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Social Status and Aggression: A Field Study Analyzed by Survival Analysis

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ABSTRACT. A field experiment was conducted in Germany to explore whether driver characteristics and the social status of cars are related to an aggressive response. Drivers waiting at a traffic light ($N = 57$) were blocked by an experimental car. The amount of time that elapsed until the drivers responded by honking their horns or beaming their headlights was recorded, and bivariate and multivariate methods of survival analysis were used to analyze the data. The status of the blocked cars was positively correlated with the tendency toward an aggressive response.

THE EFFECT OF THE SOCIAL STATUS of a frustrator on the tendency to elicit aggressive behavior was investigated by Doob and Gross (1968). These researchers timed the interval between the blocking by an experimental car of drivers waiting at a traffic light and the drivers' horn-honking response. The results of the Doob and Gross study, which were replicated by Bochner (1971), demonstrated that the status of the frustrator was inversely related to the timing of an aggressive response.

In the present experiment, we explored the effect of the social status of a frustrated person on the tendency to react in an aggressive manner. Thus, unlike Doob and Gross (1968), who varied the status of the experimental car, we varied the status of the blocked car.[1] Because social status has been positively correlat-

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ed with behavior that is more self-assertive and less deferential in cases of conflicting interests (e.g., Wright, 1994), we expected that drivers of high-status cars would exhibit more aggressive behavior than drivers of low-status cars. Another possibility—contrary to the higher status–higher aggression hypothesis—was that individuals who lacked authority might compensate by behaving more aggressively; in this case the correlation between car status and aggressive behavior would be negative.

The horn-honking experiment provides a means of discriminating empirically between these two contradictory hypotheses. Social status is measured by type of car, and degree of aggression can be operationalized as the latency period between blocking by the experimental car and the blocked driver's response (honking the horn or beaming the headlights). The blocked driver's sex and estimated age group, the age and color of the blocked car, and the presence/absence of passenger(s) in the blocked car were also noted by the experimenters. We assumed that (a) degree of aggression would vary negatively with the age of the driver and the age of the car, (b) women would react less aggressively than men, and (c) there would be fewer aggressive responses on weekends than on weekdays, when traffic is heavier. Also, in accordance with the psychology of color, we expected that a red car might indicate a higher propensity for aggression. These characteristics can be included as control variables in a multivariate analysis of response times.

The dependent variable in many psychology studies is reaction time, that is, the amount of time that elapses until a certain event occurs. The use of survival-analysis statistical techniques is appropriate in such studies, especially in those that involve "censored" data or competing risks (a time interval may be completed by more than one type of event). Our secondary goal in the present study was to demonstrate that survival-analysis methodology can be useful in socio-psychological field experiments.

Method

The present experiment was conducted at a busy intersection near the center of Munich, West Germany, on 2 afternoons (Sunday and Monday) in 1986. Traffic was heavy on both days. In contrast to Doob and Gross (1968), we did not vary the type of car that was used by the frustrator; the blocking car was always a Volkswagen Jetta, rated lower middle class by the German automobile association (ADAC). The status of the blocked car was one of the independent variables. The driver of the experimental car did not accelerate after the traffic light turned green. The experimenter, a passenger in the blocking car, timed the latency period between the blocking and the blocked driver's reaction and noted the type of reaction (horn

[1]We did not know about the Doob–Gross study until after we had already conducted the present experiment and had presented selected results; we thank Anatol Rapoport, who made us aware of the Doob–Gross study.

honking or beaming), the type of the blocked car, the sex of the blocked driver and his or her estimated age (one of three age groups), the estimated age of the car, the color of the car, and the presence/absence of passenger(s) in the blocked car.

Speed of response (in seconds) was considered as an indicator of the degree of aggressive behavior. Each blocked car was classified in one of six categories ranging from small cars to luxury cars, according to ratings by the German automobile association. A total of 60 blocking incidents were observed, but three vans were excluded from the data analysis, resulting in 57 trials.

The quasi-experimental design does not randomize between categories of the independent variables. However, a multivariate analysis of response times, with covariates (i.e., possibly correlated disturbing variables), can be used to help validate results. There is one difficulty, however. Often, a response does not occur during the observation period, so these censored data merely provide information about how much time passes without a response. The results of estimates of censored data with conventional statistical techniques such as analysis of variance or ordinary least square regression will be biased, whereas estimates obtained with survival-analysis techniques will be asymptotically efficient and unbiased (Kalbfleisch & Prentice, 1980; Tuma & Hannan, 1984). Survival-analysis techniques are advantageous even when used in sociopsychological experiments that do not involve censored response times. For example, response times are not usually normally distributed but are often skewed to the right. In this case, parametric or semiparametric survival models may yield a better fit to the data and more reliable test statistics. The following analysis is based on these techniques.

In our application, the so-called survival function describes the probability of nonresponse until time t. With exact response times (i.e., data are not grouped by time intervals, as in a demographic life table) these probabilities are estimated using the nonparametric Kaplan–Meier technique, accounting for censored data. Survival functions can be estimated separately by categories of the independent variable (status of blocked car, sex of driver, etc.), and there are tests of significance for differences in the survival curves. Note that conventional tests such as tests for differences in means or medians are not applicable when censored response times are involved.

Multivariate analysis is based on a semiparametric model (Cox-regression) and parametric models of survival analysis. Similar to a regression model, a parametric function is specified describing the effects of independent variables on response probabilities. Even if censored data are included, the effect parameters can be estimated by the maximum likelihood method.

Results and Discussion

The first part of the analysis was focused on the responses of the frustrated drivers. A response was observed for 56 blocked cars (42 horn honking, 14 beaming). One car changed lanes without responding, and the time until lane changing began was treated as a censored response time. As long as no distinction is made between different types of responses, censoring will not cause a serious bias.

The mean response time was 4.2 s, and the median (calculated from the Kaplan–Meier estimation of the survival function, including censored data) was 3.2 s. The location of the mean to the right of the median indicates a right-skewed distribution, which is very common for waiting-time data.

The mean and median response times, by status of car, are reported in Table 1. The mean and median response times decreased monotonically with the status of the car, except when the blocked car was very small. This pattern is even more noticeable when the two lowest and highest classes are collapsed.

Tests of significance for differences between survival curves (i.e., estimated proportions of nonresponses dependent on response time) yielded highly significant results (see Table 1). Estimated survival functions of response time, by class of car, are displayed in Figure 1. This pattern clearly supports the status–aggression hypothesis. The possibility that the exception of lower class cars points to a compensation effect would be somewhat speculative in light of the small number of cars in this category.

There was no evidence for a significant sex difference in response time, although the women tended to be slightly less aggressive than the men (*Mdn* =

TABLE 1
Mean Response Time in Seconds, by Class of Car

Rating		Five-class scheme			Three-class scheme		
		M^a	Mdn^b	n_i	M^a	Mdn^b	n_i
Lower class	1	3.9	3.6	6	4.9	4.1	27
Lower middle class	2	5.2	4.1	21			
Middle class	3	4.3	3.0	20	4.3	3.0	20
Upper middle class	4	2.6	2.5	6	2.4	2.5	10
Upper class	5	2.0	1.4	4			
Total		4.2	3.2	57	4.2	3.2	57
Significance p							
Log-rank test		.14[c]	.000		.05[c]	.000	
Generalized Wilcoxon test			.000			.000	

Note. n_i = number of cases in class category i.
[a]Time until lane changing, for censored case. [b]Linear interpolation from Kaplan–Meier estimation of survival function. [c]Analysis of variance, *F* test.

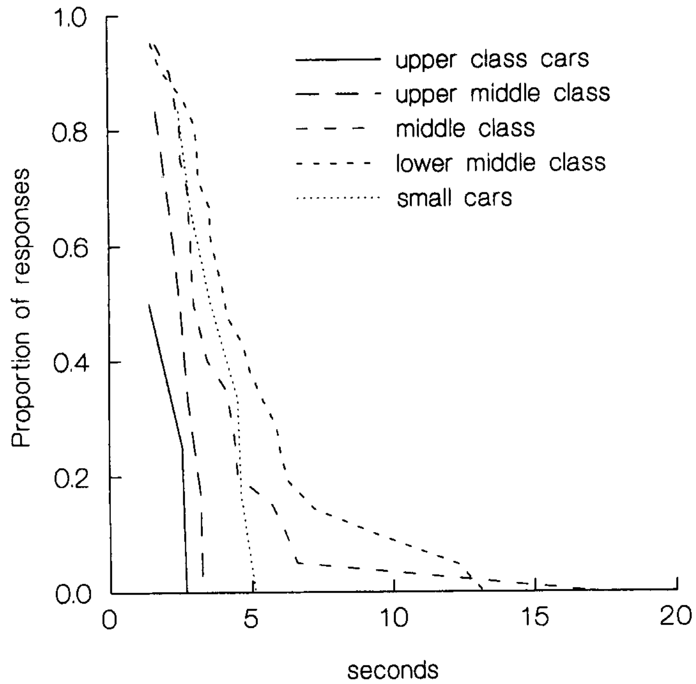

FIGURE 1. Estimated survival functions of response time, by class of car.

3.6 s vs. 3.2 s, respectively). Moreover, there were no significant differences for age of car, red cars, presence/absence of passenger(s), or day of the week. The response times for the drivers in the older group seemed to be longer than those for the drivers in the young and middle-age groups, however (*Mdn* = 4.5 s, 3.2 s, and 3.1 s, respectively). One of the two test statistics, the log-rank test, was significant for alpha = .05. Aside from the status effect, only driver's age contributed significantly to the explanation of response times.

It is conceivable that the latency period until horn honking might be a better indicator of degree of aggression. In this case, response time until beaming would be treated as additional censored data. Estimation of this competing-risks model did not yield very different results, however (see Table 2). Sex differences disappeared completely, and response times for drivers of new cars seemed to be slightly less than those for drivers of old cars. Again, the effect of car status was highly significant.

For multivariate analysis, a "hazard rate-equation," with car class and other covariates as "controls," was estimated. In this study, the hazard rate was the rate of response $r(t)$, that is, approximately the conditional probability of a response

TABLE 2
Horn-Honking Response Time (in Seconds), by Class of Car and Other Characteristics

			Significance	
Characteristic	*Mdn*	n_i	Log-rank test	Generalized Wilcoxon test
Class of car			.000	.001
Lower and middle	4.5	27		
Middle	3.4	20		
Upper middle and upper	2.5	10		
Sex of driver			.944	.990
Female	3.6	8		
Male	3.6	49		
Age group of driver			.063	.114
Young	3.5	22		
Middle aged	3.2	27		
Older	5.4	8		
Age of car			.051	.101
New	3.0	19		
Old	4.2	30		
Color			.885	.983
Red	3.6	12		
Other	3.6	45		
Passenger			.958	.915
No	4.0	30		
Yes	3.5	27		
Day			.750	.936
Sunday	3.6	28		
Monday	3.8	29		
Total	3.6	57		

Note. Beaming headlights or changing lanes was treated as censored data (15 cases). n_i = number of cases in category i.

in the next time interval (1 s) if there was no previous response. $r(t)$ may be dependent on duration t and covariates β_i. The Cox-regression model (Kalbfleisch & Prentice, 1980), with unspecified duration dependence, allows for various forms of duration dependence:

$$r(t) = h_0(t) \exp(\beta_1 x_1 + \beta_2 + x_2 + \ldots + \beta_m x_m).$$

The β-coefficients were estimated by the partial likelihood method, taking into account censored data when appropriate. If driver response is defined as horn honking or beaming, there is no serious censoring problem. In this case, ordinary least square regression (OLS) of (log)-response time was also applicable. Note, however, that in OLS the signs of the coefficients were the opposite of what they were in the Cox-regression and other hazard-rate equations because, by definition, a positive effect for response rate (speed of response) corresponds to a negative effect for response time.

In addition to Cox-regression, we estimated different parametric survival models with various forms of duration dependence. With the exception of the exponential model, which assumes (not very realistically) a time-constant response rate, the sign and significance of the estimates were rather robust concerning the choice of a particular model. We used the exponential, Weibull, Weibull-heterogeneity, and log-logistic models. The LIMDEP econometric software package (Greene, 1995) was used to compute the maximum likelihood estimation of β parameters. Finally, a Cox-regression model was estimated, with response defined as horn honking, and headlight beaming and lane changing treated as censored data

The estimated coefficients and some additional statistics are reported in Table 3. Class of car and age of driver had a significant effect on response rate. The β_i coefficients were negative for the lower class and middle-class cars and positive for the drivers in the younger age groups. None of the other covariates had a significant influence on response rate.

The positive correlation between social status and aggressive tendencies can also be confirmed by multivariate analysis. The present results extend those of the

TABLE 3
Multivariate Analysis of Response Time

Variable	Cox-regression (1)	Ordinary least square regression	Cox-regression (2)
Car rating			
Lower and lower middle class	−1.86*	.71*	−1.67*
Middle class	−1.75*	.57*	−1.55*
Female	−.47	.15	−.31
Young driver	1.20*	−.49	1.27*
New car	−.07	.09	.25
Red color	.02	−.11	.14
Constants			
β_0	—	1.13*	—
p	—	—	—
v	—	—	—
χ^2 ($df = 6$)	21.28	18.99	16.26
Predicted median	3.34	—	3.80

Note. Reference group: class 3 (upper middle class and upper class), male, eldest group of driver, old car, color other than red. Cox-regression (1), OLS: Response = honking and beaming, $n = 54$, 1 censored. Cox-regression (2): Response = honking, $n = 54$, 15 censored.
$*p = .05$.

field experiment conducted by Doob and Gross (1968) in the United States as well as those of Bochner's (1971) replication, conducted in Australia. These researchers varied the status of the experimental car and found that the social status of a frustrator inhibits an aggressive response. It appears that higher social status not only inhibits others' aggressive tendencies but also intensifies one's own.

The findings of the Doob–Gross study and the present study are not generalizable; neither Doob and Gross's results nor our results were replicated in a Swiss experiment (Jann, Suhner, & Marioni, 1995). Jann et al. observed a tendency that, although not significant, demonstrated a slight reduction in aggression in cases when the frustrator and the aggressor were of the same status (low–low or high–high), compared with cases that involved frustrators and aggressors of unequal status. Thus, cultural differences, too, may play a role in aggression.

REFERENCES

Bochner, S. (1971). Inhibition of horn-sounding as a function of frustrator's status and sex: An Australian replication and extension of Doob and Gross (1968). *Australian Journal of Psychology, 6,* 194–199.

Doob, A. N., & Gross, A. E. (1968). Status of frustrator as an inhibitor of horn-honking responses. *The Journal of Social Psychology, 76,* 213–218.

Greene, W. H. (1995). LIMDEP version 7.0 (econometric software). Bellport, NY: Econometric Software, Inc.

Jann, B., Suhner, S., & Marioni, R. (1995). *Sozialer Status und "Hupzeiten." Ergebnisse aus einem Feldexperiment* [Social status and horn-honking responses. Results from a field experiment]. University of Berne: Mimeo.

Kalbfleisch, J., & Prentice R. (1980). *The statistical analysis of failure time data.* New York: Wiley.

Tuma, N., & Hannan, M. (1984). *Social dynamics.* San Diego: Academic Press.

Wright, R. (1994). *Moral animal. Why we are the way we are: The new science of evolutionary psychology.* New York: Vintage Books.

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