Final Report

of

An

Experiment to Attempt

to

Induce Cognotive and Behavioral Changes

by Means of

Galileo theory and Methods

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Introduction

This report is designed to be of a twofold nature. First it is to expose and familiarize the reader with an innovative, new metric multidimensional scaling technique, the "Galileo" system, and second, it is to document all aspects of our study which rigorously tested this system. This presentation shall proceed by introducing the Galileo system after which our project will be discussed in detail from beginning to end.

What is the Galileo System?

In recent years, researchers have become increasingly interested in examining relationships between numerous objects or concepts. Multidimensional scaling is often used in these situations because it allows the plotting of many pair-wise comparisons of such concepts in a common multidimensional space. In such a space, similarities among and differences between concepts can be seen both numerically and graphically on common axes.

Some version of scaling known as nonmetric multidimensional scaling has been frequently utilized in studies of this nature (see Torgerson 1958; Shepard 1962; or Kruskal and Wish 1978). According to this method, individuals are asked to order their preferences or perceived cognitive similarities between concepts. For instance, a subject might be asked any or all of the following: is A more similar to B than to C, or is D preferred to E, and is E preferred to F? A great number of computer programs have been developed to perform this type of analysis largely because of the discrepancy

between the ordinal form of the collected data and the interval or ratio representation of the data in multidimensional scaling. That is, usually preferences are collected in the following form: D is preferred to E and E to F, but a truer graphic representation such as D = 2E = 3F would be preferable and more representative of individual cognitions.

A metric form of multidimensional scaling which attempts to overcome the above mentioned discrepancy between the data and its representation has been developed within a larger theory of mass communication. This form of multidimensional scaling is known as the "Galileo theory." Within the Galileo theory, dissimilarity ratings for pairs of concepts are obtained based on a common metric, then processed through the metric multidimensional scaling program to obtain an exact cognitive representation of the concepts. The Galileo theory of mass communication is based upon using this cognitive representation to predict movements of concepts through space due to the introduction of informational or persuasive messages. The unit within the program which makes the predictions of concept movements in space, the Automatic Message Generator (AMG), analyzes the coordinates of the concepts in several dimensions, assigning to each concept in the space an inertial mass of 1. The AMG constructs a vector between the concepts one wishes to move, then analyzes the surrounding concept vectors to determine which, when associated with the initial vector, will cause the highest percentage of change in the desired direction. The amount and direction of change are calculated from the Galilean Transformation equation for the acceleration of associated masses (Einstein, 1956). The accelerated concepts move along a resultant vector, which is obtained by the summation of the vectors from the concept to be moved to each of the concepts it is paired with in the message. The Galileo program operates on the cognitive representation to form optimally persuasive messages

to move one designated "start" concept towards a designated "target" concept according to this vector theory.

The first step in a Galileo study is to choose the most salient concepts in the area one wishes to investigate. This step is known as "concept elicitation" and will be explained in detail below.

Next, similarity scores for all possible pair-wise comparisons of these concepts are recorded on a common ratio scale. This is accomplished by choosing a pair of criterion concepts related to the concepts under investigation and then assigning a value, usually 100, to represent the difference between the two criterion concepts. Each of the exhaustive pair-wise concept comparisons is then compared to the criterion pair. If there is less perceived difference between the concepts in the comparison than the criterion pair, one would assign that pair a value less than the criterion pair difference. This comparison is the ratio of the perceived difference of the comparison pair to the criterion pair. One would assign a larger number to the comparison pair in the same ratio manner if the comparison concepts were seen as more different from each other than were those of the criterion pair.

The next step is to compute the mean difference score for all respondents in a designated group for each comparison pair. These means are then used to construct the metric multidimensional representation.

As earlier mentioned, one can then designate a single "start" concept to be moved toward a specific "target" concept. While this is being accomplished the AMG also analyzes other concepts in the space for movement along the "start-target" vector. The AMG analysis is particularly useful when the "self" or "yourself" has been included in the concept neighborhood, as the distance between the self and any other concept is taken to be a measure of a

person's attitude toward that concept. Using the self as the target concept thus is expected to make the individual more favorable toward that concept. The AMG also delivers several alternative concept groupings as possible messages along with their theoretical effectiveness.

The Galileo theory's measurement of attitudes and beliefs, along with the persuasive messages generated by the AMG, have been put to use in a variety of areas. Included in these areas are the marketing of automobiles, the advertising of strategies for a political candidate (Barnett, Sarota and Taylor, 1976), the tourism industry (Korzenny, Ruiz and Ben David, 1978), setting the advertising foundation for a statewide referendum, and attempts to increase the use of a dairy herd testing service offered by the Dairy Herd Improvement Association (Wallace, 1979). In each of these studies, a small sample was taken from the target population, their attitudes and beliefs were measured using the Galileo pair-wise comparison method, optimal messages generated and distributed through various mediums to the target population and the behavioral changes in the population subsequently noted. Although the above studies noted behavioral changes in the predicted directions, none attempted to determine if cognitive changes in the multidimensional representation occurred that would correspond to the changes in observed behavior. Also, no analysis was undertaken to determine if the behavioral changes in the target populations were causally linked to the persuasive broadcast messages. Lastly, although some studies have shown cognitive changes (see Cody, 1980 for a listing), these studies suffered from a lack of measures of behavioral change and/or experimental control groups for the baseline measurement of change.

The Haller-Cary Mastitis Study

Our study, to be discussed herein attempts to tie together all aspects of the Galileo theory and to produce a controlled test of the utility of the AMG section of the system. This is achieved by sending the different experimental groups different AMG messages, and by using two control groups to control for change over time and the sensitizing effects of pretesting. The informational messages distributed were single-sheet flyers, identical in style and format, but contained messages of different theoretical efficiency. Hence, this is the first applied study to use a unique medium for message diffusion, as well as control groups to regulate the confounding effects of messages in the same medium as the experimental treatment.

The topic of this research is very similar to that undertaken by Wallace (1979) as described earlier. This study focused on six counties of northwestern Wisconsin. These counties are: Buffalo, Dunn, Eau Claire, Pepin, Pierce, and Trempealeau. Of those residing in these counties, this project was interested primarily in dairy farmers that were not actual users of the Wisconsin Dairy Herd Improvement Cooperative's (DHIC) somatic cell count testing program. The goal of this study was to persuade these dairy farmers to subscribe to the Wisconsin Dairy Herd Improvement Cooperative's Somatic Cell Testing Service, known as the DHI SCT program. The Wisconsin DHIC has in the past attempted to persuade farmers to subscribe to the program through agents of the association, but the expected response level did not materialize. The thrust of our research was to test the efficacy of the AMG and the Galileo system in general by producing persuasive messages designed to encourage individual farmers to inquire further about the program and to induce increased enrollment in it. Thus we anticipated that the AMG messages

would effect cognitive change followed by concomitant changes in behavior.

The experimental design considered contained two experimental groups, one targeted to receive an optimal Galileo message (i.e. the MAX group---for maximum impact message) and the other targeted to receive an inefficient message which the AMG indicated would have a minimal effect (hence the MIN group or minimal impact group) in persuading farmers to subscribe to the DHI SCT service. These messages were administered between the two waves of interviews, coded as T1 and T2 (for time-one and time-two).

Two control groups were utilized in this study. The first control, the CON group, was interviewed at both T1 and T2, but received no persuasive message. The second control or the ZERO group was interviewed at T2 only and likewise received no message. The CON group served as the baseline group against which any change in the experimental groups was measured, while the ZERO group was used to detect any effects due to sensitization caused by the pre-testing at T1.

Sample Selection

In an attempt to obtain the best possible listing of all dairy farmers in the area under investigation we decided to accept and employ the Wisconsin DHIC membership list. Mr. Loren Cropp (1983) estimated that the approximately 1,500 dairy farmers contained in this roster represented about one-half of all dairy farmers in this six county area as of December, 1983. Although this listing is partial in the sense that it does not contain all of the dairy farmers in this area, it is however a complete listing of all current, as well as past DHI SCT users. This DHIC list is also an excellent list from the project's viewpoint as it allows for easy monitoring of the enrollment

patterns of those individuals contacted by us. These enrollment patterns reflect a substantive concern of this project for they at least partially reflect a behavioral change of those interviewed. Because of this and the other forementioned reasons we believe that after all options were considered the DHIC membership list was by far the most appropriate listing available to us.

The membership list originally acquired was from a ten county area of northwestern Wisconsin. From this list only those individuals residing in the six counties of interest were selected. Next, this better defined listing was divided into three groups or populations: the nonusers (those never having participated in the SCT program), the users (those currently in the SCT program), and the quitters (current nonusers that once participated in the SCT program). This division produced 541 nonusers, 601 users, and 327 quitters.

As most of our interest was in the nonuser population, we shall now concentrate on the manner in which we subdivided this population into two experimental groups, two control groups and a concept elicitation group. First, each of the five nonuser groups were initially assigned a number. These five numbers were then selected at random to determine their respective column number. Then having numbered the nonuser population from 1 to 541, we began using the random number table to assign cases to the respective columns. This was done by assigning the first case to column one, the second to column two and so forth. After the two experimental groups and the two control groups each contained 63 subjects we continued to sample until the fifth group, the concept elicitation group contained 93 subjects. The first group (the MIN group) was to receive the minimum effect message, the second group (the MAX group) was to receive the maximum effect message, the third group or the first control (the CON group) was to be interviewed at T1 and T2

but to receive no messages, and lastly the second control (the ZERO group) was to be interviewed at T2 and receive no messages. The size of the experimental and control groups was set at 35, with the remaining 28 subjects in each group left as a source of replacement in the event of refusals or failed contacts. The fifth group, containing 93 subjects, was used as the focus group for the elicitation of relevant concepts in the cognitive space we were studying.

In anticipation of eliminating possible sampling bias we originally oversampled, or added more cases to each group than were actually desired. This was done for two reasons. First, when "missing data" was encountered (e.g. an individual who had a private phone number that was unobtainable), the case was simply excluded rather than introducing a serious bias into the sample by say choosing the next case (Sudman, 1976). Hence some of the oversampled cases were needed in these situations. The second reason for the oversampling was related to the fact that not all individuals on the DHIC roster possessed telephone service. Although this was a rather infrequent occurence (i.e. less than five percent), we did nonetheless encounter individuals that had to be excluded because they simply did not have telephone service. However, because we found that only about five percent of the nonuser population was without telephone service, we believe that our sampling was not seriously biased against lower-income dairy farmers. These households without telephones also required use of the extra cases. At times because of the oversampling it was necessary to exclude extra cases once the desired sample size was met. This was done by performing random deletions to reduce the sample to the proper size.

Because in a simple random sample each element of the population must have an equal probability of selection we were able to avoid an additional source of bias as multiple entries for the same diary farmer were excluded.

This happened occasionally because a farmer might have two or more herds registered separately with the DHIC.

Likewise, most time periodicities were minimized because sample interviews took place seven days a week and from 8 a.m. to 8 p.m. In this manner it was possible to locate almost every desired case.

The type of simple random sampling used in the selection of nonusers is sound both substantively and methodologically. Substantively because of the four principal groups selected two represent the MIN and MAX experimental groups and the other two represent the CON and ZERO control groups. Methodologically the sampling technique is sound because the four subpopulations were selected from a single population of nonusers. This allows for the exact computation, if desired at any later point, of the sampling variance between these similarly selected samples of the population (Sudman, 1976).

Another positive quality of this study's sampling is that since it employed simple random sampling and because the samples chosen represent a high fraction of the total population the sample error of the estimate was greatly reduced (Sudman, 1976).

However, due to problems inherent to the DHIC listing certain troubles did arise. The major problem was that the listing was not completely accurate. Although the membership list is ideally updated monthly we found this not to be the case. Thus recent changes as they affected a nonuser member's status were often discovered. In such instances users were normally listed as nonusers.

Unfortunately, errors due to recent changes were not the only ones encountered. Several times people who had quit using the SCT in the distant past were also listed as nonusers and not quitters. This problem caused the

nonuser sample to include some quitters as well. These cases were discarded when found. The quitters contained in these samples were however spread out very evenly due to chance. That is, there were four in both samples one and two, and three in sample three.

The last problem found in the listing had to do with simple typographical errors. Often a last name or rural route address would have a single misplaced letter or number. In many of these circumstance we were able to remedy the situation. Still, one must wonder if perhaps some of those farmers apparently without telephone service simply did not appear because their names were grossly misspelled.

Procedures and Methodology

To begin our study it was necessary to elicit relevant concepts from the nonuser sample population. Note that of the 93 subjects selected for the concept elicitation group, 62 were sucessfully interviewed while the 21 unused cases were discarded as we believed that all of the important concepts had been obtained. The research team completed 12 of 12 attempted interviews and 50 of 55 were completed by the Wisconsin Survey Research Laboratory (WSRL). The research team was already extremely familiar with the Galileo instrument because of two unrelated preparatory studies conducted in the months prior to the undertaking this investigation. The WSRL, on the other hand, is a profit making branch of the University of Wisconsin-Madison staffed by highly trained professional telephone interviewers and survey researchers. As such, it was only necessary to brief the four interviewers from the WSRL that worked on this project as to the style of the Galileo interviews and the proper technique for eliciting responses. Special emphasis was placed on the need

for objectivity and the avoidance of coaching subjects. The interviewing team was given a practice session with the Galileo questionnaire to allow them to become familiar with the instrument before actual interviewing began. The WSRL conducted their concept eliciting interviews with help from the Computer Aided Telephone Interview (CATI) system they developed. Because of budget constraints, the WSRL limited their surveying to three attempted contacts with each subject. If an interview remained uncompleted after the three attempts it was then turned over to the research team for completion.

The purpose of our concept elicitation was to extract those concepts or ideas most frequently expressed by dairy farmers when interviewed about mastitis. The average interview lasted only five minutes although some individuals spoke with us for up to 15 minutes. During these interviews the farmers were repeatedly prompted to express their beliefs about the DHI SCT and mastitis. An interview would terminate once a farmer ceased to express new ideas. Each relevant concept was recorded and a frequency count made of the pooled subject responses to determine the most commonly used descriptors. Of the initial list, those concepts of identical or highly similar meaning were combined so that a shorter, less idiosyncratic list resulted. From this list, the seven most frequently mentioned concepts were drawn for inclusion in the questionnaire. The concepts "yourself" and "DHI somatic cell test" were then added to this list, as they were our desired start and target concepts (see Table 1 for a complete listing of all concepts). The questionnaire was limited to these nine concepts to save time and to increase the likelihood of more completed interviews. Because the instrument uses exhaustive pair-comparisons, the length of the instrument increases considerably with the addition of each additional concept. Hence, completion of our nine concept questionnaire requires the subject to make 54 pair-comparisons. So although a

fifteen concept questionnaire may be more thorough, the likelihood of completing the desired number of interviews would fall off sharply.

The instrument utilizing these nine concepts was produced automatically by the Galileo program, thereby eliminating the possibility of nonexhaustive pair-comparisons. The instrument was first tested by the research team on a pilot group of 16 randomly chosen non-users. Eight of the 16 interviews were successfully completed, there was one refusal, and seven subjects were not contacted. Based on this success rate, it was decided to begin using the instrument on the non-user experimental groups.

For the experimental group interviews, as with the focus-group interviews, the WSRL made up to three contact attempts. Those subjects who were not then contacted were turned over to the research team for completion. In each of the MIN, MAX and CON groups 35 interviews were completed, with uncontactable subjects or unusable questionnaires replaced.

The primary cognitive dependent variable was the mean distance between the concept "DHI somatic cell test" and the concept "yourself," as this distance represents an individual's attitude toward the DHI SCT. The smaller the difference score, the more favorable the attitude toward the DHI SCT. For each of the three groups measured at T1 and T2 this measure is a difference score obtained by subtracting the T2 mean from the T1 mean. These differences were coded as MAXT1-MAXT2, MINT1-MINT2, and CONT1-CONT2. A positive result of the AMG generated message was indicated by a more favorable or tolerant attitude at T2, indicating movement of the start-target concepts toward one another. The second measure of the cognitive dependent variable was the T2 similarity score of each group, coded as MAXT2, MINT2, and CONT2, representing the mean attitude of the self toward the DHI SCT at T2. The mean attitude of the self toward the DHI SCT for the ZERO group, which was measured only at T2

was used in comparisons of change over time due to effects other than those attributable to the persuasive messages.

Several hypotheses about the predicted movements of the concept "DHI SCT" toward the "self" due to the impact of the persuasive messages, or lack of messages, were made. The group which received the minimum impact message was expected to become slightly more favorable to the DHI SCT than either control group for two reasons. First, the minimum impact message was not a null message, and thus would be expected to produce some slight result, and second, because DHIC communication was received with an endorsement by a dairy scientist appended to the message. The first hypothesis was as follows:

H1: MINT1-MINT2 GT CONT1-CONT2.

A positive number above indicates the attitude becoming more favorable. Significant differences between the MINT2 and CONT2 were also hypothesized. Namely:

H2: CONT2 GT MINT2.

Here a smaller value indicates a more positive attitude.

Hypotheses were also made about the MAX group effect relative to the MIN group and the CON group, which would indicate effectiveness of the maximum impact message. The Galileo AMG predicts that the maximum message will be optimal in making the self more positive toward the DHI SCT than either the MIN group or the CON group. That is:

H3: MAXT1-MAXT2 GT MINT1-MINT2.

H4: MAXT1-MAXT2 GT CONT1-CONT2.

At T2 the MAX group was expected to have a more positive attitude toward the DHI SCT (that is, a lower distance score) than either the CON group or the MIN group. Thus:

H5: CONT2 GT MAXT2.

H6: MINT2 GT MAXT2.

Further, regarding the effects of two interviews or "sensitization effects" from the T1 pre-test, it was hypothesized that the ZERO group, interviewed only at T2 properly coded coded as ZEROT2, would have the same mean attitude toward the DHI SCT as the twice interviewed control group at T2, coded as CONT2. Hence:

H7: ZEROT2 = CONT2.

To control for attitude change over time, the two control groups were compared at the first time each group was interviewed, as we hypothesized that both would be equal. In other words:

H8: CONT1 = ZEROT2.

The hypotheses H1 through H8 were tested using T-tests, and analysis of variance was used to test for overall differences in H9 and H10, hypothesized as follows:

H9: MAXT1-MAXT2 GT MINT1-MINT2 GT CONT1-CONT2

H10: CONT2 GT MINT2 GT MAXT2

Confirmation of H1 and H2 would indicate that receiving any Galileo message causes subjects to have a more favorable attitude toward DHI SCT, although there would be no possibility of determining whether the message or the dairy scientist's endorsement or other factors caused the change. Confirming H3 and H4 would support the conclusion that the maximum effect message significantly changed attitudes as compared to not receiving this message. Confirmation of H5 and H6 would indicate that the Galileo AMG was indeed successful in the analysis of concepts for construction of a best message. Confirmation of hypothesis H7 would indicate that T1 interviews did not affect scores at T2. This point is an important one; failure to confirm this hypothesis would imply that there were testing effects from T1, and would necessitate a reanalysis of hypotheses H1 through H10. An attempt was made to

minimize this possibility by comparing the experimental groups with the control groups instead of to an hypothesized small number such as zero, but perhaps not all changes over time are reflected by this comparison. Confirmation of H8 would suggest that general attitudes toward the DHI SCT in the nonexperimental population did not change in the interval between the T1 and T2 measurements.

In addition to these hypotheses concerning the cognitive dependent variables, there are corresponding hypotheses regarding the behavioral dependent variable which require testing. The first concerns the number of farmers who actually sign up for the Somatic Cell Test following message administration. We hypothesize that a higher percentage of the farmers who received the maximum impact message would enroll in the SCT program than those receiving the minimum effect message or no message at all. That is:

H11: N(MAXUSER) GT N(MINUSER)

H12: N(MAXUSER) GT N(CONUSER)

where N stands for the percentage of the group who enroll in the SCT program. A higher percentage of the farmers in the MIN group than in the CON group would also be expected to enroll in the program. This is hypothesized as:

H13: N(MINUSER) GT N(CONUSER)

The confirmation of all these hypotheses would indicate that the Galileo measurement system was very effective in assessing and changing farmer's attitudes toward the DHI SCT program and in persuading these farmers to enroll in the program. Such results would mark the first time that the Galileo system had been shown to be effective in a highly controlled situation, both by attitude and behavior measures. Confirmation of the behavior hypotheses would also mark the first time that the Galileo AMG had positively persuaded people to take action as result of only the Galileo communication. Past

Galileo research has dealt with moderate changes, such as influences on the model of car bought or the candidate voted for; never have subjects been persuaded to vote when voting was not considered, nor have they been persuaded to purchased a "needed" new car. In past studies, the Galileo system was aided by the fact that subjects intended to act prior to message broadcasting. In this study, however, farmers were not being persuaded to favor one brand or candidate over the other, but rather were being encouraged to purchase a service they were unwilling to use previously. This was not a matter of trickery or deception, but instead the subjects were supplied with the necessary information from which to make an informed decision.

Once the first-wave interviews were completed, the spaces of the pooled groups and each of the separate experimental groups were analysed. Results from this analysis supported the assumption of random assignment of subjects to groups; none of the groups were significantly different from the others at $p = .001$ for a one-tailed T-test. Also, separate AMG runs were made to check the reliability of the vector analyses. Again, the separate runs were not significantly different at the .01 level for a one-tailed T-test, and were in agreement with the pooled group data. Using the pooled data analysis, the minimum effect message, with a resultant vector magnitude of 88.28% of the start-target vector, was constructed from the concepts "high somatic cell count," "hidden mastitis," "expensive," and "monitoring." The maximum effect message, with a resultant vector magnitude of 44.97% of the start-target vector, was composed of the concepts "creamery," "milk quality," "profit," and "monitoring."

Flyers with the persuasive messages were mailed to both the maximum and minimum experimental groups in March 1, 1984, followed by another identical flyer, except for the color, on March 5, 1984. All flyers were mailed in

envelopes containing the return address of the Dairy Science Department at the UW-Madison. The Dairy Science Department reported to us that none of the flyers were returned, so it is assumed that all of the flyers were delivered to the experimental subjects.

Four days after the second set of flyers were mailed, the second wave of interviews commenced. The same interviewers and technique used during the first wave were employed, with the exception that the WSRL completed all of these interviews, returning none to the research team. Of the 35 subjects interviewed in the minimum group at T1, 29 were reinterviewed and all of these cases were usable. In the MAX group, 30 of the 35 original subjects were reinterviewed and all cases were usable. Of the 35 in the control group, 34 were reinterviewed and all cases were usable. The post-experimental control group ZERO consisted of 32 completed interviews, of which 27 were usable. Once the second wave of interviews was completed the DHIC was instructed to identify all the subjects who subsequently subscribed to the somatic cell testing program.

Results

All data collected from subjects interviewed at both T1 and T2 as well as that of the ZERO control group were used in the final analysis. Other data collected for subjects who did not complete both interviews were however discarded from the final analyses. The final analyses proceeded in two directions: the first was to analyze all selected data, and the second was to exclude the data of any subject in the MIN or MAX group that reported that he/she did not see any of the messages. Otherwise both sets of analyses utilized the same data. Each hypothesis earlier outlined will be reviewed

below, along with its respective results.

One-tailed T-tests were used to test the hypotheses regarding intergroup differences. The one-tailed tests were used in order to minimize the chance of accepting the null hypothesis when the alternative hypothesis was in fact true. The significance level was set at $p = 0.1$ to compensate for the overly conservative sampling procedure by which approximately 50% of the population was sampled without replacement. One-way analysis of variance was used to test for differences between the three key groups. Means and standard deviations of all groups during each wave were calculated, as were the mean difference scores and their standard deviations for the MIN, MAX, and CON groups (see Table 2).

Of those subjects analyzed, 24 of the 29 dairy farmers in the minimum impact message group and 20 of the 27 in the maximum impact group reported having seen one or both flyers mailed to them. The data of those receiving at least one flyer is presented in Table 3.

The first hypothesis tested was that the MIN group's mean difference score for the concept pair "DHI somatic cell test" and "yourself" would shift closer to zero than would the same pair in the CON group. The hypothesis would also be confirmed if the MIN group's shift was less negative than the CON, in the event that other factors served to increase the start-target pair distance. This hypothesis was not supported by the data for all respondents ($T = 0.80$, $p = N.S.$).

The second hypothesis predicted the MIN group to have a more positive attitude toward the DHI SCT at T2 than would the CON group. This hypothesis was supported by both the analysis of all respondents and also by that of only those acknowledging receipt of the flyer ($T = 1.30$, $p = 0.10$ and $T = 1.90$, p LT 0.05, respectively).

Next we hypothesized that the MAX group would show a more favorable attitude shift toward the DHI SCT than would the MIN and CON groups. H3 not only failed to be supported by the data, but was shown to be significant in the opposite direction for both the full group and the group consisting only of those who received the message. (Opposite the predicted direction these results were T = 1.42, p LT 0.10 and T = 1.35, p LT 0.10, respectively).

Hypothesis H4 was not supported for either the full group (T = 0.08, p = N.S.) or those who received the message (T = 0.11, p = N.S.).

The next two hypotheses predicted that following the administration of all the messages, the MAX group would have a more favorable attitude toward the DHI SCT than those in the MIN and CON groups, regardless of initial attitudes. H5 was supported by data from all respondents (T = 1.32, p LT .10), but not by the data of only those who saw the message (T = 0.62, p = N.S.). H6 was not supported by the full data set (T = 0.11, p = N.S.). Meanwhile, there was however significant change in the opposite direction to that hypothesized for those who saw the messages in the flyers sent them (that is, MAXT2 GT MINT2, T = - 1.44, p LT 0.1).

Hypotheses 7 and 8 compared the two control groups to check for differences caused by interviewing effects and change over time. H7 (ZEROT2 = CONT2) was not supported, with the ZEROT2 group mean much lower than the CONT2 group mean (T =-2.55, p LT 0.01). There appears to be a marginal effect due to maturation, as H8 (ZEROT2 = CONT1) is also not supported (T = -1.32, p = 0.10), indicating that the subjects of the CON group became more favorable to the DHI SCT over time.

Overall effects were also examined using analysis of variance with a significance level of 0.01. H9 (MAXT1-MAXT2 GT MINt1-MINT2 GT CONT1-CONT2) was not supported by the data either for the full data set (F = 0.47, p =

N.S.) or the message receivers (F = 0.42, p = N.S.). H10 (CONT2 GT MINT2 GT MAXT2) was not supported at the 0.05 level, as there was no difference in the data for all three groups (F = 1.24, p = N.S.) or for the reduced data set (F = 1.90, p = N.S.).

The Galileo system is theorized to have a "priming" effect in making subjects more susceptible to the message topic in the future due to their increased awareness of the topic. Because of this, behavioral change will be monitored over several moths in order to detect these delayed effects of the Galileo.

The behavioral results of the study failed to support hypotheses 11, 12, and 13. Final results indicated that for the MAX, MIN, and CON groups three members of each group enrolled in the DHI SCT program. Perhaps this indicates that the observed enrollment was not due to the messages sent, but rather to the "Hawthorne effect." That is, these people may have enrolled because they were exposed to this service for the first time in such a way that made them evaluate this program's potential benefits for the first time.

Overall, few significant differences were found where they had been predicted. Some significant differences in the data appeared where none were expected, and some of the significant differences were in the opposite direction to that hypothesized. Analyses of variance performed on both the T1-T2 difference score and the T2 means across all three groups (MIN, MAX, and CON) showed no overall effect at the 0.05 significance level, which indicated that not much cognitive movement took place for the start-target pair in any of the three groups. Differences in the final attitudes for the start-target pair between the three groups was likewise minimal. The most notable difference was that the post-experimental control group (i.e. the ZERO group) was much more favorable toward the DHI SCT than the first control group (CON)

was at either T1 or T2. This suggests that the effects of maturation and the pre-test were great. As a result, interpretation of only T2 results may be misleading. It however must be noted that the ZERO group was smaller than the other three groups, with an N of 27, and therefore may not be a precise measure of the general attitude of subjects at T2 (see Table 4).

Discussion

Our objective was to test the Galileo theory's metric multidimensional scaling technique and to attempt to use the theory's automatic message generator to induce cognitive and behavioral change in a group of farmers regarding the Dairy Herd Association's somatic cell testing service. More specifically, for the cognitive change, we predicted that the mean difference score given by the MAX group for the concept pair "DHI somatic cell test and yourself" would shift closer to zero across T1 and T2 (indicating a more positive attitude shift) than would the same means for the MIN and CON groups. This prediction was also stated in that this mean at T2 for the MAX group would be lower (a more positive attitude toward the DHI SCT) than the T2 means for the MIN and CON groups. Another hypothesis stated that the MIN group would have a larger mean shift toward zero than the CON group and that at T2 the MIN group mean would be lower than the T2 CON group mean. Behaviorally, we predicted that a higher percentage of those receiving the maximum message would sign up for the DHI SCT program than those in the other groups, and that more of those in the MIN group would sign up than those in the CON group (after controlling for the relative sizes of the groups).

Looking at cognitive changes in the MAX group in comparison to the other groups we found support for only one of these hypotheses. The mean score for

the difference between "DHI somatic cell test and yourself" for the MAX group at T2 (MAXT2) was found to be less than the mean difference for the CON group at T2 (CONT2), but this finding was only marginally significant (T = 1.32, p LT 0.10) and only held when looking at all respondents in the MAX group. When comparing only those in the MAX group that reported seeing the message with those of the CON group there was no significant difference. This indicates that those who saw the persuasive message were less positive toward the testing service than the others in the MAX group who said they had not seen the message sent to them. This was confirmed statistically (T = 12.66, p LT 0.01).

More surprising findings were discovered when comparing the MIN and MAX groups. For instance, the MIN group showed a significantly more favorable attitude shift toward the DHI SCT both when comparing the entire group and when looking only at those reporting to have seen their respective messages (p LT 0.10). Also, when examining the T2 mean differences there is a significant finding (p LT 0.10) of the MIN group being more favorable toward the testing service than the MAX group when only looking at the message receivers. There is however no difference when comparing all the data for both groups. The T2 mean for the MIN group is also significantly more favorable than the T2 mean for the CON group, both for all subjects (p LT 0.10) and for only message receivers (p LT 0.05). The shift in mean distances over time for the MIN group was not different from the shift for the CON group when looking at either all farmers or only message receivers.

In summing up our results it appears that the maximum effect message had almost no effect on cognitive attitudes toward the testing service, while the minimum effect message appeared to be almost as effective as we had predicted the maximum effect message to be. The minimum message appears to be very good

when looking at T2 attitudes (i.e. the mean difference score at T2) where, when looking at those who reported seeing messages only, we see our strongest results with the minimum message receivers having significantly better attitudes toward the DHI SCT service than either the MAX group ($p = 0.10$) or the CON group ($p = 0.05$). Hence the minimum message appears to have worked as we had predicted the maximum would, and the maximum worked as the minimum was predicted to function.

One fault of this study is that it suffered from a small sample size in each of its groups. The Galileo system is designed to work on a set of group means which can have very high variances. Hence the group means used are not necessarily good indicators of the population means. One odd response can dramatically increase or decrease a group mean, which may change the multidimensional configuration the AMG uses, in effect biasing the message generating process or present abnormally large attitude shifts over time. We may have seen this problem in the ZERO group, where quite few responses of 0 were recorded on the crucial concept-pair "DHI somatic cell testing and yourself." Because this was a very small sample ($n = 27$), the low group mean caused by the many 0 scores lead us to conclude that there was change in the population attitude over time. This also caused us to conclude that there was a statistically significant effect of interviewing at T1 on the T2 responses, when this may in fact have been due to the poor ZERO group sample. Since there was very little change in the CON group over time we will continue this discussion by assuming that the ZERO group was not reliable enough to be considered seriously. For future Galileo studies we recommend that researchers obtain samples as large as possible in order to get more precise measures of the means and for use in the AMG analysis and for measuring real cognitive change. We now continue by excluding the ZERO group data from our

discussion.

One of the possible reasons for the reversal of predicted effects could be a type of "placebo effect," whereby all messages, no matter what their content could result in certain attitudinal changes. When looking at T2 means for all farmers we see that the MAX and MIN groups have essentially the same attitude at T2 toward the testing service, both of which are better than the CON group attitude. The MIN group showed a greater mean attitude shift than the max group, but it could be argued that only the T2 mean matters, because this is the representation of the farmer's attitudes as a result of the message, and it should not matter where these attitudes were before receipt of the message as long as the resulting attitudes are the same. This theory becomes very unstable if we look only at the data from people who reported receiving the message because MINT2 is less than MAXT2, but still one might argue that all farmers saw the messages whether they reported seeing them or not because two copies were sent to each farmer and none were returned as undeliverable. This explanation contends that people's attitudes gravitate to a certain point following a message regardless of their initial view, which is contrary to the Galileo view which says people all shift in the same direction and their final result or end point depends upon their start point. This placebo effect does not receive support from the message receiver's data (the very data that should support it). Hence we discard this theory in favor of another.

The Galileo theory's AMG works on mean distance scores and then designates concepts for use in a persuasive message to induce the moving together of two specified concepts. Past users of the theory who have used these concepts in messages to persuade a population have indicated that the concepts given by the AMG may not be able to be worked into a logical

message. The Galileo program's authors do indicate that it is preferable to construct a fairly good message using concepts (or groups of concepts) which may have vague connotations for the audience. The AMG identified the MAX group message to be a powerful one for moving the self and DHI SCT close together, but it never said the message was sensible, or that farmers would not associate "monitoring milk quality" with the California (paddle) test or other tests for the quality of milk. It could be that the maximum message may have led to a change in dairying habits completely unrelated to the DHI SCT.

Although Galileo gives a list of concepts for use in a message, there are no set rules regarding the addition of non-concept words to the message. It seems realistic to consider that the predicted movement of the start-target concepts would be altered by the addition of non-concept words to the message, as these words would then be considered as additional concepts in the message even though they were not present in the Galileo analysis. The basic premises of Galileo theory insist that a change in the predicted movement would occur due to the addition of these non-designated concepts, but that deviations from the predicted path would vary differently for different words. We predict that articles (e.g. a, or, the) and forms of the verb to be (i.e. is, are) would not change the direction as these words are mainly connectors between concepts and have no real meaning in themselves, but other more substantial words from the subject neighborhood, or negations, may cause the actual concept paths to vary quite a bit from the predicted paths.

The maximum impact Galileo message "monitoring milk quality increases your profit at the creamery" and the minimum impact message "monitoring high somatic cell counts can reduce expensive hidden mastitis", each contain key words that were not designated for use by the Galileo AMG (in part because the words were not included in the analysis). The maximum message contains the

word "increases" and the minimum message contains the word "reduces," both potential concepts for changing the influence of their respective messages. An alternate explanation for the results obtained in this study stems from the hypothesis that these two words changed the impact of each message due to their inclusion as "extra" concepts. Some support of this view stems from our informal discussions with farmers in which some opinions regarding dairy farming were expressed to us; this support is discussed below.

The dairy farmers we spoke with seemed to express the view that hidden mastitis is a disease that shows up periodically in cows, for which few preventive measures can be taken. Mastitis cuts down on a cow's milk production and results in high somatic cell counts, a sign of low quality milk. The farmers indicated that they became aware of mastitis either when a cow developed a rash indicative of mastitis, or when the creamery tested the farmer's milk and noticed a high somatic cell count (which lowers the price rate paid for the farmer's milk), pointing to a mastitis problem somewhere in the farmer's herd. The farmers viewed this mastitis problem as their own, largely believing they control their own milk quality; this meaning that the creamery has no say in their profits because the creamery cannot control milk quality. This is a key point when analyzing the maximum message which contained the phrase "increases your profit at the creamery", (see Appendix 1) a phrase that means little to farmers due to their belief that they control profits and the creamery is unable to influence profit. This phrase is also difficult for farmers because producing higher quality milk does not really increase their profits, the effect of high quality milk is that farmers avoid penalties for low quality milk or perhaps "get their name in the newspaper." Looking at the minimum impact message (see Appendix 2) we see the phrase "reduce expensive hidden mastitis," something which is <u>much</u> more believable

for farmers because monitoring high somatic cell counts with the DHI SCT results in avoiding penalties at the creamery, or in other words, reduces expensive hidden mastitis. The farmers were influenced by the message which prompted them to avoid the penalties for a high somatic cell count and therefor the minimum message proved more persuasive than the supposed maximum message which preached a position seen as unfeasible by many farmers.

An alternative explanation supported by our results is that the addition of extraneous concepts into a Galileo message can dramatically change the efectiveness of the persuasive message. In our study the addition of the concept "increase" into the maximum message marketed the DHI SCT as something which would increase profits, while the farmers see the test as a means of escaping penalties. Although the DHI SCT ultimately does increase profits, it does so only indirectly by reducing expenses through escaping creamery penalties. It is because the direct effect of the DHI SCT is to reduce expenses (due to creamery penalties) that the minimum effect message becomes very persuasive when the concept "reduce" is added. We theorize that the minimum message was more effective due to its dealing with the direct benefits of the DHI SCT, while the maximum message was less persuasive by addressing only the indirect effects of the testing service. We theorize that adding concepts to the group designated by the AMG can significantly change the context of the message, hence change the predicted effects due to the persuasive message, and it was this type of process at work in our study which led to our reversed results for the two messages.

Conclusions

It is unclear exactly what caused the unexpected results of this study,

and no conclusions can be made about whether the Galileo instrument yields true metric measures. It is also unclear whether adding extraneous concepts is bad all of the time, or if this is harmful only when these concepts are in the neighborhood of the study. Regardless of the cause of our results, it is recommended that the addition of any concepts to future Galileo messages, and even whether extraneous concepts should be added at all, be considered very carefully with a demanding look at the concept's precise meaning within the neighborhood under study.

This investigation has however been helpful in evaluating the Galileo AMG by providing a situation under which various messages of different hypothesized effects can be studied under controlled conditions and allowing for the comparison of the effects of different messages. We believe that the basic experimental design of this study is methodologically well constructed and that it could effectively serve a a model for other Galileo studies to replicate. Still, we strongly recommend that future studies employ messages comprised solely of original Galileo concepts. We further recommend that future Galileo studies investigate the impact of extraneous concepts. Lastly, it would also be useful to conduct additional studies with the AMG, whereby each individual's cognitive and behavioral change is more closely followed.

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TABLE 1

Concept Number	Concept Label
001	HIGH SOMATIC CELL COUNT
002	CREAMERY
003	MILK QUALITY
004	PROFIT
005	HIDDEN MASTITIS
006	EXPENSIVE
007	DHI SOMATIC CELL TEST
008	MONITORING
009	YOURSELF

Table 1: Concepts utilized by the Galileo instrument.

TABLE 2

Mean distance scores at T2 and mean shift scores across time for MAX, MIN, and CON groups (all data) for the concept pair "DHI somatic cell test and yourself"

GROUP	N	MEAN	STD. DEV.
MAXT2	[illegible]	47.6	36.8
MINT2	[illegible]	46.3	48.7
CONT2	31	64.2	57.6
MAXT1-MAXT2	[illegible]	-5.1	52.7
MINT1-MINT2	[illegible]	14.4	55.0
CONT1-CONT2	[illegible]	-4.3	114.[illegible]

TABLE 3

Mean [illegible] scores at T2 and mean shift scores across [illegible] for MAX, MIN, and CON groups for the concept pair " DHI somatic cell test and yourself" using data from Reported message receivers* only

GROUP	N	MEAN	STD. DEV.
MAXT2	20	56.0	37.3
MINT2	24	39.1	40.3
CONT2	31	64.2	57.6
MAXT1-MAXT2	20	-7.0	59.4
MINT1-MINT2	24	13.2	39.1
CONT1-CONT2	31	-4.0	114.0

* Those in the MAX and MIN groups who, at T2 interviewing, reported receiving at least one Galileo communication

Group means and tests of significance for all hypotheses : for both all respondents, and reported message receivers only.*

HYPOTHESIS			ALL DATA					MESSAGE RECEIVERS*					
	Group 1		Group 1 N	Group 1 $\bar{X}$	Group 2 N	Group 2 $\bar{X}$	T***	Sig.	Group 1 N	Group 1 $\bar{X}$	Group 2 N	Group 2 $\bar{X}$	T***	Sig.	Conclusion
H_1 :	MINT1-MINT2	> CONT1-CONT2	29	13.8	31	-4.0	1.33	N.S.	23	13.2	31	-4.0	0.[illegible]	N.S.	H_1 not supported
H_2 :	[illegible]	> MINT2	31	64.2	29	46.3	1.30	p=.10	31	64.2	24	39.1	1.[illegible]	p=.05	H_2 supported, both groups
H_3 :	MAXT1-MAXT2	> MINT1-MINT2	27	-6.1	29	14.0	-1.42	p<.10**	20	-7.0	24	13.2	-1.35	p<.10**	H_3 supported opposite direction, both groups
H_4 :	MAXT1-MAXT2	> CONT1-CONT2	27	-6.1	31	-4.0	0.08	N.S.	20	-7.0	31	-4.0	0.11	N.S.	H_4 not supported
H_5 :	CONT2	> MAXT2	31	64.2	27	47.3	1.32	p<.10	31	64.2	20	56.0	0.62	N.S.	H_5 supported by all farmer's data only
H_6 :	MINT2	> MAXT2	29	46.3	27	47.3	-0.11	N.S.	24	39.1	20	56.0	-1.44	p<.10**	H_6 supported opposite direction, message receivers only
H_7 :	ZEROT2	= CONT2	28	33.3	31	64.2	-2.55	p<.01							H_7 rejected, there is a difference
H_8 :	CONT1	= ZEROT2	31	60.0	28	33.3	-1.32	p=.10							H_8 rejected, there is a difference

*Message receivers are those in the MAX and MIN groups who reported seeing one or both of the Galileo messages
**These results are significant in the direction opposte the hypothesis
***T-value is positive if results are in a direction consistent with hypothesis. T-value negative if trend of the results are contrary to the hypothesis listed.

	ALL DATA	MESSAGE RECEIVERS*
H_4 : MAXT1-MAXT2>MINT1-MINT2>CONT1-CONT2	F= 0.47 N.S.	F=0.42 N.S.
H_5 : CONT2 > MINT2 > MAXT2	F=1.24 N.S.	F=1.90 N.S.

Appendix I

2/29/84

University of Wisconsin
Department of Dairy Science
College of Agricultural and Life Sciences
Madison, Wisconsin 53706

MONITORING MILK QUALITY

increases your PROFIT at the CREAMERY

Sign Up for DHI's SOMATIC CELL TEST Program Now

Contact: Dairy Herd Improvement Cooperative (715) 235-1128
403 Cedar Avenue West
Menomonie, Wisconsin 54751

****

"The average dairyman who uses DHI's Somatic Cell Test to make decisions can earn $5.00 for every dollar spent."

: Maximum-effect message. Concepts from the AMG analysis are in capitals.

Allan Bringe

Dr. Allan Bringe
University of Wisconsin
Dairy Scientist

Appendix 2

2/29/84

University of Wisconsin
Department of Dairy Science
College of Agricultural and Life Sciences
Madison, Wisconsin 53706

MONITORING
HIGH SOMATIC CELL COUNTS
can reduce
EXPENSIVE
HIDDEN MASTITIS

Sign Up for DHI's SOMATIC CELL TEST
Program Now

Contact: Dairy Herd Improvement Cooperative (715) 235-1128
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Menomonie, Wisconsin 54751

****

"The average dairyman who uses DHI's Somatic Cell Test to make decisions can earn $5.00 for every dollar spent."

_____: Minimum-effect message. Concepts from the AMG analysis are in capitals.

Allen n Bringe

Dr. Allan Bringe
University of Wisconsin
Dairy Scientist

Appendix 3

SOME COMMENTS ON MARK'S AND TONY'S DRAFT REPORT

1. I don't have a final set of data, which excludes those cases who said they did not receive the mailed messages. Therefore my interpretations are limited. I can now access the MACC UNIVAC from here via TELENET, so sometime I will try to look at the final data set.

2. My analysis has been based on the attached photocopy of the results at 19 March 1984.

3. The first observation is that the MIN EFFECT message worked.

   Min effect message worked as predicted by the theory (using all data).

	TIME 1	TIME 2		
		JWC DATA	MS + TAB DATA	
			All Data	Message Receivers
ST-TG	56.8[1]			
Predicted ST-TG		45.28		
Actual ST-TG		46.35	46.3	39.1
	(N=35)	(N=32)	(N=29)[2]	(N=24)

   Note 1: Pooled mean (N=102 cases) is 51.30 (AMG performed on 102 cases)
   Note 2: Why the drop in n to 29?

   The MINT1 - MINT2 mean difference of 14.4 in MS + TAB's Table 2 seems larger than I would have thought. Has the T1 sample size been reduced?

   Because the MIN EFFECT message was not at right angles (i.e. 88.28%, versus 100% of resultant vector) I think MS + TAB's H_1 test may be an invalid comparison.

4. The MAX EFFECT message appeared to have either an opposing effect, or no effect, or a small effect in the predicted direction.

	TIME 1		TIME 2		
	JWC	MS + TAB	JWC	MS + TAB	
				All Data	Messages Received
ST-TG	50.6	41.5[3]			
Predicted			23.07		
Actual			45.9	47.6	56.0
	(N=35)		(N=30)	(N=27)	(N=20)

   Note 3 : Pooled mean (102 cases) is 51.30; MS + TAB mean 41.5 — I have derived by difference from their Table 2 (47.6-6.1). This seems low, or alternatively, the group mean is unstable when cases are removed. Discrepancy here needs clarifying as it is central to the analysis.

The perverse effect observed in this data is aggravated when the decline in the grand mean T_1 to T_2, 50.7 to 43.3, is taken into account (i.e. the overall cognitive space shrunk).

5. The analysis based on message receivers (N=20) in 4 above is likely to be unreliable. Our experience last year suggests that at less than 35 or 30 cases (at best) the means become notoriously unstable.

6. Control Group - No significant change (t test)

JWC :	ST-TG (T_1)	62.67	ACTUAL (T_2)	69.67
MS + TAB :			ACTUAL (T_2)	64.2

The control group grand mean (for all concepts) increased 4.9 units or 10 per cent.

7. The extremely large SD for CONT 1 indicates instability and will prejudice any t test involving this group. The cause for this SD should be investigated - it may be caused by data errors or by one or two cases. The SD for CONT 1 with 32 cases was 30.5; when cases increased to N = 35, SD = 103.34.

8. Small N's display very large instability, therefore difficult to have much confidence in experimental group effects where $N \leq 30$.

9. There are a number of bases for statistical comparison:

   (a) T_1 and T_2 for each experimental group (t tests.)

   (b) T_1 vs T_2 for each experimental group (Procrustes Rotation). – Joe Woelfel + Jure did this @ SUNY with 19 March data

   (c) Experimental comparisons : Change in PANEL 1 vs. PANEL 2. Vs. change in CONT.

..oOo..

John Amy
20 July '64