X^2 (DF=2)	p
I	≤2500	0.551	0.222	0.200	79.37	0.0000
	2501-9999	0.528	0.403	0.448	12.16	0.0023
	≥ 10,000	0.649	0.480	0.580	8.86	0.0119
	All	0.559	0.364	0.400	65.75	0.0000
II	≤ 2500	0.699	0.531	0.432	55.17	0.0000
	2501-9999	0.708	0.660	0.623	4.86	0.0880
	≥ 10,000	0.686	0.501	0.412	129.50	0.0000
	All	0.693	0.540	0.459	172.39	0.0000
III	≤ 2500	0.707	0.685	0.592	12.45	0.0020
	2501-9999	0.740	0.593	0.587	9.78	0.0075
	≥ 10,000	-	-	-	-	-
	All	0.716	0.659	0.590	18.42	0.0001
IV	≤ 2500	0.757	0.607	0.503	41.42	0.0000
	2501-9999	0.627	0.453	0.302	31.76	0.0000
	≥10,000	-	-	-	-	-
	All	0.713	0.556	0.437	70.67	0.0000
V	≤2500	0.578	0.502	0.520	2.82	0.2441
	2501-9999	0.540	0.600	0.456	6.25	0.0439
	≥10,000	0.460	0.340	0.380	4.69	0.0958
	All	0.533	0.484	0.462	5.63	0.0599
I+II	≤2500	0.643	0.415	0.345	117.32	0.0000
	2501-9999	0.607	0.517	0.526	13.48	0.0012
	≥10,000	0.680	0.497	0.438	125.23	0.0000
	All	0.649	0.481	0.440	220.81	0.0000
III+IV	≤2500	0.729	0.650	0.553	45.93	0.0000
	2501-9999	0.683	0.523	0.445	35.78	0.0000
	≥10,000	-	-	-	-	-
	All	0.715	0.611	0.520	78.66	0.0000
I+IV	≤2500	0.669	0.442	0.373	100.28	0.0000
	2501-9999	0.556	0.417	0.406	29.48	0.0000
	≥ 10,000	0.649	0.480	0.580	8.86	0.0119
	All	0.617	0.436	0.414	119.53	0.0000
II+III	≤2500	0.703	0.608	0.512	57.18	0.0000
	2501-9999	0.719	0.638	0.611	12.53	0.0019
	≥ 10,000	0.686	0.501	0.412	129.50	0.0000
	All	0.699	0.571	0.493	180.81	0.0000
I+II+III+IV	≤2500	0.589	0.540	0.455	144.98	0.0000
	2501-9999	0.631	0.519	0.501	38.90	0.0000
	≥ 10,000	0.680	0.497	0.438	125.23	0.0000
	All	0.669	0.521	0.464	291.75	0.0000

For Group I, the proportion speeding for all cities decreased in Stage 2 (car and radar are made visible with ticketing initiated). For Stage 3, with conditions the same as for Stage 2, there is a small overall increase in the proportion of speeders; however, this erosion of the effect of the use of the radar occurs only in large populations.

In Group II, the proportion of speeders decreases consistently as the study progressed. The large decrease from .693 in Stage I to .540 in Stage 2 suggests, as in Group I, a positive effect due to making the radar unit and car visible and ticketing the offenders. The additional decrease to .459 in Stage 3 suggests that media publicity is important. However, publicity seems to have a greater effect in the smaller and larger cities than in the medium-sized ones.

In Group III, a reduction of .057 (i.e., from .716 in Stage 1 to .659 in Stage 2) was observed subsequent to initiation of ticketing along with visibility of the radar unit. The vehicle was visible in both stages. The additional decrease of .069 in Stage 3 appears to be a result of the addition of media publicity. The publicity again seems to have a greater effect in small cities than medium ones; there are no large cities in Region III for comparison.

A steady decrease in the proportion of speeders is also observed in Group IV. The difference of .077 between Stages 1 and 2 here is larger than the corresponding decrease with the same change in conditions for Group III. The additional decrease of .119 from Stage 2 to Stage 3

(no change in conditions) is larger than the corresponding one from Group III which had publicity added. This larger decrease without publicity may be due to differences in the two regions or it may be a consequence of a marginal effect of publicity being offset by other effects.

It is interesting to note that the proportion of speeders initially exceeded 50 percent in all five groups (see Figures 2 and 3). In all situations a reduction in the initially high proportion of speeders resulted after some effort was made to produce such reduction. The largest decrease usually occurred between the first and second stages.

In order to further examine the effect of car visibility, Groups I and II were combined as were Groups III and IV (see Table 3). The Stage 1 to Stage 2 difference of .168 (a 26 percent decrease) for Group (I + II) is greater than the corresponding difference of .104 (a 15 percent decrease) for Group (III + IV). Since Group (I + II) changed from car and radar concealed with no ticketing to car and radar visible with ticketing whereas Group (III + IV) always had the car visible, there would appear to be some reduction in the proportion of speeders due to visibility of the police car.

A comparison of the Stage 2 to Stage 3 difference of Group (I + IV) with that of Group (II + III) suggests a positive effect due to media publicity since all other conditions were the same for the regions in these stages. The Group (II + III) (with publicity) difference of .078

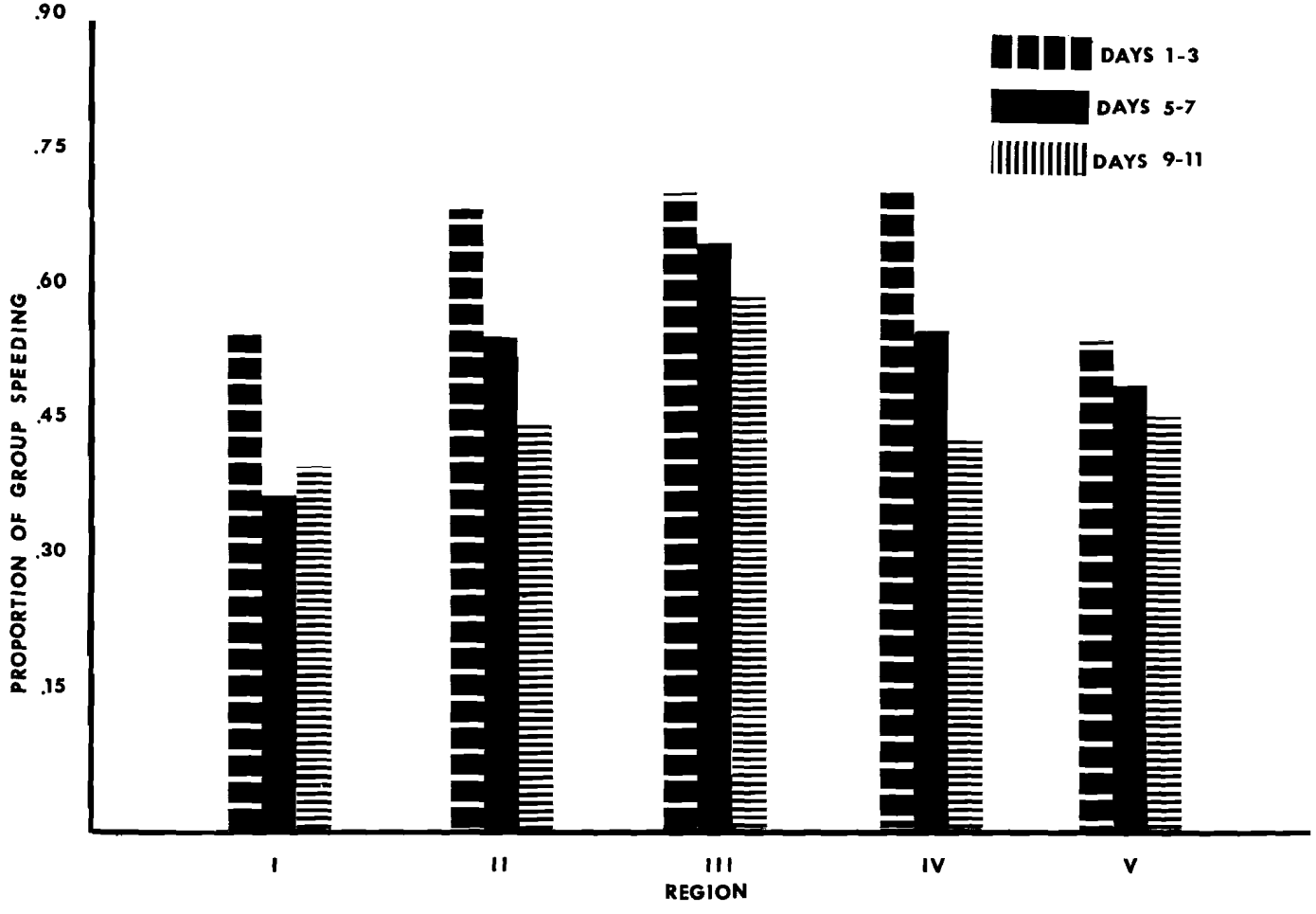

Figure 2. Proportion of group speeding by region

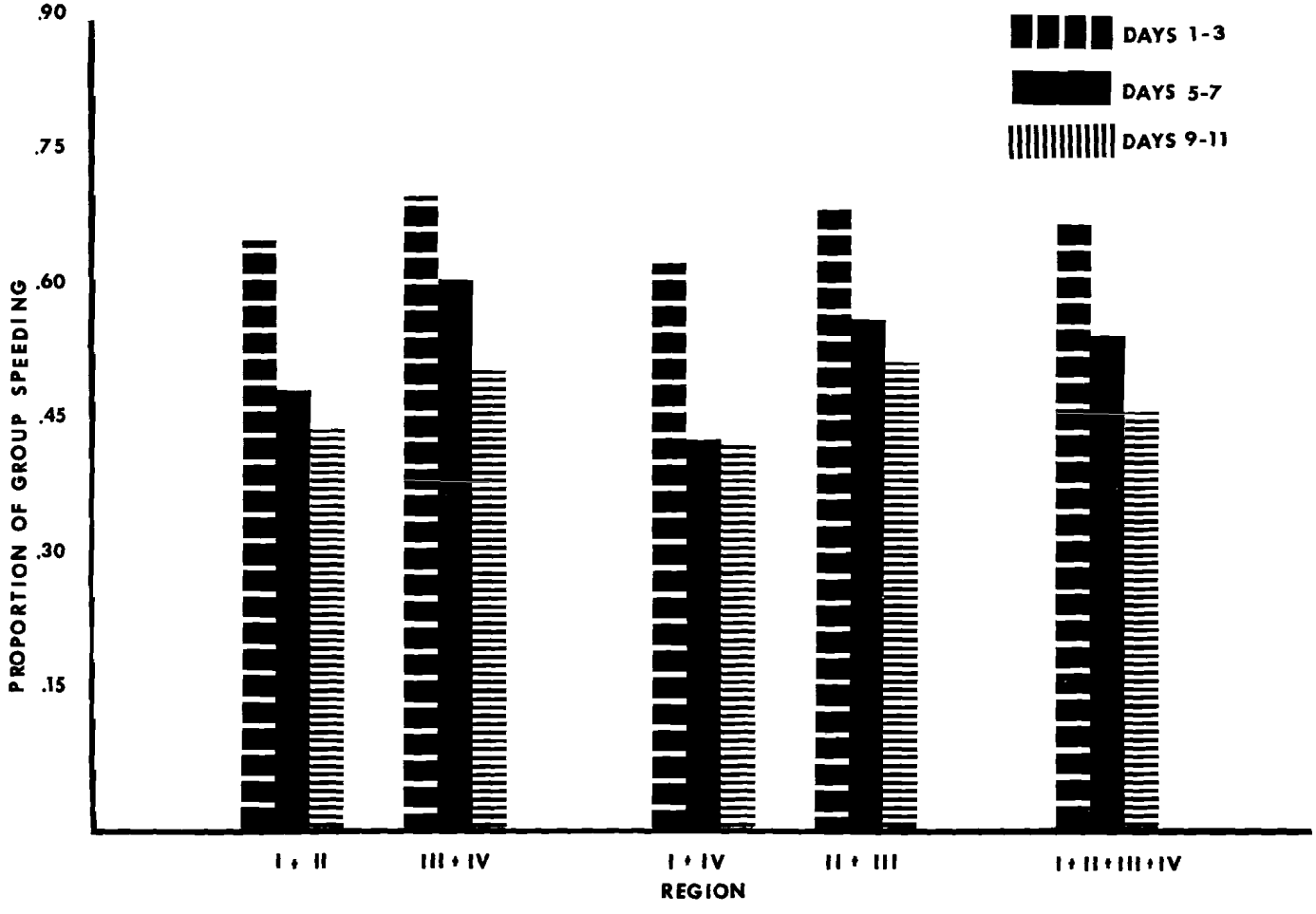

Figure 3. Proportion of group speeding by combined regions

(a 14 percent decrease) is in fact greater than the Group (I + IV) (without publicity) difference of .022 (a 5 percent decrease) so that it again appears that media publicity is to some extent effective in reducing vehicle speeds.

Proportion of Group Speeding Recklessly. Since there are relatively few reckless (i.e.exceeding the speed limit by at least 15 mph) speeders, there may be especially large differences due to random fluctuations. Therefore, the results for the reckless speeding group should be interpreted with caution.

Group I has the lowest proportion of reckless speeders in the first stage (i.e.,.019 from Table 4). There are no significant differences between this already low Stage 1 proportion and those of the other stages.

In Group II, there is a significant decrease in proportions across the three time periods. The Stage 1 to Stage 2 difference of .011 (.029 to .018) suggests visibility of car and radar together with ticketing is effective in reducing the proportion of reckless speeders. Moreover, publicity seems to contribute to a further reduction during Stage 3.

While the proportion of reckless speeders steadily decreases over time periods in Group III, the observed differences are not statistically significant.

In Group IV the decrease of .029 (.038 to .009) at Stage 2 is

Table 4. Proportion of group speeding recklessly (35 mph posted speed limit) by population group within region

Proportion of Group Speeding by 15 mph or More						
Region	Population	Days 1-3	Days 5-7	Days 9-11	X^2 (DF=2)	p
I	≤2500	0.018	0.004	0.000	5.24	0.0728
	2501-9999	0.019	0.013	0.021	0.71	0.7012
	≥10,000	0.020	0.007	0.007	1.60	0.4493
	All	0.019	0.009	0.012	2.62	0.2698
II	≤2500	0.035	0.008	0.019	6.75	0.0342
	2502-9999	0.085	0.077	0.013	16.70	0.0002
	≥10,000	0.007	0.001	0.000	8.82	0.0122
	All	0.029	0.018	0.007	20.30	0.0000
III	≤2500	0.077	0.059	0.035	6.40	0.0408
	2501-9999	0.033	0.047	0.020	1.66	0.4361
	≥10,000	-	-	-	-	-
	All	0.065	0.055	0.030	6.90	0.0318
IV	≤2500	0.057	0.013	0.007	17.76	0.0001
	2501-9999	0.000	0.000	0.007	2.02	0.3642
	≥10,000	-	-	-	-	-
	All	0.038	0.009	0.007	15.50	0.0004
V	≤2500	0.067	0.022	0.049	5.14	0.0765
	2501-9999	0.047	0.000	0.000	14.17	0.0008
	≥10,000	0.000	0.000	0.000	0.00	1.0000
	All	0.042	0.010	0.021	12.01	0.0025
I+II	≤2500	0.028	0.007	0.012	10.09	0.0064
	2501-9999	0.048	0.041	0.018	9.80	0.0074
	≥10,000	0.009	0.002	0.001	9.46	0.0088
	All	0.026	0.015	0.009	20.10	0.0000
III+IV	≤2500	0.068	0.039	0.022	17.80	0.0001
	2501-9999	0.017	0.023	0.013	0.88	0.6440
	≥10,000	-	-	-	-	-
	All	0.052	0.034	0.020	15.51	0.0004
I+IV	≤2500	0.040	0.010	0.004	22.76	0.0000
	2501-9999	0.013	0.010	0.017	1.17	0.5571
	≥10,000	-	-	-	-	-
	All	0.026	0.009	0.010	14.29	0.0008
II+III	≤2500	0.056	0.033	0.027	9.54	0.0085
	2501-9999	0.067	0.067	0.016	16.77	0.0002
	≥10,000	-	-	-	-	-
	All	0.039	0.028	0.013	25.05	0.0000
I+II+III+IV	≤2500	0.049	0.024	0.017	25.41	0.0000
	2501-9999	0.038	0.036	0.016	9.50	0.0086
	≥10,000	0.009	0.002	0.001	9.46	0.0088
	All	0.034	0.021	0.012	35.38	0.0000

significant. Since the car was visible in both stages, this is apparently due to visibility of the radar unit in combination with ticketing the offenders.

A comparison of Stage 1 to Stage 2 differences for Group (I + II) with Group (III + IV) indicates little difference due to the effect of visibility of the police car. Comparing Group (I + IV) with Group (II + III) in the second and third stages of the study does seem to indicate a reduction in reckless speeding due to publicity (an 11 percent increase vs a 54 percent decrease, respectively).

The overall trend in proportions speeding recklessly is illustrated in Figures 4 and 5. Clearly the overall effort is effective in reducing the proportion of reckless speeders.

Average Speed of Group. Average speeds classified by time period and population are given in Table 5. Also presented are the estimated pooled standard deviation, s_p, of the speeds within the three time periods, the variance ratios, F_1 for comparing the three time periods and F_2 for comparing Stage 1 data with the pooled data from Stages 2 and 3, and the corresponding probability levels, p_1 and p_2. The degrees of freedom are $(2, \infty)$ and $(1, \infty)$ for the unpooled and pooled data, respectively. (The denominator d.f.$= \infty$ since n = number of observations is very large.)

In Group I, the average speed initially decreased and then remained

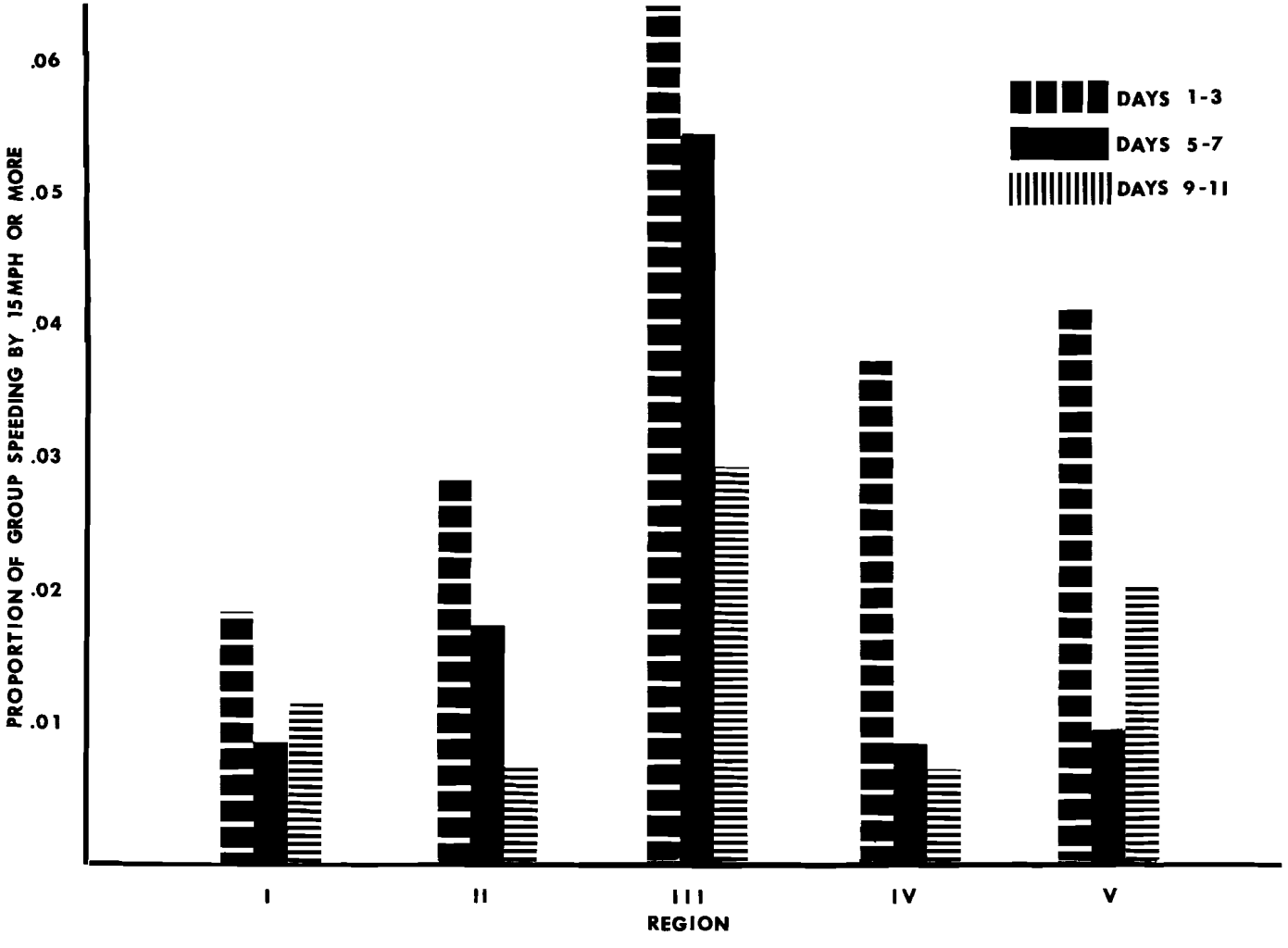

Figure 4. Proportion of group speeding recklessly by region

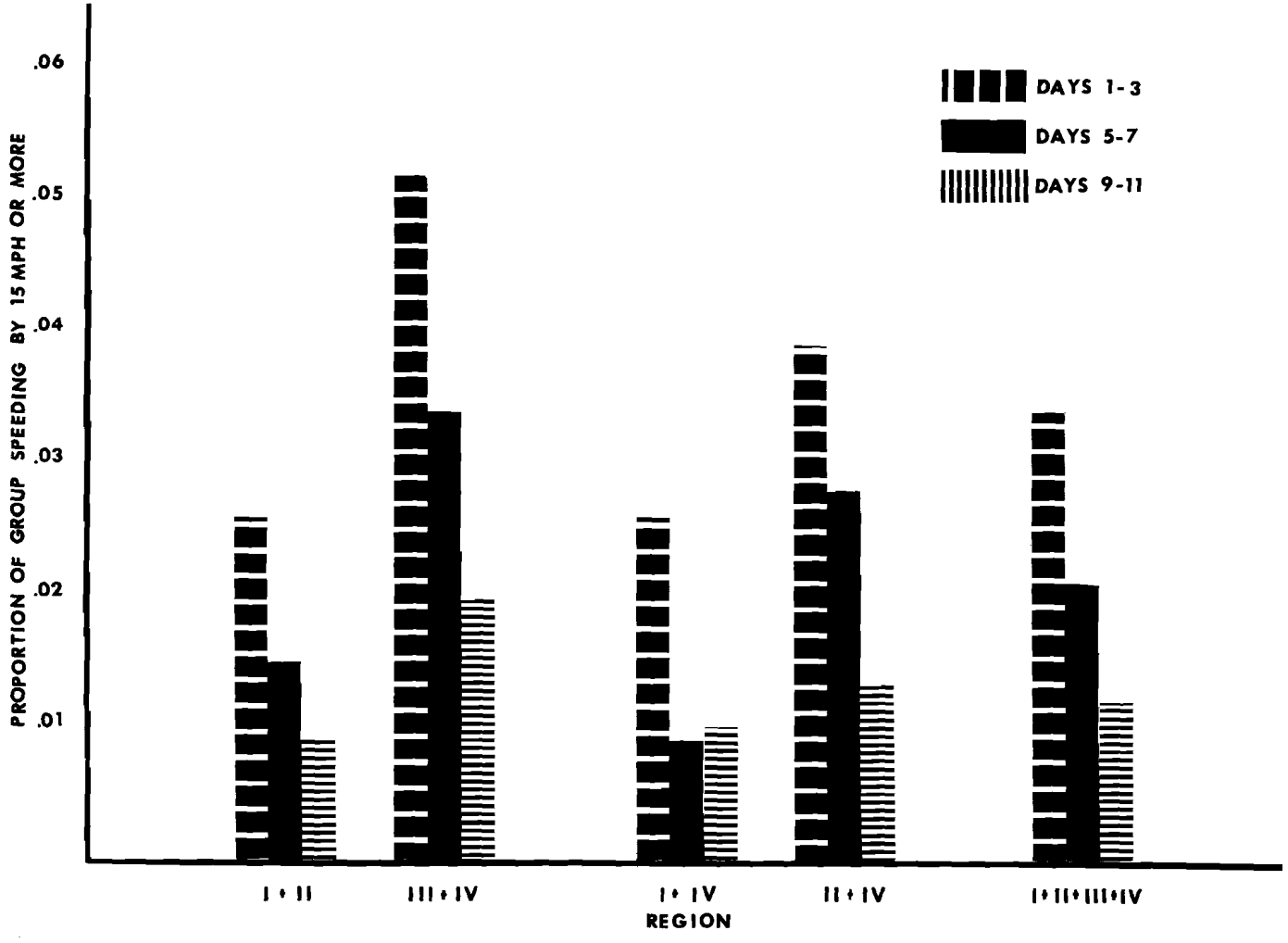

Figure 5. Proportion of group speeding recklessly by combined regions

Table 5. Average speeds (35 mph posted speed limit) by population group within region

Region	Population	Average of Group: Days 1-3	Days 5-7	Days 9-11	Days 5-7 and 9-11 Pooled	s_p	F_1 (DF=2,∞)	p_1	F_2 (DF=1,∞)	p_2
I	≤2500	36.9	32.1	32.1	32.1	5.8	50.89	0.0000	101.92	0.0000
	2501-9999	36.7	35.1	35.9	35.5	6.3	6.38	0.0020	9.17	0.0028
	≥10,000	38.1	36.5	36.4	36.5	5.1	5.37	0.0053	10.73	0.0012
	All	37.1	34.5	34.9	34.7	6.1	38.91	0.0000	76.20	0.0000
II	≤2500	38.8	35.5	34.8	35.1	7.1	33.81	0.0000	65.97	0.0000
	2501-9999	40.0	39.7	38 1	38 9	7.3	5.64	0.0041	4.02	0.0462
	≥10,000	38.5	36.1	34.8	35.4	5.0	111.44	0.0000	196.22	0.0000
	All	38.9	36.6	35.5	36.1	6.2	113.23	0.0000	198.99	0.0000
III	≤2500	40.3	39.7	37.8	38.7	7.0	12.67	0.0000	11.87	0.0007
	2501-9999	39.3	37.4	36.7	37.0	8.5	3.74	0.0253	6.92	0.0091
	≥10,000	-	-	-	-	-	-	-	-	-
	All	40.0	39.0	37.5	38.3	7.5	15.02	0.0000	18.67	0.0000
IV	≤2500	40.3	37.1	35.4	36.3	7.1	35.05	0.0000	61.68	0.0000
	2501-9999	38.0	35.9	33.0	34.4	6.0	25.79	0.0000	33.35	0.0000
	≥10,000	-	-	-	-	-	-	-	-	-
	All	39.5	36.7	34.6	35.7	6.8	56.98	0.0000	92.55	0.0000
V	≤2500	38.5	36.4	36.7	36.5	8.6	3.93	0.0210	7.73	0.0059
	2501-9999	36.5	36.4	35.0	35.7	5.9	2.97	0.0534	1.72	0.1910
	≥10,000	35.0	34.3	34.3	34.3	5.7	0.75	0.4736	1.49	0.2235
	All	36.9	35.8	35.5	35.6	7.2	5.45	0.0049	10.61	0.0013
I+II	≤2500	38.1	34.2	33.8	34.0	6.8	73.33	0.0000	145.43	0.0000
	2501-9999	38.2	37.1	36.9	37.0	7.0	5.97	0.0030	11.60	0.0007
	≥10,000	38.4	36.1	35.1	35.6	5.1	111.38	0.0000	199.94	0.0000
	All	38.3	35.9	35.3	35.6	6.2	141.60	0.0000	270.77	0.0000
III+IV	≤2500	40.3	38.5	36.7	37.6	7.1	40.73	0.0000	60.09	0.0000
	2501-9999	38.7	36.7	34.9	35.8	7.4	19.32	0.0000	29.64	0.0000
	≥10,000	-	-	-	-	-	-	-	-	-
	All	39.8	37.9	36.2	37.1	7.3	59.28	0.0000	88.61	0.0000
I+IV	≤2500	38.8	35.0	34.0	34.5	6.9	71.98	0.0000	138.51	0.0000
	2501-9999	37.1	35.3	35.1	35.2	6.3	15.65	0.0000	31.07	0.0000
	≥10,000	-	-	-	-	-	-	-	-	-
	All	38.0	35.3	34.8	35.0	6.4	84.10	0.0000	164.05	0.0000
II+III	≤2500	39.5	37.6	36.3	36.9	7.2	37.98	0.0000	64.13	0.0000
	2501-9999	39.8	39.0	37.7	38.3	7.7	8.38	0.0003	10.22	0.0016
	≥10,000	-	-	-	-	-	-	-	-	-
	All	39.1	37.3	36.0	36.6	6.6	115.43	0.0000	192.75	0.0000
I+II+III+IV	≤2500	39.2	36.5	35.3	35.9	7.1	99.14	0.0000	181.38	0.0000
	2501-9999	38.3	37.0	36.3	36.6	7.1	19.94	0.0000	35.06	0.0000
	≥10,000	38.4	36.1	35.1	35.6	5.1	111.38	0.0000	199.94	0.0000
	All	38.7	36.5	35.5	36.0	6.6	193.18	0.0000	349.11	0.0000

essentially unchanged. Comparison of Stage 1 (car and radar concealed, no ticketing) with the combined Stages 2 and 3 (car and radar visible, ticketing) indicates a substantial reduction in average speed in each of the three population groups. This finding implies that visibility of car and radar together with ticketing is effective in reducing the average speed.

In Group II, it can be seen that in all populations combined there is a general trend toward reduced speeds as the study progressed. The reduction of 2.3 mph from the Stage 1 average speed of 38.9 to the Stage 2 average of 36.6 (effect of visibility of car and radar with ticketing) is greater than the reduction of 1.1 mph from the Stage 2 average of 36.6 to the 35.5 average of Stage 3 (effect of publicity).

The average speed in Group III steadily decreases but the decreases are less than the corresponding ones for Group II.

The average speed in Group IV also tended to decrease with time periods. The Stage 1 to Stage 2 difference of 2.8 mph apparently results from making the radar visible on an already visible car and initiating the ticketing of offenders. In going from Stage 2 to Stage 3 with identical conditions there is a decrease of 2.1 mph; such a continued decrease without changing conditions was not observed in Group I and could be a region effect.

The overall results, i.e.Group (I+II+III+IV), show a steady decline in average speed across time periods in all population categories. The

average speeds are 38.7, 36.5 and 35.5 in Stages 1, 2 and 3, respectively, all slightly above the posted speed limit (see Figure 6).

Average Speed of Speeders. The average speed of speeders is given in Table 6. There is also a column in this table to present the number of speeders, n, on which the estimate, s_p, is based. In Group I, the average speed of the speeders initially decreased from 41.5 mph to 40.3 mph but then remained essentially constant. Since in Stage 2 the car and radar unit were visible with tickets given whereas in Stage 1 the car and radar unit were hidden with no tickets given, this decrease in the average speed of speeders can probably be attributed to visibility of car and radar together with ticketing. No further reduction is obtained by continuing the Stage 2 procedure into Stage 3.

For Group II, there is a consistent decline in the average speed of the speeders. The decrease observed at Stage 3 appears to be due to media publicity since all other conditions were identical.

The Stage 1 (car visible, radar concealed and no ticketing) to Stage 2 (car and radar visible, ticketing) difference is negligible for Group III. The subsequent reduction of 1.6 mph (43.5 to 41.9) is presumably a result of media publicity.

In contrast to Group III, there is an initial reduction of 1.8 mph (43.0 to 41.2 mph). There is also a slight further reduction for Stage 3 which has the same conditions as Stage 2 (i.e.car and radar unit

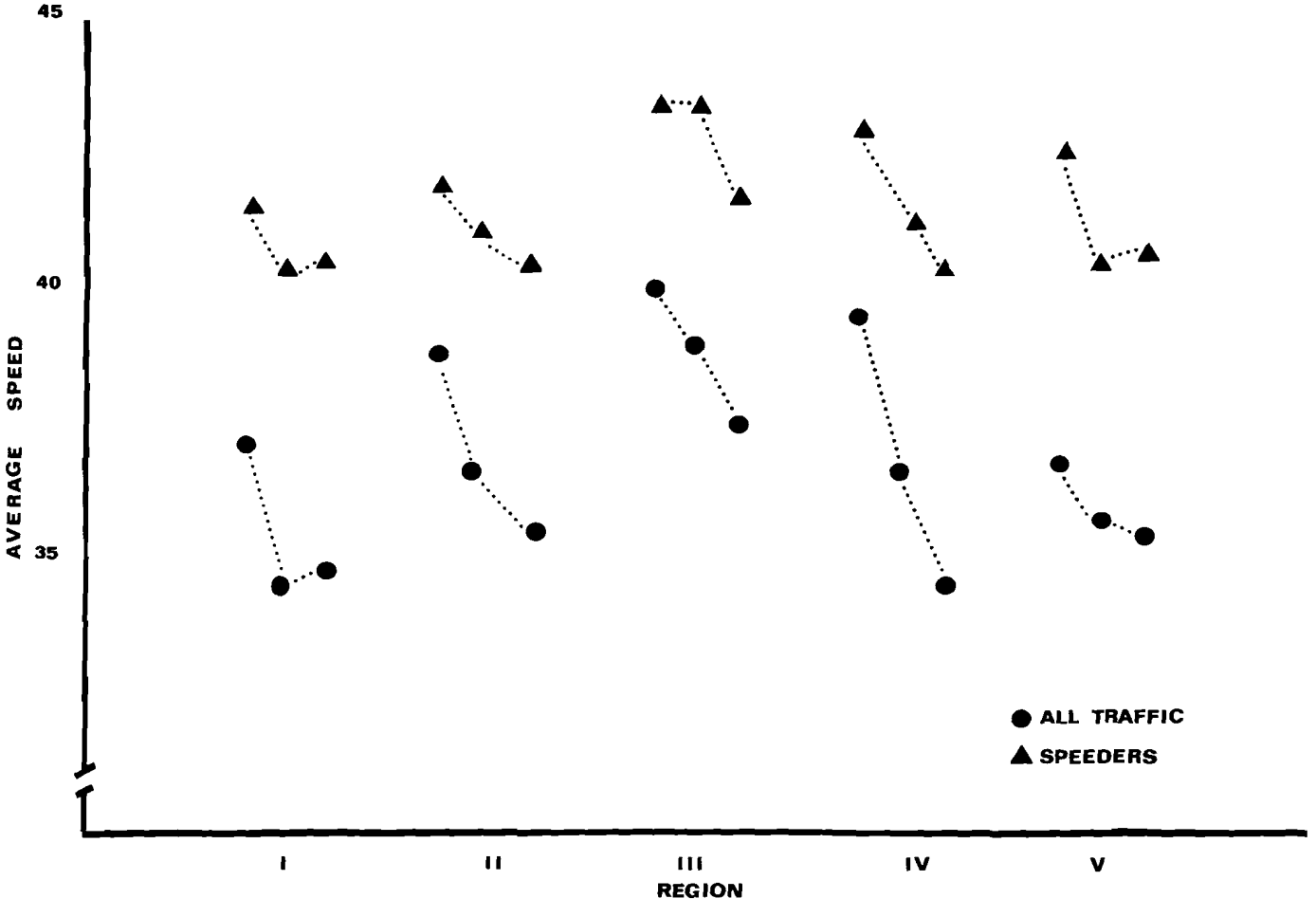

Figure 6. Average speeds (all traffic and reckless speeders) by region

Table 6. Average speed of speeders (35 mph posted speed limit) by population group within region

Region	Population	Average of Speeders: Days 1-3	Days 5-7	Days 9-11	Days 5-7 and 9-11 Pooled	s_p	n	F_1 (DF=2, ∞)	P_1	F_2 (DF=1, ∞)	P_2
I	≤2500	41.6	39.6	39.7	39.6	4.2	219	5.62	0.0042	11.27	0.0009
	2501-9999	41.5	40.4	41.2	40.8	5.1	517	2.05	0.1298	2.07	0.1508
	≥10,000	41.5	40.5	39.5	39.9	3.5	257	7.52	0.0007	11.59	0.0008
	All	41.5	40.3	40.5	40.4	4.6	993	7.45	0.0006	14.63	0.0001
II	≤2500	42.6	40.4	40.8	40.6	4.2	623	18.00	0.0000	35.00	0.0000
	2501-9999	43.6	44.0	41.6	42.9	5.5	594	10.28	0.0000	2.14	0.1440
	≥10,000	41.2	40.1	39.5	39.8	3.3	1322	30.11	0.0000	53.92	0.0000
	All	42.0	41.1	40.4	40.8	4.3	2539	30.45	0.000049	49.76	
III	≤2500	43.7	43.2	41.7	42.5	5.3	744	9.01	0.0001	7.94	0.0050
	2501-9999	43.0	44.1	42.5	43.3	4.2	288	3.29	0.0387	0.51	0.4757
	≥10,000	-	-	-	-	-	-	-	-	-	-
	All	43.5	43.5	41.9	42.7	5.1	1032	9.92	0.0000	4.88	0.0274
IV	≤2500	43.6	41.3	40.3	40.8	4.9	560	25.86	0.0000	46.76	0.0000
	2501-9999	41.8	40.9	40.5	40.7	3.6	207	2.16	0.1180	3.97	0.0476
	≥10,000	-	-	-	-	-	-	-	-	-	-
	All	43.0	41.2	40.3	40.8	4.3	767	26.10	0.0000	47.15	0.0000
V	≤2500	44.3	41.8	42.9	42.4	7.1	360	3.63	0.0275	5.94	0.0153
	2501-9999	41.7	39.6	39.2	39.4	3.9	239	9.32	0.0001	18.41	0.0000
	≥10,000	41.2	40.0	38.8	39.4	3.1	177	9.29	0.0002	14.37	0.0002
	All	42.8	40.7	40.9	40.8	5.7	776	11.19	0.0000	22.17	0.0000
I+II	≤2500	42.3	40.2	40.6	40.4	4.2	842	21.19	0.0000	41.59	0.0000
	2501-9999	42.6	42.5	41.4	41.9	5.4	1111	4.71	0.0091	3.30	0.0696
	≥10,000	41.2	40.1	39.5	39.8	3.3	1579	37.15	0.0000	65.08	0.0000
	All	41.9	40.9	40.4	40.7	4.4	3532	34.94	0.0000	63.25	0.0000
III+IV	≤2500	43.6	42.4	41.1	41.8	5.0	1304	26.08	0.0000	37.61	0.0000
	2501-9999	42.4	42.7	41.8	42.3	4.1	495	1.65	0.1931	0.05	0.8232
	≥10,000	-	-	-	-	-	-	-	-	-	-
	All	43.3	42.5	41.3	42.0	4.8	1799	24.09	0.0000	30.51	0.0000
I+IV	≤2500	42.8	41.0	40.1	40.6	4.5	779	25.94	0.0000	48.07	0.0000
	2501-99994	41.6	40.6	41.1	40.8	4.8	724	2.92	0.0546	4.61	0.0321
	≥10,000	41.5	40.5	39.5	39.9	3.5	257	7.52	0.0007	11.59	0.0008
	All	42.2	40.7	40.4	40.6	4.5	1760	27.09	0.0000	52.95	0.0000
II+III	≤2500	43.1	42.0	41.3	41.7	4.9	1367	15.93	0.0000	28.00	0.0000
	2501-9999	43.4	44.1	41.9	43.0	5.1	882	12.65	0.0000	0.89	0.3457
	≥10,000	41.2	40.1	39.5	39.8	3.3	1322	30.11	0.0000	53.92	0.0000
	All	42.4	41.8	40.9	41.4	4.6	3571	37.45	0.0000	42.48	0.0000
I+II+III+IV	≤2500	43.0	41.6	40.9	41.3	4.7	2146	36.39	0.0000	65.41	0.0000
	2501-9999	42.5	42.5	41.5	42.1	5.1	1606	6.23	0.0020	3.05	0.0830
	≥10,000	41.2	40.1	39.5	39.8	3.3	1579	37.15	0.0000	65.08	0.0000
	All	42.3	41.5	40.7	41.1	4.6	5331	54.69	0.0000	87.00	0.0000

visible, ticketing but no media publicity).

Inspection of Group (I+II+III+IV) shows a tendency toward decreased average speeds in the latter phases of observation regardless of the population size. The decrease is substantial from a statistical significance viewpoint but, nevertheless, the overall average speed of speeders remains in excess of five miles per hour above the limit (see Figure 7).

In general, the results involving the average speed of speeders are somewhat conservative. If the program is effective and eliminates 90% of the speeders but the remaining 10% continue traveling at very high speeds, the 10% will inflate the average speed disproportionately and, thus the corresponding tests for statistical significance must be interpreted accordingly.

Summary. From the previous discussion together with detailed results in Appendix F, it should be apparent that no general statements can be made which hold for all sites or for all population sizes. Nevertheless, the results do suggest that visibility of the patrol car and radar unit together with ticketing is effective in reducing the proportion of speeders as well as the average speed of traffic regardless of the population size. If a patrol car is already visible, visibility of the radar unit along with ticketing appear to be effective in further reducing the proportion of speeders and the average speed

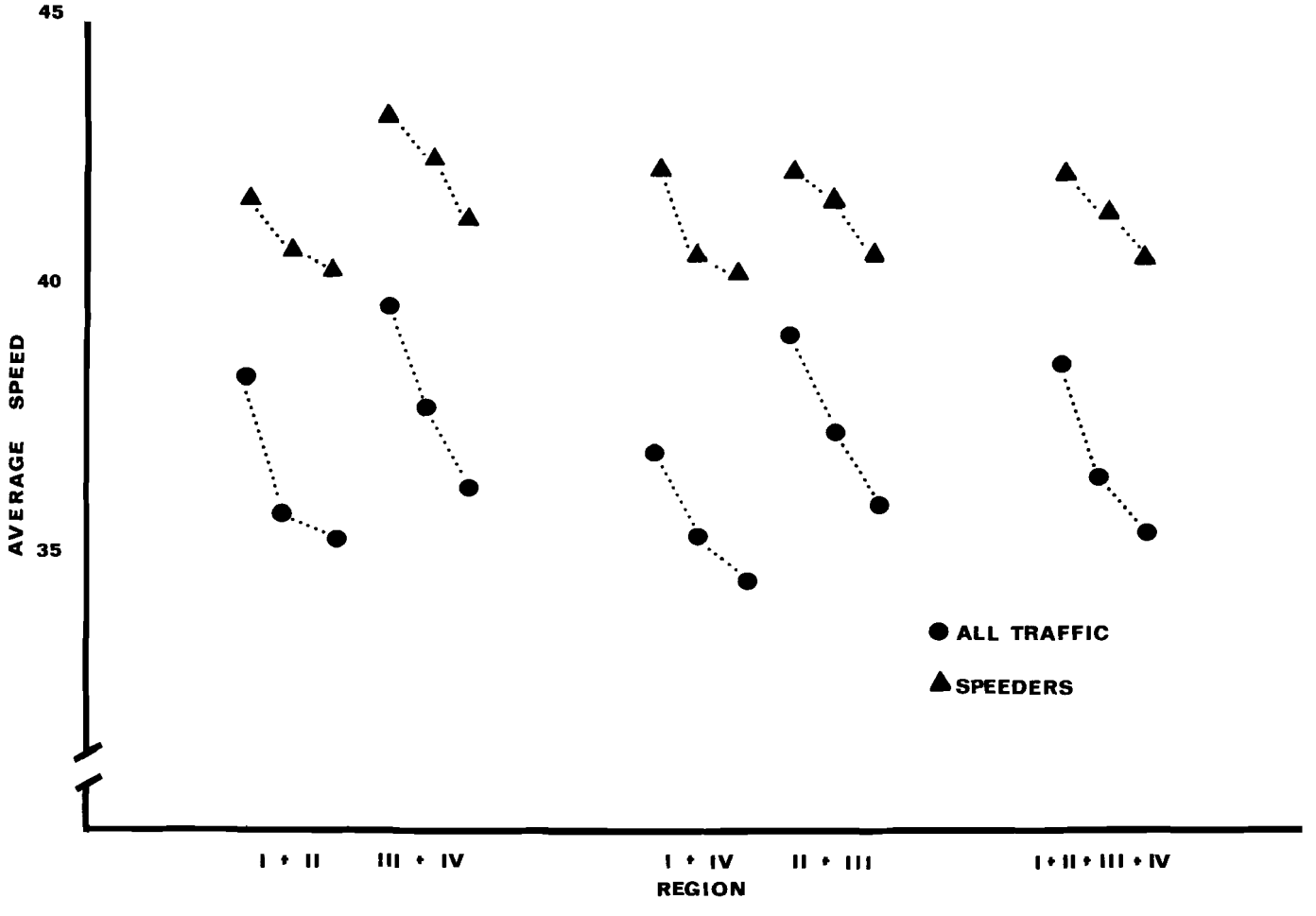

Figure 7. Average speeds (all traffic and reckless speeders) by combined regions

particularly in the small and medium populations. Lack of data prohibit making statements concerning radar and ticketing in large populations. There appears to be an overall effect of publicity in reducing the proportion of speeders in small and large populations.

Other findings include the observation that most of the sites studied had more than 50 percent speeders initially with a substantial reduction as a result of the effort being carried out. Overall the proportion of speeders decreased by 30.6 percent from .669 to .464; an even more striking decrease of 64.6 percent was observed for the proportion of reckless speeders (.034 to .012) The overall average speed for all sites decreased 8.2 percent from 38.7 mph to a slightly excessive 35.5 mph. The average speed of speeders decreased only 3.7 percent from 42.3 mph to 41.7 mph. Apparently those who still were speeding at the end of the study were not influenced as much as the population in general.

DISCUSSION AND RECOMMENDATIONS

The express purpose of this project was to evaluate speed measuring equipment used in enforcement programs designed to eliminate excessive speeding. Following the recommendations given by Council (1971), intensive efforts were made to stimulate the interest and concern of the local police agencies in order to maximize the extent to which the data were collected in a uniform and reliable manner. In addition, careful consideration was given to the study design in order to maximize the information obtained with respect to visibility of car and radar, ticketing, and publicity.

Results of the study provide convincing evidence that a statistically significant reduction in both the proportion of speeders and the average speed of traffic can be accomplished by combinations of the types of efforts carried out by the patrolmen during the course of this project. Each of the factors, car visibility, radar visibility, ticketing, and publicity, when considered alone, reflect marginal evidence of effectiveness. This is fairly consistent with results from others studies such as Crowther, Shumate and Smith (1961) who studied the effect of pneumatic road tubes on vehicle speeds, Bennett (1958) who examined the use of radar in traffic enforcement, and Fleischer (1971) who studied the effect of

public service announcements by broadcast media on safety belt usage patterns in Modesto and Salinas, California. However, when these factors are considered together, the results provide definitive evidence of positive effects due to the enforcement effort.

It should be emphasized that the results vary from site to site so that it cannot be stated that the overall findings apply to every site. Furthermore, trends are not always consistent for the different population categories. Nevertheless, the dominant trends obtain.

In spite of the reductions found, the proportion of speeders remained relatively high (.464 overall for the 35 mph sites) although the overall average speed was reduced from 38.7 mph to 35.5 mph. This final average speed may exceed the posted limit primarily due to the public presuming some leeway in speed enforcement in order to avoid frivolous arrests. Hence, the proportion of speeders (but not, the average speed) might be elevated by a large number of drivers driving just above the posted speed limit.

Also, since the daily sampling of speeds was completed in a relatively short period of time (average of 15 to 45 minutes daily), the first-hand exposure of the public to the radar operation may not have been sufficient to warrant expectations of more substantial changes in the speed patterns. By increasing the number of daily observations or merely requiring the police officer to be at the site a longer period of time, the probable lack of first-hand exposure would be reduced.

Based on the results of the study, concentrated efforts aimed at reducing excessive speeding trends seem to have at least short term merit. However, there is some indication that constant effort may result in an erosion of the effects. Hence, intensive efforts carried out in an on-again, off-again manner may be more effective than constant application of the effort. For example, repeated application of a large scale effort for a one week period, followed by a two week break and then another week of concentrated effort might be most effective. The length of the optimum cycle for this type of effort is a subject for future investigation.

Some practical by-products for the State of North Carolina derived from this project include the following:

(1) The project has provided speed-measuring devices (radar units) for many North Carolina municipalities which otherwise possibly could not have afforded them.

(2) Police officers have been trained in the correct usage of these devices.

(3) The project has engaged the cooperation of these patrolmen (as well as the neighboring news media) in the conduct of a scientific evaluation of the effectiveness of certain uses of such speed-measuring devices (with resulting splendid cooperation by these patrolmen and news media).

(4) Finally, by coordinating the evaluation, it has strengthened HSRC's capabilities in conducting future evaluations using municipal police or similar agencies.

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Crowther, Richard F., Shumate, Robert P., and Smith, R. Dean (1961). The effect of pneumatic road tubes on vehicle speeds. Traffic Safety. Chicago: National Safety Council

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Appendix A: (1) Original and (2) Follow-up
Administrative Memoranda for
Municipal Police Departments

A (1)

STATE OF NORTH CAROLINA

GOVERNOR'S OFFICE

ROBERT W. SCOTT
GOVERNOR

GOVERNOR'S HIGHWAY SAFETY PROGRAM
OFFICE OF COORDINATOR
ELBERT L. PETERS, JR.
227 E. EDENTON STREET
RALEIGH, N. C. 27601

November 4, 1970

MEMORANDUM

TO: Anytown, North Carolina

FROM: Richard H. Chadwick R.H.C.

SUBJECT: Meetings Scheduled for Recipients of Radar Speed Measuring Devices - Project Number PT 70-004 (001)

Following the requests of fifty (50) political subdivision of North Carolina for speed measuring devices, our office submitted a project to the National Highway Safety Bureau to purchase the units through the North Carolina State Purchase and Contract Division.

The project has been approved with Richard Chadwick as the Project Director. One of the requirements of the Bureau on approved projects is that the program be periodically evaluated by the State, and the National Highway Safety Bureau be provided with an evaluation summary.

In regards to the above outlined requirement, details relating thereto and other significant matters pertaining to your receiving and using the radar units, we will conduct short meetings at the following listed dates, times and places. It is most important that you or a representative who is familiar with reporting procedures be present.

December 8, 1970 - 9:30 a.m. - Greenville-Highway Patrol Troop "A" Headquarters
December 8, 1970 - 3:30 p.m. - Fayetteville - Highway Patrol Troop "B" Headquarters
December 9, 1970 - 3:00 p.m. - Hickory Police Department
December 10, 1970- 9:30 a.m. - Greensboro - Highway Patrol Troop "D" Headquarters
December 10, 1970- 3:30 p.m. - Raleigh - Highway Patrol Troop "C" Headquarters

You may attend either of the above meetings. Please return the enclosed form stating which one you will attend.

RHC/be
Enclosure

cc: Bryle Carraway, Captain R. F. Williamson, Captain R. E. Sherrill, Captain W. S. McKinney, Captain J. T. Jenkins, Colonel E. C. Guy, Mrs. Ginger Furness and Dr. B. J. Campbell

A (2)

STATE OF NORTH CAROLINA

GOVERNOR'S OFFICE

ROBERT W. SCOTT
GOVERNOR

GOVERNOR'S HIGHWAY SAFETY PROGRAM
OFFICE OF COORDINATOR
ELBERT L. PETERS, JR.
227 E. EDENTON STREET
RALEIGH, N. C. 27601

February 17, 1971

MEMORANDUM

TO: Anytown, North Carolina

FROM: Richard H. Chadwick

SUBJECT: RADAR MEETING SCHEDULE FOR FEBRUARY 24, 10:00 A.M.

Your radar unit has arrived and will be delivered to you or your representative at the Greensboro meeting to be held at the Greensboro Highway Patrol Troop D Headquarters, 10:00 a.m, Wednesday, February 24.

At a previous meeting you were furnished evaluation report forms with instructions; bring these forms with you Wednesday at which time they will be briefly reviewed.

You are strongly urged to either send or at least accompany you at this meeting the officer you plan to assign to this unit during the first 11 days evaluation period, as Mr. Ernie Hostetler in cooperation with the Department of Community Colleges will present a several hour training program on the use of the radar. Mr. Hostetler will also during this meeting arrange with you to return to your respective department to train additional men you wish to receive the radar training sponsored by the Community Colleges.

We are calling you in addition to sending you this memorandum as it will probably be several days before you receive this notice.

RHC/be

Appendix B: (1) Initial Detailed Instructions
(2) List of Material Required for
for the Evaluation

INSTRUCTIONS FOR RADAR EVALUATION
IN anytown, NORTH CAROLINA (III)

The evaluation of the effects of the recently acquired radar unit will be a three-stage procedure. Basically, each radar operator is to clock twenty-five (25) vehicles on each of eleven (11) consecutive days at the same location and approximately the same time each day. If several operators use the same unit each day of the evaluation period, they may select their own surveillance location and indicate on the data sheet why that particular location was chosen.

Remember, this evaluation is a necessary provision in the purchase and use of the radar units. The North Carolina Highway Safety Research Center in Chapel Hill is aiding you in this evaluation. If you have any questions about any of the instructions or for some reason are having trouble obtaining the data as required, call:

Donald Reinfurt, Donald Levine or Forrest Council
Highway Safety Research Center
Chapel Hill, Telephone # 933-3051 or 933-5009

STAGE I (Days 1-3): Clocking vehicle visible; radar unit concealed

1. The purpose of this stage is to determine the characteristics of the traffic flow with a police vehicle present but before the town's purchase of a radar is known. There should be no publicity about the radar unit. It is best to make no arrests. If an arrest must be made due to greatly excessive speeds, try to obtain a moving speedometer clock. In any case do not inform the violator of the presence of the radar.
2. The clocking vehicle is to be clearly visible. The radar unit though, is to be hidden as well as possible within the clocking vehicle.
3. Each operator will obtain twenty-five (25) speeds per day for three consecutive days beginning at the same time each day and at the same location.

   *IMPORTANT: Obtain speeds for the FIRST twenty-five vehicles that you can. Don't just get the first twenty-five speeders.

4. Fill out the data sheets as you are clocking the vehicles. Use one form for each day.
5. The most important information is the speed! If you get the speed but can't get some (or all) of the other information, use that data as one of the twenty-five anyway. The supplementary data on sex, race, and approximate age of driver will provide valuable information for studying the relationships of speeds with these driver characteristics.

STAGE II (Days 4-7): Clocking vehicle and radar unit completely visible

1. The purpose of this stage is to determine how the traffic flow has changed once ticketing has begun but before publicity by press, radio and TV has begun. When you ticket someone, now make sure the person knows he was timed by radar.
2. The radar unit and clocking vehicle are to be clearly visible.
3. Stage II begins immediately after Stage I, i.e., on the fourth day of the study. Each operator will obtain twenty-five speeds per day for the next four days. The observations should be made at the same time and location as in Stage I.
4. Fill out the data forms while obtaining the speeds of the vehicles.
5. Again in this stage, the speed is of utmost importance. If the speed is obtained, then use that vehicle whether or not you have the other information. Please try, though to get all the information.

STAGE III (Days 8-11): Clocking vehicle and radar unit visible.

1. The purpose of the last stage is to determine the traffic flow change once publicity has begun.
2. The radar unit and clocking vehicle are again to be clearly visible.
3. On the morning following the last day of Stage II, (i.e. on the morning of the eighth day of the study) the publicity is to begin. By way of preparation, this will involve the following:
   a. Contact your local newspaper for publicity about your

new radar. Use either the sample publicity to be provided by the Highway Safety Research Center or something written by yourself or the paper.

If your town is not served by a local newspaper, contact the nearest weekly and daily and ask for their cooperation. If your town has only a weekly, then notify the nearest daily as well as your town's weekly.

*NOTE: Since the publicity is to start on the eighth morning of the study, if you are contacting a weekly, start taking your observations seven days before the weekly publication date. For example, if the weekly publishes on a Wednesday, then, start the study on the previous Wednesday. For a daily, you need not worry about the starting date, as long as the publicity begins on the eighth day. Have the publicity continue for four days. Certain of your neighboring newspapers are being sent the same sample publicity and will be awaiting your contacting them. You need to inform them of the starting date of the publicity.

b. Ask your nearest radio and TV station to make public service spot announcements about the radar. Again the announcements should start on the eighth morning of the study and continue for four days. Certain stations will know about the publicity and expect and will need to hear from you as to when to start their announcements.

c. On the eighth day and each day following publicize the number of arrests made with the device.

Use local press and broadcasting facilities. If possible get quotes from those arrested (without names).

4. Start recording the speed of vehicles immediately after Stage II (no lapse between Stage II and III). Each operator is to obtain

twenty-five (25) readings per day for the next four days. The location and beginning time should remain the same for each operator.

5. Fill out the data forms while clocking.
6. Collect all the forms for each radar unit and mail them to the Highway Safety Research Center. Please do this as soon as possible after the 11-day period has elapsed.

List of material to be submitted to the Highway Safety Research Center by radar evaluation coordinator from Anytown, N.C.

1. Name, position, telephone number and address of radar evaluation coordinator.

2. Date on which 11-day (consecutive) study period began.

3. Data sheets (there should be at least one sheet per day per machine, i.e. at least 11 data sheets for each radar unit).

4. Were there any reasons in particular for the choosing of the times at which you took your observations?

5. Newspaper clippings (send all articles that appear in the press together with the name of the newspaper and the date).

6. The names of the radio and television stations contacted.

7. Comments, questions, problems with this study.

REMEMBER: Your cooperation is imperative in order to carry out the evaluation. In effect, you are performing the evaluation required by the federal government for projects such as these. Hopefully, this evaluation should aid you with the future use of your radar unit.

Appendix C: (1) Publicity Information for HSRC, (2) Instructions to the News Media, and (3) Sample Publicity Materials

C (1)

Information for Highway Safety Research Center
(to be filled out at orientation sessions Dec. 8 - Dec. 10)

1. City Anytown, N.C.

2. Name, address, telephone number and position (e.g. Chief of Police) of one person who can be contacted about the radar study.

   Name _____ Position _____

   Tel. # _____ Address _____

3. Does your city currently have any radar units? ____

   If so, approximately how many? _____

4. Name of the newspaper(s) most commonly read in your town?

   Daily _____

   Weekly _____, Publication day of weekly _____

5. Name of the radio and television stations most commonly listened to in your town.

   Radio _____ Television _____

C (2)

THE UNIVERSITY OF NORTH CAROLINA
HIGHWAY SAFETY RESEARCH CENTER
CHAPEL HILL 27514
(919) 933-3051

Dear Sir:

Anytown, N. C., has been selected to help us answer a question:

Is the use of radar as a speed detector effectively reducing the number of speeders?

An evaluation of radar as a speed deterrent is being conducted as part of the Governor's Highway Safety Program. In order to accomplish the objectives of the evaluation, a publicity campaign must be conducted to inform the public that radar units are being used to detect speeders within the city limits. This is where you come in.

Enclosed you will find some sample publicity. You may use it as is, rewrite it, or generate a local-angle story. How you present the information is your decision; whatever you choose to do will be appreciated.

PROPER TIMING IS MANDATORY IF THE STUDY IS TO BE SUCCESSFUL!

Chief John Doe is to notify you when he is ready for you to release the publicity. Please do nothing until he gets in touch with you. If you would like to check with him on your own and interview him for a local story, that would be fine. BUT, IN ORDER TO CONDUCT A MEANINGFUL STUDY, PLEASE RELEASE NO PUBLICITY UNTIL HE GIVES YOU A SPECIFIC 'START' DATE.

As a community leader, you may help improve highway safety by aiding us with this study. Thank you in advance for your cooperation.

Sincerely yours,

Donald W. Reinfurt

Donald W. Reinfurt, Ph.D.
Staff Associate

DWR/ehf
Enclosure

NEWS RELEASE

The Anytown (name of city) police department has added some new hush-hush equipment.

"Hush-hush," that is, up until today.

Can you guess what it is from the following clues?

The apparatus is fully transistorized and solid state with an integrated circuit and variable range control.

A radio?

Nope.

It has an automatic timer, electronic calibration and a luminous dial that can easily be read in the dark.

A jazzed up clock?

Wrong again.

Here's the final clue: It's a timing device and it works by sending out radio waves.

Yep, folks, you guessed it. RADAR.

Police Chief John Doe announced this morning that radar equipment furnished by the Governor's Highway Safety Program with a National Highway Safety Bureau grant will be put to use in (name of town) as of today.

Radar is capable of clocking any vehicle traveling between 5 mph and 120 mph that comes within 4,000 feet of the antenna.

And now that the cat is out of the bag, Chief Doe has two words of advice: "Slow down!"

The first guy who gets "Locked into" a radar scanning device may be you.

NEWS RELEASE

Radar is now being used to detect speeders within the (name of city) Anytown city limits, City Police Chief John Doe announced today.

The equipment was purchased by the Governor's Highway Safety Program with a grant from the National Highway Safety Bureau and will be used in (name of city) Anytown to crack down on heavy footed drivers.

(Name of city's) Anytown's new radar equipment is capable of clocking any car traveling between 5 mph and 120 mph that comes within 4,000 feet of the radar antenna.

This is the way radar works:

A stationary car equipped with a radar unit sends out radio waves at regular intervals.

If these waves strike a fixed object, they "bounce off" of the fixed object and return to the stationary patrol car at the same regular intervals at which they were sent out. Since the regular intervals (or frequency) of the waves are unchanged, the speed timing device registers zero miles per hour.

However, when the radio waves strike a moving object, in this case a car approaching the stationary transmitter, the waves are compressed; that is, the interval between waves becomes smaller. The faster the car is traveling, the closer the waves crowd together.

The radar receiver captures these high frequency waves and converts them into miles per hour. This means that waves striking a car traveling 60 mph bounce off twice as fast as waves striking a car moving at 30 mph.

Speeding on city streets is a big problem in North Carolina.

Excessive speed was a factor in one fifth of all urban accidents occurring in North Carolina in 1969, according to statistics released by the Governor's Highway Safety Program.

PUBLIC SERVICE SPOT ANNOUNCEMENT (30 seconds)

MORE SPEEDERS WILL FEEL THE PINCH OF THE LAW IN THE DAYS AHEAD, ACCORDING TO POLICE CHIEF John Doe.

IN FACT, Anytown (name of city) RESIDENTS HAVE BEGUN TO FEEL THE NIP OF STEEPED UP SPEED ENFORCEMENT AS OF TODAY.

CITY POLICE HAVE ACQUIRED ADDITIONAL RADAR EQUIPMENT WHICH IS BEING USED TO CRACK DOWN ON LEAD-FOOTED DRIVERS IN THE CITY'S BUSINESS AND RESIDENTIAL ZONES.

SPEEDING ON CITY STREETS IS FAR TOO COMMON THROUGHOUT THE STATE, CHIEF Doe SAID. EXCESSIVE SPEED WAS A FACTOR IN ONE FIFTH OF ALL URBAN ACCIDENTS OCCURRING IN NORTH CAROLINA IN 1969.

ACCORDING TO CHIEF Doe, THE RADAR EQUIPMENT WAS PURCHASED BY THE GOVERNOR'S HIGHWAY SAFETY PROGRAM WITH A GRANT FROM THE NATIONAL HIGHWAY SAFETY BUREAU. EACH UNIT IS VALUED AT NINE HUNDRED DOLLARS.

PUBLIC SERVICE SPOT ANNOUNCEMENT (10 seconds)

1. IF YOUR'RE TOOLING AROUND TOWN RIGHT NOW LISTENING TO ME, CHECK YOUR SPEED. (Name of city) anytown CITY POLICE HAVE NEW RADAR EQUIPMENT AND THEY PLAN TO MAKE GOOD USE OF IT. SO TAKE THIS FRIENDLY ADVICE AND SLOW DOWN.

2. RADAR EQUIPMENT IS NOW BEING USED FEVERISHLY IN (name of city) anytown TO APPREHEND SPEEDERS.
DON'T BE ONE OF THOSE "OH-THEY'LL-NEVER-CATCH-ME" KIND. IT'S BETTER TO SLOW DOWN THAN RISK A TICKET OR AN ACCIDENT. RIGHT FOLKS?

3. IF YOU'RE HUNG UP ON HOT FOOTING IT AROUND TOWN, HANG LOOSE. CITY POLICE HAVE BRAND NEW FULLY AUTOMATED RADAR EQUIPMENT. THEY SAY IT'S EASIER TO USE THAN THE OLD EQUIPMENT AND SO MUCH FUN. SO SLOW DOWN, SPEED CAN CAUSE ACCIDENTS AS WELL AS EMBARASSING TICKETS.

4. YOUR CITY POLICE OFFER THIS LITTLE REMINDER. ~~LOW~~ HIGH SPEED ACCIDENTS CAN RESULT IN COSTLY DAMAGE AND SERIOUS INJURY. IN 1969 EXCESSIVE SPEED WAS A FACTOR IN ONE FIFTH OF ALL URBAN ACCIDENTS OCCURRING IN NORTH CAROLINA. NEW RADAR EQUIPMENT IS NOW BEING OPERATED ON (name of city) anytown STREETS AS A PART OF A CITY-WIDE DRIVE TO CUT DOWN ON SPEEDING AND ACCIDENTS INVOLVING SPEED. COOPERATE. OBEY THE CITY SPEED LIMITS.

Appendix D: Sample of Publicity Material Actually Used

MAYLO HIGHLITES

C. W. Hones, Co-ordinator of Family Ministries — March 14, 1971

**** **** **** ****

RANLO

HAS

RADAR

The word has already gone out from the Ranlo Town Hall. Those christians and other citizens who drive like Jehu (II Kings 9:20) are in for real trouble. All drivers are urged to abide by the speed limits and avoid being caught by the radar unit now being used by our Police Department. Let's all cooperate and make our town a safer place in which to drive.

**** **** **** ****

Durham Morning Herald
Wednesday, March 10, 1971

Chapel Hill Drivers: 'Smile, You're On Radar'

By DENNIS BENFIELD
Herald Staff Writer

CHAPEL HILL — If you drive along West Franklin Street and if you drive in excess of the speed limit, today just may not be your day.

Or, as the comedian on the country music show would say, "Smile, you're on radar."

Today marks the second phase of an experiment in Chapel Hill by the Governor's Highway Safety Committee and the University of North Carolina Highway Safety Research Center to see if radar speed checks are an effective deterrent to speeding within city limits.

A number of Tar Heel cities, in addition to Chapel Hill, are taking part in the experiment, all operating on their own timetables but with specific instructions on tests to be conducted and data to be gathered.

"There are 27 different cities operating 50 new radar units at the present time," according to Capt. Coy E. Durham, assistant chief of the Chapel Hill Police Department. He said the radar units were provided by the Governor's Highway Safety Committee.

"Wednesday, Thursday, Friday and Saturday," Durham said Tuesday, "we'll be cracking down on speeders. We've experimented for a week; now speeders will be apprehended and given citations."

Durham has been in charge of the project which began in Chapel Hill March 3.

"Each day we set up our radar unit at the same location — a space on West Franklin Street — at the same time," he explained. "The car was not hidden, because the whole idea of this thing is to find out if radar is a deterrent to speeding inside the city limits."

At first, Durham said, speeders were not apprehended and an intensive set of records was kept instead.

"We had our man make observations of the first 25 cars that passed his unit. He kept a chart of information such as each driver's speed, sex, general age group, race and comments — like what kind of vehicle he was driving if it was not an automobile."

In addition the captain noted, the charts bore data such as weather conditions, posted speed limit in the area, visibility and time of the tests.

"Our men started at 1 o'clock every afternoon for five straight days," Durham said, "and it usually took a half hour to 40 minutes for them to observe 25 cars — not just speeders but the first 25 cars."

Durham said the West Franklin Street location was chosen "because of complaints from the public."

When completed, the captain plans to study the data collected and mail it, along with his own personal observations and recommendtions, to the Governor's Highway Safety Committee in Raleigh.

That group will survey the results, then pass the information from all 27 cities along to the Highway Safety Research Center in Chapel Hill for intensive study and detailed evaluation.

Captain Durham and Chapel Hill Police Chief William D. Blake said they may recommend that similar experiments be conducted on other streets within the city limits to determine whether posted speed limits are the most practical.

"Airport Road, to cite a hypothetical example," noted Blake, "is a relatively accident-free road, and it's four-lane now for a good distance outside Chapel Hill. But the posted speed limit is 35 miles per hour when it's obvious that people drive faster most of the time.

"You just don't have any idea what the average speed on some roads is unless you resort to some experiment like this," Blake concluded.

The town's normal policy of enforcing speed limits, Durham added, is discretionary. "It depends on the time of day, traffic and weather conditions and whether or not we've had any complaints of speeders from the residents of the area," he said.

"Time of day is especially important — if you're driving along 15-501 By-Pass (speed limit

... OR ELSE

45 m.p.h.) at 3 o'clock in the morning you're not as likely to get a speeding ticket as if it's 3 o'clock in the afternoon.

"It's just natural that you're going to drive faster when there's nothing in front of you," he said.

But today through Saturday, the Chapel Hill Police Department reminds you, the average driver, to slow down to the speed limit within the town itself — or get a long, pink slip of paper to remind you to slow down next time.

New Radar Unit Now In Operation In City

RADAR — The piece of equipment attached to the door of the patrol car ejects radio beams which when "bounced off" moving objects are translated into miles per hour readings on the control panel.

Radar is now being used to detect speeders within the Graham city limits, City Police Chief R. E. Sykes announced today.

The equipment was purchased by the Governor's Highway Safety Program with a grant from the National Highway Safety Bureau and will be used in Graham to crack down on heavy footed drivers.

Graham's new radar equipment is capable of clocking any car traveling between 5 mph and 120 mph that comes within 4,000 feet of the radar antenna in any direction.

This is the way radar works:

A stationary car equipped with a radar unit sends out radio waves at regular intervals.

If these waves strike a fixed object, they "bounce off" of the fixed object and return to the stationary patrol car at the same regular intervals at which they were sent out. Since the regular intervals (or frequency) of the waves are unchanged, the speed timing device registers zero miles per hour.

However, when the radio waves strike a moving object, in this case a car approaching the stationary transmitter, the waves are compressed; that is, the interval between waves becomes smaller. The faster the car is traveling, the closer the waves crowd together.

The radar receiver captures these high frequency waves and converts them into miles per hour. This means that waves striking a car traveling 60 mph bounce off twice as fast as waves striking a car moving at 30 mph.

Speeding on city streets is a big problem in North Carolina.

Excessive speed was a factor in one fifth of all urban accidents occurring in North Carolina in 1969, according to statistics released by the Governor's Highway Safety Program.

In connection with the safety program's evaluation of radar the city officers have completed an eleven day study in which they clocked and observed drivers, but did not stop them. The drivers in violation will now be stopped, notes Captain William Miles as the radar goes into operation officially.

Captain Miles and Sergeants B. E. Helm, Gordon Champion and R. F. Perdue recently attended a course on the operation of the equipment and will pass their training on to the other officers on the force.

The captain indicates the Graham department has had radar equipment for a number of years, but the new piece (which plugs into the cigarette lighter) is more modern and up-to-date.

The department applied for the $600 radar equipment in the latter part of 1970.

Appendix E: Follow-Up Letter

THE UNIVERSITY OF NORTH CAROLINA
HIGHWAY SAFETY RESEARCH CENTER
CHAPEL HILL 27514
919) 933-3051

April 16, 1971

Dear Chief Dor,

Mr. Richard Chadwick of the Governor's Highway Safety Program had recently forwarded to us the data which you collected. As a result of your efforts in obtaining the requested measurements, we at the Highway Safety Research Center have extensive data for analyzing the effectiveness of radar in reducing the speed of traffic.

As soon as we receive the data from the remaining towns, we will start our evaluation. Suggestions for the most efficient use of the radar will be based on this evaluation.

You may wish to run some newspaper, radio, and television publicity before you receive our comments. In anticipation of this, we have enclosed some sample publicity which can be used.

If you have any questions or remarks before you receive our comments, please call us. We want to take this opportunity to thank you for your cooperation.

Sincerely yours,

Donald W. Reinfurt

:bto
Enclosure

Appendix F: Supplementary Tables

Table A1. Proportion of group speeding (35 mph posted speed limit) by site within city

Region	City	Site	Proportion of Group Speeding: Days 1-3	Days 5-7	Days 9-11	X^2 (DF=2)	p
I	Lenior	1	0.427	0.227	0.373	7.15	0.0280
	Hickory	2	0.868	0.733	0.787	4.32	0.1153
	Hudson	4	0.427	0.240	0.227	8.97	0.0113
	Morganton	5	0.747	0.440	0.240	39.17	0.0000
	Marion	6	0.320	0.107	0.280	10.71	0.0047
	Spindale	7	0.320	0.467	0.413	3.44	0.1791
		8	0.613	0.387	0.613	10.33	0.0057
		9	0.640	0.613	0.693	1.09	0.5798
	Hazelwood	10	0.773	0.267	0.227	57.10	0.0000
	Fairmont	11	0.453	0.160	0.147	23.83	0.0000
II	High Point	12	0.520	0.373	0.507	3.96	0.1381
		13	0.800	0.640	0.480	16.67	0.0002
		14	0.653	0.373	0.240	27.36	0.0000
		15	0.520	0.320	0.333	7.88	0.0194
	Randleman	16	0.840	0.440	0.573	26.35	0.0000
	Mebane	17	0.880	0.707	0.453	31.74	0.0000
	Durham	18	0.680	0.413	0.360	17.65	0.0002
		19	0.667	0.227	0.733	45.80	0.0000
	Lowell	20	0.573	0.573	0.560	0.04	0.9802
		21	0.613	0.507	0.640	3.08	0.2144
	Reidsville	23	0.693	0.680	0.640	0.52	0.7710
	Stoneville	25	0.653	0.453	0.520	6.27	0.0435
	Mt. Airy	26	0.733	0.587	0.680	3.72	0.1557
	Raleigh	27	0.880	0.493	0.187	72.54	0.0000
		32	0.800	0.707	0.187	66.64	0.0000
		35	0.733	0.573	0.427	14.47	0.0007
		36	0.600	0.707	0.440	11.12	0.0038
	Garner	37	0.929	0.973	0.613	41.89	0.0000
	Ellerbe	38	0.520	0.307	0.160	22.27	0.0000
		39	0.600	0.747	0.453	13.44	0.0012
III	Smithfield	40	1.000	1.000	1.000	0.00	1.0000
	Magnolia	42	0.587	0.707	0.600	2.79	0.2478
	Ranlo	43	0.893	0.813	0.653	13.35	0.0013
	Zebulon	44	0.773	0.720	0.560	8.56	0.0138
		45	0.947	0.907	0.867	2.84	0.2417
	Clayton	47	0.480	0.187	0.173	22.35	0.0000
	Ramseur	48	0.333	0.280	0.280	0.68	0.7118
IV	Hope Mills	49	1.000	0.773	0.827	18.23	0.0001
	Maxton	50	0.853	1.000	0.787	16.92	0.0002
	Hamlet	51	0.613	0.413	0.307	14.72	0.0006
	Elizabethtown	52	0.613	0.427	0.333	12.28	0.0022
	Tabor City	53	0.560	0.227	0.067	46.69	0.0000
	Raeford	54	0.640	0.493	0.297	17.64	0.0002
V	Wilson	56	0.627	0.480	0.427	6.44	0.0400
	Bethel	57	0.600	0.507	0.547	1.33	0.5143
	Washington	58	0.293	0.200	0.333	3.52	0.1720
	Aulander	59	0.733	0.507	0.280	30.83	0.0000
	Princeville	60	0.400	0.493	0.733	17.87	0.0001
	Murfreesboro	61	0.413	0.507	0.473	1.35	0.5092
	Plymouth	62	0.667	0.693	0.440	12.11	0.0024

Table A2. Proportion of group speeding (speed limit other than 35 mph) by site within city

				Proportion of Group Speeding				
Region	City	Site	Speed Limit	Days 1-3	Days 5-7	Days 9-11	X^2 (DF=2)	p
I	Belmont	3	45	0.473	0.440	0.467	0.18	0.9139
II	Reidsville	22	30	0.840	0.840	0.680	7.63	0.0220
	Burlington	24	45	0.293	0.093	0.013	27.00	0.0000
	Raleigh	30	25	0.827	0.427	0.307	44.55	0.0000
		33	25	0.893	0.920	0.760	9.03	0.0109
		28	45	0.720	0.480	0.200	40.82	0.0000
		31	45	0.867	0.747	0.280	61.89	0.0000
		34	45	0.827	0.533	0.053	91.76	0.0000
		29	60	0.800	0.493	0.200	54.01	0.0000
III	Chapel Hill	41	20	0.880	0.960	0.987	8.49	0.0143
	Zebulon	46	45	0.547	0.453	0.320	7.90	0.0192
IV	Lawndale	55	20	0.973	0.960	0.920	2.49	0.2879
V	Havelock	63	40	0.573	0.520	0.413	3.98	0.1367

Table A3. Proportion of group speeding recklessly (35 mph posted speed limit) by site within city

Region	City	Site	Proportion of Group Speeding by 15 mph or More: Days 1-3	Days 5-7	Days 9-11	X^2 (DF=2)	p
I	Lenoir	1	0.013	0.000	0.013	1.01	0.6035
	Hickory	2	0.026	0.013	0.000	2.00	0.3679
	Hudson	4	0.000	0.000	0.000	0.00	1.0000
	Morganton	5	0.013	0.000	0.013	1.01	0.6035
	Marion	6	0.000	0.000	0.000	0.00	1.0000
	Spindale	7	0.000	0.013	0.000	2.01	0.3660
		8	0.013	0.000	0.027	2.03	0.3624
		9	0.067	0.053	0.067	0.15	0.9277
	Hazelwood	10	0.053	0.013	0.000	5.32	0.0700
	Fairmont	11	0.000	0.000	0.000	0.00	1.0000
II	High Point	12	0.000	0.000	0.000	0.00	1.0000
		13	0.000	0.000	0.000	0.00	1.0000
		14	0.000	0.000	0.000	0.00	1.0000
		15	0.000	0.000	0.000	0.00	1.0000
	Randleman	16	0.000	0.000	0.027	4.04	0.1327
	Mebane	17	0.107	0.040	0.013	6.87	0.0322
	Durham	18	0.013	0.000	0.000	2.01	0.3660
		19	0.013	0.000	0.000	2.01	0.3660
	Lowell	20	0.013	0.013	0.000	1.01	0.6035
		21	0.040	0.013	0.000	3.56	0.1686
	Reidsville	23	0.013	0.000	0.000	2.01	0.3660
	Stoneville	25	0.040	0.000	0.027	2.86	0.2393
	Mt. Airy	26	0.013	0.013	0.000	1.01	0.6035
	Raleigh	27	0.000	0.000	0.000	0.00	1.0000
		32	0.013	0.000	0.000	2.01	0.3660
		35	0.013	0.000	0.000	2.01	0.3660
		36	0.013	0.013	0.000	0.98	0.6126
	Garner	37	0.286	0.267	0.053	15.38	0.0005
	Ellerbe	38	0.013	0.000	0.000	2.01	0.3660
		39	0.013	0.000	0.027	2.03	0.3624
III	Smithfield	40	0.040	0.093	0.040	2.61	0.2712
	Magnolia	42	0.067	0.040	0.080	1.07	0.5857
	Ranlo	43	0.013	0.027	0.040	1.03	0.5975
	Zebulon	44	0.120	0.147	0.040	5.04	0.0805
		45	0.187	0.080	0.013	13.55	0.0011
	Clayton	47	0.027	0.000	0.000	4.04	0.1327
	Ramseur	48	0.000	0.000	0.000	0.00	1.0000
IV	Hope Mills	49	0.133	0.013	0.013	14.26	0.0008
	Maxton	50	0.013	0.013	0.000	1.01	0.6035
	Hamlet	51	0.000	0.000	0.000	0.00	1.0000
	Elizabethtown	52	0.067	0.027	0.013	3.37	0.1854
	Tabor City	53	0.013	0.000	0.000	2.01	0.3660
	Raeford	54	0.000	0.000	0.014	2.04	0.3606
V	Wilson	56	0.000	0.000	0.000	0.00	1.0000
	Bethel	57	0.013	0.053	0.080	3.63	0.1628
	Washington	58	0.000	0.000	0.000	0.00	1.0000
	Aulander	59	0.147	0.000	0.000	23.13	0.0000
	Princeville	60	0.040	0.013	0.067	2.78	0.2491
	Murfreesboro	61	0.013	0.000	0.000	2.00	0.3679
	Plymouth	62	0.080	0.000	0.000	12.33	0.0021

Table A4. Proportion of group speeding recklessly (speed limit other than 35 mph) by site within city

Proportion of Group Speeding by 15mph or More								
Region	City	Site	Speed Limit	Days 1-3	Days 5-7	Days 9-11	X^2 (DF=2)	p
I	Belmont	3	45	0.000	0.000	0.000	0.00	1.0000
II	Reidsville	22	30	0.067	0.027	0.013	3.37	0.1854
	Burlington	24	45	0.000	0.000	0.000	0.00	1.0000
	Raleigh	30	25	0.000	0.000	0.000	0.00	1.0000
		33	25	0.040	0.000	0.000	6.08	0.0478
		28	45	0.000	0.000	0.000	0.00	1.0000
		31	45	0.027	0.013	0.000	2.03	0.3624
		34	45	0.013	0.000	0.000	2.01	0.3660
		29	60	0.000	0.000	0.000	0.00	1.0000
III	Chapel Hill	41	20	0.027	0.000	0.013	2.03	0.3624
	Zebulon	46	45	0.013	0.000	0.000	2.01	0.3660
IV	Lawndale	55	20	0.347	0.053	0.067	31.33	0.0000
V	Havelock	63	40	0.000	0.000	0.000	0.00	1.0000

Table A5. Average speeds (35 mph posted speed limit) by site within city

			Average of Group									
Region	City	Site	Days 1-3	Days 5-7	Days 9-11	Days 5-7 and 9-11 Pooled	s_p	F_1 (DF=2,222)	p_1	F_2 (DF=1,223)	p_2
I	Lenoir	1	35.3	33.7	34.3	34.0	4.7	2.15	0.1189	3.75	0.0541
	Hickory	2	40.9	39.3	38.5	38.9	4.2	6.44	0.0019	11.60	0.0008
	Hudson	4	34.9	32.5	33.1	32.8	5.1	4.67	0.0103	8.93	0.0031
	Morganton	5	38.8	34.7	33.0	33.8	6.5	15.41	0.0000	28.39	0.0000
	Marion	6	34.4	32.2	34.7	33.5	3.8	9.10	0.0002	3.03	0.0831
	Spindale	7	33.0	35.7	35.0	35.4	6.5	3.64	0.0278	6.77	0.0099
		8	38.1	34.2	34.5	35.8	4.8	14.11	0.0000	9.91	0.0019
		9	39.4	38.5	39.6	39.0	7.2	0.43	0.6511	0.10	0.7521
	Hazelwood	10	40.2	31.8	30.7	31.3	6.6	44.95	0.0000	88.81	0.0000
	Fairmont	11	35.7	32.0	32.4	32.2	5.2	11.08	0.0000	22.00	0.0000
II	High Point	12	36.5	34.3	35.7	35.0	4.3	4.94	0.0080	5.75	0.0 73
		13	39.4	37.0	36.3	36.7	4.1	11.19	0.0000	21.29	0.0000
		14	37.0	34.2	33.6	33.9	4.7	10.82	0.0000	21.14	0.0000
		15	35.6	33.6	34.2	33.9	4.5	4.11	0.0177	7.51	0.0066
	Randleman	16	40.2	34.1	37.1	35.6	5.8	20.08	0.0000	29.61	0.0000
	Mebane	17	43.2	39.1	36.6	37.9	5.8	23.60	0.0000	39.74	0.0000
	Durham	18	37.4	34.9	34.0	34.5	4.8	9.54	0.0001	17.92	0.0000
		19	37.6	32.9	38.5	35.7	4.7	30.15	0.0000	6.78	0.0098
	Lowell	20	36.7	36.2	36.5	36.3	5.5	0.20	0.8189	0.29	0.5908
		21	37.1	36.8	37.7	37.2	6.7	0.38	0.6843	0.02	0.8877
	Reidsville	23	38.5	38.8	37.6	38.2	5.0	1.21	0.3002	0.20	0.6552
	Stoneville	25	39.1	35.4	36.0	35.7	5.8	8.64	0.0002	16.92	0.0001
	Mt. Airy	26	39.7	37.1	38.0	37.6	5.3	4.40	0.0134	7.72	0.0059
	Raleigh	27	42.5	36.9	30.7	33.8	4.6	118.70	0.0000	133.32	0.0000
		32	40.8	38.3	32.3	35.3	4.6	67.68	0.0000	55.23	0.0000
		35	39.6	37.0	34.9	36.0	4.5	19.63	0.0000	30.16	0.0000
		36	38.4	38.6	35.0	36.8	5.2	11.19	0.0000	4.15	0.0428
	Garner	37	46.9	48.9	40.3	44.6	6.9	31.28	0.0000	4.06	0.0451
	Ellerbe	38	34.0	31.0	29.1	30.0	8.6	6.20	0.0024	10.51	0.0041
		39	37.5	37.6	35.1	36.4	6.0	4.03	0.0191	1.56	0.2130
III	Smithfield	40	43.6	44.6	43.0	43.8	4.1	2.98	0.0528	0.07	0.7916
	Magnolia	42	38.2	39.1	38.2	38.6	7.9	0.30	0.7411	0.15	0.6989
	Ranlo	43	41.8	40.3	38.4	39.4	5.7	6.60	0.0016	8.60	0.0037
	Zebulon	44	41.4	42.7	37.1	39.9	8.1	9.69	0.0001	1.66	0.1989
		45	45.2	42.7	39.9	41.3	5.0	20.35	0.0000	28.35	0.0000
	Clayton	47	35.0	30.3	30.4	30.3	7.3	9.85	0.0001	19.77	0.0000
	Ramseur	48	34.8	33.5	35.3	34.4	4.4	3.09	0.0475	0.26	0.6106
IV	Hope Mills	49	46.6	40.6	40.5	40.6	5.3	32.35	0.0000	64.97	0.0000
	Maxton	50	39.0	39.5	37.5	38.5	4.1	4.33	0.0143	0.65	0.4210
	Hamlet	51	38.1	35.7	33.1	34.4	5.9	13.16	0.0000	19.03	0.0000
	Elizabethtown	52	38.8	36.2	34.0	35.1	7.1	8.59	0.0003	13.34	0.0003
	Tabor City	53	36.6	32.1	29.7	30.9	7.2	17.11	0.0000	29.99	0.0000
	Raeford	54	37.9	36.1	32.9	34.5	6.1	12.66	0.0000	14.44	0.0002
V	Wilson	56	37.5	36.2	35.1	35.6	5.2	4.02	0.0193	6.30	0.0128
	Bethel	57	37.1	37.2	37.3	37.3	8.1	0.02	0.9802	0.02	0.8877
	Washington	58	32.5	32.3	33.6	33.0	5.5	1.14	0.3217	0.36	0.5491
	Aulander	59	41.8	36.4	33.8	35.1	6.1	33.40	0.0000	58.58	0.0000
	Princeville	60	36.5	35.4	38.8	37.1	10.7	1.97	0.1419	0.18	0.6718
	Murfreesboro	61	33.9	35.3	34.7	35.0	5.9	1.06	0.3482	1.73	0.1898
	Plymouth	62	39.0	37.4	35.2	36.3	5.5	8.75	0.0002	11.29	0.0009

Table A6. Average speeds (speed limit other than 35 mph) by site within city

Average of Group												
Region	City	Site	Speed Limit	Days 1-3	Days 5-7	Days 9-11	Days 5-7 and 9-11 Pooled	sp	F_1 (DF=2,222)	P_1	F_2 (DF=1,223)	P_2
I	Belmont	3	45	44.2	43.7	44.0	43.9	8.8	0.05	0.9512	0.05	0.9512
II	Reidsville	22	30	36.6	35.7	33.9	34.8	5.6	4.46	0.0126	4.87	0.0085
	Burlington	24	45	41.0	37.6	35.3	36.5	6.0	17.00	0.0000	27.98	0.0000
	Raleigh	30	25	30.2	25.9	23.4	24.7	4.1	51.16	0.0000	84.16	0.0000
		33	25	31.9	31.8	29.0	30.4	4.0	12.80	0.0000	6.52	0.0018
		28	45	49.7	46.5	41.9	44.2	4.9	46.47	0.0000	53.76	0.0000
		31	45	51.3	49.4	42.9	46.1	5.1	56.50	0.0000	40.43	0.0000
		34	45	51.1	48.0	39.5	43.8	5.0	103.49	0.0000	70.43	0.0000
		29	60	65.6	62.4	55.1	58.8	5.5	71.18	0.0000	59.54	0.0000
III	Chapel Hill	41	20	26.6	28.7	28.9	28.8	4.2	7.04	0.0011	13.10	0.0000
	Zebulon	46	45	47.1	45.6	43.2	44.4	6.5	7.09	0.0010	8.61	0.0003
IV	Lawndale	55	20	33.5	27.3	26.7	27.0	5.7	31.60	0.0000	62.83	0.0000
V	Havelock	63	40	42.4	41.7	39.6	40.7	6.0	4.27	0.0152	3.82	0.0234

Table A7. Average speed of speeders (35 mph posted speed limit) by site within city

Region	City	Site	Average of Speeders: Days 1-3	Days 5-7	Days 9-11	Days 5-7 and 9-11 Pooled	s_p	n	F_1 (DF=2,n-3)	P_1	F_2 (DF=1,n-2)	P_2
I	Lenoir	1	40.2	38.2	39.3	38.8	3.4	77	1.90	0.1570	2.75	0.1016
	Hickory	2	42.1	41.2	39.6	40.4	3.4	180	8.73	0.0002	10.67	0.0013
	Hudson	4	39.7	39.5	40.2	39.8	3.5	67	0.20	0.8192	0.03	0.8630
	Morganton	5	41.2	38.6	41.4	39.6	6.5	107	1.90	0.1547	1.61	0.2073
	Marion	6	39.6	38.1	39.2	38.9	2.1	53	1.33	0.2737	1.28	0.2632
	Spindale	7	40.2	41.6	41.1	41.4	4.2	90	0.80	0.4526	1.43	0.2350
		8	41.3	38.2	40.3	39.5	3.4	121	6.93	0.0014	7.27	0.0080
		9	43.6	42.5	42.8	42.7	5.9	146	0.44	0.6449	0.83	0.3638
	Hazelwood	10	43.1	39.3	38.8	39.1	4.8	95	7.91	0.0007	15.89	0.0001
	Fairmont	11	40.7	40.2	40.1	40.1	3.4	57	0.17	0.8441	0.35	0.5565
II	High Point	12	39.9	38.8	39.1	39.0	2.8	105	1.55	0.2172	2.83	0.0956
		13	40.7	39.4	39.8	39.6	3.0	144	2.83	0.0624	5.18	0.0243
		14	39.4	39.7	39.4	39.6	3.0	95	0.09	0.9140	0.12	0.7298
		15	39.4	38.3	38.4	38.4	2.9	88	1.16	0.3184	2.32	0.1314
	Randleman	16	41.6	40.0	41.4	40.8	3.7	139	2.06	0.1314	1.55	0.2153
	Mebane	17	44.5	41.6	41.4	41.5	4.9	153	7.12	0.0011	14.28	0.0002
	Durham	18	39.9	39.7	39.3	39.5	2.9	109	0.38	0.6848	0.47	0.4945
		19	40.2	38.5	41.0	40.4	3.0	122	4.56	0.0124	0.11	0.7407
	Lowell	20	40.5	40.4	40.0	40.2	3.2	128	0.21	0.8109	0.19	0.6637
		21	42.3	41.9	40.8	41.2	4.1	132	1.69	0.1886	1.84	0.1773
	Reidsville	23	41.3	41.2	40.3	40.8	3.6	151	1.31	0.2729	0.78	0.3786
	Stoneville	25	42.8	39.9	40.2	40.1	4.1	122	6.37	0.0024	12.78	0.0005
	Mt. Airy	26	41.9	40.7	40.8	40.7	3.7	150	1.81	0.1673	3.64	0.0583
	Raleigh	27	43.7	41.2	37.2	40.1	2.8	117	31.93	0.0000	37.89	0.0000
		32	42.8	40.6	38.1	40.1	3.0	127	15.86	0.0000	23.01	0.0000
		35	41.6	40.0	39.3	39.7	2.8	130	7.78	0.0007	14.04	0.0003
		36	42.3	40.8	38.6	39.9	3.8	134	8.79	0.0003	10.93	0.0012
	Garner	37	47.8	49.3	44.9	47.6	6.0	184	7.55	0.0007	0.08	0.7776
	Ellerbe	38	42.1	39.6	38.6	49.3	3.3	74	6.96	0.0017	13.24	0.0005
		39	41.3	40.0	41.0	40.4	3.8	135	1.66	0.1941	1.71	0.1932
III	Smithfield	40	43.6	44.6	43.0	43.8	4.1	225	2.98	0.0528	0.07	0.7916
	Magnolia	42	42.7	41.7	44.0	42.7	6.3	142	1.47	0.2335	0.00	1.0000
	Ranlo	43	43.0	42.6	41.6	42.1	4.0	177	1.79	0.1700	1.79	0.1827
	Zebulon	44	44.5	46.7	42.1	44.7	6.0	154	6.88	0.0014	0.04	0.8418
		45	45.8	43.5	40.8	42.2	4.6	204	19.62	0.0000	26.58	0.0000
	Clayton	47	41.5	41.3	40.0	40.7	4.0	63	0.69	0.5055	0.64	0.4268
	Ramseur	48	39.4	39.1	39.0	39.0	3.2	67	0.11	0.8960	0.20	0.6562
IV	Hope Mills	49	46.6	43.1	41.9	42.5	4.3	195	22.00	0.0000	40.95	0.0000
	Maxton	50	40.3	39.5	39.2	39.4	3.2	198	1.84	0.1616	3.47	0.0640
	Hamlet	51	41.7	40.8	40.9	40.9	3.5	100	0.76	0.4704	1.50	0.2236
	Elizabethtown	52	44.4	42.2	39.3	40.9	1.6	103	8.06	0.0006	11.07	0.0012
	Tabor City	53	42.1	41.6	37.6	40.7	4.0	64	2.74	0.0725	1.60	0.2106
	Raeford	54	41.8	41.0	40.0	40.6	3.8	107	1.61	0.2048	2.42	0.1228
V	Wilson	56	41.4	39.9	39.5	39.7	3.0	115	4.19	0.0176	8.12	0.0052
	Bethel	57	41.3	43.4	44.7	44.1	4.8	124	5.55	0.0049	9.64	0.0024
	Washington	58	40.9	40.2	37.9	38.8	3.2	62	5.42	0.0069	5.68	0.0203
	Aulander	59	45.1	40.7	39.8	40.4	4.9	114	13.52	0.0000	26.69	0.0000
	Princeville	60	47.2	41.4	42.7	42.2	9.7	122	3.29	0.0407	6.17	0.0144
	Murfreesboro	61	40.8	39.5	38.4	39.0	3.6	104	3.67	0.0289	5.68	0.0190
	Plymouth	62	42.3	39.6	40.1	39.8	4.1	135	5.81	0.0038	11.41	0.0010

Table A8. Average speed of speeders (speed limit other than 35 mph) by site within city

Average of Speeders													
Region	City	Site	Speed Limit	Days 1-3	Days 5-7	Days 9-11	Days 5-7 and 9-11 Pooled	s_p	n	F_1 (DF=2,n-3)	p_1	F_2 (DF=1,n-2)	p_2
I	Belmont	3	45	52.5	51.5	51.6	51.6	3.0	103	1.14	0.3217	2.28	0.1047
II	Reidsville	22	30	38.1	37.2	36.9	37.1	4.5	177	1.07	0.3448	2.00	0.1378
	Burlington	24	45	49.7	47.7	46.0	47.5	2.4	30	5.24	0.0119	4.80	0.0091
	Raleigh	30	25	31.6	29.6	28.2	29.0	2.6	117	15.29	0.0000	26.23	0.0000
		33	25	32.8	32.4	30.7	31.6	3.2	193	7.29	0.0009	5.56	0.0044
		28	45	51.9	51.2	48.8	50.5	2.9	105	6.37	0.0020	5.27	0.0058
		31	45	52.8	51.4	48.9	50.7	3.2	142	11.37	0.0000	13.56	0.0000
		34	45	52.8	52.3	48.8	52.0	3.1	106	3.08	0.0479	1.53	0.2188
		29	60	67.5	66.6	64.2	65.9	3.0	112	6.81	0.0014	6.90	0.0012
III	Chapel Hill	41	20	27.8	29.1	29.1	29.1	3.5	212	2.62	0.0751	5.27	0.0058
	Zebulon	46	45	52.6	50.6	50.3	50.4	3.6	99	4.34	0.0142	8.68	0.0002
IV	Lawndale	55	20	33.9	27.6	27.3	27.5	17.3	214	33.11	0.0000	66.32	0.0000
V	Havelock	63	40	47.2	46.9	44.2	45.7	3.3	113	8.05	0.0004	5.05	0.0072