

PROGRAMMING TIME OF VELOCITY, ARM, AND DIRECTION

by

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Dedicated to my parents Jose and Otilia Fortuna,
for their guidance, moral support, and love.

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CHAPTER I

INTRODUCTION

How are motor programs constructed? In an attempt to answer this question several motor control theorists have attempted to define the components (hereafter called response parameters) that may be contained in a motor program. Response parameters that are frequently identified are arm, movement direction, movement extent, and movement velocity. The basic plan of attack has been to manipulate these parameters within a reaction time framework and observe whether the presence or absence of these parameters affects the time to initiate a specified response, reaction time being an estimate of the time to program these response parameters.

Recently, however, there has been some debate as to whether such an approach can actually provide any insight into the construction of a motor program. Rosenbaum (1980) developed, what he called, the selective feature model of motor programming. The basic tenant of this model is that response parameters can be programmed independently and separately from other parameters that may also be contained

in the motor program. For example, in support of this model Rosenbaum found that reaction time for programming arm was greater than reaction time for programming direction, and reaction time for programming direction was greater than reaction time for programming extent.

In opposition to this selective feature model, Goodman and Kelso (1980) contend that the programming of movement is "not the outcome of parameterizations dispersed in time, but rather may be centrally or peripherally manipulated as a holistic structure" (pg 493). This position is based on the inability to find differences in the programming time among arm, direction, and extent. Consequently, they maintain that a movement can not be decomposed into its component parameters. Moreover, individual movement parameters can not be individually manipulated in a way that provides meaningful insight into the nature of the construction process.

The present study was a further attempt to determine which of these two views, selective feature or holistic, best describes the operations underlying the construction of a motor program. The starting point for this experiment was conducted by Larish (Note 1, Note 2) and McCracken (1979). Larish (Note 1) also manipulated the response parameters of arm, direction, and extent and found

that the reaction time to program direction was longer than the reaction time to program either extent or arm, but that these latter two programming times were equivalent. It is clear that these findings failed to replicate either Rosenbaum (1980) or Goodman and Kelso (1980). Nevertheless, they support the basic spirit of the selective feature model: response parameters have different programming times.

Mc Cracken (1979) was interested in the programming relationships among velocity, direction, and extent. He reported that the reaction time for programming velocity was the longest, programming extent shorter, and programming direction was the shortest. Given the differences in programming times among these parameters, these results support the selective feature model. Perhaps the most interesting result surfacing from this experiment was the programming order between direction and extent. Recall, Rosenbaum (1980) and Larish (Note 1) found that the time to program direction was longer than the time to program extent, whereas, Mc Cracken found the order to be reversed. How might one account for such a finding? The reason may be related to the constraints placed on movement speed. Rosenbaum and Larish instructed their subjects to "move as fast as you can", therefore, there were no specific movement time constraints for subjects to follow. In contrast, Mc Cracken

manipulated velocity by requiring subjects to execute movements of different extents within specified movement time ranges. Consequently, when one has to move at specified velocities the extent of movement becomes a more critical component than direction. That is, velocity can not be fully defined without first knowing the extent of movement. Again, it should be emphasized that such an interpretation is consistent with the selective feature model because one parameter (velocity) is affecting the programming relationship of two other parameters (direction and extent).

Larish (Note 2) attempted to replicate the results reported by Mc Cracken (1979), but rather than finding the reaction time for programming extent longer than the reaction time for programming direction, no difference in programming time was found. At first glance this lack of difference between extent and direction is supportive of the Goodman and Kelso (1980) position, however, there is at least one other possible explanation, which is compatible with Mc Cracken's position. When compared to the results from Larish (Note 1), where the programming of direction took longer than the programming of extent, we see that the introduction of velocity as a parameter eliminated this difference. While direction remains to be a dominant parameter, with velocity now a variable the importance of movement

extent has been increased to the same level of direction, and hence the equivalent reaction times.

Assuming this is an accurate description of these events, there are several other predictions that follow, and it is the intent of this study to examine one such prediction. The above explanation is without doubt post hoc and it is necessary to devise an independent assessment for evaluating its validity. The present experiment was designed to provide such an assessment by examining the programming relationships of velocity, arm, and direction; special interest focused on the programming order between arm and direction. Recall that in Larish (Note 1) the time to program direction was longer than the time to program arm. By combining these two parameters with velocity, extent is no longer an uncertain parameter (there is only one movement extent), hence, velocity should not affect the previously observed programming order between direction and extent: Direction should still have a longer programming time than arm.

Statement of Problem

The purpose of this study was to investigate the programming time of velocity, arm, and direction. The main hypothesis was on the relationship between arm and direction. Based on Larish's studies (Larish Note 1, Note 2),

one could expect to find reaction time for velocity greater than reaction time for direction, and reaction time for direction greater than reaction time for arm.

Definition of Terms

Reaction time is the elapsed time between the presentation of stimulus and the release of a reaction-time key.

Movement time is the elapsed time between the release of a reaction-time key and the striking of a target key.

Motor program is "a set of muscle commands that are structured before a movement begins, and that allows the entire sequence to be carried out uninfluenced by peripheral feedback" (Keele, 1968).

Pre-program refers to the ability to construct a motor program prior to the onset of a reaction stimulus.

Programming refers to the operations involved in constructing a motor program after a stimulus response has been presented (Klapp, 1977b).

CHAPTER II

REVIEW OF RELATED LITERATURE

In recent years, one of the principal objectives of response programming research has been to illuminate the characteristics of motor program construction. To this end, Rosenbaum (1980) introduced a modification of the partial advance information paradigm (Leonard, 1958)--the movement precuing technique--as another tool for examining the motoric decisions accompanying the construction process. In a typical precuing experiment subjects execute rapid, aimed movements that vary on a number of movement parameters, such as limb, movement duration, movement direction, and movement extent. Prior to the onset of a reaction stimulus, advance information, referred to as a precue, is provided about the characteristics of the forthcoming movement. More accurately, precues are designed to convey either total, partial, or no knowledge about the intended movement, and herein lies the utility of this technique. By simply including all possible precue combinations, insight can be gained into the independent and interactive roles each of the movement parameters has in motor program construction, the principal

assumptions being that one can pre-program the parameters specified in the advance information, response latency primarily reflects the programming time of any parameter(s) remaining unspecified prior to the reaction stimulus, and programming time will be a direct function of the response parameter(s) included in the task.

Consider a situation in which movements of one limb can be made to the left or right and to one of two targets that vary in extent. In this instance there are two movement parameters, direction and extent, thus four responses are possible. With such an experimental arrangement several aspects of response programming can potentially be studied. For the purposes of the present study, two specific operations were of interest: 1) pre-programming and 2) programming. Pre-programming refers to the ability to construct a motor program prior to the onset of a reaction stimulus. Further, once constructed, the appropriate response commands are held in a short-term memory response output buffer awaiting release to the specified musculature (Klapp, 1977b, 1980). For pre-programming to occur one simply has to be given advance information about the intended response. For example, if informed that a response in the right direction to the near target will be required, the motor program to execute this move can be fully constructed

prior to the presentation of its associated reaction signal. Programming refers to the operations involved in constructing a motor program after a stimulus response has been presented (Klapp, 1977b). For instance, if the direction and extent of an impending movement are unknown, neither parameter can be pre-programmed with any degree of certainty. Instead, it is only after the reaction signal is presented that the uncertainty can be resolved and the appropriate parameters programmed.

Rosenbaum (1980) manipulated three movement parameters. These were: arm (left or right), direction (forward or backward), and extent (near or distant). Thus, eight distinct movements (see Figure 1) and eight distinct precue conditions were possible. Precued movement characteristics were presented via letters; for instance "L" meant left arm, "F" meant forward direction, and "D" meant distant extent. Typical precue conditions (see Table 1) indicated the intended arm, direction, and extent (3 precues); the intended arm or direction or extent (1 precue); or no prior knowledge about the intended movement (0 precues). The reaction stimuli chosen were colors, i. e. one color was assigned to signal one of the eight possible movements. For example, the color red could have designated a movement with the left arm, in the forward direction, to the near extent.

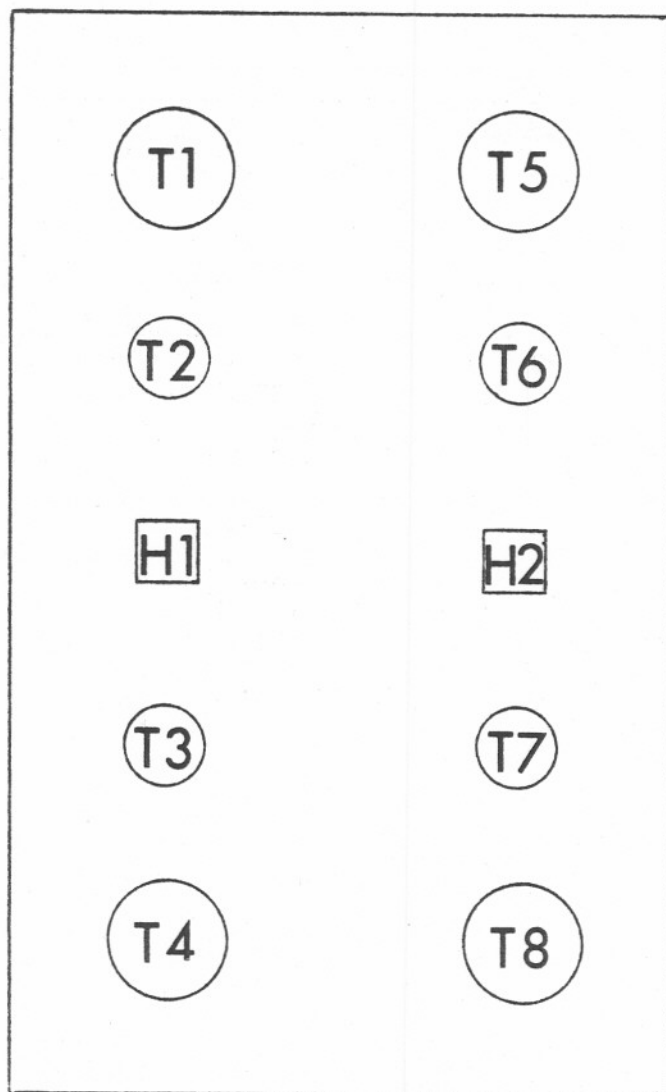


Figure 1: Response panel

Table 1

Precue-movement Combinations in
Arm, Direction, and Extent
Experiment

Precue	Movement	Program
LFD	LFD	NONE
*FD	LFD	ARM (A)
L*D	LFD	DIRECTION (D)
LF*	LFD	EXTENT (E)
**D	LFD	A & D
F	LFD	A & E
L**	LFD	D & E
***	LFD	A, D, & E

L= left, D= distant, F= forward, *= no precue information

Analysis of the data revealed a general increase in reaction time as the number of movement parameters remaining to be programmed increased. The elevation in reaction time as a function of the number of alternatives was identified by Hick in 1952 and by Hyman in 1953. For the purposes of programming, interest focused on the precue conditions that only allowed partial pre-programming; the

two and one precue conditions. In the former, only one parameter remained unspecified prior to movement initiation and reaction time was viewed as the time to program this parameter. The results showed that programming time was longest for arm, shorter for direction, and shortest for extent. In the latter, two parameters remained unspecified prior to movement initiation, thus reaction time reflected the time to program a combination of parameters. The data revealed that programming time was longest for arm and direction, shorter for arm and extent, and shortest for direction and extent. On the basis of further analyses, these parameters appeared to be programmed serially and independently from one another, and there was no strict programming order associated with these parameters. In other words, one parameter was programmed at a time, but the programming was not bound by a specific order in which the parameters were specified.

Rosenbaum's precuing technique has been criticized by some researchers (Goodman and Kelso, 1980; Larish, 1980) because the stimulus-response mapping used was highly incompatible. Recall, he used colors as reaction signals. This choice forced subjects to perform a translation process before they could program the desired response parameters. More specifically, subjects had to make a color code-to-position code translation (e.g. red meant

left-forward-distant) before the movement itself could be programmed. Therefore one is unable to determine if Rosenbaum's results are a function of the translation process or the programming process.

Goodman and Kelso (1980), and Larish (1980) were interested in resolving this issue and did so by contrasting the programming of arm, direction, and extent using stimulus-response mapping that required a translation or that were compatible. The spatially compatible mapping used by Goodman and Kelso is presented in Figure 2. By using a direct mapping, the translation component is no longer a major contributing factor in the task, thus, the actual programming relationships among the parameters can be assessed with greater reliability than if a less compatible mapping was used.

In the translation condition, Goodman and Kelso (1980) did indeed replicate Rosenbaum's findings, but in their compatible condition the results were altogether different. No difference was found among the programming of arm, programming of direction, and programming of extent. Likewise, the programming of arm and direction, arm and extent, and direction and extent were all equivalent. These results led Goodman and Kelso to argue against the selective feature model. What conclusions can we make from

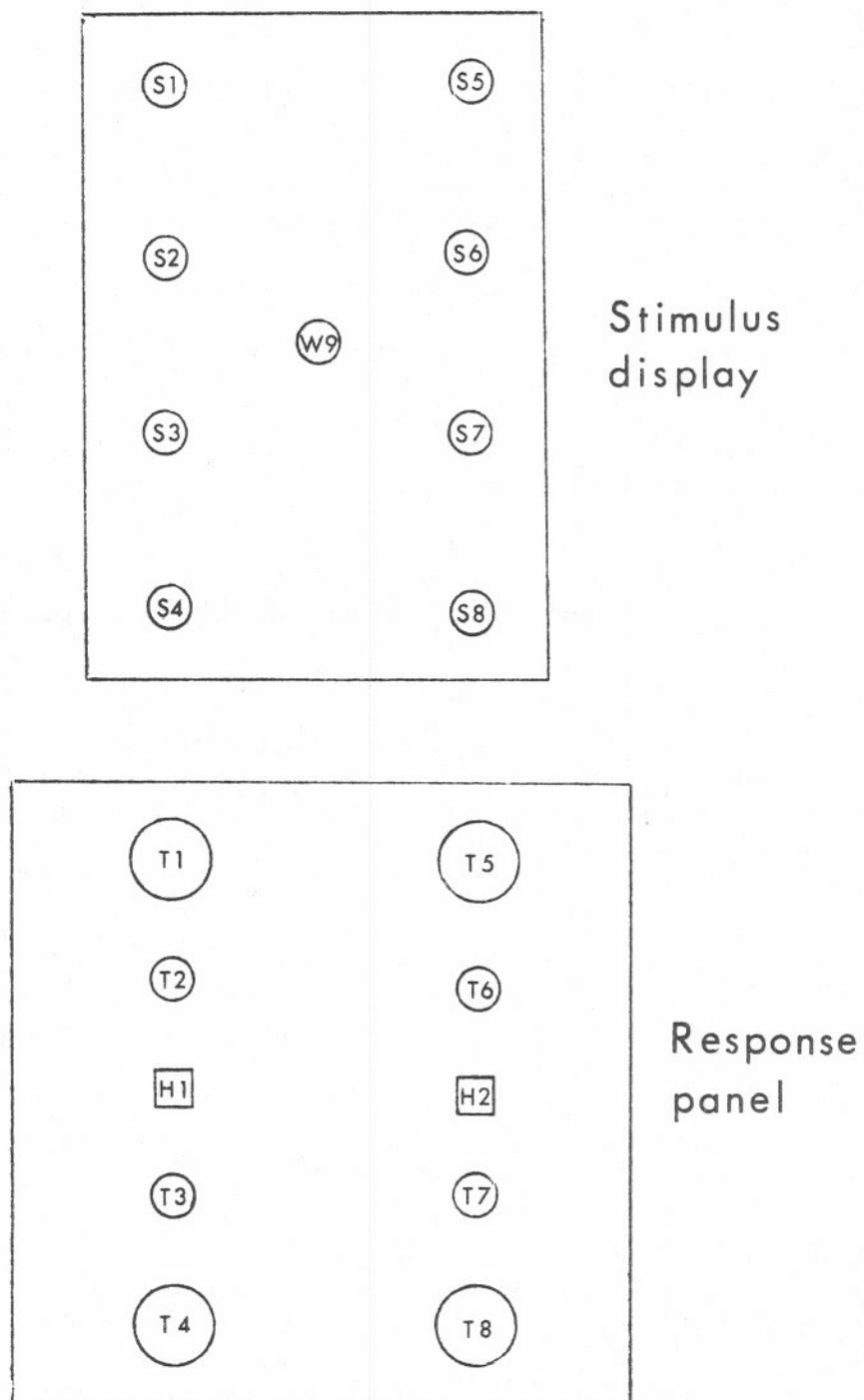


Figure 2: Compatible stimulus-response ensemble for arm, direction, and extent

the above results? One can conclude that it makes no difference to manipulate movement parameters such as arm, direction, extent, and velocity because they are not programmed separately, but rather as a unit.

The motor program concept has been studied based on two main models: The holistic model and the selective feature model. The holistic model states that movement parameters are programmed together as a unit, and it means that there is no difference in reaction time among the parameters. This model basically infers that one is unable to manipulate movement parameters because they are not programmed separately. So manipulations of movement parameters do not affect motor program. On the other hand in the selective feature model, which supports the idea that movement parameters are programmed separately, by manipulating movement parameters the role that each one plays in a motor program can be seen. Are there any data that support these models?

Recently in an experiment that was done in the Motor Behavior Laboratory at the University of Iowa, Larish (Note 1) manipulated the movement parameters of arm, direction, and extent. Larish's results showed that programming time for direction was greater than programming time for extent, and programming time for extent was equivalent to

programming time for arm. Programming time for arm and direction was equivalent to programming time for direction and extent, and that both were greater than programming time for arm and extent. Although these results failed to replicate either Rosenbaum (1980) or Goodman and Kelso (1980), they do support the selective feature model since differences in programming were found; differences that were consistent across the program one and program two parameter conditions.

Mc Cracken (1979) provided confirming evidence for the utility of the selective feature model. In a somewhat different experimental task, but using the precuing technique, Mc Cracken examined the programming characteristics of movement duration (150 msec, + or - 30% and 400 msec, + or - 30%), extent (near and far), and direction (left and right). Subjects' task was to move throughout one of the designed movement durations and strike one of four movement barriers situated in the frontal plane. Precues were given verbally and two colored lights (red and green), mounted at the base of each barrier, served as "go" signals. The desired movement duration was cued by one of the colored lights (e.g. red = 150 msec and green = 400 msec), and extent and direction information was directly discernible once the reaction stimulus was illuminated. Thus, an experimental

situation was created in which two parameters (direction and extent) were highly compatible, but the third (deviation) definitely required a stimulus-response translation.

As expected, the number of parameters remaining to be programmed had a significant effect on overall RT. As before, however, the data of most interest were the partial pre-programming conditions. Within the program one parameter conditions a differential RT effect was found, where program duration was longest, program extent was shorter, and program direction was shortest. As for the program two parameter conditions, the programming of direction and extent was the fastest, and the programming of duration and extent, and the programming of duration and direction were slower, but equivalent to each other.

When compared to Rosenbaum (1980), at least two major differences are apparent. First, Rosenbaum reported that programming time for direction was longer than programming time for extent, whereas, Mc Cracken (1979) reported a longer latency for programming extent. Second, Rosenbaum found that the hierarchical effect in the program one parameter conditions also held in the program two parameter conditions. That is, the time to program arm and direction was longest, program arm and extent was shorter, and program direction and extent was shortest. In contrast, the same

pattern was not evident in Mc Cracken's study. The time to program duration and extent was equivalent to the time to program duration and direction.

Mc Cracken (1979) argued that the reversal between extent and direction had to be interpreted in light of their importance in defining movement duration. More specifically, before duration can be fully programmed, it is necessary to have some knowledge about movement extent. In contrast, direction information provides little additional knowledge that will facilitate the programming of duration. Hence, extent maintains a more important relationship with duration than does direction, and when extent is unknown prior to response initiation a longer RT latency will result.

There are however several methodological differences between Mc Cracken's (1979) experiment and the previously cited precuing experiments. Mc Cracken allowed subjects to use visually guided movements, whereas, Goodman and Kelso (1980), Larish (1980; Note 1), and Rosenbaum (1980) did not allow subjects to see the target buttons. It is unclear what effects visual input would have on the programming of the parameters. The manipulation of movement direction was quite different. Mc Cracken had a 45 degree discrepancy from one direction to another, but the other

studies had a 180 degree discrepancy from one direction to another. As one can see in Goodman and Kelso (1980), Larish (1980; Note 2), and Rosenbaum (1980) subjects had to use the agonist and antagonist muscle group relationship, because they had to move in an opposite direction, and one might argue that this could make the programming time of direction more difficult. Another difference was the accuracy requirements of the task. Mc Cracken used targets where terminal accuracy was not a real requirement, but the other studies used relatively small target keys and required subjects to terminate their movements on these keys. It is not known what effect these differences in accuracy requirements might have on the findings that were reported by Mc Cracken.

Larish (Note 2) designed an experiment to replicate Mc Cracken's (1979) findings, but using procedures that were compatible with Goodman and Kelso (1980), Larish (1980), and Rosenbaum (1980). The results of this experiment showed that time for programming duration was greater than time for programming direction and for programming extent, however, there was no difference between programming time for direction and for extent. At first glance such results apparently fail to substantiate Mc Cracken's claim regarding the effect that movement duration has on the relationship between direction and extent. If, however,

these findings are compared to those in Larish (Note 1) another interpretation emerges. When subjects had to execute movements as rapidly as possible, Larish (Note 1) found that the programming time of direction was longer than the programming time of extent. It appears that with the addition of duration as a response parameter (Larish, Note 2) this difference disappears, and it may mean that extent is indeed becoming a more critical parameter. If both duration and extent must be known to completely program duration, one could argue that in the program extent condition, duration was not fully pre-programmed. As such, a portion of the reaction time in the program extent condition would be attributed to the programming of duration. Hence, this added component to the reaction time may account for the lack of difference between direction and extent. This interpretation, then, would be consistent with Mc Cracken's position. But, since this is a post hoc explanation of the Larish (Note 2) findings, the present experiment was designed to provide another test of this explanation.

CHAPTER III

PROCEDURES FOR OBTAINING DATA

Introduction

This chapter contains the description of the apparatus used for obtaining the data, and the procedures utilized in the experimental task.

Subjects

Sixteen subjects (eight males and eight females), were recruited from The University of Iowa campus. Four subjects received extra credit in an undergraduate motor learning course.

Apparatus

The apparatus consisted of a response board, a stimulus display, a movement time feedback clock, and a PDP8a digital minicomputer. The stimulus display consisted of eight red light-emitting diodes (LED's) and a yellow LED mounted into a 20 x 14 cm plexiglass board. The red LED's were set in two horizontal rows, with four LED's in each row. The yellow LED was placed in the middle of the two rows of red LED's. The red LED's served as precue

information and stimulus signal, and the yellow LED served as a warning signal. The stimulus display was mounted at eye level, approximately 90 cm from the subjects, and it employed a visual angle slightly less than two degrees.

The response board consisted of six buttons (Cherry Electrical Products Corp., switch N# M62-0100) mounted into a 45.5 x 30.5 cm plexiglas board. The buttons were mounted on two vertical columns, with three buttons on each column. The columns were 21 cm apart. The middle button on each one of the two columns was called "home keys", and the other buttons were called "target keys" (Figure 3). The home keys had a 1.1 cm diameter, the target keys had a 1.3 cm diameter, and they were situated 3.5 cm away from the home keys. Subject's view of the response board was blocked by a cloth screen, which did not interfere with subject's arm movement. A movement time feedback clock (Hunter Mfg. Co., model 120 c Klockounter) was placed slightly to the left of the stimulus display. The function of this clock was to provide feedback information about the movement time duration of subject's response.

The whole apparatus was mounted on a table 75 cm high, and the apparatus was interfaced to a Digital Equipment Corporation PDP 8a minicomputer. The minicomputer was programmed to randomly present precues and stimulus information; to store data; to record reaction time,

movement time, and performance error; and also to control the movement time clock.

Procedures

A trial was initiated by subject pushing the home keys twice with both index fingers and at the same time. After that a precue information was immediately presented. Subjects were instructed to use this advance information to pre-program the movement parameters contained in the precue(s). Subjects were instructed to use the warning light as a fixation point in order to avoid lateral eye movements. After an elapsed time of three seconds the warning light (LED # 9 in Figure 3) was presented, and a following variable foreperiod (700, 900, 1100, or 1300 msec) a reaction stimulus was illuminated. When reaction stimulus appeared the task was to leave the home key and move to the designated target key as quickly and accurately as possible, and afterward feedback information about movement time was provided by the feedback clock. Subjects were told to stay on the home keys until they fully knew where they had to move. This information was provided to ensure that movements were programmed before the release of the home key.

This experiment manipulated three movement parameters: velocity, arm, and direction. So eight possible precue combinations or programming conditions were possible:

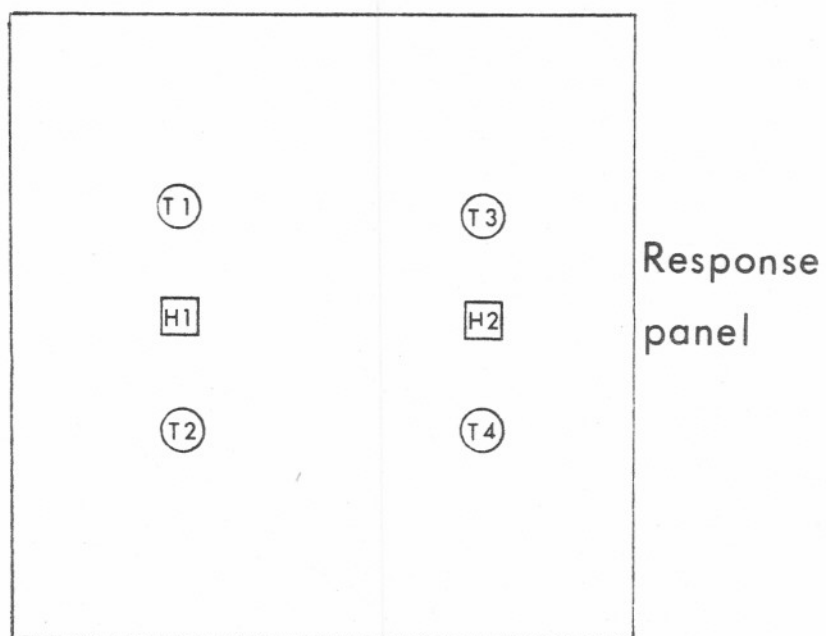
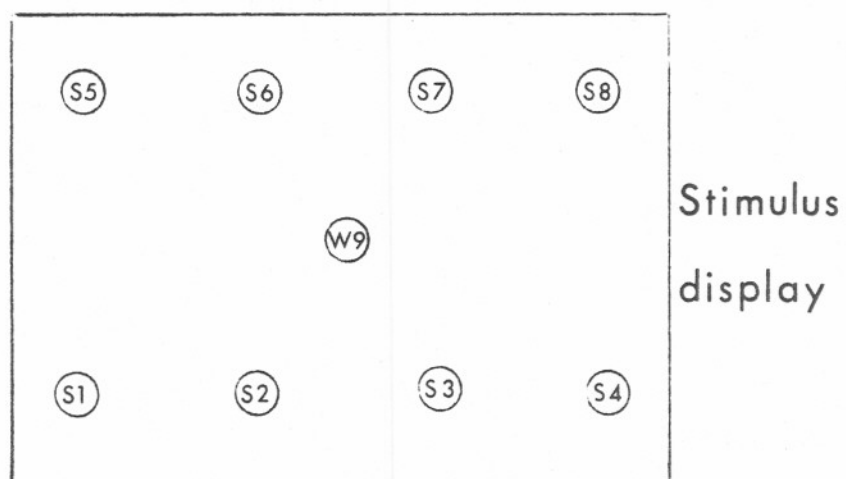


Figure 3: Response board
and stimulus display

1) program none, where all three parameters were known prior to response initiation; 2) program arm, where direction and velocity were known prior to movement initiation; 3) program velocity, where direction and arm were known prior to movement initiation; 4) program direction, where velocity and arm were known prior to movement initiation; 5) program velocity and arm, where direction was known prior to movement initiation; 6) program velocity and direction, where arm was known prior to movement initiation; 7) program arm and direction, where velocity was known prior to movement initiation; and 8) program velocity, arm, and direction, where no prior information was given. Thus all three movement parameters were unknown prior movement initiation.

Each subject performed six blocks of 64 correct trials per day during five consecutive days. The first two days were used as practice and familiarization with the experiment. An experimental session began with subjects doing some warm-up movements made from the home key to each response key. These trials were executed without precue or reaction stimuli. On the average a testing session lasted fifty minutes.

Three principal dependent measures were recorded on each trial, which were: 1) reaction time, defined as the elapsed time between the appearance of the stimulus light

and the release of the home key; 2) movement time, defined as the elapsed time between the release of the reaction-time key and the striking of a target key; 3) errors, defined as the release of the home key before the stimulus light was illuminated (short RT) or release of the home key after an elapsed time above 1200 msec (long RT), striking of an incorrect target key (wrong key), striking a target key with wrong hand (wrong hand), and having a movement time below 90 msec for the fast velocity and below 190 msec for the slow velocity (movement time too quick) or having a movement time above 150 msec for the fast velocity and above 310 msec for the slow velocity (movement time too slow). Each error committed by subjects was repeated latter on the testing session. The maximum error rate per testing session was established as 15% and each subject was constantly reminded to keep the error rate below 15% and in any session that error rates were above the boundary limits, it was terminated and repeated on the next day. The mapping between the stimulus signal and the response parameters was set in the following way (see Figure 3 for details): the four lights on the right side of the stimulus display signaled a movement with the right arm, the four lights on the left side of the stimulus display signaled a movement with the left arm, the four top lights signaled a movement in the forward direction, the

four botton lights signaled a movement in the backward direction. The velocity parameter was manipulated in a way that either the four inside lights or the four outside lights meant to move slow or meant to move fast. The slow velocity condition required subjects to have a movement time ranging from 190 to 310 msec and the fast velocity condition required subjects to have a movement time ranging from 90 to 150 msec. Eight subjects were assigned to the condition that had the four outside lights as fast movement and the four inside lights as slow movement, and eight subjects were assigned to the condition that had the four outside lights as slow movements and the four inside lights as fast movements.

CHAPTER IV

ANALYSIS OF DATA

Introduction

In this chapter the data for the three dependent measures (reaction time, movement time, and performance errors) are presented. For all statistical analyses a .05 level of significance was adopted for testing the null hypothesis.

Reaction Time

To determine the programming relationships among the three movement parameters two separated ANOVA'S were conducted. The first examined the relationship of the parameters when only one of the parameters remained to be programmed: program velocity, program arm, or program direction. The second examined the relationship of the parameters when two of the parameters remained to be programmed: program velocity and arm, program velocity and direction, or program arm and direction.

In the one parameter program the analysis showed the main effect of velocity was significant, $F(1, 15) =$

12.38, $\underline{P} < .05$. indicating that the faster velocity movement ($X = 430$ msec, $SD = 98$ msec) was initiated more quickly than the slower velocity movement ($X = 460$ msec, $SD = 109$ msec). The Programming conditions main effect was also significant, $\underline{F} (2, 30) = 7.68$, $\underline{P} < .05$. A post hoc analysis using Tukey's HSD procedure showed that the time to program velocity ($X = 460$ msec, $SD = 103$ msec) was greater than either the time to program arm ($X = 432$ msec, $SD = 101$ msec) or program direction ($X = 442$ msec, $SD = 109$ msec), but these latter two conditions were equivalent.

The only interaction found to be significant was for Direction and Programming conditions, $\underline{F} (2, 30) = 20.86$, $\underline{P} < .05$ (see Table 3). Post hoc analysis within a programming condition, again using Tukey's HSD procedure, showed that for programming direction, forward movements were initiated faster than backward movements, whereas, for programming velocity and for programming arm, forward movements were initiated more slowly than backward movements. The reason for such a reversal is unclear, however, this result has no bearing on the main purpose of the experiment. A second analysis within direction indicated that for backward movements the time to program velocity was greater than the time to program direction, and the time to program direction was greater than the time to program arm, and for forward

movements the time to program velocity was greater than the time to program direction, and the time to program direction was almost equivalent to the time to program arm.

Table 2

Mean RT (msec) for Programming One
Parameter as Function of Direction

Program	Direction	
	Forward	Backward
Velocity	X 465.1 SD 104.0	455.6 101.0
Arm	X 441.3 SD 103.3	423.3 96.7
Direction	X 436.5 SD 104.8	447.6 113.1

In the program two parameter conditions the Velocity main effect was significant, $F(1, 15) = 7.98$, $p < .05$, and again the faster velocity movement ($X = 475$ msec, $SD = 108$ msec) was initiated more rapidly than the slower velocity movement ($X = 508$ msec, $SD = 110$ msec). The Programming

conditions main effect was also significant, $F(2, 30) = 17.62$, $P < .05$. A subsequent post hoc analysis showed that the time to program velocity and arm ($X = 499$ msec, $SD = 107$ msec) and program velocity and direction ($X = 502$ msec, $SD = 112$ msec) were equivalent and both were longer than the time to program arm and direction ($X = 473$ msec, $SD = 110$ msec).

The interactions of Direction and Programming conditions and Velocity and Programming conditions were significant, $F(2, 30) = 9.93$, $P < .05$ and $F(2, 30) = 3.60$, $P < .05$. For the Direction by Programming conditions interaction the time to initiate a backward movement was longer than the time to initiate a forward movement in the program velocity and direction condition (see Table 3). Forward and backward movements had similar initiation times in the remaining two programming conditions; velocity and arm, and arm and direction. Pairwise comparisons among the programming conditions within a direction showed that for forward movements the time to program velocity and arm was greater than the time to program velocity and direction, and the time to program velocity and direction was greater than the time to program arm and direction. For backward movements the time to program velocity and direction was greater than the time to program velocity and arm, and the time to program velocity and arm was greater than the time to program arm and direction.

Table 3

Mean RT (msec) for Programming Two
Parameters as Function of Directionn

Program	Direction	
	Forward	Backward
Velocity-Arm		
X	504.7	493.7
SD	106.1	107.7
Velocity-Direction		
X	493.4	511.6
SD	109.2	113.3
Arm-Direction		
X	467.4	478.3
SD	104.5	115.4

For the Velocity-Programming conditions interaction the faster velocity movement had a shorter reaction time in all the programming conditions (see Table 4); a result that is consistent with the Velocity main effect. Also, for both velocities the time to program velocity and arm, and velocity and direction are equivalent and both are slower than the time to program arm and direction.

Table 4

Mean RT (msec) for Programming Two
Parameters as Function of Velocity

Program	Velocity	
	Fast	Slow
Velocity-Arm		
	X 478.6	519.8
	SD 109.9	100.3
Velocity-Direction		
	X 482.7	522.3
	SD 114.0	105.6
Arm-Direction		
	X 464.5	481.2
	SD 100.3	119.2

Movement Time

An analysis similar to that reported for the reaction time was conducted on movement time: One ANOVA for the program one parameter condition and a second ANOVA for the program two parameter conditions.

For the program one movement parameter, ANOVA the Velocity and Programming main effects were significant, $F(1, 15) = 6791.59$ and $F(2, 30) = 5.68$, $P < .05$. For the Velocity main effect, the fast velocity movement ($X = 115$

msec, SD= 74 msec) had a more rapid movement time than the slow velocity movement ($X = 242$ msec, SD= 132 msec), which was of course expected. The Programming main effect was found significant because the movement time for the programming velocity condition ($X = 178$ msec, SD= 63 msec), was more rapid than the movement time for the programming direction condition ($X = 180$ msec, SD= 65 msec). Both, however, were equivalent to the movement time in the programming arm condition ($X = 179$ msec, SD= 65 msec).

The Velocity by Programming interaction was also significant, $F(2, 30) = 4.24$, $P < .05$. Post hoc analysis showed that for all three programming conditions movement time for the fast velocity movement was more rapid than the slow velocity movement (see Table 5). This result is consistent with the velocity main effect reported above. A simple main effect analysis within movement velocity showed that the interaction was caused by the slow velocity condition. Movement times among the programming conditions for the fast velocity movement were equivalent, however, the movement time for programming velocity was shorter than the movement time for programming arm, and movement time for programming direction, which were equivalent.

Finally the four-way interaction of Direction, Arm, Velocity, and Days was significant, $F(4, 60) = 2.71$, P

<.05. However, since a qualitative observation of the interaction failed to show any substantive differences a formal post hoc examination was not performed. A table of the means and standard deviations for this interaction is presented in Appendix C.

Table 5

Mean MT (msec) for Programming One
Parameter as Function of Velocity

Program	Velocity	
	Fast	Slow
Velocity		
	X 115.8	244.1
	SD 0.7	1.4
Arm		
	X 115.5	243.0
	SD 0.8	1.2
Direction		
	X 115.5	240.2
	SD 0.7	1.3

For the program two parameters ANOVA the Velocity main effect was significant, $F(1, 15) = 9649.51$, $p < .05$, and as expected fast velocity movements ($X = 116$ msec, $SD = 74$

msec) were completed quicker than slow velocity movements ($X = 241$ msec, $SD = 129$ msec). The Programming main effect was significant, $F(2, 30) = 6.52$, $P < .05$, and a post hoc analysis pairwise comparisons showed that the movement time for programming arm and direction ($X = 180$ msec, $SD = 65$ msec) was longer than for programming velocity and arm ($X = 177$ msec, $SD = 62$ msec) and programming velocity and direction ($X = 177$ msec, $SD = 63$ msec).

The Velocity by Programming interaction was again significant, $F(2, 30) = 11.53$, $P < .05$. In congruence with the main effect for Velocity, in all three programming conditions fast velocity movements were more rapid than slow movements (see Table 6). Further, for the fast velocity movement the movement time for programming velocity and arm was longer than the movement time for programming velocity and direction and programming arm and direction. For the slow movement, the MT in the programming velocity and arm condition was more rapid than in the programming velocity and direction condition. All other pairwise comparisons were not significant.

A three-way interaction (Arm, Velocity, and Day) was significant, $F(2, 30) = 5.56$, $P < .05$. A post hoc analysis was not computed because no meaningful differences were apparent after an inspection of the data. A table of

means and standard deviations for this interaction is presented in Appendix C.

Table 6

Mean MT (msec) for Programming Two
Parameters as Function of Velocity

Program	Velocity	
	Fast	Slow
Velocity-Arm		
X	125.3	244.1
SD	0.7	1.3
Velocity-Direction		
X	115.2	239.2
SD	0.7	1.3
Arm-Direction		
X	116.0	238.7
SD	0.8	1.2

Performance Errors

Prior to the beginning of testing, it was pre-determined that an error rate of 15% would be needed for the session to be considered acceptable. Although the first two sessions were designated as practice for everyone, four subjects required additional practice sessions before achieving

the 15% level: Two subjects required an additional one day of practice; one subject required an additional two days of practice; one subject required an additional three days of practice.

Table 7 represents the error rates (in percentages) as function of programming condition for the three days of testing where overall errors were 15% or less. The table clearly indicates that performance errors resulting from moving the incorrect arm, the reaction time being below or above the established boundaries, and contacting the incorrect response key are negligible. In fact, they are all less than 1%, a result that is seen across all programming conditions. The majority of performance errors are related to the movement times themselves. That is, the largest number of performance errors were made because the acceptable limit placed on the movement times were exceeded. Further, it appears that the percentage of movement times too quick or too slow are nearly equivalent, both for the fast and slow velocity movements and across the programming conditions. Such results indicate that performance errors are not confounding the reaction time and movement time results.

Discussion

Before discussing the main hypothesis, let's look at the relationship between velocity and reaction time. The

Table 7

Error Rates (%) for
Programming Condition and
Velocity

		<u>Types of Performance Errors</u>					
		Wrong Hand	RT Short	RT Long	Wrong Key	MT Quick	MT Slow
P(VAD)	Quick					8.07	
P(VAD)	Slow	0.17			0.08		7.72
P(AD)	Quick					6.51	
P(AD)	Slow	0.08		0.08			6.25
P(VD)	Quick	0.08		0.26	0.08	8.50	
P(VD)	Slow		0.08	0.08			7.98
P(VA)	Quick			0.17	0.34	7.38	
P(VA)	Slow	0.08		0.08	0.08		5.20
P(D)	Quick			0.17	0.08	7.73	
P(D)	Slow	0.08		0.26		1.47	6.94
P(A)	Quick	0.08				5.55	
P(A)	Slow	0.43		0.08	0.08		5.29
P(V)	Quick			0.17		6.60	
P(V)	Slow				0.17	0.08	6.33
P(NONE)	Quick	0.26		0.34		7.64	0.08
P(NONE)	Slow		0.17				9.02

P= program, V= velocity, A= arm, D= direction

results showed that reaction time for initiating a fast movement was shorter than reaction time for initiating a slow movement. These findings replicate Falkenberg and Newell (1980). The possible explanation for such findings is that slow movements require the inhibition of a greater number of muscle fibers, and on the other hand fast movements require the activation of a greater number of muscle fibers. The inhibition of muscle fibers takes more time than the activation of a muscle fiber, and that is the possible reason why fast movements had quicker reaction times than slow movements.

The results concerning the programming relationship of direction and arm, however were equivocal. For movements in the backward direction, the programming time of direction is greater than the programming time of arm. These results are consistent with those found by Larish (Note 1). In contrast, for movements in the forward direction, the programming time of direction and arm are equivalent. At this point it is unclear why movement direction interacts with the programming of direction and with the programming of arm (possible reasons are presented in the weaknesses section that follows), but one point is clear: The present findings can not be used to evaluate the results from Larish (Note 2), nor can they be used to reconcile the

discrepancy between the selective feature model of programming and the holistic model of programming.

The results obtained in the program two parameter conditions are also very puzzling. For backward movements the programming time for velocity and direction is greater than programming time for velocity and arm, and for forward movements the programming time for velocity and arm is greater than programming time for velocity and direction. As one can see the relationship between programming time for velocity and arm, and programming time for velocity and direction reversed between forward and backward movements. As in the programming one parameter condition, direction is interacting with the programming conditions in an unexplained way. Although there is not a clear an exact answer for such findings, there are some differences between this experiment and the experimnts that were used as support for the stated hypothesis that may explain these findings.

Weaknesses of Study

In the Arm, Direction, and Extent Larish (Note 1) experiment and also in the Velocity, Direction, and Extent (Note 2) expreriment the visual display was set in a different way. The visual display for both experiments Larish (Note 1) and Larish (Note 2) was the same one we used in this experiment (see Figure 3), the only difference was that

it was tilted 90 degree in the clockwise direction. The visual display for the two previous experiments implied a highly compatible relationship with the response to be made on the response panel, which is not the case in our experiment.

The previous experiments Larish (Note 1) and Larish (Note 2) had the "go" signal presented in the same configuration and also in the same direction in which subjects had to execute the required movement on the response panel. For example (see Figure 2) in Larish (Note 1) when subjects had to program all three parameters (arm, direction, and extent) and when the "go" signal came on, the required movement was executed in the same direction provided by the "go" signal. In the present experiment (see Figure 3), however, when subjects had to program all three parameters (velocity, arm, and direction) and when the "go" signal came on, the required movement was not executed in the same direction provided by the go signal. As one can see the stimulus display and the response to be made on the response panel did not have a highly spatial configuration, and it might be the reason why the results did not come out in the way that they were predicted previously. This experiment did not have a highly compatible relationship between the visual display and the response to be made on the response panel, and this

translation process might be the explanation for the results. Simon and Craft (1970) found that incompatibility between the visual display and the response to be made on the response panel increases reaction time. This experiment does not have enough power to explain the degree of incompatibility between the visual display and the response to be made. Future studies should be designed in order to investigate and also to explain our findings.

Suggestion for Future Studies

It is suggested that a new experiment should be designed, with a more compatible relationship between the visual display and the response panel. In this case we should repeat the same experiment with the visual display (see Figure 3) tilted 90 degree in the clockwise direction. By doing this we should eliminate the translation between the visual display and the response panel, and also we should get the results that were predicted for this experiment.

CHAPTER V

SUMMARY

Purpose

The purpose of this experiment was to shed light on how motor programs are structured. The focus of this study was the programming time of velocity, arm, and direction. Reaction time was used as the unit for measuring programming time.

Procedures

Sixteen subjects were recruited from the University of Iowa campus. The task was to execute an aimed hand movement by using the index fingers. The subject's task was to prepare the movement in advance based on the precue information, and only when the stimulus light came on did the subject program the required movement and leave the home key in order to hit the target key.

Findings

The relationship between velocity and reaction time results, showed that fast movements were initiated more rapidly than slow movements. This pattern of results was

shown for programming one parameter condition and for programming two parameter conditions. In the programming one parameter condition the Programming main effect results showed that velocity took longer to be programmed than either direction or arm. But these latter two had equivalent reaction times. The Direction by Programming interaction main effect showed that backward movements were initiated faster than forward movements. For backward movements the results obtained were what were previously predicted. In Table 2 is shown that reaction time for direction was greater than reaction time for arm.

In the programming two parameter conditions the Programming main effect results showed that reaction time for velocity and direction was equivalent to reaction time for velocity and arm, and both had greater reaction times than arm and direction. These results do not follow the same pattern that were obtained for one parameter condition. The Programming by Direction interaction showed that programming time for velocity and direction, and for velocity and arm, reversed between forward and backward movements.

Conclusions

As one can see only for backward movements the obtained results show support for previously stated hypothesis. But for the two parameter conditions the obtained

results are not consistent and also do not have the same pattern obtained for one parameter condition. The interaction of direction on both, one parameter condition and two parameter conditions does not allow to support either the selective feature model of programming or the holistic model of programming.

APPENDICES

APPENDIX A

RAW DATA

Table 8

RT (msec) for Arm,
Direction, and Velocity

Explanation of the Data Coding

Columns 1-2 specify subjects
Columns 3-4 specify days of testing
Columns 6-8 specify precues given
 n= no precue
 v= velocity
 a= arm
 d= direction
 va= velocity and arm
 vd= velocity and direction
 ad= arm and direction
 vad= velocity, arm, and direction
Columns 10-32 specify fast movements
Columns 34-56 specify slow movements

0101	n	50.33	51.00	51.00	49.17	56.66	59.00	53.50	54.10
0101	v	48.50	50.66	48.66	47.83	51.83	49.00	50.00	54.70
0101	a	46.00	52.66	54.50	54.00	50.66	54.66	47.83	57.33
0101	d	47.33	46.50	48.00	41.50	53.33	54.83	50.66	53.00
0101	va	44.33	41.16	47.00	47.33	45.50	52.16	49.66	47.50
0101	vd	44.83	41.00	42.50	40.50	48.66	43.50	45.83	45.83
0101	ad	48.00	47.00	50.83	44.33	52.00	49.00	52.50	49.66
0101	vad	35.66	33.50	39.16	35.26	37.00	36.16	45.33	32.83
0102	n	51.66	54.33	52.00	52.50	57.16	56.83	57.16	59.00
0102	v	50.16	50.83	51.00	53.50	56.33	56.50	50.83	53.50
0102	a	49.33	53.83	53.66	54.16	53.00	59.00	55.66	60.00
0102	d	50.16	47.33	49.16	46.16	57.00	57.16	51.83	59.33
0102	va	47.16	48.16	51.66	48.66	47.66	58.83	52.16	53.66
0102	vd	51.00	48.00	46.33	45.16	54.33	48.66	45.16	54.00
0102	ad	53.50	46.50	50.83	52.33	50.33	51.33	52.33	54.83
0102	vad	45.00	43.33	44.33	43.00	49.83	34.16	41.66	38.50
0103	n	46.33	50.33	49.83	51.83	51.66	58.66	52.83	58.66
0103	v	48.66	50.16	48.00	49.16	48.66	52.50	49.33	57.83
0103	a	44.33	48.50	50.83	51.50	52.00	51.50	49.16	55.00
0103	d	44.66	48.16	45.33	44.50	51.50	51.16	49.33	55.33
0103	va	43.00	45.00	48.00	45.50	43.50	49.00	45.33	48.66
0103	vd	44.00	40.66	47.83	43.66	49.16	44.50	42.83	46.50

Table 8 (cont.)

0103	ad	42.33	42.33	48.00	45.66	44.66	49.33	48.16	50.16
0103	vad	36.16	39.00	40.33	38.83	31.66	36.83	38.83	39.50
0201	N	39.50	42.33	33.66	47.50	43.33	50.50	41.66	50.50
0201	v	35.66	37.83	30.33	36.83	34.66	40.16	33.00	41.16
0201	a	33.50	38.83	32.66	44.66	43.16	49.50	41.33	44.33
0201	d	37.66	36.16	36.50	38.16	42.16	50.33	41.50	48.33
0201	va	33.83	29.33	29.83	33.66	31.66	35.50	32.33	34.50
0201	vd	31.00	30.50	28.83	33.00	31.16	43.33	29.33	35.33
0201	ad	36.00	36.33	28.83	32.00	35.00	41.16	36.00	39.33
0201	vad	26.83	25.50	26.00	26.00	26.66	31.50	26.00	29.00
0202	n	46.83	49.16	31.66	41.16	44.66	52.16	40.66	53.66
0202	v	38.66	36.33	30.50	42.16	36.66	47.50	33.16	41.50
0202	a	31.66	43.83	34.83	45.00	42.00	49.50	35.83	46.83
0202	d	37.66	36.33	34.83	34.83	43.50	48.33	40.16	46.83
0202	va	29.50	33.83	28.50	35.00	30.66	40.16	33.83	36.33
0202	vd	34.00	31.33	26.83	30.16	30.50	40.50	30.66	43.33
0202	ad	34.16	41.83	33.83	39.50	37.00	45.33	35.33	47.33
0202	vad	24.83	25.83	24.33	25.83	27.66	31.00	24.33	33.16
0203	n	34.16	42.50	36.00	41.16	42.16	47.83	43.00	48.16
0203	v	34.66	37.50	32.50	36.66	38.33	42.50	33.33	40.50
0203	a	39.16	35.50	33.66	37.00	45.50	47.00	33.83	42.50
0203	d	33.83	41.33	35.66	38.16	38.66	47.16	44.66	48.16
0203	va	29.16	32.00	30.83	33.00	32.33	38.00	32.16	33.50
0203	vd	33.83	28.16	29.66	28.00	29.33	37.50	31.66	37.33
0203	ad	33.66	33.50	34.66	35.33	40.33	41.00	34.66	41.00
0203	vad	24.33	26.16	23.16	25.16	32.16	32.66	25.00	31.00
0301	n	50.66	49.66	48.66	49.16	52.00	54.66	55.66	52.83
0301	v	48.83	48.83	48.00	47.83	54.00	49.66	56.50	50.33
0301	a	46.00	47.33	46.50	45.83	52.16	55.50	45.33	48.50
0301	d	49.16	44.66	49.33	42.16	54.16	59.33	51.83	48.66
0301	va	43.66	45.50	40.16	43.83	54.33	55.00	48.00	52.33
0301	vd	50.16	48.33	50.50	45.66	54.83	53.66	52.66	55.00
0301	ad	46.16	44.00	39.83	44.00	50.83	52.16	50.16	44.33
0301	vad	37.00	35.50	38.16	41.50	40.33	47.16	53.83	46.33
0302	n	47.00	48.33	49.50	45.50	50.83	54.00	46.50	54.00
0302	v	46.00	49.83	48.83	41.83	50.83	50.50	51.00	54.33
0302	a	43.16	47.83	43.83	44.50	46.33	57.66	48.33	52.16
0302	d	47.16	44.66	46.00	40.16	49.16	68.66	51.16	47.16
0302	va	43.00	45.66	41.83	44.33	47.33	51.66	48.33	50.16
0302	vd	51.33	46.50	45.83	45.50	45.33	50.66	51.00	49.50
0302	ad	41.33	43.16	40.00	42.50	45.50	51.66	49.16	46.66
0302	vad	33.83	29.83	39.50	34.50	41.16	47.16	48.00	45.50
0303	n	46.00	48.33	45.16	42.83	50.00	53.16	47.00	50.50
0303	v	48.33	45.50	50.00	44.83	49.66	55.16	53.50	52.50
0303	a	48.50	43.83	43.66	40.50	53.33	52.33	44.83	48.33
0303	d	50.00	47.16	43.83	38.00	48.00	50.16	48.33	48.66
0303	va	42.16	47.00	48.66	43.66	47.50	52.66	50.83	48.50
0303	vd	47.16	41.33	41.50	37.50	45.66	52.66	47.50	59.66

Table 8 (cont.)

0303	ad	38.83	38.16	44.00	44.50	43.50	50.50	45.16	50.33
0303	vad	40.00	36.83	36.83	36.50	38.83	43.66	42.16	44.66
0401	n	53.83	55.66	54.00	56.33	58.00	59.33	56.16	53.50
0401	v	53.66	55.00	43.83	46.50	51.00	48.50	48.16	46.00
0401	a	47.33	54.83	54.83	54.33	53.33	59.83	58.16	54.66
0401	d	56.66	48.33	56.33	45.66	54.66	54.16	58.16	58.16
0401	va	46.83	47.00	47.00	44.50	47.66	50.83	45.00	46.66
0401	vd	42.33	40.50	46.66	40.66	48.50	47.16	48.16	46.16
0401	ad	47.50	37.66	53.33	48.50	46.66	44.83	52.33	50.66
0401	vad	37.83	32.83	39.16	36.83	36.33	43.66	38.66	36.33
0402	n	50.66	53.00	53.33	47.83	52.33	56.00	59.00	54.00
0402	v	47.83	46.50	55.50	45.00	48.16	47.33	49.83	43.50
0402	a	51.83	49.50	58.16	52.33	52.16	52.66	50.16	51.50
0402	d	46.50	49.50	55.83	48.66	54.00	53.16	52.50	53.66
0402	va	45.33	43.50	45.66	45.33	44.66	43.66	41.50	42.33
0402	vd	41.16	42.00	47.66	39.66	45.83	42.33	42.50	43.66
0402	ad	40.83	38.66	41.66	43.66	48.00	48.16	46.50	52.66
0402	vad	35.16	32.83	38.50	35.16	36.50	39.16	38.16	35.16
0403	n	54.50	53.83	61.50	53.83	59.00	58.33	57.50	52.83
0403	v	46.50	41.66	46.00	46.00	49.66	45.16	47.16	50.00
0403	a	43.50	56.16	53.50	49.16	52.33	55.66	53.50	52.33
0403	d	52.83	55.83	54.33	54.66	58.50	52.33	57.33	50.33
0403	va	38.83	47.83	49.16	43.00	40.00	57.16	50.16	41.16
0403	vd	36.83	37.00	40.83	40.66	49.33	42.50	53.16	42.00
0403	ad	41.66	40.50	45.50	47.33	49.66	52.00	54.33	47.66
0403	vad	35.00	35.33	38.33	38.66	38.33	38.83	37.50	33.83
0501	n	48.33	41.16	38.66	46.50	48.83	45.83	51.50	51.66
0501	v	36.50	37.83	40.83	41.50	36.83	34.00	40.00	34.16
0501	a	37.83	31.16	39.33	37.33	43.16	43.50	50.00	46.50
0501	d	33.83	32.66	39.66	42.00	48.33	44.00	49.83	49.83
0501	va	35.00	35.00	37.00	36.66	29.83	35.16	29.66	32.00
0501	vd	33.66	34.16	39.33	35.50	34.33	30.50	34.83	36.16
0501	ad	33.33	29.50	34.33	34.00	44.16	39.83	40.83	42.66
0501	vad	28.33	26.66	31.00	28.33	24.50	26.16	27.66	25.66
0502	n	44.00	40.50	50.83	45.33	43.66	47.16	47.66	47.50
0502	v	39.50	36.66	41.00	42.16	45.33	38.66	38.50	32.83
0502	a	36.50	39.16	44.83	41.16	47.66	44.33	45.83	46.33
0502	d	35.50	37.33	48.00	41.50	46.33	41.50	48.00	48.50
0502	va	36.00	35.66	39.83	37.00	32.33	29.16	34.50	32.66
0502	vd	35.83	33.16	39.66	38.83	32.83	34.50	33.50	33.33
0502	ad	37.16	32.50	39.33	35.83	43.66	38.00	44.83	44.00
0502	vad	29.66	29.00	33.50	35.16	25.00	24.83	27.83	33.16
0503	n	39.83	39.16	50.66	42.33	49.16	48.83	48.50	47.33
0503	v	33.83	35.16	40.16	40.00	31.66	33.33	31.50	35.33
0503	a	35.50	34.66	45.16	38.00	41.66	40.66	44.16	44.66
0503	d	35.00	33.00	49.16	42.83	43.50	41.66	45.50	47.00
0503	va	33.66	34.00	38.33	39.00	26.00	28.83	32.00	27.16
0503	vd	32.66	27.50	39.33	35.66	28.83	33.50	39.33	29.00

Table 8 (cont.)

0503	ad	32.83	26.66	39.50	32.00	40.83	40.33	44.50	43.50
0503	vad	35.50	27.00	30.83	26.33	22.66	23.33	28.83	23.66
0601	n	44.16	50.50	45.83	45.33	59.00	67.00	58.83	71.33
0601	v	46.16	46.66	45.83	46.83	54.00	52.16	54.16	53.16
0601	a	44.16	43.66	41.66	49.50	61.50	60.16	58.83	59.83
0601	d	41.16	41.83	40.50	43.33	59.00	58.16	65.66	57.83
0601	va	43.16	44.83	44.00	43.50	51.33	43.16	47.50	47.00
0601	vd	42.00	37.00	39.83	40.16	51.33	46.00	47.16	43.50
0601	ad	42.33	41.66	43.00	37.66	53.83	53.16	54.33	58.83
0601	vad	34.16	30.33	33.83	31.83	35.33	36.66	39.00	42.00
0602	n	44.50	45.50	41.66	47.16	59.16	59.16	59.66	56.16
0602	v	44.50	42.50	38.33	42.50	52.50	54.00	55.83	50.00
0602	a	37.83	43.50	39.66	42.83	55.55	60.83	55.00	53.33
0602	d	44.33	38.66	42.50	42.83	55.00	58.50	58.16	57.33
0602	va	38.66	39.00	36.83	42.83	48.83	44.83	46.16	46.66
0602	vd	41.50	38.33	33.50	36.83	50.16	47.83	50.83	45.66
0602	ad	37.83	34.33	34.83	32.16	51.83	55.00	49.83	48.50
0602	vad	27.50	28.33	29.00	27.50	31.33	38.00	39.50	29.66
0603	n	50.33	47.33	47.66	49.33	56.83	62.50	62.66	58.83
0603	v	45.16	42.50	43.33	45.00	52.66	57.16	50.66	57.16
0603	a	44.33	42.83	42.33	44.50	57.50	58.83	57.00	56.50
0603	d	46.00	40.00	43.33	40.16	60.66	62.16	59.16	54.83
0603	va	38.00	39.16	43.50	37.50	50.83	50.66	49.50	44.83
0603	vd	46.50	39.16	43.83	34.83	49.33	47.16	50.83	45.33
0603	AD	40.00	32.50	35.83	32.33	54.66	57.33	52.33	49.33
0603	vad	29.66	29.83	34.35	32.33	30.00	30.66	36.50	29.50
0701	n	70.66	68.50	70.33	72.66	74.83	78.00	71.33	82.33
0701	v	65.50	68.66	65.83	64.66	79.00	80.50	67.50	79.00
0701	a	76.00	78.00	87.83	63.50	79.83	79.50	69.16	79.33
0701	d	70.66	67.00	75.66	67.50	73.50	80.66	75.00	65.66
0701	va	65.66	70.33	66.83	58.00	72.00	83.16	59.16	74.66
0701	vd	59.33	60.33	66.33	54.50	71.33	72.66	72.66	60.50
0701	ad	64.16	58.83	69.33	61.66	67.00	74.00	70.66	63.83
0701	vad	66.33	64.00	50.33	47.16	62.66	55.33	64.33	53.66
0702	n	64.33	62.16	60.16	69.50	73.66	70.16	67.00	68.50
0702	v	54.16	55.83	54.50	61.50	64.16	73.83	59.50	71.83
0702	a	57.00	63.83	48.66	55.66	63.16	67.16	62.66	62.33
0702	d	59.66	56.33	57.00	48.33	68.33	66.50	67.16	63.66
0702	va	63.33	53.00	49.50	57.33	63.83	63.83	60.16	63.00
0702	vd	53.66	54.16	53.33	45.00	63.33	61.50	58.00	55.50
0702	ad	60.16	49.83	53.16	46.66	57.33	58.50	61.00	63.00
0702	vad	47.83	43.83	42.00	43.16	54.00	54.50	55.00	48.16
0703	n	65.16	60.83	60.16	57.00	68.33	66.50	69.66	69.16
0703	v	57.66	60.16	60.16	56.33	62.00	64.16	64.33	71.83
0703	a	59.50	62.00	51.16	53.50	65.16	72.83	64.66	62.66
0703	d	59.00	57.50	63.66	57.50	67.50	66.66	69.33	67.00
0703	va	55.83	53.16	49.83	51.00	72.83	60.00	60.66	62.83
0703	vd	56.33	54.00	57.16	49.66	63.00	59.83	68.66	55.83

Table 8 (cont.)

0703	ad	55.83	57.00	51.16	44.83	71.50	61.16	62.50	59.50
0703	vad	47.00	51.33	49.83	41.16	51.00	57.16	59.66	53.50
0801	n	63.00	63.16	68.16	59.66	63.33	68.50	67.50	67.00
0801	v	62.33	58.00	58.83	62.16	57.66	58.83	54.60	56.63
0801	A	57.66	60.50	59.66	59.83	62.66	59.83	60.83	66.50
0801	d	58.16	57.16	60.00	59.66	56.63	62.83	62.50	60.00
0801	va	58.66	57.16	49.66	58.50	51.66	55.83	53.50	55.50
0801	vd	55.16	52.00	55.33	50.33	55.16	48.66	56.16	51.33
0801	ad	52.00	49.66	52.66	49.33	62.00	59.66	61.00	59.16
0801	vad	46.83	40.50	43.33	37.66	43.50	46.00	47.50	44.33
0802	n	61.00	59.00	62.33	60.16	60.33	59.00	64.16	63.66
0802	v	58.66	54.16	54.66	57.66	54.50	54.16	61.50	59.66
0802	a	56.50	58.00	55.33	63.66	59.66	58.33	60.16	60.83
0802	d	56.66	50.50	59.50	55.83	63.33	58.00	57.83	58.50
0802	va	52.00	53.16	51.50	54.50	49.16	52.66	51.66	53.83
0802	vd	54.66	46.83	49.00	46.83	50.00	50.16	50.00	47.33
0802	ad	47.33	48.16	50.66	46.83	57.33	54.66	57.66	54.33
0802	vad	42.50	37.50	42.83	41.50	42.16	43.83	39.83	41.00
0803	n	61.83	58.00	62.00	65.00	66.33	63.16	69.83	66.83
0803	v	58.16	58.50	55.16	60.66	57.00	58.83	58.66	60.66
0803	a	51.16	58.50	59.00	66.66	61.33	60.50	64.00	62.83
0803	d	55.16	53.16	55.16	58.66	64.66	61.50	61.66	64.16
0803	va	55.83	57.16	56.66	59.16	55.00	65.50	55.33	56.33
0803	vd	53.16	58.83	54.00	49.66	52.83	49.33	56.66	51.83
0803	ad	50.16	49.16	51.83	54.00	58.33	60.16	58.16	61.00
0803	vad	40.66	38.83	41.00	45.16	51.16	45.50	48.50	42.83
0101	n	38.83	37.33	40.50	41.00	34.66	37.16	39.50	35.16
0101	v	31.83	31.83	33.16	34.00	29.83	26.33	31.83	34.33
0101	a	35.16	33.50	36.66	34.16	31.16	32.83	42.00	40.50
0101	d	34.50	34.83	43.16	36.16	37.16	34.16	37.33	33.33
0101	va	30.66	27.50	31.00	29.16	25.16	24.33	30.33	27.16
0101	vd	33.33	28.33	31.00	34.33	30.00	27.33	29.66	27.83
0101	ad	30.33	32.50	33.83	31.66	31.66	35.00	39.00	37.66
0101	vad	25.16	25.50	29.83	29.50	25.83	22.66	28.33	26.33
0102	n	41.83	42.66	49.50	45.33	39.50	38.50	38.16	40.50
0102	v	40.00	38.33	34.83	36.66	35.50	33.83	35.83	34.16
0102	a	35.66	41.33	40.33	45.83	37.33	40.83	42.50	46.66
0102	d	40.66	43.16	41.16	41.83	35.66	37.50	42.16	36.33
0102	va	30.66	35.83	37.66	36.16	28.66	30.83	34.16	35.50
0102	vd	33.66	34.50	32.00	31.00	32.83	29.50	36.33	29.50
0102	ad	34.16	40.00	40.33	40.16	35.00	38.66	36.33	43.50
0102	vad	27.50	29.00	34.83	31.33	27.50	26.66	31.83	27.83
0103	n	41.00	43.50	46.50	44.00	36.50	37.16	41.00	39.50
0103	v	35.50	33.16	39.00	35.16	31.83	30.50	37.00	32.50
0103	a	39.83	37.33	42.16	39.50	36.00	34.16	39.00	43.16
0103	d	40.66	39.66	42.66	42.16	34.50	37.33	42.83	36.16
0103	va	31.83	34.83	38.66	35.00	29.33	30.00	32.83	32.66
0103	vd	33.33	33.16	34.66	32.33	32.66	28.33	36.00	31.50

Table 8 (cont.)

0103	ad	34.83	37.33	40.66	40.50	34.83	33.33	38.66	35.00
0103	vad	31.33	31.50	35.16	29.66	31.33	27.33	31.66	28.83
0201	n	84.66	71.00	70.66	73.33	64.33	65.50	62.66	68.00
0201	v	50.50	62.83	50.00	71.33	55.66	66.33	53.83	51.83
0201	a	74.00	73.50	65.66	73.66	57.66	65.83	73.00	65.83
0201	d	71.50	79.33	69.00	74.50	64.50	56.16	67.83	51.66
0201	va	44.66	53.00	44.16	45.00	52.83	54.00	56.83	54.33
0201	vd	44.33	45.33	45.00	42.00	56.83	56.16	48.83	51.83
0201	ad	76.33	72.50	68.83	60.83	67.00	61.83	54.83	62.00
0201	vad	32.16	35.50	36.50	33.16	47.33	52.00	45.83	44.00
0202	n	81.50	70.33	63.83	70.50	66.33	64.66	65.00	59.83
0202	v	53.16	58.83	56.50	57.33	56.16	65.33	52.00	57.00
0202	a	70.66	67.50	64.83	66.50	63.50	64.50	59.16	66.33
0202	d	67.50	71.50	66.16	63.50	63.50	65.00	60.00	57.16
0202	va	43.66	50.33	45.50	48.16	54.33	59.50	52.33	53.16
0202	vd	49.16	52.66	48.16	45.16	52.83	52.66	49.33	55.00
0202	ad	66.16	64.33	66.66	63.16	60.50	53.83	55.33	58.66
0202	vad	34.00	31.50	36.33	43.16	45.83	46.50	47.50	49.00
0203	n	67.00	63.50	64.83	65.16	58.83	55.83	58.66	57.83
0203	v	47.00	52.33	43.33	50.50	55.00	53.50	45.50	56.33
0203	a	73.16	68.00	63.83	58.66	51.83	55.83	56.66	55.66
0203	d	66.33	63.16	64.16	64.33	59.83	52.16	55.33	52.83
0203	va	41.83	44.66	45.33	48.16	47.33	50.33	46.16	50.50
0203	vd	43.33	40.33	40.66	36.66	54.83	48.33	41.83	49.50
0203	ad	63.33	62.33	59.00	55.00	50.00	50.16	54.50	55.66
0203	vad	34.00	36.00	35.33	34.50	42.33	40.83	44.50	40.33
0301	n	50.83	59.16	51.83	53.33	51.66	51.50	51.00	54.83
0301	v	46.83	50.83	46.66	52.00	39.16	48.00	46.00	47.00
0301	a	49.16	55.16	51.33	53.66	53.16	53.33	49.50	57.66
0301	d	57.50	52.50	53.83	51.00	51.16	46.33	49.66	44.66
0301	va	39.00	39.66	47.83	50.00	41.33	44.00	43.00	48.66
0301	vd	47.66	47.50	43.16	37.16	40.66	39.50	40.33	40.66
0301	ad	47.66	44.50	49.33	53.16	46.66	52.00	42.16	39.83
0301	vad	36.83	43.33	38.16	32.66	35.16	32.83	34.00	33.66
0302	n	49.16	61.50	52.33	56.66	49.50	56.16	54.66	58.66
0302	v	55.66	55.50	48.66	59.00	50.16	56.16	41.33	52.66
0302	a	51.66	56.83	50.66	59.50	49.33	53.83	45.66	53.33
0302	d	56.66	61.16	51.00	57.33	52.16	47.33	53.16	44.33
0302	va	53.66	53.66	51.66	54.16	41.33	48.33	52.16	54.83
0302	vd	50.50	50.83	42.66	42.33	50.50	46.16	49.16	47.66
0302	ad	53.33	53.33	48.66	50.50	52.33	44.50	49.00	44.00
0302	vad	38.33	44.66	43.00	45.50	46.16	34.33	43.16	38.83
0303	n	54.33	54.66	53.66	58.00	51.00	51.00	55.33	55.00
0303	v	55.66	59.50	52.33	54.33	46.00	52.83	49.00	55.16
0303	a	51.66	55.50	50.83	53.33	49.83	54.33	51.16	51.33
0303	d	53.50	56.33	49.16	54.16	53.16	48.16	52.83	47.00
0303	va	45.66	61.00	53.50	49.50	60.16	46.00	48.00	51.83
0303	vd	47.66	51.50	53.66	50.83	48.66	44.83	46.00	45.33

Table 8 (cont.)

0303	ad	52.33	55.50	51.66	55.83	44.83	44.00	46.16	46.00
0303	vad	49.16	50.83	36.66	39.83	47.83	34.16	41.66	42.16
0401	n	47.50	45.83	50.00	52.66	50.16	48.00	50.00	50.16
0401	v	38.50	41.33	41.50	44.66	45.16	39.83	46.00	45.50
0401	a	41.50	47.83	45.00	47.50	46.00	43.00	51.33	53.00
0401	d	44.00	44.33	46.83	52.50	49.66	47.16	47.33	46.16
0401	va	35.66	39.66	39.16	42.16	35.83	40.00	43.16	46.16
0401	vd	34.66	42.50	36.66	40.16	38.66	40.00	44.66	39.16
0401	ad	39.33	40.50	43.33	46.00	45.66	40.83	44.66	44.83
0401	vad	28.66	36.66	34.00	37.50	32.16	33.33	39.16	37.50
0402	n	43.00	54.66	51.16	53.00	46.00	45.00	52.50	49.66
0402	v	36.83	42.00	40.50	45.83	43.83	40.33	45.66	46.16
0402	a	36.83	48.33	43.16	48.66	42.00	45.33	49.00	50.00
0402	d	45.33	44.16	43.66	47.66	40.00	43.33	48.83	50.33
0402	va	34.33	37.66	39.66	43.33	40.83	40.33	43.66	40.83
0402	vd	36.50	36.50	41.66	40.50	37.83	39.50	45.50	40.33
0402	ad	36.00	37.66	40.66	40.00	42.66	40.83	46.66	42.33
0402	vad	32.00	35.00	35.16	38.16	36.50	42.16	39.66	41.50
0403	n	37.50	45.16	42.16	49.33	43.33	42.50	50.33	52.66
0403	v	34.16	37.16	41.33	40.50	40.00	41.33	43.16	44.33
0403	a	34.16	43.16	43.33	45.33	40.50	44.33	47.33	45.83
0403	d	40.83	44.33	42.50	44.83	37.66	38.16	47.16	45.33
0403	va	32.66	39.33	38.33	41.16	37.33	38.33	41.00	50.00
0403	vd	32.33	34.50	38.50	38.16	37.83	38.16	43.83	36.50
0403	ad	34.00	34.00	38.66	38.33	40.00	35.83	43.66	43.16
0403	vad	32.33	34.00	39.50	37.66	36.16	33.83	38.50	36.33
0501	n	67.00	70.50	59.66	64.00	66.66	68.16	69.16	79.66
0501	v	61.33	65.00	62.66	68.16	62.50	65.00	63.16	65.83
0501	a	59.83	60.66	60.00	63.83	72.00	71.66	67.00	73.66
0501	d	56.83	66.33	69.83	60.16	69.50	67.66	67.83	68.33
0501	va	56.50	62.66	56.16	58.33	66.33	64.83	63.00	66.83
0501	vd	59.33	54.00	54.66	56.33	58.00	53.66	58.00	61.33
0501	ad	52.66	62.33	59.83	55.33	62.83	59.00	62.16	59.33
0501	vad	47.83	56.33	46.66	44.16	57.00	56.83	52.66	54.66
0502	n	65.66	65.83	62.83	68.16	69.16	73.66	67.50	75.83
0502	v	59.00	69.83	61.00	67.83	68.00	64.66	71.16	68.00
0502	a	65.83	65.83	64.83	67.16	70.00	79.83	71.00	76.83
0502	d	62.00	60.33	66.16	71.00	66.50	66.00	64.16	71.66
0502	va	58.33	60.66	61.50	61.50	63.50	68.16	62.83	65.33
0502	vd	60.16	57.66	67.50	52.50	65.83	59.16	67.33	58.66
0502	ad	52.83	58.00	53.66	52.50	67.33	63.00	61.33	62.66
0502	vad	41.16	54.00	51.00	50.33	58.00	59.33	53.33	61.33
0503	n	65.00	70.66	73.00	68.66	73.33	74.16	73.66	79.16
0503	v	67.00	64.00	70.50	63.50	81.50	68.50	79.50	78.00
0503	a	64.50	73.33	64.33	68.00	71.16	76.33	70.33	79.16
0503	d	70.16	69.00	62.66	64.83	77.66	68.50	78.00	75.50
0503	va	64.66	64.83	64.00	60.50	69.33	76.66	71.83	71.66
0503	vd	63.66	65.66	68.00	64.83	72.16	71.50	70.33	65.83

Table 8 (cont.)

0503	ad	64.50	64.83	67.33	66.00	64.50	62.83	80.66	63.66
0503	vad	55.00	58.16	53.83	52.66	61.33	63.50	62.66	59.66
0601	n	40.33	40.66	41.83	44.16	43.83	42.83	46.66	44.83
0601	v	37.16	38.00	38.00	40.83	39.16	37.16	35.50	36.00
0601	a	39.83	39.66	39.33	41.16	37.33	43.83	44.16	45.83
0601	d	39.16	40.00	40.83	43.00	40.00	41.66	44.00	44.16
0601	va	36.33	36.16	36.66	36.50	31.50	30.83	31.66	32.33
0601	vd	33.66	35.66	37.66	36.66	34.50	32.50	34.33	33.83
0601	ad	33.33	34.83	37.33	34.16	41.00	36.00	39.66	39.66
0601	vad	29.33	29.50	33.00	31.00	26.83	24.50	31.00	26.00
0602	n	44.00	39.83	44.33	40.16	43.83	47.50	44.66	44.66
0602	v	40.66	37.00	42.83	38.66	38.83	31.83	39.16	37.50
0602	a	40.66	44.83	42.66	41.50	37.00	40.33	43.16	43.33
0602	d	40.00	40.83	41.66	40.66	44.00	43.83	42.66	44.16
0602	va	36.83	35.16	39.33	37.16	35.66	34.33	37.33	35.33
0602	vd	36.66	35.16	36.66	36.33	36.16	36.00	37.16	34.50
0602	ad	36.50	36.66	35.66	35.00	36.00	42.66	41.16	40.16
0602	vad	29.16	30.33	32.83	30.83	30.33	28.66	31.33	31.50
0603	n	45.66	42.50	45.66	42.50	45.00	49.66	45.50	43.83
0603	v	41.16	40.83	45.50	41.66	40.00	38.16	44.16	39.00
0603	a	39.16	42.16	42.33	42.16	39.50	50.66	49.50	47.00
0603	d	42.50	41.66	41.50	41.33	41.66	45.83	45.66	45.16
0603	va	37.66	38.66	38.50	38.33	37.66	36.33	41.16	41.16
0603	vd	37.66	36.50	39.16	37.33	38.50	38.50	37.16	36.33
0603	ad	40.66	38.66	40.33	35.50	39.00	40.33	43.66	41.83
0603	vad	40.66	38.66	40.33	35.50	39.00	40.83	43.66	41.83
0701	n	44.66	46.16	39.83	42.16	49.66	49.16	50.00	47.50
0701	v	45.50	45.66	37.66	41.66	39.00	50.00	37.33	37.33
0701	a	45.00	41.00	39.50	42.00	49.50	42.66	46.50	43.16
0701	d	44.33	42.16	41.66	34.83	54.50	43.16	43.66	45.50
0701	va	41.33	39.00	37.83	34.16	37.66	37.33	37.16	36.00
0701	vd	42.50	44.33	44.50	39.00	43.00	39.66	39.16	31.66
0701	ad	38.50	42.66	38.16	35.50	43.00	46.50	42.83	44.66
0701	vad	42.16	37.33	36.16	38.33	37.50	33.66	35.66	39.83
0702	n	41.16	39.33	35.66	38.33	50.16	41.83	46.16	43.16
0702	v	40.66	38.16	37.83	35.16	39.50	39.16	34.83	33.83
0702	a	40.50	38.33	33.83	39.33	44.66	44.66	45.00	44.00
0702	d	38.16	35.16	35.83	37.50	46.50	42.33	41.16	38.00
0702	va	36.66	36.16	35.83	34.66	34.83	33.33	30.83	30.33
0702	vd	35.66	32.16	34.00	33.16	35.83	36.50	35.83	29.00
0702	ad	36.16	35.33	37.33	31.00	45.83	39.83	43.66	39.33
0702	vad	37.00	27.50	29.83	29.16	35.16	28.50	29.83	26.50
0703	n	38.66	39.50	37.16	35.66	47.50	42.83	43.66	38.83
0703	v	40.66	38.33	36.66	35.66	38.66	37.50	34.16	32.50
0703	a	37.50	38.16	34.83	35.33	44.00	40.16	42.16	37.16
0703	d	37.66	35.83	38.50	31.16	45.50	37.83	43.33	35.00
0703	va	37.33	34.66	35.00	30.33	34.66	32.00	33.66	32.16
0703	vd	37.16	33.00	31.66	30.33	36.66	32.50	30.66	31.66

Table 8 (cont.)

0703	ad	34.00	32.66	34.00	30.50	43.66	37.00	39.33	35.33
0703	vad	35.33	28.00	33.16	25.50	26.66	25.50	28.33	25.66
0801	n	33.50	32.50	36.00	35.66	47.50	39.33	49.00	44.00
0801	v	32.50	28.16	32.66	29.83	33.66	31.50	34.83	31.16
0801	a	32.83	28.00	33.66	30.00	40.66	35.83	44.66	40.33
0801	d	35.16	32.50	30.66	32.33	45.83	41.66	43.50	41.33
0801	va	30.16	26.66	32.83	28.16	33.50	29.00	31.66	28.00
0801	vd	32.50	29.83	33.16	27.66	34.66	30.66	30.16	30.16
0801	ad	28.66	25.33	28.66	27.00	39.50	36.00	40.66	37.00
0801	vad	26.66	23.50	27.00	24.66	32.33	24.00	29.16	26.00
0802	n	34.00	32.66	34.66	32.00	43.00	37.66	46.00	38.50
0802	v	32.00	29.50	31.33	31.16	32.83	32.16	36.33	32.16
0802	a	32.00	29.33	33.50	32.16	36.33	39.83	43.16	38.00
0802	d	34.00	29.16	30.66	30.66	41.66	40.50	43.16	41.50
0802	va	30.33	28.83	30.16	30.66	33.50	29.50	32.83	29.16
0802	vd	33.00	26.33	30.33	29.00	32.33	27.16	32.33	31.83
0802	ad	31.33	24.83	29.83	29.83	38.83	38.33	38.66	35.50
0802	vad	28.16	25.50	28.16	26.33	33.83	24.16	29.83	27.66
0803	n	44.16	35.33	47.00	40.33	54.83	52.33	53.50	49.66
0803	v	37.00	38.16	38.16	36.16	39.66	41.50	41.50	38.16
0803	a	40.16	36.33	43.33	40.33	45.00	45.00	49.16	46.50
0803	d	40.66	37.33	38.16	35.00	49.50	44.50	49.16	46.00
0803	va	33.16	37.00	33.83	47.00	35.50	36.66	37.83	38.00
0803	vd	38.83	37.00	34.16	31.83	37.33	35.33	41.16	32.16
0803	ad	40.66	26.00	33.00	34.33	48.66	40.83	45.00	47.50
0803	vad	32.83	31.16	33.33	33.50	36.83	29.83	34.16	38.16

Table 9

MT (msec) for Arm,
Direction, and Velocity

Explanation of the Data Coding

Columns 1-2 specify subjects

Columns 3-4 specify days of testing

Columns 6-8 specify precues given

N= no precue

V= velocity

A= arm

D= direction

VA= velocity and arm

VD= velocity and direction

AD= arm and direction

VAD= velocity, arm, and direction

Columns 10-32 specify fast movements

Columns 34-56 specify slow movements

0101	n	10.33	11.50	10.66	11.50	22.66	24.50	25.00	22.00
0101	v	10.83	11.00	10.50	11.33	23.16	23.00	23.50	22.33
0101	a	10.50	11.33	10.66	10.83	22.66	25.00	22.50	24.16
0101	d	10.50	12.50	10.66	11.00	22.00	23.83	24.16	21.83
0101	va	11.33	11.00	12.00	10.83	22.83	23.00	23.66	20.66
0101	vd	11.66	11.50	10.83	11.16	20.83	23.66	23.00	21.83
0101	ad	10.83	10.16	11.33	11.00	21.66	24.00	21.83	21.83
0101	vad	10.50	11.50	11.83	11.33	25.00	22.33	22.83	21.66
0102	n	11.66	11.83	11.00	11.00	25.50	26.00	23.66	24.50
0102	v	12.50	12.16	11.00	11.00	23.16	26.50	23.00	22.50
0102	a	11.33	11.50	11.66	11.33	23.83	25.83	24.00	23.83
0102	d	11.00	12.00	10.66	11.00	23.83	26.00	24.66	23.16
0102	va	10.66	11.33	10.66	12.33	23.00	26.16	23.66	22.83
0102	vd	11.16	11.50	10.66	11.33	23.00	25.00	23.83	23.16
0102	ad	11.16	11.00	11.83	11.16	23.33	23.83	24.16	23.83
0102	vad	11.50	13.50	12.33	12.33	24.00	25.83	24.00	23.00
0103	n	11.00	12.33	11.00	10.00	24.00	26.16	24.16	24.66
0103	v	11.66	11.33	10.83	10.83	23.16	24.83	23.50	23.33
0103	a	11.00	10.83	11.50	10.83	24.50	24.50	24.16	24.00
0103	d	10.83	12.83	10.16	10.66	22.66	27.16	25.33	24.33
0103	va	11.83	11.00	12.16	11.16	22.33	24.66	23.16	22.00
0103	vd	11.16	11.16	10.66	11.00	23.00	23.83	24.33	24.16

Table 9 (cont.)

0103	ad	10.50	11.16	10.00	10.33	22.66	24.16	23.33	22.00
0103	vad	12.00	12.16	11.00	11.50	24.83	25.83	23.16	23.66
0201	n	12.33	12.50	12.16	11.83	26.66	27.83	24.50	25.50
0201	v	11.83	12.83	12.00	11.50	26.33	27.33	24.50	24.50
0201	a	12.16	12.00	12.33	12.00	27.00	25.66	26.16	26.33
0201	d	12.66	12.00	11.50	10.83	27.00	26.66	25.83	25.00
0201	va	11.66	11.66	11.66	11.83	25.83	24.33	24.33	25.83
0201	vd	12.50	10.83	12.00	11.66	23.33	26.33	26.16	21.16
0201	ad	12.33	11.33	11.50	11.50	27.50	28.00	25.33	25.33
0201	vad	12.00	12.16	11.33	11.66	27.33	25.50	24.83	25.33
0202	n	11.50	12.16	11.66	11.83	26.83	26.83	25.00	24.16
0202	v	12.00	12.50	12.33	11.33	25.16	25.00	25.50	25.33
0202	a	12.66	12.66	12.00	11.50	27.00	26.83	24.16	23.50
0202	d	12.16	10.66	11.50	11.50	25.83	27.00	25.33	24.66
0202	va	12.50	12.66	12.66	13.00	24.50	24.50	24.16	24.66
0202	vd	11.33	12.16	11.33	12.33	25.83	22.66	25.33	23.83
0202	ad	11.50	12.66	12.16	10.66	24.00	25.66	25.66	25.83
0202	vad	11.83	12.66	12.16	11.83	27.83	23.83	26.00	22.33
0203	n	12.33	11.16	12.33	11.50	27.33	26.33	23.66	23.33
0203	v	11.66	12.00	12.16	10.83	25.50	24.50	25.83	24.00
0203	a	11.83	11.33	11.83	11.66	24.66	24.66	25.33	25.33
0203	d	12.00	11.83	11.33	11.16	26.33	26.33	24.66	23.33
0203	va	12.50	12.33	12.00	10.66	25.83	25.16	24.33	23.50
0203	vd	11.66	12.16	11.83	10.33	25.50	24.66	26.66	23.00
0203	ad	11.66	11.50	11.50	10.33	26.50	25.33	26.33	24.00
0203	vad	11.50	11.66	11.50	11.66	26.00	25.83	27.50	24.50
0301	n	11.00	11.50	12.16	9.66	24.00	25.66	24.83	27.16
0301	v	11.66	12.66	12.33	11.00	24.00	24.00	25.50	26.16
0301	a	11.66	11.33	11.16	10.33	22.83	25.16	24.66	25.00
0301	d	12.00	11.50	11.66	10.66	24.16	24.00	25.16	25.50
0301	va	12.16	11.66	12.50	11.83	26.16	26.00	24.33	24.83
0301	vd	11.50	11.16	11.16	11.16	24.16	26.00	24.16	26.16
0301	ad	11.33	12.00	11.00	11.33	25.00	24.33	25.00	22.16
0301	vad	12.00	11.66	11.50	10.83	23.16	21.83	25.16	25.50
0302	n	11.83	12.16	11.50	11.16	22.83	26.00	23.66	25.50
0302	v	12.00	11.33	12.00	11.33	23.66	21.66	21.00	24.16
0302	a	12.16	11.66	11.83	11.83	23.16	24.16	23.83	22.83
0302	d	11.50	11.83	12.50	10.66	24.33	21.50	25.00	24.16
0302	va	12.66	12.00	11.33	11.33	22.66	23.16	24.33	23.16
0302	vd	12.00	11.66	11.83	11.66	23.00	23.33	24.33	25.16
0302	ad	10.66	11.33	12.16	11.83	23.50	23.16	21.66	24.33
0302	vad	12.00	10.83	10.66	12.66	23.50	26.16	26.00	24.83
0303	n	11.66	11.33	11.66	11.16	23.50	22.16	24.66	27.00
0303	v	12.83	11.16	12.16	10.83	21.66	25.33	24.50	24.50
0303	a	10.33	11.66	11.33	11.33	24.33	24.33	24.16	23.00
0303	d	12.33	11.50	13.50	11.00	22.33	22.33	24.00	23.00
0303	va	12.66	11.83	13.33	11.00	24.00	22.83	25.66	23.16
0303	vd	12.66	11.83	12.33	10.66	22.83	23.83	23.16	24.33

Table 9 (cont.)

0303	ad	12.66	12.00	11.50	11.33	23.16	24.00	24.66	23.83
0303	vad	10.83	11.33	13.16	10.83	23.33	24.50	23.16	25.33
0401	n	10.83	12.33	10.83	12.16	23.16	24.50	25.00	25.16
0401	v	11.33	12.00	11.83	13.00	24.00	22.66	24.33	24.00
0401	a	12.16	12.83	12.66	13.33	24.66	24.16	24.66	25.16
0401	d	11.00	12.83	12.33	13.00	24.16	23.16	25.00	25.83
0401	va	12.16	12.83	11.83	12.66	24.33	24.16	24.83	23.50
0401	vd	10.50	12.33	11.16	11.50	23.66	24.33	26.50	23.83
0401	ad	11.50	12.33	12.16	12.83	25.16	23.00	24.33	25.50
0401	vad	12.33	12.83	12.00	13.50	24.33	24.66	27.50	26.33
0402	n	11.50	12.83	11.50	13.16	23.33	24.16	24.50	23.50
0402	v	11.33	11.33	12.66	12.83	23.83	24.33	25.33	23.66
0402	a	10.33	11.33	12.00	12.16	24.00	23.66	26.00	23.33
0402	d	11.16	11.66	12.33	11.33	23.33	25.83	24.16	23.83
0402	va	12.00	11.83	12.50	11.66	23.33	24.00	24.33	23.33
0402	vd	11.83	10.33	12.33	12.50	24.33	24.50	25.50	22.66
0402	ad	11.00	12.33	11.66	12.16	24.50	25.00	26.33	25.00
0402	vad	10.83	12.50	11.83	12.33	22.16	26.83	25.50	25.16
0403	n	11.00	11.50	12.33	11.83	25.33	25.33	25.16	23.33
0403	v	11.50	11.16	11.00	12.50	21.66	24.00	23.50	24.16
0403	a	11.83	12.66	12.66	12.00	24.66	24.66	26.16	25.33
0403	d	11.16	11.66	11.16	12.66	24.16	23.16	22.83	24.83
0403	va	12.66	12.33	11.16	12.66	23.83	24.16	23.83	25.16
0403	vd	11.50	11.66	12.66	12.00	23.83	23.50	23.66	23.33
0403	ad	12.00	12.33	11.66	12.50	25.83	25.66	26.33	24.83
0403	vad	10.66	11.83	12.16	13.16	24.16	25.16	26.00	27.66
0501	n	11.00	10.16	11.33	11.33	23.83	23.83	25.33	23.16
0501	v	11.33	11.66	12.33	11.66	24.33	24.33	24.33	24.16
0501	a	13.00	11.83	12.66	11.66	24.66	24.50	25.50	24.16
0501	d	12.16	11.66	10.66	10.83	25.50	25.83	26.33	23.16
0501	va	11.00	11.00	10.83	11.00	25.16	24.16	23.16	24.66
0501	vd	11.33	11.16	13.00	10.83	24.83	23.83	24.66	23.50
0501	ad	11.83	12.16	11.66	12.16	26.16	24.00	23.50	24.16
0501	vad	11.33	11.66	12.33	10.50	24.66	22.50	24.33	24.83
0502	n	11.33	12.00	11.83	12.66	26.16	22.33	26.00	23.83
0502	v	12.16	11.00	11.00	12.00	25.83	23.83	21.83	23.66
0502	a	11.83	11.66	11.16	11.33	25.00	23.66	24.33	24.50
0502	d	11.00	12.50	12.50	11.83	25.50	24.83	26.33	24.00
0502	va	11.33	11.50	10.83	12.50	25.83	22.66	22.33	23.33
0502	vd	11.66	12.50	11.00	11.83	25.16	21.33	21.83	23.66
0502	ad	11.50	11.66	13.00	11.83	26.00	24.50	23.33	21.66
0502	vad	12.33	10.66	12.00	11.33	23.83	24.16	23.00	22.33
0503	n	11.33	11.66	11.16	11.00	25.16	24.16	25.00	25.50
0503	v	13.00	12.83	10.83	11.00	23.66	24.16	25.33	24.66
0503	a	11.50	12.00	10.83	12.66	24.50	26.66	23.16	23.83
0503	d	11.66	12.50	10.33	9.83	23.66	26.00	26.00	26.66
0503	va	13.33	13.00	12.83	11.00	26.00	24.50	24.50	23.33
0503	vd	11.33	12.00	11.00	12.83	24.66	24.50	25.16	24.00

Table 9 (cont.)

0503	ad	11.16	11.83	11.00	10.83	24.16	25.33	24.83	26.16
0503	vad	11.83	12.16	11.16	11.66	25.83	25.33	24.33	24.50
0601	n	12.50	12.50	12.66	11.50	24.66	23.33	25.16	23.00
0601	v	11.33	12.16	11.16	12.16	23.66	23.83	23.83	21.66
0601	a	12.00	11.00	11.83	10.66	24.00	23.16	25.16	23.16
0601	d	12.16	12.50	12.50	11.83	25.66	23.33	25.33	22.00
0601	va	10.66	10.83	13.33	12.00	24.00	23.50	25.16	23.33
0601	vd	12.83	11.50	12.00	11.83	22.66	23.33	23.16	21.16
0601	ad	11.66	11.50	11.33	12.16	24.16	24.00	23.50	23.66
0601	vad	12.50	10.83	12.33	11.66	25.66	24.00	25.66	22.16
0602	n	10.83	12.00	11.50	11.00	25.00	25.00	22.83	23.83
0602	v	11.33	10.33	11.83	11.33	22.83	22.33	21.83	24.00
0602	a	12.50	10.33	11.16	12.33	24.66	23.16	22.50	23.50
0602	d	10.83	10.83	11.83	11.83	24.33	22.33	24.50	24.00
0602	va	11.16	12.50	12.33	11.16	23.83	23.66	23.33	23.50
0602	vd	11.66	11.00	11.00	12.16	24.00	25.50	23.83	23.33
0602	ad	11.83	11.16	11.16	10.33	24.33	22.33	25.16	23.83
0602	vad	11.33	10.66	11.83	11.66	24.00	24.16	23.33	24.00
0603	n	10.83	9.83	10.66	12.50	24.50	25.33	23.33	23.83
0603	v	10.50	11.50	11.16	11.66	23.66	22.66	23.66	23.66
0603	a	10.33	11.16	11.50	11.00	25.66	24.33	24.83	25.66
0603	d	10.33	11.00	11.66	11.83	25.16	22.66	24.16	23.00
0603	va	11.83	12.33	12.16	11.00	25.16	23.83	22.33	23.50
0603	vd	12.50	11.66	11.50	12.00	23.83	22.83	23.50	23.00
0603	ad	10.33	12.00	11.50	12.16	25.33	22.50	26.16	22.33
0603	vad	11.16	11.66	12.16	11.83	23.83	23.50	24.16	22.50
0701	n	10.00	13.16	13.16	12.66	24.66	21.83	26.83	23.66
0701	v	10.16	12.66	11.00	12.16	22.50	22.33	24.00	23.50
0701	a	11.33	11.83	12.50	12.00	23.66	23.33	23.50	21.83
0701	d	9.83	13.33	11.83	12.16	24.33	24.16	23.66	24.33
0701	va	11.50	12.50	12.33	11.66	23.00	22.83	22.66	23.16
0701	vd	10.83	11.83	12.66	11.66	23.16	21.50	22.66	22.16
0701	ad	10.33	12.50	12.66	12.66	25.33	23.66	23.66	23.50
0701	vad	10.83	11.00	12.33	12.00	24.33	23.83	22.66	23.50
0702	n	9.66	12.16	11.83	11.66	24.00	22.00	26.50	22.66
0702	v	10.83	11.66	11.33	11.66	24.66	20.83	24.50	23.00
0702	a	10.33	11.16	13.50	11.83	25.83	23.16	24.16	22.00
0702	d	10.66	12.00	11.66	12.16	24.13	24.16	22.33	23.66
0702	va	10.83	11.83	13.50	11.83	24.83	22.16	23.50	22.66
0702	vd	10.00	12.00	11.83	12.16	22.66	21.50	23.50	22.83
0702	ad	9.83	11.83	13.66	11.66	24.50	24.66	23.50	24.33
0702	vad	10.50	11.00	11.66	12.33	25.33	21.83	25.00	24.00
0703	n	10.50	11.33	10.50	11.33	26.33	24.16	24.83	22.83
0703	v	10.83	10.83	12.66	11.50	24.00	22.83	24.16	22.83
0703	a	10.50	11.16	12.00	11.33	21.83	21.16	24.00	22.66
0703	d	10.00	12.50	11.00	11.83	24.33	23.66	22.50	21.66
0703	va	11.50	11.66	11.33	11.66	22.66	22.66	23.00	23.00
0703	vd	10.33	12.16	11.66	11.33	23.66	22.83	22.00	24.00

Table 9 (cont.)

0703	ad	9.83	11.66	11.16	11.16	24.50	23.00	23.66	23.83
0703	vad	11.00	12.00	13.33	12.33	22.83	22.00	23.33	23.00
0801	n	10.83	11.83	11.16	12.00	22.16	26.50	24.00	25.00
0801	v	11.00	12.16	10.33	11.66	22.83	26.33	23.00	23.33
0801	a	10.83	12.66	12.00	12.66	23.83	25.66	22.00	26.66
0801	d	11.83	11.83	11.00	12.50	22.00	27.00	20.16	26.50
0801	va	10.50	11.83	11.50	11.33	21.66	26.16	21.83	24.83
0801	vd	11.16	10.66	11.16	12.00	23.00	25.50	21.16	26.33
0801	ad	11.00	12.00	10.33	12.16	25.66	24.00	24.00	25.00
0801	vad	10.83	11.16	11.50	12.00	24.16	24.83	23.83	25.33
0802	n	10.33	11.50	10.66	11.83	21.50	23.83	24.33	24.83
0802	v	10.66	11.83	11.16	11.83	23.33	24.33	24.16	25.16
0802	a	11.16	13.50	11.16	10.50	22.83	23.33	22.66	24.50
0802	d	12.16	11.83	11.00	12.50	22.83	23.33	25.83	24.00
0802	va	10.16	11.66	11.33	11.83	22.83	24.16	22.33	24.66
0802	vd	10.33	10.66	11.83	11.33	23.16	23.50	25.00	25.16
0802	ad	10.83	12.00	12.16	11.83	24.00	24.16	24.50	25.00
0802	vad	10.66	11.33	10.33	11.83	25.16	25.00	24.00	24.16
0803	n	12.00	11.83	10.66	11.66	25.83	25.50	25.00	26.00
0803	v	10.50	11.66	10.50	10.66	23.66	25.83	24.83	25.50
0803	a	11.50	10.66	10.66	11.16	23.66	26.00	24.16	24.33
0803	d	12.50	11.50	11.83	11.83	25.33	26.33	26.50	25.66
0803	va	11.33	11.00	11.33	10.83	23.16	24.66	23.50	25.66
0803	vd	10.83	10.50	11.16	12.00	23.33	24.00	25.16	24.66
0803	ad	12.50	10.50	10.83	11.33	25.83	25.00	28.00	25.00
0803	vad	12.00	10.50	10.83	11.00	26.33	23.16	25.33	26.00
0101	n	11.16	11.50	10.66	11.50	23.50	23.50	23.33	24.33
0102	d	10.33	12.00	11.50	10.66	24.66	22.16	25.33	23.50
0101	v	12.16	12.33	11.83	11.16	23.00	22.83	22.66	24.16
0102	va	11.00	11.66	11.00	11.00	24.66	22.50	25.33	25.83
0101	a	10.33	11.33	10.50	11.00	22.66	23.16	23.66	23.83
0102	vd	10.50	12.16	10.83	10.50	24.00	23.16	24.50	24.16
0101	d	12.33	11.33	10.50	11.16	24.00	26.16	23.33	22.50
0102	ad	11.00	11.16	12.00	10.33	23.66	23.83	23.50	27.00
0101	va	11.66	11.33	11.00	11.16	22.50	23.16	22.00	22.00
0102	vad	13.33	12.00	11.50	11.00	23.00	24.50	24.66	25.16
0101	vd	12.00	11.66	10.66	10.50	21.83	23.66	24.33	24.33
0103	n	11.33	11.50	12.16	10.83	23.00	22.66	25.00	24.16
0101	ad	11.33	11.00	10.83	10.00	22.66	24.00	22.50	24.16
0103	v	11.83	11.66	12.33	11.33	22.33	23.00	24.00	23.83
0101	vad	12.50	10.66	13.16	11.33	22.83	25.00	23.66	25.00
0103	a	11.66	10.66	12.00	11.50	23.33	23.16	23.83	25.16
0102	n	10.83	11.00	11.16	11.00	24.66	22.50	25.00	23.83
0103	d	11.50	11.00	12.33	11.33	23.16	23.16	25.33	23.16
0102	v	12.00	11.16	11.50	10.33	22.33	23.16	24.00	24.00
0103	va	12.00	11.00	12.66	11.16	24.83	23.00	25.16	25.83
0102	a	11.50	12.33	12.50	11.66	23.00	23.16	25.33	26.66
0103	vd	12.00	11.16	12.33	11.33	21.83	23.66	25.16	25.66

Table 9 (cont.)

0103	ad	12.16	11.16	12.00	11.66	22.50	23.50	24.83	24.50
0103	vad	12.66	10.50	11.83	11.66	24.16	22.50	24.83	24.33
0201	n	10.83	10.83	11.00	12.50	24.50	23.00	25.00	23.83
0201	v	11.00	10.16	11.50	11.83	24.33	23.33	26.83	24.50
0201	a	11.00	10.33	10.33	11.66	25.00	24.66	24.50	24.16
0201	d	10.66	10.00	10.83	11.83	24.83	22.16	23.50	26.33
0201	va	11.66	10.00	11.00	11.66	23.83	23.33	22.83	26.00
0201	vd	11.50	10.66	11.00	11.83	26.33	23.83	24.00	23.50
0201	ad	10.16	10.66	10.66	11.66	26.16	23.50	27.00	26.33
0201	vad	11.50	10.50	11.50	12.33	25.66	23.83	24.66	25.00
0202	n	10.00	10.16	11.66	11.83	24.66	23.33	24.00	23.83
0202	v	10.33	11.00	10.66	11.83	25.66	20.83	23.83	24.66
0202	a	10.16	11.16	10.50	11.50	23.50	23.16	22.33	22.33
0202	d	10.66	10.50	11.33	12.16	24.83	23.66	24.50	24.66
0202	va	11.33	10.50	11.66	12.50	24.83	22.16	23.50	24.83
0202	vd	11.33	10.83	9.83	11.83	25.83	22.50	27.33	24.16
0202	ad	11.16	11.00	10.66	12.83	24.33	24.33	23.00	24.66
0202	vad	10.83	10.16	11.00	11.66	22.83	23.00	24.83	23.66
0203	n	11.00	10.00	10.50	12.00	25.00	22.83	23.50	25.16
0203	v	11.16	10.00	11.50	11.50	25.83	23.83	25.50	23.83
0203	a	11.16	10.16	10.16	11.83	23.66	24.50	22.66	25.16
0203	d	11.00	11.00	10.50	11.83	23.50	23.16	24.66	23.33
0203	va	11.16	11.00	12.16	11.50	23.83	22.66	23.83	24.16
0203	vd	12.50	9.83	11.50	12.16	24.16	22.50	24.33	25.00
0203	ad	10.33	10.50	11.33	11.33	24.50	23.16	23.66	23.33
0203	vad	11.16	10.16	12.66	12.00	25.33	25.83	24.66	23.83
0301	n	11.83	10.83	11.83	11.50	23.16	24.50	24.16	23.83
0301	v	12.33	11.66	12.83	11.50	23.50	22.33	22.66	23.83
0301	a	12.00	11.16	11.33	11.50	23.83	24.00	25.50	25.16
0301	d	12.16	11.50	12.33	12.33	24.16	23.33	23.66	22.66
0301	va	12.00	11.33	12.16	12.16	24.00	23.83	22.83	24.66
0301	vd	12.66	11.50	11.50	12.00	24.33	23.50	25.16	23.50
0301	ad	11.83	10.83	12.00	11.33	23.83	23.50	22.50	23.50
0301	vad	12.33	12.00	13.16	12.16	24.66	26.00	23.33	24.00
0302	n	12.00	12.00	11.50	11.16	23.50	23.33	25.66	26.16
0302	v	12.33	10.33	10.83	11.16	22.83	22.00	24.83	23.16
0302	a	11.33	11.66	12.66	11.66	24.33	21.66	24.66	24.33
0302	d	12.50	11.83	11.83	11.66	22.66	23.33	23.00	24.16
0302	va	12.50	11.00	12.16	11.33	22.00	23.83	23.83	24.33
0302	vd	11.50	11.83	12.00	11.50	23.33	24.33	24.00	22.66
0302	ad	11.00	11.16	12.16	11.33	24.83	26.33	22.66	25.00
0302	vad	12.00	11.66	11.83	10.83	24.33	26.16	24.16	25.00
0303	n	10.66	11.33	11.33	12.66	23.66	21.66	22.33	24.00
0303	v	11.50	11.66	11.66	11.33	22.33	22.16	23.66	22.16
0303	a	12.16	11.66	11.16	12.16	25.16	23.50	22.83	23.33
0303	d	12.50	12.00	11.16	12.33	23.33	20.83	23.16	23.50
0303	va	12.16	10.33	12.50	11.66	23.16	21.66	21.66	22.33
0303	vd	11.83	11.33	11.16	11.00	22.66	21.66	24.66	24.16

Table 9 (cont.)

0303	ad	12.33	11.50	11.50	12.33	23.00	21.16	23.00	24.16
0303	vad	11.83	11.00	11.83	12.16	23.16	23.83	22.16	22.00
0401	n	11.83	12.83	10.00	10.66	24.16	27.50	24.00	25.33
0401	v	11.16	12.50	10.83	11.16	22.33	25.50	21.83	24.16
0401	a	11.00	12.00	10.33	11.00	23.33	24.33	23.83	24.66
0401	d	11.00	13.66	10.00	11.16	24.33	25.83	23.00	24.16
0401	va	10.83	11.33	10.50	11.83	23.50	22.83	23.16	25.83
0401	vd	12.66	11.16	10.33	11.50	24.83	24.33	23.16	23.66
0401	ad	10.66	13.00	10.50	11.50	24.66	26.16	21.33	25.66
0401	vad	12.66	11.66	10.66	10.50	20.83	22.33	22.16	24.33
0402	n	11.33	11.00	10.33	11.66	24.83	26.33	21.83	25.00
0402	v	11.00	11.66	10.16	10.00	23.66	24.66	23.33	27.50
0402	a	11.66	10.83	12.66	11.16	25.66	24.00	25.66	27.00
0402	d	10.83	11.16	10.66	11.33	25.16	25.16	24.83	27.50
0402	va	10.66	12.00	10.33	10.33	22.83	24.16	22.83	22.83
0402	vd	10.83	10.66	10.50	11.16	22.00	22.33	22.50	25.33
0402	ad	10.83	11.33	11.00	10.66	23.66	26.16	23.50	27.16
0402	vad	12.16	10.83	12.00	12.00	22.33	25.33	23.16	24.16
0403	n	10.66	11.50	10.83	10.50	24.66	25.50	25.33	27.00
0403	v	11.33	11.50	11.33	11.16	25.00	26.00	23.33	25.33
0403	a	10.83	12.83	10.50	11.50	22.83	24.50	24.33	23.83
0403	d	10.50	11.16	10.66	11.83	24.00	24.83	25.50	25.16
0403	va	10.50	11.16	10.16	11.00	22.16	24.33	25.00	26.50
0403	vd	11.00	11.33	10.66	11.50	24.16	24.83	24.66	22.83
0403	ad	11.33	11.33	9.83	12.00	23.83	23.66	23.66	27.66
0403	vad	12.16	10.83	11.16	11.33	22.66	24.16	23.50	24.66
0501	n	12.33	11.33	13.00	12.00	24.50	24.66	26.33	23.83
0501	v	12.50	10.50	12.00	11.83	25.33	22.83	24.66	24.00
0501	a	10.83	9.66	12.50	11.66	27.00	25.33	23.33	22.83
0501	d	12.66	11.50	11.50	10.66	26.33	24.16	26.33	24.33
0501	va	12.16	11.50	12.33	11.33	24.50	23.83	24.33	24.33
0501	vd	12.50	11.66	12.00	12.00	25.83	22.33	24.83	22.50
0501	ad	12.33	11.16	13.66	12.33	24.00	25.83	25.16	24.33
0501	vad	12.66	10.50	13.16	12.00	23.83	21.83	24.50	24.16
0502	n	13.00	11.33	12.16	11.00	23.66	25.83	23.16	24.00
0502	v	12.16	11.00	10.83	11.66	25.83	22.33	22.83	24.00
0502	a	12.33	11.33	11.33	10.16	25.33	21.50	24.00	23.33
0502	d	12.33	12.00	10.66	11.33	26.66	24.00	25.00	24.00
0502	va	11.16	11.16	11.83	10.16	23.50	22.00	24.00	24.33
0502	vd	12.16	11.00	11.33	12.00	23.50	22.50	22.00	23.83
0502	ad	12.33	10.66	10.66	10.66	26.50	23.33	25.33	24.66
0502	vad	11.50	11.66	11.83	11.16	25.83	22.66	24.16	24.00
0503	n	11.50	12.33	10.83	12.66	25.66	22.33	23.00	22.50
0503	v	11.50	11.33	11.50	11.16	24.33	23.16	23.50	22.50
0503	a	12.83	10.66	11.50	11.33	22.33	22.33	24.16	24.66
0503	d	12.00	11.50	11.16	11.83	23.66	22.00	24.16	23.50
0503	va	11.16	10.83	12.00	11.16	22.00	24.00	25.00	21.66
0503	vd	11.66	11.16	11.50	11.83	22.83	22.00	23.66	24.33

Table 9 (cont.)

0503	ad	12.66	11.33	11.50	11.00	24.33	25.00	22.83	23.33
0503	vad	13.50	12.00	11.83	12.66	24.50	23.83	22.00	22.33
0601	n	11.16	11.50	11.33	11.83	26.00	25.00	23.66	25.66
0601	v	11.83	10.50	10.83	11.33	24.16	25.00	26.16	26.33
0601	a	11.33	11.16	10.83	10.50	24.66	26.50	25.50	25.50
0601	d	12.00	10.83	12.00	10.16	24.00	25.50	26.33	23.50
0601	va	10.66	11.66	10.16	12.33	23.66	24.16	25.83	23.50
0601	vd	11.16	11.66	11.50	10.66	25.16	23.00	25.50	24.33
0601	ad	11.33	11.83	10.66	12.00	24.00	26.33	24.16	24.83
0601	vad	12.50	11.66	11.66	11.66	24.66	24.33	25.83	24.50
0602	n	11.33	11.00	11.66	11.50	25.50	24.16	26.33	24.50
0602	v	10.83	10.83	12.00	11.66	24.33	24.33	23.66	24.16
0602	a	11.00	10.66	11.33	10.83	23.66	25.16	24.16	24.83
0602	d	11.83	10.83	12.66	12.16	24.50	25.16	25.50	26.33
0602	va	11.50	10.33	10.66	11.66	24.33	23.16	25.66	23.83
0602	vd	11.50	11.50	11.83	11.50	23.50	23.83	25.33	24.66
0602	ad	11.83	11.66	11.83	12.50	24.50	24.33	24.83	24.50
0602	vad	12.00	10.50	11.33	11.16	23.33	23.50	26.83	23.83
0603	n	11.16	11.83	10.83	11.83	23.50	23.00	24.33	24.33
0603	v	12.16	11.50	11.50	11.50	23.66	23.00	25.83	24.26
0603	a	12.50	10.66	11.83	11.66	25.83	22.83	24.66	25.83
0603	d	11.00	11.33	11.16	11.83	25.16	24.16	26.16	25.00
0603	va	10.33	11.33	11.00	11.66	23.83	24.83	26.16	23.83
0603	vd	11.50	11.66	11.00	12.00	23.83	24.33	24.00	25.16
0603	ad	11.66	10.83	10.33	12.50	24.33	23.33	26.50	24.50
0603	vad	11.50	11.16	11.33	11.16	25.66	24.66	25.16	25.00
0701	n	11.66	12.33	12.33	12.00	24.50	24.83	25.83	26.16
0701	v	11.00	12.33	12.00	12.00	23.66	24.50	25.50	27.00
0701	a	11.50	12.33	13.00	12.33	26.16	27.33	26.00	25.16
0701	d	11.16	12.00	11.83	11.33	27.50	25.83	24.83	27.33
0701	va	10.00	12.16	12.50	11.16	23.83	25.33	25.16	23.16
0701	vd	11.50	11.16	11.33	11.66	25.33	25.33	24.16	26.66
0701	ad	11.66	12.16	12.00	12.16	26.50	25.00	25.00	26.33
0701	vad	12.00	11.16	11.66	11.00	26.16	25.50	26.50	25.16
0702	n	10.83	10.66	13.50	12.66	23.00	24.83	23.83	25.50
0702	v	11.66	12.50	13.83	12.66	23.00	23.66	24.16	22.83
0702	a	11.83	12.83	12.50	12.50	24.16	24.16	24.50	24.33
0702	d	12.50	13.50	13.50	12.00	22.83	24.00	26.50	24.00
0702	va	12.50	12.50	12.66	12.00	21.66	21.16	26.33	22.50
0702	vd	11.00	13.33	14.16	13.33	24.16	23.00	23.66	25.33
0702	ad	11.16	13.50	12.33	13.00	23.33	26.50	24.83	25.66
0702	vad	13.33	12.66	11.83	13.83	23.83	23.50	23.50	25.16
0703	n	11.16	11.66	12.00	12.33	23.33	24.00	26.66	23.16
0703	v	11.16	12.00	11.66	12.50	23.66	22.83	26.33	22.66
0703	a	10.16	13.00	12.50	12.00	22.83	24.16	25.83	24.00
0703	d	11.33	12.16	12.00	11.83	23.50	22.33	23.66	23.16
0703	va	11.66	13.16	10.66	11.66	23.66	22.50	25.16	22.00
0703	vd	11.16	12.00	11.16	11.66	23.00	21.83	24.66	25.50

Table 9 (cont.)

0703	ad	11.00	12.33	12.16	11.83	23.66	24.16	26.00	23.66
0703	vad	10.83	12.50	11.66	13.50	25.00	22.33	23.66	23.33
0801	n	12.00	11.66	11.00	12.33	22.50	26.16	23.33	25.83
0801	v	11.83	12.16	12.16	11.83	23.33	26.16	27.16	26.16
0801	a	11.83	12.83	10.33	12.16	25.00	24.50	24.33	24.66
0801	d	11.66	12.16	11.50	12.00	23.16	26.00	25.00	25.33
0801	va	10.83	11.83	10.33	12.50	24.50	24.83	24.83	23.00
0801	vd	11.00	11.50	12.33	11.50	23.00	24.83	26.33	23.50
0801	ad	10.66	12.50	12.00	12.00	23.33	24.83	25.16	24.16
0801	vad	10.83	12.83	12.66	12.16	22.50	24.50	21.50	23.66
0802	n	10.66	13.50	11.00	12.66	26.66	26.83	24.66	25.33
0802	v	11.50	12.83	11.16	12.66	25.16	25.00	23.66	26.33
0802	a	10.50	13.00	10.50	12.83	25.16	26.83	23.50	22.16
0802	d	10.16	12.66	11.66	12.16	24.33	27.00	26.00	24.66
0802	va	11.33	12.33	9.83	12.33	23.83	26.83	23.66	25.33
0802	vd	10.83	12.50	11.00	12.16	25.00	23.50	22.33	25.16
0802	ad	10.33	13.16	11.66	12.00	25.16	23.33	24.16	24.33
0802	vad	9.33	13.83	11.00	12.66	23.16	23.33	24.00	25.50
0803	n	10.50	12.33	11.16	11.83	24.00	23.33	25.00	25.50
0803	v	10.83	12.33	11.66	12.16	24.83	24.66	26.00	26.33
0803	a	11.50	13.66	11.33	11.66	26.16	24.83	24.66	25.66
0803	d	10.83	12.66	11.16	12.00	25.50	24.00	25.33	25.16
0803	va	10.16	13.16	12.83	12.33	24.83	26.50	24.50	24.66
0803	vd	10.16	11.83	12.33	12.33	24.50	27.33	24.50	25.33
0803	ad	11.83	12.66	12.16	11.50	24.50	26.50	24.66	23.33
0803	vad	9.66	12.00	11.33	11.66	25.83	25.83	26.50	24.16

APPENDIX B
ANALYSES OF VARIANCE SUMMARY TABLE

Table 10

Analysis of Variance (RT) Summary Table
for Programming Two Parameters (AD, VA,
VD)

Source of Variation	SS	DF	MS	F
X	105.27610	1	105.27610	F(1,15) = 1.48
A	7.89866	1	7.89866	F(1,15) = 0.08
XA	8.79726	1	8.79726	F(1,15) = 0.60
V	3043.72274	1	3043.72274	F(1,15) = 7.98 *
XV	0.72150	1	0.72150	F(1,15) = 0.03
AV	7.22475	1	7.22475	F(1,15) = 0.61
XAV	0.00619	1	0.00619	F(1,15) = 0.00
P	2023.12793	2	1011.56397	F(2,30) = 17.62 **
XP	441.62231	2	220.81115	F(2,30) = 9.73 **
AP	22.83564	2	11.41782	F(2,30) = 0.78
XAP	41.19636	2	20.59818	F(2,30) = 2.98
VP	358.56193	2	179.28097	F(2,30) = 3.60 *
XVP	2.48956	2	1.24478	F(2,30) = 0.10
AVP	1.23099	2	0.61549	F(2,30) = 0.05
XAVP	2.01632	2	1.00816	F(2,30) = 0.16
D	187.53671	2	93.76836	F(2,30) = 0.54
XD	52.08217	2	26.04108	F(2,30) = 2.71
AD	8.76905	2	4.38453	F(2,30) = 0.79
XAD	0.87955	2	0.43978	F(2,30) = 0.07
VD	6.78977	2	3.39488	F(2,30) = 0.27
XVD	8.78603	2	4.39301	F(2,30) = 0.35
AVD	28.56644	2	14.28322	F(2,30) = 1.35
XAVD	15.02259	2	7.51130	F(2,30) = 0.96
PD	82.26855	4	20.56714	F(4,60) = 2.52
XPD	64.75534	4	16.18883	F(4,60) = 2.04
APD	39.96415	4	9.99104	F(4,60) = 1.81
XAPD	14.39897	4	3.59974	F(4,60) = 0.52
VPD	50.06448	4	12.51612	F(4,60) = 1.46
XVPD	61.58751	4	15.39688	F(4,60) = 2.62 *
AVPD	21.44287	4	5.36072	F(4,60) = 0.70
XAVPD	14.09284	4	3.52321	F(4,60) = 0.45
S	108610.50635	15		
ERR X	1065.76126	15	71.05075	
ERR A	1466.57796	15	97.77186	

Table 10 (cont.)

Source of Variation	SS	DF	MS	F
ERR XA	220.21017	15	14.68068	
ERR V	5720.77852	15	381.38523	
ERR XV	398.68992	15	26.57933	
ERR AV	177.74693	15	11.84980	
ERR XAV	262.88287	15	17.52552	
ERR P	1722.72122	30	57.42404	
ERR XP	681.13319	30	22.70444	
ERR AP	438.48931	30	14.61631	
ERR XAP	207.69735	30	6.92325	
ERR VP	1492.11135	30	49.73705	
ERR XVP	386.91204	30	12.89701	
ERR AVP	387.75688	30	12.92523	
ERR XAVP	186.12091	30	6.20403	
ERR D	5242.30225	30	174.74341	
ERR XD	288.34714	30	9.61157	
ERR AD	167.15180	30	5.57173	
ERR XAD	186.83737	30	6.22791	
ERR VD	373.88967	30	12.46299	
ERR XVD	380.33320	30	12.67777	
ERR AVD	233.65025	30	7.78834	
ERR XAVD	235.74303	30	7.85810	
ERR PD	489.10205	60	8.15170	
ERR XPD	475.27633	60	7.92127	
ERR APD	330.76835	60	5.51281	
ERR XAPD	412.23738	60	6.87062	
ERR VPD	515.52210	60	8.59203	
ERR XVPD	353.14040	60	5.88567	
ERR AVPD	456.74285	60	7.61238	
ERR XAVPD	469.93490	60	7.83225	

* Significant at .05 level of significance

** Significant at .01 level of significance

X= direction, A= arm, V= velocity P= program, D= days

S= subjects

Table 11

Analysis of Variance (RT) Summary for
Programming One Parameter (Velocity, Arm,
and Direction)

Source of variation	SS	DF	MS	F
X	86.34075	1	86.34075	F(1,15) = 1.67
A	0.94073	1	0.94703	F(1,15) = 0.01
XA	30.99469	1	30.99469	F(1,15) = 3.64
V	2626.13163	1	2626.13163	F(1,15) = 12.38 **
XV	31.75381	1	31.75381	F(1,15) = 1.52
AV	2.18753	1	2.18753	F(1,15) = 0.34
XAV	3.64050	1	3.64050	F(1,15) = 0.33
P	1559.59438	2	779.79719	F(2,30) = 7.68 **
XP	428.33817	2	214.16908	F(2,30) = 20.86 **
AP	51.79126	2	25.89563	F(2,30) = 2.56
XAP	10.73488	2	5.36744	F(2,30) = 0.41
VP	446.23969	2	223.11984	F(2,30) = 2.54
XVP	2.45888	2	1.22944	F(2,30) = 0.11
AVP	14.95011	2	7.47505	F(2,30) = 1.06
XAVP	1.77098	2	0.88549	F(2,30) = 0.11
D	39.74555	2	19.87278	F(2,30) = 0.11
XD	15.27009	2	7.63504	F(2,30) = 0.80
AD	37.65654	2	18.82827	F(2,30) = 4.33 *
XAD	22.57165	2	11.28583	F(2,30) = 1.02
VD	13.82979	2	6.91489	F(2,30) = 0.87
XVD	5.51053	2	2.75527	F(2,30) = 0.29
AVD	16.21211	2	8.10606	F(2,30) = 1.05
XAVD	7.39508	2	3.69754	F(2,30) = 0.36
PD	72.63588	4	18.15897	F(4,60) = 1.94
XPD	8.59748	4	2.14937	F(4,60) = 0.28
APD	15.48809	4	3.87202	F(4,60) = 0.45
XAPD	19.78626	4	4.94656	F(4,60) = 0.78
VPD	9.62530	4	2.40633	F(4,60) = 0.26
XVPD	10.96077	4	2.74019	F(4,60) = 0.55
AVPD	17.76216	4	4.44054	F(4,60) = 0.55
XAVPD	20.45642	4	5.21410	F(4,60) = 0.79
S	96771.24558	15		
ERR X	773.86201	15	51.59080	
ERR A	1086.28587	15	72.41906	

Table 11 (cont.)

Source of variation	SS	DF	MS	F
ERR XA	127.87844	15	8.52523	
ERR V	3182.25887	15	212.15059	
ERR XV	313.68019	15	20.91201	
ERR AV	97.65274	15	6.51018	
ERR XAV	164.40335	15	10.96022	
ERR P	3046.44359	30	101.54812	
ERR XP	308.01202	30	10.26707	
ERR AP	302.93306	30	10.09777	
ERR XAP	388.09060	30	12.93635	
ERR VP	2638.96771	30	87.96559	
ERR XVP	328.86936	30	10.96231	
ERR AVP	212.42841	30	7.08095	
ERR XAVP	250.36050	30	8.34535	
ERR D	5472.09172	30	182.40306	
ERR XD	287.98063	30	9.59935	
ERR AD	130.30134	30	4.34338	
ERR XAD	332.01066	30	11.06702	
ERR VD	237.33114	30	7.91104	
ERR XVD	289.35875	30	9.64529	
ERR AVD	232.65757	30	7.75525	
ERR XAVD	309.63557	30	10.32119	
ERR PD	561.29172	60	9.35486	
ERR XPD	461.02791	60	7.68380	
ERR APD	515.36380	60	8.58940	
ERR XAPD	378.83687	60	6.31395	
ERR VPD	554.87048	60	9.24784	
ERR XVPD	300.48216	60	5.00804	
ERR AVPD	488.08547	60	8.13476	
ERR XAVPD	386.16604	60	6.43610	

* Significant at .05 level of significance

** Significant at .01 level of significance

X= direction, A= arm, V= velocity, P= program, D= days
S= subjects

Table 12

Analysis of Variance (MT) Summary Table for
Programming One Parameter (Velocity, Arm, and
Direction)

Source of variation	SS	DF	MS	F
X	0.25116	1	0.25116	F(1,15) = 0.04
A	1.61925	1	1.61925	F(1,15) = 0.52
XA	1.73368	1	1.73368	F(1,15) = 0.64
V	46325.24094	1	46325.24094	F(1,15) = 6791.59 **
XV	2.93123	1	2.93123	F(1,15) = 1.19
AV	1.93963	1	1.93963	F(1,15) = 1.46
XAV	0.20453	1	0.20453	F(1,15) = 0.23
P	8.73881	2	4.36941	F(2,30) = 5.68 **
XP	0.05914	2	0.02957	F(2,30) = 0.03
AP	1.55441	2	0.77721	F(2,30) = 0.89
XAP	1.38077	2	0.69039	F(2,30) = 1.17
VP	7.14887	2	3.57444	F(2,30) = 4.24 *
XVP	1.92497	2	0.96249	F(2,30) = 1.45
AVP	2.49010	2	1.24505	F(2,30) = 2.81
XAVP	0.49274	2	0.24637	F(2,30) = 0.49
D	7.42646	2	3.71323	F(2,30) = 2.26
XD	2.70913	2	1.35457	F(2,30) = 1.16
AD	2.28269	2	1.14135	F(2,30) = 1.34
XAD	1.40237	2	0.70119	F(2,30) = 0.78
VD	3.30411	2	1.65206	F(2,30) = 0.69
XVD	1.29662	2	0.64831	F(2,30) = 0.71
AVD	1.80000	2	0.90000	F(2,30) = 0.92
XAVD	2.80593	2	1.40296	F(2,30) = 1.79
PD	3.47868	4	0.86967	F(4,60) = 1.16
XPD	1.35806	4	0.33952	F(4,60) = 0.66
APD	3.85232	4	0.96308	F(4,60) = 1.48
XAPD	6.29435	4	1.57359	F(4,60) = 2.71 *
VPD	3.36093	4	0.84023	F(4,60) = 1.87
XVPD	1.58285	4	0.39571	F(4,60) = 0.72
AVPD	0.36052	4	0.09013	F(4,60) = 0.10
XAVPD	1.94151	4	0.48538	F(4,60) = 0.84
S	153.32253	15		
ERR X	86.79684	15	5.78646	
ERR A	47.03426	15	3.13562	

Table 12 (cont.)

Source of variation	SS	DF	MS	F
ERR XA	40.74044	15	2.71603	
ERR V	102.31452	15	6.82097	
ERR XV	36.94544	15	2.46303	
ERR AV	19.97243	15	1.33150	
ERR XAV	13.59262	15	0.90617	
ERR P	23.08519	30	0.76951	
ERR XP	29.49239	30	0.98308	
ERR AP	26.14827	30	0.87161	
ERR XAP	17.74331	30	0.59144	
ERR VP	25.30335	30	0.84345	
ERR XVP	19.92130	30	0.66404	
ERR AVP	13.27416	30	0.44247	
ERR XAVP	15.12631	30	0.50421	
ERR D	49.29408	30	1.64314	
ERR XD	34.98803	30	1.16627	
ERR AD	25.64756	30	0.85492	
ERR XAD	27.02991	30	0.90100	
ERR VD	71.38513	30	2.37950	
ERR XVD	27.23330	30	0.90778	
ERR AVD	29.28160	30	0.97605	
ERR XAVD	23.57178	30	0.78573	
ERR PD	45.08458	60	0.75141	
ERR XPD	30.76388	60	0.51273	
ERR APD	38.91372	60	0.64856	
ERR XAPD	34.79356	60	0.57989	
ERR VPD	27.02589	60	0.45043	
ERR XVPD	32.92021	60	0.54867	
ERR AVPD	52.98185	60	0.88303	
ERR XAVPD	34.75136	60	0.57917	

* Significant at .05 level of significance

** Significant at .01 level of significance

X= direction, A= arm, V= velocity, P= program, D= days

S= subjects

Table 13

Analysis of Variance (MT) Summary Table
for Programming Two Parameters (AD, VA,
VD)

Source of variation	SS	DF	MS	F	
X	0.06286	1	0.06286	F(1,15) =	0.02
A	4.30100	1	4.30100	F(1,15) =	2.21
XA	0.44063	1	0.44063	F(1,15) =	0.16
V	45118.95351	1	45118.95351	F(1,15) =	9649.51 **
XV	2.18492	1	2.18492	F(1,15) =	0.94
AV	0.19609	1	0.19609	F(1,15) =	0.11
XAV	0.28596	1	0.28596	F(1,15) =	0.14
P	15.30432	2	7.65216	F(2,30) =	6.52 **
XP	1.49820	2	0.74910	F(2,30) =	0.65
AP	2.11318	2	1.05659	F(2,30) =	3.05
XAP	0.56026	2	0.28013	F(2,30) =	0.35
VP	20.22968	2	10.11484	F(2,30) =	11.53 **
XVP	0.38930	2	0.19465	F(2,30) =	0.16
AVP	2.17830	2	1.08915	F(2,30) =	2.47
XAVP	1.41627	2	0.70813	F(2,39) =	0.85
D	0.47044	2	0.23522	F(2,30) =	0.12
XD	2.68034	2	1.34017	F(2,30) =	1.62
AD	4.17991	2	2.08996	F(2,30) =	2.72
XAD	0.80603	2	0.40301	F(2,30) =	0.48
VD	0.95171	2	0.47586	F(2,30) =	0.23
XVD	0.32397	2	0.16198	F(2,30) =	0.25
AVD	6.85040	2	3.42520	F(2,30) =	5.56 **
XAVD	3.94378	2	1.97189	F(2,30) =	3.05
PD	1.76143	4	0.44036	F(4,60) =	1.00
XPD	4.36129	4	1.09032	F(4,60) =	1.37
APD	1.63250	4	0.40813	F(4,60) =	0.60
XAPD	2.56709	4	0.64177	F(4,60) =	0.87
VPD	0.73044	4	0.18261	F(4,60) =	0.27
XVPD	5.26810	4	1.31702	F(4,60) =	1.84
AVPD	1.66337	4	0.41584	F(4,60) =	0.60
XAVPD	4.51748	4	1.12937	F(4,60) =	2.04
S	111.07147	15			
ERR X	57.30371	15	3.82025		
ERR A	29.24972	15	1.94998		

Table 13 (cont.)

Source of variation	SS	DF	MS	F
ERR XA	42.05214	15	2.80348	
ERR V	70.13666	15	4.67578	
ERR XV	35.01238	15	2.33416	
ERR AV	27.15157	15	1.81010	
ERR XAV	31.46807	15	2.09787	
ERR P	35.18945	30	1.17298	
ERR XP	34.58500	30	1.15283	
ERR AP	10.38351	30	0.34612	
ERR XAP	23.92414	30	0.79747	
ERR VP	26.31004	30	0.87700	
ERR XVP	37.09909	30	1.23664	
ERR AVP	13.23706	30	0.44124	
ERR XAVP	24.87602	30	0.82920	
ERR D	57.76613	30	1.92554	
ERR XD	24.81138	30	0.82705	
ERR AD	23.02543	30	0.76751	
ERR XAD	24.93006	30	0.83100	
ERR VD	61.07162	30	2.03572	
ERR XVD	19.10320	30	0.63677	
ERR AVD	18.46688	30	0.61556	
ERR XAVD	19.38496	30	0.64617	
ERR PD	26.45496	60	0.44092	
ERR XPD	47.85787	60	0.79763	
ERR APD	40.80459	60	0.68008	
ERR XAPD	44.44784	60	0.74080	
ERR VPD	40.92483	60	0.68208	
ERR XVPD	42.98238	60	0.71637	
ERR AVPD	41.86157	60	0.69769	
ERR XAVPD	33.19305	60	0.55322	

* Significant at .05 level of significance

** Significant at .01 level of significance

X= direction, A= arm, V= velocity, P= program, D= days

S= subjects

APPENDIX C

MEANS MT (MSEC) SUMMARY TABLE

Table 14

MT (msec) for Direction and Arm,
as Function of Velocity and Day

		Day 1		Day 2		Day 3	
V	A	F	B	F	B	F	B
Fast							
	Left	X 115.1	117.9	114.3	116.4	114.0	116.1
		SD 0.7	0.9	0.7	0.8	0.7	0.8
	Right	X 115.2	115.8	116.8	116.0	114.3	115.3
		SD 0.8	0.7	0.8	0.7	0.7	0.6
Slow							
	Left	X 242.6	245.8	242.9	239.1	239.7	239.8
		SD 1.3	1.4	1.1	1.6	1.2	1.4
	Right	X 244.3	244.3	242.1	241.9	245.1	241.6
		SD 1.4	1.4	1.2	1.2	1.1	1.1

V= velocity, A= arm, F=forward, B=backward

Table 15

MT (msec) for Arm and
Velocity as Function of Day

Day	Velocity		Arm
<hr/>			
<hr/>			
1			
		Left	Right
	Fast	X 114.8	116.1
		SD 0.7	0.7
	Slow	X 242.3	240.2
		SD 0.7	1.4
2			
	Fast	X 114.7	116.6
		SD 0.7	0.8
	Slow	X 238.7	241.4
		SD 1.2	1.2
3			
	Fast	X 115.6	115.3
		SD 0.8	0.7
	Slow	X 238.9	242.7
		SD 1.2	1.3

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