Interaction Analysis as a Tool for Evaluating On-Road Driver Instruction

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One of the persistent difficulties encountered in attempts to improve driver eduction courses has been the lack of a reliable measure of on-road instruction. Accurate description of what actually occurs in the car during training would permit evaluation of a number of aspects of on-road instruction, such as various instructional approaches, the relative effectiveness of teachers with different types of students, student progress through the course, and the role played by student observers. Interaction analysis, which has been used for many years in research studies of instructional processes in the classroom, holds some promise for analysis of this type of instruction.

Although many interaction systems have been devised as research instruments (92 were cited by Simon and Boyer, 1), most are not suitable for large-scale evaluation efforts. The system for the analysis of classroom communication (SACC), an instrument developed as a tool for evaluation of classroom teaching in a large-scale field project (2), was readily adapted for coding one-to-one instruction in the car. The details of the coding procedure can be found in the final report of the California Driver Training Evaluation Study (3). Briefly, there are five major categories of teacher behavior, five major categories of student behavior, and two major categories that refer to the non-task-oriented behavior of anyone in the car. The categories refer to verbal and physical behaviors and feeling tones. There are several gradations in each category, and each behavior is codable into one unique and meaningful category. This technique was used in observing 2500 high-school driver trainees at all stages of learning chosen at random from approximately 15 000 students involved in a controlled study of driver education (2).

The training of the coders is a vital step in building a reliable instrument. Our coders did not have, and should not have had, a background in driver education. They did, however, have to be intelligent and diligent. They were trained in 2 weeks on a half-time basis. In our study, the coder sat in the right rear seat, where he or she soon became inconspicuous to both driver and instructor. In this experiment, there were six coders. The interobserver agreement ranged from 68 to 91 percent for all tests, usually from 80 to 89 percent. The mere statistics do not tell the whole story; disagreements occurred largely in the intensive dimension, i.e., degrees of positive reinforcement, generality of information, and the like. Since this judgment depends to some extent on context and intonation, it is somewhat difficult to standardize. In many of the statistical analyses reported below, judgments were collapsed across the several subgroups of a behavioral category, which had the effect of increasing the reliability further.

In the analysis of the behavioral categories, not only were the individual cells of the matrix analyzed but also some categories were collapsed to create 14 composite categories, e.g., Teacher Positive Affect (all levels), Teacher Control (all types), Noise (all sources), and Total Teacher Talk. Not only were these composite categories more reliably coded, they were also more interesting pedagogically.

The picture of the driving instructor that emerged from the analysis was not very different from that of the classroom teacher (4, 5, 6). The general findings from 100 years of observing teacher behavior in the classroom are that (a) teachers do 80 percent of the talking; (b) students ask very few questions, and those they do ask usually concern the mechanics of the classroom; (c) the kind and level of teacher affect are important; and (d) a teacher's style is extremely difficult to change. One might suppose that teachers of perceptual-motor skills, in a one-to-one relationship, would behave differently and that the students, now engaged in a task that presumably interests them, with individual attention, would also behave quite differently.

This does not appear to be the case. The greatest amount of teacher behavior occurred in Total Teacher Talk, which had a mean of 5.92 statements per minute and a maximum of 36.21 statements per minute! On the other hand, Total Student Talk was only 0.69 statements per minute and consisted largely of specific questions about the task. Since students did not ask

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clarifying questions, the teacher was not aware of misunderstandings. Practicing of a particular skill (defined as several maneuvers of the same sort in sequence, e.g., passing one car, then trying it again and again) was very infrequent in our sample, both for simple skills like backing (Skill Practice 1, 0.08 per minute) and for more complex maneuvers like overtaking and passing (Skill Practice 2, 0.09 per minute). Yet to develop competence in psychomotor skills of even the simplest sort, a great deal of practice is necessary.

One of the more interesting categories was Noise. This refers to events that are not task related and that are clearly distracting to the driver. Noise occurred on the average of 0.81 times per minute, but in one case it occurred 13.27 times per minute (these were discrete events, some of them lasting an appreciable time). It is hard to see how a student could learn much or perform well under such circumstances. Noise 5 (non-task-directed distraction by the teacher) occurred on an average of 0.24 times per minute, although one teacher produced distractions at the rate of 4.09 times a minute. An important improvement in the instruction could be made by taking steps to reduce distraction, including unnecessary talk by the teacher even when it is task related, since there is good evidence that any talk distracts attention from the task and attention is particularly important in the early stages of learning.

The student observers also distracted the driver. Task-related interactions between teacher and student observer occurred at mean rates of 0.12 and 0.11 per minute. There was thus not much involvement on the part of student observers, and it is appropriate to question whether the practice of requiring long hours of observation (often 18 hours) is justifiable. The unoccupied observers contributed significantly to the sheer noise and distraction and were often observed to be studying, sleeping, or commenting on social events. On the other hand, if they were to be more involved in relevant tasks, those tasks would have to be so designed that they would not add to distraction of the driver; i.e., they should not involve questions and answers between teacher and observers.

In comparisons of different types of instructional programs, a number of statistically significant differences were found. There were significant differences in teaching techniques between instructors at public high schools and instructors from commercial driving schools. Public-school instructors talked more, tolerated more noise (distraction) in the car, gave less practice in elementary skills, and received fewer student questions. There was also less positive affect (feeling tone) in the public-school program ($p < 0.001$). These differences should be examined in greater depth to discover whether they are related to student learning, as we hypothesized.

In comparisons of public-school programs using simulators (3 hours of in-car instruction and 12 hours of instruction in the simulator) with those having only in-car instruction (6 hours), significant differences were found in the amount of control exercised by the instructor. The simulator-trained students were subject to more physical control ($p < 0.006$), understandably, since these students have less experience in actual control of the car. The two sorts of programs, although they are often said to be equivalent, are clearly not behaviorally equivalent in the eyes of instructors. The important pedagogical question is whether the highly controlled student learns as much as one who has more freedom. Again, this is a question that can and should be answered experimentally.

It was hypothesized that the tight control restricts the development of important perceptual skills. The data provided clear evidence that instructors treat male and female students differently. Females were subject to more Specific Commands (Control 1), more Physical Control, and more Total Control ($p < 0.001$) in all cases. They received significantly more correctional remarks (Teacher Negative Affect 1 and Total Teacher Negative Affect) but also more Total Teacher Positive Affect. In spite of all this, there was no difference in skill practice, although it would seem females should require more because they enter with less vehicular experience and were rated by their instructors as less skillful. This appears to indicate that lessons were not usually tailored to students' needs even in one-to-one instruction.

A similar conclusion was derived from some limited data on the effect of socioeconomic level. Neither Teacher Negative Affect (largely informational feedback as to errors) nor Total Control showed any difference across socioeconomic levels. In view of the fact that students of low socioeconomic levels had less vehicular experience, lower scores on performance and rating scales, and lower scores on the state's road test, one would expect both more control and more correction of errors. These students should also have received more practice in both simple and complex skills, but they did not.

There was some evidence, however, that teaching techniques were moderately flexible. For all programs except the shortest (3 hours in the car plus 12 hours in the simulator), there was more Total Teacher Talk at the beginning and less toward the end of training. The same thing occurred in Total Control: All programs except the short simulator program had more control early and less late in training and all the differences were highly significant ($p < 0.0001$ or better). However, for the short simulator programs, early and late training were not different. These programs (only 3 hours in the car) were clearly different from all the others in the way the student was handled by instructors. This was borne out by data on Teacher Negative Affect 1 (corrections for information purposes), in which these programs showed no change over time, whereas all other programs did. These data provided strong evidence that the standard simulator program (12 hours plus 3 in-car hours) is not equivalent to 6 hours in the car—nor to still longer programs.

All programs but these short simulator programs tended to have a greater concentration of skill practice in the early training hours. This consisted largely of practice in simple skills. There was very little practice of complex skills in any program at any time. This, too, was a finding of some significance, since psychological research universally shows the necessity for great amounts of practice for mastery of both simple and complex skills. It points to a need for revision of in-car training and enlistment of parents in providing greatly expanded opportunities for the time-consuming practice of skills.

Interaction analysis is a feasible method for obtaining objective data descriptive of the on-road training phase of driver instruction. It yields highly significant differences among programs and students in a number of different behavioral categories. The data are descriptive of instructional strategies, distractions, use of observer's time, student involvement, and changing strategies as the student progresses through the course. The data presented here show that educational prescriptions for the on-road curriculum could be devised and their effectiveness assessed objectively.

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