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An Empirical Investigation of the Impact of the Anchor and Adjustment Heuristic on the Audit Judgment Process

A dissertation submitted to the

Division of Graduate Studies and Research
of the University of Cincinnati

in partial fulfillment of the
requirements for the degree of

DOCTOR OF PHILOSOPHY

in the Department of Accounting and Business Law
of the College of Business Administration

1988

by

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ABSTRACT

This research investigated the operation of the anchor and adjustment heuristic in the environment of the continuing audit engagement. Specifically, the impact of information concerning the previous year's compliance test results was measured over several reported error rates from the current year's compliance test results. The experimental instrument was applied to two classes of participants, audit practitioners from both public accounting and a government audit service. Each participant was required to supply a estimate of the total population error rate using the information given and the risk assessment methodology. The results of this empirical investigation determined that the addition of prior year information appears to moderate the impact of the anchor and adjustment heuristic by reducing the participants' confidence that the sample error rate represents an acceptable population error rate.

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TABLE OF CONTENTS

ABSTRACT ii

ACKNOWLEDGEMENTS iii

ILLUSTRATIONS vi

Chapter I 1
Research Overview 1
Introduction 1
Audit Opinion Process 2
Professional Judgment 5
Heuristics in the Audit Process 6
The Profession's Position 8
Risk Assessment Method 9
Fractile Assessment Method 10
Research Questions 11
Summary 14

Chapter II 15
Literature Review 15
Accounting Research 15
Studies in Elicitation Methods 16
Studies in Heuristics and Bias 18
Studies in the Normative Framework . . 21
Psychological Research 24
Studies in Decision Making under Uncertainty 24
Representativeness Heuristic 25
Availability Heuristic 25
Anchor and Adjustment Heuristic . . . 26
Lens Model of Decision Making 28
Studies in Applied Decision Making with Heuristics 29

Chapter III 31
Research Methods 31
Research Questions and Hypotheses 31
Testing of Hypotheses 34
Participants 35
Experimental Materials 37
Masking of the Main Experimental Question . 38
Administration of the Experiment 39
Administering the Experiment to Private Sector Auditors 39
Administering the Experiment to Governmental Auditors 40
Questionnaire 41

Chapter IV 43
Data Analysis 43
Hypotheses Testing 43
Compilation of Participants' Responses 43
Determination of the Appropriate Analysis Method 45
Hypothesis 1 46
Hypothesis 2 49
Hypothesis 3 50
Other Analysis 50
Professional Certification 50
Continuing Professional Education . . 52

Chapter V 54
Conclusions 54
Summary 54
Conclusions and Implications for Practice . 55
Review of Prior Work Papers 55
Impact of Prior Audit Evaluations . . 57
Current Sample Error Rate 58
Heuristic Modification 59
Limitation to External Validity 59
Direction for Future Research Efforts . . . 61

Appendix 1 Audit Judgment Exercise 62

Appendix 2 Questionnaire 71

Appendix 3 Participant Data. 73

Appendix 4 Chi Square Goodness of Fit Test 75

Appendix 5 Analysis of Variance 78

Appendix 6 Rationale for Tests of Hypothesis 2 . . . 80

Bibliography 82

ILLUSTRATIONS

Exhibit

2-1	Lens Model	29
4-1	Participant Responses	44
4-2	Friedman F_r Results (Hypothesis 1).	48
4-3	T-Test (One-tailed) Results	49
4-4	Friedman F_r Results (Certification)	51
4-5	Regression Table	53

Figure

3-1	Experimental Design	34
A4-1	Histogram	75
A6-1	Interaction Results	80

Chapter I

Research Overview

Introduction

The use of statistical sampling procedures in the conduct of audits is of increasing importance to the profession. Auditing has progressed from a position of permitting the use of statistical sampling (Grinaker and Barr, 1965) to defending its non-use in certain circumstances on audits (Holmes and Burns, 1979). Statistical sampling is still considered situation specific (Burton, Palmer, and Kay, 1981), and as such, demands professional judgment as to when it is appropriate or more importantly, when it is not. However, current audit procedures concerning the evaluation of statistical samples allow the auditor to choose the evaluation technique (Burton, Palmer, and Kay, 1981). This position is explained in the most recent policy in this area [Statement on Auditing Standards (SAS) 39, American Institute of Certified Public Accountants (AICPA), 1981]. This statement continues to permit use of a judgmental technique for determining whether sample results from compliance tests are indicative of problems significant enough to alter subsequent plans for substantive audit test procedures.

Audit Opinion Process

The auditor's opinion formulation process has been the subject of much research in accounting during the last ten to fifteen years (Felix and Kinney, 1982). Within the process, primary emphasis has been put on the area of internal control evaluation and testing, simply because it is this initial stage that forms the foundation for the rest of the examination. In this area, some researchers have studied auditor behavior in making probabilistic judgments with respect to evaluating the results of analytic reviews and internal control compliance tests (Felix and Kinney 1982, also Libby 1981). Decomposing the audit opinion formulation process into its components (Waggoner, 1986) illustrated that these decisions are made up of both sampling and nonsampling risk elements. These two risk elements were defined in SAS 39 as follows:

> "Sampling risk arises from the possibility that, when a compliance or a substantive test is restricted to a sample, the auditor's conclusions may be different from the conclusions he would reach if the test were applied in the same way to all items in the account balance or class of transactions.
>
> Nonsampling risk includes all the aspects of audit risk that are not due to sampling. An auditor may apply a procedure to all transactions or balances and still fail to detect a material misstatement or a material internal accounting control weakness. Nonsampling risk includes the possibility of selecting audit procedures that are not appropriate to achieve the specific objectives.... Nonsampling risk also arises because the auditor may fail to

> recognize errors included in documents that he examines which would make that procedure ineffective even if he were to examine all items."

The concept of nonsampling risk would then include the individual biases that all decision makers bring into the process. One of these biases can be attributed to the operation of judgment heuristics or rules of thumb which have been the subject of much research in several disciplines. This line of research can find its genesis in the seminal work of Tversky and Kahneman (1974). Their research of biases in judgments detailed some of the heuristics of decision making under uncertainty. Out of Tversky and Kahneman's work, researchers in other fields, like accounting, transplanted their concepts to determine what, if any, impact was felt in those disciplines.

Probabilistic judgment is the basis for the rendering of any audit opinion. Since this individual audit judgment is not scientific, there are no rules available to judge the propriety of the auditor's opinion other than subsequently revealed contrary information. Although the auditor's opinion appears to represent a singular opinion it is in fact a representation of the consensus of the auditing firm concerning the particular client's financial reports. Indeed, in human judgment literature, consensus is one of the accepted methods of determining the "correct" answer to whatever problem is presented to the participants (Libby and Lewis, 1982). This use of a

substitute (the consensus judgment of experts) where there is a lack of objective criterion data making the direct measurement of achievement impossible, is part of many decisions required in accounting. Even with the consensus of experts there is no guarantee that items sampled are truly representative of the population as a whole. However, in the application of the attestation function, the only way to prove the auditor "wrong" (in the sense that a clean opinion is inappropriate) is to develop contrary financial information. The opportunity to exercise professional judgment occurs continually throughout the audit process. These professional judgments extend from which information is required; to how much; to how it is to be collected and evaluated; to the ultimate decision of whether the information gathered and evaluated supports the issuance of an audit opinion, which is the culmination of the auditor's professional judgment process.

At the heart of any audit effort lies the auditor's evaluation of the client's system of internal control. The second standard of field work (AICPA, 1983) states that:

> "There is to be a proper study and evaluation of the existing internal control as a basis for reliance thereon and for the determination of the resultant extent of the tests to which auditing procedures are to be restricted."

The primary emphasis here is to ensure that sufficient

audit work is being accomplished to properly support the degree of reliance placed on the client's internal controls. The compliance tests that serve as the basis and justification for this reliance are normally accomplished on a sample of relevant items selected by the auditor. If statistical sample selection procedures have been employed then a proper evaluation scheme also needs to be used. Current practice permits the use of the risk assessment method for evaluation purposes (SAS 39, AICPA, 1981). This particular method is one of two judgmental evaluation methods originally considered as appropriate prior to the issuance of SAS 39. The other method, fractile assessment, was abandoned because its approach to judgment was not considered to be the most conservative approach.

Professional Judgment

The introduction of professional judgment also includes the introduction of bias as indicated by the literature of psychology when discussing human judgment. This literature describes judgment and choice as characterized by extensive biases (Einhorn and Hogarth, 1981). The individual judge inserts his/her own biases into the process through the use of heuristics in the decision process. It is this area of bias, the use of

heuristics, that the current research investigated. All three heuristics described by Tversky and Kahneman (1974) including the anchoring and adjustment heuristic can cause problems for the audit and auditor. The most significant peril arising from the anchoring and adjustment heuristic is that the auditor is more likely to place unwarrented reliance on the client's internal control system. In doing so, subsequent substantive testing may be inapproriately limited, resulting in insufficient evidential matter, which would inhibit the auditor from issuing an opinion if the short-coming were known. The issuance of SAS 39 was an attempt to compensate for the inclusion of bias resulting from auditors' heuristics, primarily, the anchoring and adjustment heuristic. The only method that would completely eliminate this type of bias seems to be somewhat slower in coming. Acceptance by the profession of statistical evaluation of audit compliance test results would control for the heuristically induced bias. Increased knowledge of the auditor's decision process can lead to improving that process through identification of both the details of the process and the major variables involved.

Heuristics in the Audit Process

The heuristics used by the auditor can be defined as

educated rules-of-thumb that bring in common-sense approaches to problem solving (Hax and Candea, 1984). The anchoring and adjustment heuristic, the focus of this research, is such a rule-of-thumb which establishes an estimate of a population parameter based on limited initial information (for example, prior year workpapers) and adjusts that estimate as new information (sample data) becomes available. This adjustment process is not a strict Bayesian (statistical) revision of the prior probabilities (Kahneman and Tversky, 1972). That is, the process does not take the previously established probabilities (the anchor - prior probabilities) and using the Bayesian formula[1], revise those priors into current probabilities (posterior probabilities) given the sample results. What does occur is an internal revision of the prior estimates of the probabilities using a modified adjustment technique. This adjustment process has been shown to inadequately adjust for the sample information provided (Tversky and Kahneman, 1974). Previous accounting research indicates that this heuristic results in adjustments which significantly influence auditors' judgments concerning the amount of subsequent audit tests required (Joyce and Biddle, 1981). The direction of the

---

[1] Bayes Rule can be expressed as:

$$\frac{P(H_1|D)}{P(H_2|D)} = \frac{P(D|H_1)}{P(D|H_2)} \frac{P(H_1)}{P(H_2)}$$

(from Libby, 1981)

where H_1 and H_2 are the alternative hypotheses and D is the datum.

change was not that predicted by the conventional anchoring and adjustment heuristic. It was, however, in line with the conservative approach that one associates with auditing; that is, when internal control improved the experimental participants exhibited a consistent conservative stance and did not reduce the subsequent substantive audit tests looking toward those tests as a confirmation of the improved internal control system.

The Profession's Position

The publication of SAS 39 (AICPA, 1981) eliminated the auditors' choice between two judgmental methods (risk assessment and fractile assessment) for evaluating sample results. The outcome was a recommendation that the risk assessment method be used. These two methods for eliciting subjective probability distributions concerning the estimate of the population error rate, have been described as being formally equivalent (Tversky and Kahneman, 1974). Since the tolerable error rate is tested against the sample error rate to determine the efficacy of the client's system of internal controls, then investigation of the effects of different evaluation methods is required to further our understanding of this important decision process. Elicitation of subjective probability distributions for given population parameter

can be obtained through the two methods named above: either risk assessment or fractile assessment by the participant.

Risk Assessment Method

In risk assessment, the subject would be asked to assess the probability that the true parameter values will exceed the tolerable error rate which represents the amount of error that the auditor can accept in the client's financial records without either correcting the error(s) or modifying the audit report (Holmes and Burns 1979). In the risk assessment method, the auditor judges the likelihood that sampling error can explain the difference between the sample error rate and the maximum allowable rate, in other words, what is the probability that the sample error rate is truly representative of the population error rate. If, for instance, we were auditing payables, our interest may be whether the receiving reports were matched to purchase orders prior to payment. Given our example, if the auditor receives sample results from a statistical sampling procedure (e.g. population = 3000 paid accounts payable vouchers, sample = 40, sample error rate = .5%), and estimates the probability that the population error rate does not exceed a specified upper error limit (e.g. I am 90% confident that there are no

more than 8% incorrectly matched purchase orders) then the auditor tends to underestimate the 90% confidence interval, increasing the alpha or chance of committing a type I error, rejecting a true hypothesis (Kinney and Uecker, 1982).

Fractile Assessment Method

The other method, known as the fractile assessment method, permits an auditor to add a subjective assessment of sampling error to the sample error rate and compare the result with the maximum allowable error (AICPA, 1979). Using the example given above, the auditor would anchor on the sample error rate (.5%) and then estimate with a given confidence level whether the population error rate exceeds the auditor's estimate (there is a one in twenty chance that the population error rate will exceed eight per cent). This increases the opportunity for the auditor to commit a type II error, accepting a false hypothesis. The fractile assessment method was eliminated as an acceptable method of evaluating sample results with the publication of SAS 39. The difference between the two methods does not come from the methods themselves, since they both should lead to the same evaluation. Problems result from individuals using different modes of adjustment from different initial anchors (Kinney and Uecker, 1982). The

current research deals with the risk assessment methodology only, since this is the method selected by the profession.

Research Questions

This research is designed to provide insight into the effect of the anchor and adjustment heuristic on compliance audit test evaluations. Specifically, if the anchor and adjustment heuristic would be affected by providing the participants additional audit information concerning compliance sample evaluations from the previous year's audit files. This research question was investigated through an analysis of a laboratory experiment which elicited subjective probabilities concerning compliance test sample results. The experiment, which consisted of a booklet containing various audit questions, attempted to duplicate the normal audit setting by describing a situation which is commonplace in the audit environment. Evaluation of compliance testing is an essential first step in determining how much reliance the auditor will place on the client's system of internal control according to the second standard of field work. These evaluations are normally accomplished by the auditor-in-charge at the client's place of business based on audit evidence

gathered by subordinates. In most continuing engagements, the auditor-in-charge will have the prior year's workpapers available as a reference for the current audit team. This apparent addition of information to a risky decision should improve the auditor ability to judge. Since we have to make inferences concerning the internal control process from a sample of "key" (another judgment) control applications, we are concerned with the structure of the general decision task. With such an emphasis, the general task needs to be specified in its natural environment (Einhorn and Hogarth, 1981). This research adds to the environment the aspect of prior information which will provide an additional data point for the anchor thus including choice in the anchor process. The research measures the relative weight that prior information can bring to the decision process by improving the task structure (Joyce and Biddle, 1981).

Additionally, prior research also examined whether the state of the prior audit information had a bearing on current audit evaluations. That is whether the acceptability of the prior year's sample evaluation would further modify the subjective probability generated by the evaluation of compliance test sample results. If the prior audit work indicated that a similar sample was acceptable or not, what effect did that have on the current auditor's ability to appropriately assess the

current audit work. Similar questions were asked in other research efforts which resulted in determinations that directional change in internal control strength have an impact on the current audit planning effort for substantive testing (Joyce and Biddle, 1981).

An associated question arises when the sample error rates approximate the previous year's error rate. Does the similarity of those error rates affect auditor judgment? To delve into this question, auditors' responses were measured over two different sample error rates, one close to this year's results and one quite distant. Based on previous psychological and accounting research, the participants should not be able to sever the evaluation one from the other, thus a further impediment on auditor's ability to assess probability through the use of risk assessment method. Some of this recent research centered on the information search process that takes place (Brown in Moriarity and Joyce, 1984) and the confidence the searcher places in the resulting judgment. Ashton's comments (Ashton in Moriarity and Joyce, 1984) make a cogent point that most experimental judgment tasks involve all the necessary information and that the information is perfectly reliable. This current research effort included prior sample evaluation results which of themselves connoted a risky decision and not perfectly reliable data for the purposes of making professional

judgments concerning the client's current year financial statements.

Summary

This investigation addresses three research questions involving the anchor and adjustment heuristic;

* Does the availability of prior year sample results affect current year evaluations of compliance test results?
* Does the acceptability of prior year sample results affect current year evaluations of compliance test results?
* Does the comparability of sample error rates between prior and current year compliance tests affect evaluation of current year sample results?

An empirical experiment was conducted using employees of both national and regional public accounting firms and government agency auditors. These participants were members of the audit staffs of their respective firms and as such had had experience in evaluating sample results from compliance tests on client's internal control systems. The experimental instrument was an audit scenario which required each participant to provide their probabilities concerning the confidence (elicitation of a subjective probability) they would have in a sample from a compliance test.

Chapter II

Literature Review

The basic premise in human judgmental theory is that man has a limited cognitive ability to deal with an extremely complex environment. In order to cope effectively with that environment, the judgmental process has been reduced to heuristics or simple judgment rules of thumb. These heuristics and their involvement in the human judgment process, especially the area of probabilistic judgment, have been the subject of extensive research efforts in accounting and psychology. The next section addresses the applicable research in accounting. It is followed by a section discussing the relevant research in psychology.

Accounting Research

Accounting's interest in behavioral decision making is engendered by the essences of the accounting/auditing process the use of financial information to make decisions concerning the business entity. Libby's assertion that "(d)ecision making is the basis for the demand for accountant's services and is involved in many of their more difficult duties" serves as an explanation of the interest in the area of decision making. In the arena of human

information processing, the major subdivisions form an outline for our discussion of the relevant research in accounting concerning probabilistic judgment.

Studies in Elicitation Methods One of the early research areas in the opinion formulation process was to relate professional judgment and the use of statistical procedures. Under this heading of applicable statistical procedures there were two distinct possible evaluation procedures, that of the "classical" and "Bayesian" approaches. To differentiate between these two, we need only to view the "classical" approach as a snapshot of the sample information. The procedure does not provide for any additional information other than that contained in the sample data which is evaluated on its own. Sample data in the accounting context has been described in a probability research effort (Corless, 1972) as "sampling evidence; all other audit evidence...(is) nonsampling evidence." Thus, subsequent to gathering sampling evidence, we need only to apply the appropriate statistical technique for evaluation. The Bayesian procedure uses "nonsampling" evidence to establish a prior probability concerning the area under investigation. Then, after obtaining sample data, Bayes Theorem or Rule is used to revise the prior probability estimates considering the information provided by the sample data into posterior probability estimates. During the early 1970's when statistical sampling and evaluation were

becoming de rigueur in the profession, Corless concluded that statistically revised estimates (using Bayes Theorem) may be better interpreters of audit evidence than intuitively developed estimates. This conclusion was reached despite the finding that prior knowledge (in Corless' study relative to internal control strength) tightened the probability distribution (less variability). Corless' study presupposed that the method used to obtain the probability estimates from the auditor participants was appropriate. In the mid to late 1970's, several papers were published that concentrated on the validity of elicitation methods (Chesley, 1975, 1976, 1977). These studies concluded that method of elicitation did appear to have an impact on task evaluation and the resultant probabilities depending upon the participants' familiarity with the data presentation method. As stated previously, the audit opinion normally represents the consensus of the audit firm implying that it is a group judgment rather than an individual one. However many of the underlying decisions are those of the individual auditor-in-charge. One of the primary decisions to be made at the auditor-in-charge level is that of internal control evaluation. Thus an issue that should be of concern is the comparability of group versus individual internal control judgments. This was the focus of a study by Trottman et al which reported that a comparison of group versus individual evaluations were of

the same magnitude but slightly lower for groups than individuals. The basic conclusion was that no apparent need existed to call into question the present scheme of internal control evaluation; it appropriately remains the purview of the auditor-in-charge (Trottman, Yetton, and Zimmer 1983). These studies reinforced the belief that individual decisions form the basis of auditing.

Studies in Heuristics and Bias Part of the cognitive structure brought into this decision making process would be the heuristics applied by the auditor-in-charge. One of the initial research efforts in this area attempted to determine the extent that practitioners used two heuristics, representativeness and protectiveness (Uecker and Kinney, 1977), which were assumed to lead to systematic errors in the judgmental evaluation of sample outcomes. The results of that study indicated that practicing CPAs judgments were affected significantly by bias introduced through the subjective evaluation of sample outcomes. A full seventy-four per cent of the participants made at least one serious error in judgment. That is, in the evaluation of four different cases, auditor participants "in effect said that a sample result which is unacceptable evidence at the ninety percent level **is better** than a sample result which is in fact acceptable evidence at the 95% level of confidence" (emphasis in the original). The research concluded that auditors employed a more complex model of information

processing than had been indicated in the human information processing literature but that judgmental evaluation was a real concern for practitioners. However the participants' better than expected results lead to the conclusion that auditors were more sophisticated in their ability to evaluate statistical sample data than most others. This implied that the use of simple heuristics was not as widespread among auditors as originally thought.

In a series of three experiments (with six treatments), Joyce and Biddle (1981) researched the use of heuristics by auditors, primarily focusing on the anchoring and adjustment heuristic as the basis for their research. The second experiment in the series required the participants to make a decision on the extent of necessary audit procedures (for sales that were booked but the items had not yet been shipped), they would require given the specific directional changes in internal control strength from the prior year to the current year. The participants were given an initial internal control assessment (from the prior year) which was to be the anchor and then the current assessment of internal control (from weak to strong and strong to weak). The participants then were required to make a judgment on the subsequent extent of audit. In concert with previous research in the field of psychology, the participants tended to overaudit when the movement was from strong to weak and underaudit as it went from weak to

strong internal control. Unfortunately, the research design was such that the dependent variable (extent of audit) was confounded with a decision rule or heuristic that combined the utility of the decision (extent of audit) with probabilities (Libby, 1981). Despite this, the experimental results did show a significant main effect ($p<.0001$) for the internal control manipulation and significant effect ($p<.0002$) for the interaction (order x internal control strength). These effects indicate that information from prior years may have a considerable impact on subsequent audit plans through the establishment of an anchor and subsequent insufficient adjustment based on the sample data made available to the auditor.

During the consideration of the SAS on sampling procedures, the AICPA's Sampling Standards Task Force had the results of another study (Kinney and Uecker, 1982) which compared the two judgmental assessment methods (fractile and risk assessment) available to evaluate outcomes of audit test samples. The difference between the two methods did not flow from the methods themselves, since they should both lead to the same assessment but resulted from individuals using different modes of adjustment from different initial anchor. On the basis of Kinney and Uecker's study, the preference for the risk assessment method was expressed. Unfortunately there were difficulties with the study performed, Kinney and Uecker, due to the press of time,

could not control the selection of participants. The participants were selected by members of their accounting firms increasing the statistical risk to the results of their study due to the lack of control over the selection of the participants. If accomplished with the appropriate control, the selection of participants should be random from the entire pool of available participants. By permitting the firms to select the participants, the experimenters did not control for the "risk of bias", that is the firms could choose only those individuals who would perform the experimental task very well or those whose time would not have a serious impact on doing business. Another problem with this study is that when the participants were required to complete the experimental instrument neither experimenter was available to ensure proper application of the instrument. Recently, an additional research study was accomplished in this area with the stated purpose to test the possibility that auditors' anchor, when evaluating compliance sample results under the risk assessment methodology, is not as proposed in Kinney and Uecker's (1982) experiment (Butler,1986). The results of this study indicate that auditors, in fact, have an internal anchor of 5 to 10 percent as a tolerable error rate in determining risk assessments.

Studies in the Normative Framework Another research effort (Waggoner, 1986) detailed the interplay of detection risk,

inherent risk and control risk as defined in SAS 47, Audit Risk and Materiality in Conducting an Audit (AICPA, 1983). Within the definition of control risk is included the concept that this risk is "initially based on a preliminary review of the internal control system and prior year's workpapers (in words of the current research effort - an anchor)." Further, "this initial assessment is" presumed to be "confirmed or refuted by performing compliance tests of the controls to be relied upon in restricting the extent of substantive testing (adjusting the anchor)," (parenthetic phrases not in the original). The explanation of this later confirmation or corroboration concept is that the process in determining the amount of total audit risk depends to a significant extent upon proper evaluation of the sample results of compliance tests. The mathematical model which represents the various risks is described below:

$$IR \times CR \times DR = AR$$

where: AR = audit risk
IR = inherent risk
CR = control risk (risk that errors have not been detected by the internal control system)
DR = detection risk (risk that errors not detected by the internal control system will not be detected by the auditor)

Control risk has been defined (Libby, Artman & Willingham, 1985) to be a function of control design strength (CD), the results of the auditor's test of those controls (TR). This evaluation of compliance tests is viewed in continuing engagements, with respect to prior

year's test results and the evaluation of those test results. The auditor's judgment of the audit test strength should be affected by the availability of the prior year's data in the form of sample test results and the evaluation of the test result by the previous auditor-in-charge. The model proposed must then be modified to include the consideration of prior information as described below:

CR = f(CD, TR, TS)

where: TS = f(PT * PE)
PT = prior year test results
PE = evaluation of prior year test results
CR = control risk that internal controls will not detect errors
CD = control design strength
TR = test result
TS = test strength

This adjustment of the initial anchor, if not accomplished with rigor will increase the potential for inappropriate reliance on the client's internal system of control is increased. The second problem that exists is that of nonsampling error particularly that the auditor cannot interpret the results correctly even when presented with the data from the internal control review procedures. This was demonstrated in a recent study involving staff auditors and error recognition in several different audit environments (Blocher, 1983). Specifically, a significant percentage of errors in an internal control compliance test (among other errors were not detected by the auditors. The range for all errors was from 34.7% to 57.3%.

Psychological Research

The research in psychology regarding the investigation of a specific audit judgment and the impact of the anchor and adjustment heuristic is addressed in this section.

Studies in Decision Making under Uncertainty Accounting interest in the area of heuristics and biases developed out of the research of two psychologists, Tversky & Kahneman in the early 1970's. Their research into the process of judgment under uncertainty lead to the identification and elaboration of three heuristics, which decision makers use to assess probabilities and predict values. This particular type of decision making was so readily identified as the audit opinion formulation process that accounting researchers could easily extend the experimental task to one in an accounting framework. The application of the laws of probability to the human decision process tended to reduce this process to an abstract mathematical science. When the theories were first applied to the human decision environment, the results were not consistent with those previously developed laws of probability. Tversky & Kahneman and others documented through their research that individuals operated under a different decision making environment than that hypothesized. The precision of the laws of probability was being modified by the internal rules

of thumb that the decision makers used. The method of modification was dependent upon the particular heuristic used in given circumstances. Tversky & Kahneman noted the existence of three heuristics (representativeness, availability, and, anchor and adjustment) that appeared to have a significant impact on the decisions being made.

Representativeness Heuristic The representativeness heuristic relates an object to a group by way of resemblance. If object A looks as though it was produced by process B, then the more likely it is that object A actually came from process B. One of the example used to illustrate this heuristic is the comparison of offspring. The participants are given pictures of two individuals one short and one tall, the likelihood of being born tall, and data on the parents of one of the two which indicates that the father is also tall. The participants are then asked to judge which individual was fathered by the tall man. The result should be based on the likelihood ratio. With the operation of the representativeness heuristic, participant tend to select the tall individual. This simplistic rule which permits the human mind to easily relate objects to a class without examining all the causal details often entails systematic errors or bias (Libby, 1981).

Availability Heuristic This heuristic depends upon the ability of the participant to recall similar events. This ease of recall then affects the participant's probability

estimate of current events. An experiment was conducted using common causes of death in series of two and having the participants pick which is the cause of more death in the particular pair. Invariably, the participants picked the least probable cause since those were the ones which received the most coverage in the news. One of the pairs made the participants choose between botulism and lightning. Even though lightning kills many more people than does botulism, the fact that botulism receives much more media attention lead the participant to always choose it over lightning. Although these two heuristics have some implications for audit, they should not be a source of systematic bias during the normal course of the audit because the application of all the standards of field work are employed to prevent such biases.

Anchor and Adjustment Heuristic In the audit environment, the rules for proceeding (i.e. Standards) do not permit the auditor to draw conclusions without having the weight of evidential material support the decision. It then appears that evaluation is the critical decision point in the audit process. Certainly, as described above, accounting researchers isolated that particular decision for examination. However, even that procedure may cause inferences to be made which may or may not introduce systematic bias into the audit decision process. It is important to recognize the anchoring and adjustment

heuristic as potentially the most relevant heuristic given an audit environment. Because auditing tends to be a repetitive process (i.e. the same organization continues to employ the same audit firm year to year), the tendency may exist to anchor on past measurements and adjust that initial anchor when presented with additional information. This process may not be recognized as being part of their decision procedures by decision makers (Wright 1980). Wright's research reiterated Tversky & Kahneman by stating that individuals will use anchors for judgments when the prior information is in the same metric (stated in the same terms, $ or percentages). The study also states that "(w)hen an obvious anchor cue is not available, people do not seem to use the anchor and adjustment heuristic, and judgments are not biased..." (Wright 1980). However other psychological research into the impact of heuristics on the decision process has supported the hypothesis that, under restrictive conditions, heuristics can operate in a satisfactory manner, reducing both the cognitive effort and time between decision recognition and resolution (Hogarth, 1981). Hogarth's research revealed that prior heuristic research was conducted on isolated, discrete events rather than the continuous decision process in which incremental information/feedback refined the decision outcome. This portion of heuristic research had not been addressed previously in an accounting context and does pose

significant problems which the current research examines.

In describing the process of judgment and choice, it is necessary to view this process as a complex statistical formulation that goes beyond the cognitive capabilities of the individual. Out of this apparent chaos, the individual must elicit a structure and content upon which to base a judgment or make a choice. Heuristics aid in this reduction of the complex environment by inducing structure (Einhorn and Hogarth, 1981). The Statements on Auditing Standards emphasize the evaluation of sample data since auditing is performed primarily on a sampling basis. This is true whether samples are selected on a judgmental basis or selected and evaluated through the use of statistical theory. Within this sample evaluation process, psychological research has explored the process whereby the individual weighs cues or bits of information in a multifaceted decision environment.

Lens Model of Decision Making When reviewing the decision process, early researchers noted that decision makers viewed the criterion event through various cues or imperfect predictors of the event in a probabilistic manner. Different weights were assigned to the various cues and the cues were combined in a variety of fashions. One of the first to reduce this process to a model (Brunswik, 1952) called it a lens model comparing the cues to the lens of the eye which takes light and bends and focuses the light so

that the brain can see. All of the foregoing research depends upon the lens model of decision making, which specifies a linear relationship among the variables or cues as the most appropriate representation of the process.

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Exhibit 2-1

Lens Model

ENVIRONMENT		CUE SET	DECISION MAKER	
		x_1		
	r_1	x_2	r_{1c}	
Criterion	r_2	.	r_{2c}	Expert
	r_i	x_i	r_{ic}	Evaluation
	.	.	.	
	r_k	.	r_{kc}	
		.		
		x_k		

[based on Dudycha & Naylor (1966) in Libby, 1981]

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Studies in Applied Decision Making with Heuristics Other research into the operation of the anchor and adjustment heuristic followed in the applied psychology literature. These research efforts were directed toward isolating the decision variables to determine which had an effect on the decision process. A recent study whose primary objective was to compare judgments made by experts and amateurs given the anchor and adjustment heuristic supported the original study results of Tversky & Kahneman. Both amateur and expert judges were influenced by the heuristic which moderated their ability to adjust their estimates of true

real estate prices from the anchor given in the experimental instrument. Although in the study results, experts were influenced almost as much as the amateur by the anchor, the experts explicitly denied use of the anchor information in the formulation of their "independent estimate" of the price of real estate. This denial is associated with the experts' inherent interest to maintain their expertise (Northcraft & Neale, 1987).

Chapter III

Research Methods

Previous research reviewed in Chapter II forms the basis and rationale for continuing the research effort in the area of heuristics and their involvement in the accounting and auditing process. The research questions addressed by this study have been introduced in the three formal hypotheses developed in Chapter I. A more detailed discussion of the experimental hypotheses, research questions, and research methods follow in the subsequent sections of this chapter.

Research Questions and Hypotheses

The current research was designed to test the effect of the anchor and adjustment heuristic on compliance audit test evaluations. Specifically, one of the three questions raised addressed the issue of whether probabilistic judgments might be affected by providing the participants additional audit information concerning compliance sample evaluations from the previous year's audit files? The following research hypothesis was developed to address this question:

H_1: The addition of prior information to an audit compliance evaluation will affect the subjective probability relating to the total population.

This research question was investigated through an analysis of a laboratory experiment which elicited subjective probabilities concerning compliance test sample results. The experiment simulated the normal audit setting by describing a situation which is commonplace in the audit environment. Evaluation of compliance testing is an essential audit step performed to justify reliance placed on selected internal controls. These evaluations are normally accomplished by the auditor-in-charge at the client's place of business based on audit evidence gathered by junior auditors. In most continuing engagements, the auditor-in-charge will have the prior year's workpapers available as a reference for the current audit team. The addition of information to a risky decision should, it is hypothesized, improve the auditor's ability to judge. Since the auditors-in-charge have to make inferences concerning the internal control process from a sample of "key" (another judgment) control applications, they are concerned with the structure of the general decision task. The research reported in this dissertation addresses prior information as a part of the auditors' decision set. The addition of the prior information cue provides an additional data point for the auditor-in-charge to use as an anchor thus including choice in the anchor and adjustment process.

Additionally, this research also examined whether the

state of the prior audit information had a bearing on current audit evaluations. That is whether the acceptability of the prior year's sample evaluation would further modify the subjective probability generated by the evaluation of compliance test sample results. If the prior audit work indicated that a similar sample was acceptable or not, what effect did that have on the current auditor's assessment of the the current audit work? This research question is the basis for the second research hypothesis:

H_2: The acceptability of the prior year's sample results will affect the auditor's evalauation of current year's compliance sample results.

Similar questions were studied in other research efforts which resulted in determinations that directional change in internal control strength have an impact on the current audit planning effort for substantive testing (Joyce and Biddle, 1981). The current research was interested in testing whether the acceptability of prior data would have an effect on the elicitation of subjective probabilities rather than the effect on subsequent substantive testing.

An associated question arises when the sample error rates approximate the previous year's error rate. Does the similarity of those error rates affect auditor judgment? This becomes the basis for the third and final hypothesis:

H_3: Sample error rates will have an effect on the risk evaluation of compliance testing.

To delve into this question, auditors' responses were measured over two different sample error rates (0% and 4%), one close to last year's results (4.2%) and one quite distant. The extreme difference between the two values should be sufficient to ensure that the subjective probabilities elicited are statistically significant.

Testing of Hypotheses

The testing of the research hypotheses was accomplished by performing a laboratory experiment in which the participants were given an audit judgment exercise to elicit subjective probabilities from a risk assessment point of view. Through the measurement of the subjective probabilities (the dependent variable) over the various information states of the prior audit effort and current sample error rates (the independent variables), the difference among the states could be measured (see figure 3-1).

Figure 3-1

EXPERIMENTAL DESIGN

	ERROR RATE 0%	ERROR RATE 4%	
41	21	20	With Information
21	10	11	Without Information
	31	31	Sample Size = 62

INFORMATION STATE

To insure that the confounding effects of the participants individual differences are properly accounted for the experimental design included random assignment of the experimental material to the participants. Each participant was presented with the case material which included both the main experimental question and two other audit probability questions (see appendices 1 and 3) used to mask the main question. The order of presentation of the questions to the participants was varied through a random ordering of the material in the individual audit judgment exercise packets. The packets themselves were also arranged in random order.

Participants

Sixty-two professional auditors served as participants in the audit judgment experiment. These participants were either members of a public accounting firm or a governmental agency. The public accounting participants were drawn from five local offices of four different public accounting firms. One of the local offices was a regional firm, the three others represented "Big Eight" firms. Two of the local offices represented one of the "Big Eight" firms.

The public accounting participants were drawn from audit staff members who were attending continuing

education programs at their offices. These individuals were chosen based on availability and were not randomly selected. Geographically, all of the participants were working in the same region of the midwestern United States.

The governmental auditors were stationed in the midwest but had audit responsibility world wide for the Department of the Air Force. Only those individuals who had sufficient experience auditing (two years or more) took part in this experiment.

The experiment was presented to all participants as an audit judgment exercise which involved the evaluation of sample data resulting from a compliance test. This is the type of work normally associated with senior/semi-senior auditors and represents one of the first tasks to be accomplished during the course of an audit.

Members of the public accounting firms viewed a videotape of the experimenter which introduced the exercise to the participant. The participants from the government agency were selected by their supervisors and were asked to complete the audit judgment exercise. Questions concerning the exercise were not permitted under either situation.

Experimental Materials

The audit judgment exercise was designed to represent a situation that can occur in the normal course of an audit, that is, the unavailability of the regularly scheduled auditor-in-charge. As the replacement auditor-in-charge, an individual can expect to make decisions regarding the entire audit. The earlier the replacement occurs, the more fundamental the decisions become. In the experimental situation the participant was required to analyze sample data in order to complete part of the internal control evaluation process. This decision (whether or not the sample data indicate that the tolerable error will be exceeded in the population) is a very important first step in determining the reliance that will be placed on the client's internal control systems. The participants were asked to evaluate sample data (the results of a compliance test) through the risk assessment method by providing their estimate of the probability (between 0% and 100%) that the population error rate would exceed 8%. The experiment was varied in the amount of information available to the participants. Two information states were used: (1) the first group had no information other than the sample data on which to base their evaluation, the classical statistical situation; (2)

members of the second group were told that during the previous audit of this client, the prior auditor-in-charge used sample data which showed a 4.2% error rate. Within this second grouping there were two subsets: one subset had previous information in which the previous auditor-in-charge estimated that the population error rate would not exceed 8%; and the other subset had previous information in which the auditor-in-charge determined that the population error rate would exceed 8%.

All of the information states, including the two information subsets mentioned above, were manipulated over two sample error rates (0% and 4%), one close to the previous year's result (4.2%) and one rather distant.

Masking of the Main Experimental Question

To further increase the reliability of the data collected, the experimental instrument included two other questions regarding audit judgments. These questions also required the participants to make additional audit evaluations. These two questions were included to ensure the participants would not attempt to thwart the purposes of the experiment. The first of the two questions related to the collectability of an electronics retailer's account receivables. The participants had to provide their estimate of the probability of collection for the problem

described in appendix 1. The second masking question related to the appropriate sample size that should be taken when internal controls are improved from the previous audit and the firm's audit manual recommended sample size that is larger than the previous year's sample. The participants were to respond with one of three answers: (1) use the sample size employed in the previous year; (2) use the sample size recommended by the firm's audit manual; or (3) determine a sample rate tailored to the current year decision circumstances. The results of these questions and the main experimental question are further discussed in Chapter IV.

Administration of the Experiment

The experiment was conducted at the offices of all the participants. Each participant was provided with a copy of the experimental materials and a demographic questionnaire. The procedure for administration of the experiment varied due to differences in the place of employment between those in pulic accounting and those in a government agency.

Administering the Experiment to Private Sector Auditors

For each of the participating public accounting firms, the researcher attended a continuing professional education seminar being conducted by the firm for its employees.

During the conduct of the continuing professional education seminar, the researcher addressed the participants and explained the reason he was in attendance. The researcher then proceeded to show a videotape presentation to the participants (a copy of the transcript of that videotape is contained at enclosure 1). The videotape presented the researcher in an office setting that could not be identified as a public accounting office or government installation. The taped message clearly stated that the researcher had obtained permission from the participants' firm and solicited the participants or viewers help in determining how auditors make judgments in practice. Subsequent to viewing the videotape presentation the researcher distributed the experimental material in a normal fashion (sequence); however, the order of presentation had been previously randomized. The participants were then asked to complete the experimental materials and upon completion return them to the researcher who was still in attendance. Generally five to fifteen participants were available at each of these seminars depending upon the firms.

Administering the Experiment to Governmental Auditors

The researcher distributed the experimental materials to the government participants in their offices along with instructions on how to complete the experimental instrument. The individuals were asked to participate

after the permission of the head of the division was obtained. Each participant was contacted individually to provide instructions on the completion of the experimental materials. The governmental auditors were instructed to ask no questions but merely to complete the instrument. Each participant was then left with a packet and told that they were expected to complete the packet by the next working day. The completed experimental materials and the demographic questionnaire were collected on the following day.

Questionnaire

Included in the experimental packet given to all public accounting and government participants was a questionnaire designed to collect demographic data about the participants. Completion of the questionnaire was to be accomplished by each participant subsequent to finishing the experimental material. The purpose of the demographics was to gain information concerning the backgrounds of each participant; their educational exposure to the area of statistical analysis, their employment history especially with their current employer; their exposure to both the judgmental evaluation of sample results and the use of statistical analysis; and other important individual data. These data were utilized to

add explanatory information to the results of the main experimental question addressed by the participants. A copy of the questionnaire can be found in Appendix 2 while the responses to the questionnaire are in Appendix 3.

Chapter IV

Data Analysis

Hypotheses Testing

Compilation of Participants' Responses

The individual responses to the experimental question and the two masking questions are presented in Exhibit 4-1. The sixty-two participants provided an answer to each of the three questions in the research instrument. The responses to the main experimental question and the first of the masking questions are subjective estimates of probabilities. The first response is a probability estimate using the risk assessment methodology concerning the participant's confidence in the compliance sample results presented by a junior auditor. The second question addresses the ability to collect an account receivable. The remaining question relates to the use of the previous year's sample size when internal control improvements have been adopted. For each participant, the data also included the manipulated independent variables (information state and error rate) that were in the experimental packet for each participant. The quantitative results of the main experimental question were used in the analysis to determine the impact, if any

of the anchor and adjustment heuristic on the audit judgment process.

Exhibit 4-1

Participant Responses

	(%) Probability Assmt	Inform State	Error Rate	(%) Ques 2	Ques 3
1	5	3	1	50	3
2	10	3	2	75	3
3	5	2	2	50	3
4	8	2	1	50	3
5	4	2	2	50	3
6	50	3	2	50	2
7	20	2	1	50	3
8	10	3	2	50	3
9	5	2	1	90	1
10	9	2	2	50	3
11	5	1	1	50	2
12	8	1	1	90	3
13	5	1	2	50	3
14	4	2	1	90	3
15	10	1	2	75	2
16	10	2	2	95	3
17	16	3	2	100	1
18	0	2	2	100	2
19	1	1	1	80	1
20	10	2	2	90	3
21	5	3	1	50	1
22	10	3	2	90	3
23	25	3	2	90	3
24	10	1	1	75	1
25	10	1	2	80	2
26	5	3	1	50	3
27	1	2	1	100	1
28	5	2	1	100	3
29	5	1	1	70	3
30	10	2	2	100	3
31	20	2	2	75	2
32	5	3	1	75	2
33	10	2	1	100	3
34	2	1	1	100	3
35	3	1	2	100	3

Exhibit 4-1 (cont)

Participant Responses

	(%) Probability Assmt	Inform State	Error Rate	(%) Ques 2	Ques 3
36	40	2	2	100	2
37	5	2	1	70	3
38	5	3	1	77.5	3
39	5	1	2	50	3
40	5	3	1	50	2
41	7	3	2	90	2
42	25	1	2	100	2
43	35	3	2	90	3
44	20	1	2	60	1
45	0	1	2	100	2
46	0	1	2	0	3
47	0	1	2	50	3
48	5	1	2	80	3
49	0	2	1	95	3
50	5	2	1	50	1
51	5	2	1	99	3
52	25	2	2	50	1
53	1	3	1	100	3
54	20	3	1	50	3
55	5	3	1	50	3
56	5	3	1	70	1
57	5	3	2	50	2
58	5	3	2	50	3
59	3	1	1	68	3
60	5	1	1	80	3
61	0	1	1	50	3
62	5	1	1	100	1

Determination of the Appropriate Analysis Method

The probability assessment data presented in Exhibit 4-1 was analyzed through the use of the analysis of variance (ANOVA). ANOVA was employed because the experimental design is that of a factorial experiment.

This procedure requires certain assumptions to support that statistical method. The primary assumption that one must make is that the probability density function from which the sample is drawn is normally distributed. Validating this assumption would permit the use of the parametric test for determination of statistical significance if differences between samples exist. The chi square goodness of fit test was performed on the sample data (see appendix 4) to determine if the data are normally distributed. This test resulted in the rejection of the null hypothesis that this random sample represents observations on a normally distributed random variable with the mean and standard deviation developed from the sample data. The rejection of the null hypothesis leads to the use of the nonparametric test for determining whether differences between sample data are statistically significant (Conover, 1971).

Hypothesis 1

The first research hypothesis stated that there would be an impact on the current audit effort if auditors had information from a prior audit concerning the same compliance evaluation. The following null hypothesis was formulated to permit statistical testing of this hypothesis;

H_0: there will be no difference between the means of the subjective probability estimates derived from two groups of experimental participants; one group having information from a prior audit concerning a similar evaluation and the other group having no prior information.

This statement of the null hypothesis was tested by partitioning the participants into two groups and comparing the estimates of probability elicited using the risk assessment methodology. In the previous paragraphs, the need to abandon the parametric tests was demonstrated through the lack of normally distributed data. In this case it was necessary to select the most appropriate nonparametric test available. A review of research statistics (Conover, 1971) indicated that the Freidman ranks test was the most appropriate. The data that is included in this experiment are related, that is, there exists a relationship among the cells which goes beyond that of matched pairs or just two related samples. Since this data include several related samples, it is inappropriate to attempt to use the matched pairs ranks test to analyze the data. Instead, a test is required which does not depend upon "the assumption of symmetry needed for the matched pairs Wilcoxon signed ranks test..." (Conover,1971). The results of the appropriate nonparametric Friedman F_r analysis of variance is presented in Exhibit 4-2.

Exhibit 4-2

Friedman F_r Results

Dependent Variable: Rankpass = Rank for Probability Assessment

Source	df	sum of squares	mean square	F_r value	Prob > F_r
Model	2	2406.036	1203.018	13.80	.0001
Information State	1	1469.246	1469.246	16.85	.0001
Error Rate	1	1017.327	1017.327	11.67	.0012
Error	59	5143.673	87.181		
Corrected Total	61	7549.710			

As Exhibit 4-2 shows, the probability of exceeding the test statistic is extremely small which indicates that the null hypothesis would be rejected at the .05 level of significance. This is the level of significance selected as the appropriate thresehold for this experiment which indicates that the addition of information, specifically, prior year sample evaluation information, affected the participants' estimates of current year probabilities. Since this procedure (Friedman's F_r) is based on an ANOVA on the ranks within blocks (in this instance the with and without information blocks) rather than the raw data, use of the interaction term was not considered appropriate (Conover, 1971). Additional analysis was performed using different assumptions. The results of those analyses are shown in appendix 5 which tend to lend additional support

to the results presented here.

Hypothesis 2

The second research hypothesis was converted to the following null form:

H_0: there would be no difference in the probability estimates between those participants that received favorable information and those that had unfavorable information.

The belief is that unfavorable information from a prior year will cause the current auditor-in-charge to become more conservative as demonstrated through a higher estimate of the probability of significant error in the current audit. Using the t-test for comparison of the means of the two groups' probability estimate, the following results were obtained:

Exhibit 4-3

T-Test (One-tailed) Results

Dependent Variable: Probability Assessment

Information Category	N	Mean	Std Dev	Std Err	T	Deg of Freedm	Prob> |T|
Favorable	21	9.33	9.74	2.13	-.685	39	.492
Unfavorable	20	11.70	12.29	2.75			

The results of this comparison demonstrate that the null hypothesis cannot be rejected and it appears that the

directional content of information in the audit environment is not significant. Other statistical procedures were used under different assumptions and the results of those tests are contained in appendix 6.

Hypothesis 3

This particular hypothesis can be readily assessed by reference to Exhibit 4-2. Using the statement of the null hypothesis:

H_0: that different error rates will not affect participants' probability estimates under the risk assessment methodology.

The probability that the calculated F value would be exceeded is extremely remote, that is, no greater than .0024. It can then be asserted with some confidence that the error rates do have a significant impact on the participants' ability to use the risk assessment method to estimate the probability that population error rate does not exceed 8%.

Other Analysis

Professional Certification

The individual participants provided additional data concerning their backgrounds and prior experience in the

auditing arena. As the information presented in appendix 3 indicates over 66% of the experimental participants have achieved professional certification as Certified Public Accountants (CPA's). This particular designation requires that its holders be fully aware of the basic rules of their chosen profession. A comparison of those holding the professional certificate to those who do not, indicates that there is a statistically significant effect somewhat in excess of the stated level of .05 associated with the inclusion of the professional certificate variable. In the following table, a nonparametric ANOVA (Exhibit 4-4) is presented:

Exhibit 4-4

Friedman F_r Results

Dependent Variable: Rankpass = Rank for Probability Assessment

Source	df	sum of squares	mean square	F_r value	Prob > F_r
Model	3	2723.210	907.737	10.91	.0001
Information State	1	1375.647	1375.647	16.63	.0001
Error Rate	1	975.130	975.130	11.72	.0011
Prof Cert	1	317.174	317.174	3.81	.0557
Error	58	4826.500	83.216		
Corrected Total	61	7549.710			

The information depicted above indicates that the impact of the professional certificate adds a little more

explanatory power than the original experimental variable, information state. Even in this analysis, the information state maintains its priority as the variable with the most explanatory power.

Continuing Professional Education

This variable was included in the analysis as part of the stepwise regression performed on the transformed dependent variable. The dependent variable, probability assessment, to perform the nonparametric test was ranked and subsequently analyzed in the stepwise regression procedure. The level set for entry of a variable was .20, the same level set for keeping the variable in the regression equation. The resulting regression table is presented on the following page:

Exhibit 4-5

Regression Table

	df	sum of squares	mean square	F value	Prob> F
Regression	3	5660.916	1886.972	8.30	.0001
Error	58	13188.084	227.381		
Total	61	18849.000			

	B value	std error	type II SS	F value	Prob> F
Intercept	17.244				
Info St	7.714	4.086	810.447	3.56	.0640
Error Rt	12.342	3.386	2353.586	10.35	.0021
CPE	-14.114	4.752	2006.111	8.82	.0043

R Square = .30032978
C(P) = -1.62060546

No other variable met the .20 significance level for entry.

Chapter V

Conclusions

Summary

Our focus in this research has been to determine the effect that current audit practice has on the ability of auditors to form proper judgments concerning sample data. The research questions were directed to the measurement of the impact of prior information on the "risk assessment" probability evaluation technique. This technique is currently approved by the AICPA in the Codification of Statements on Auditing Standards. The research also examined the impact of favorable information versus unfavorable information from prior years' work and the amount of significance placed on the curent year's sample error rate in estimating the tolerable population error rate.

To examine these questions, the research took the form of a laboratory experiment using as participants practicing auditors from a variety of work environments. Most of the participants were professional staff members of public accounting firms located in the southwestern Ohio area. Other participants were government auditors stationed in the same geographic area but with worldwide audit responsibility. The experimental instrument

required all the participants to complete an audit task assuming the role of substitute auditor-in-charge. The task was structured to resemble a decision making problem normally encountered on the job. The participants were required to evaluate sample data to arrive at an estimate of tolerable population error rate for a compliance test. The independent variables that were controlled in this experiment were related to the prior year's audit information and the current error rate.

Conclusions and Implications for Practice

In general, the results indicate that the process that most auditors employ during the course of continuing audit engagements, will result in both effective and efficient auditing. This means that increased audit effort can be indicated through the application of the risk assessment methodology which is consistent with the conservative approach that auditors should exhibit. In the context of the current research efforts, the practice established in the standards of field work for review of prior year's work enhances the auditors' abilities to accomplish the attestation function with minimum resource expenditure.

Review of Prior Work Papers The result of testing the first research hypothesis (that information state will

influence risk assessment probabilities) and the movement to a more conservative opinion of population error when additional information is available to the auditor-in-charge should lead to more extensive substantive audit testing when prior work papers are available for review and the risk assessment methodology is utilized by the decision maker, in this case the auditor-in-charge. Rather than reducing uncertainty, the addition of information apparently caused the experimental participants to exhibit higher degrees of uncertainty and simultaneously increases resource expenditures in both the development and execution of more extensive audit testing. This skepticism of the auditor-in-charge provides for viewing the probability of each piece of information in isolation. Considering that compliance testing is specific to the year and the management control system procedures currently in effect, then prior year sample results should not be taken to be additive to the current year work. This addition of information was shown to actually reduce the confidence that the participant was willing to place in the system by increasing the probability that the population error rate will exceed the stated tolerable error rate. This phenomena will be limited to the area of compliance testing and review since this situation does not lend itself to easy quantification. However, this particular result should

give rise to a more concerted effort to emphasize statistical evaluation of all appropriately gathered samples. Use of this evaluation process, if the current results are generalizable, would properly quantify risk while keeping audit fees down.

Impact of Prior Audit Evaluations The second research hypothesis (there is a significant difference between favorable and unfavorable prior information) when tested was found to be not statistically significant. This finding of a weak relationship between the prior year's sample data evaluation and the current year's evaluation of compliance testing, supports the wisdom of the standards of field work particularly the first and third, promulgated by the AICPA. Auditors-in-charge need to know what has occurred with regard to the client in the past. However those evaluations are just that--past history and need to be revalidated through the current audit testing process. In this respect, the auditor-in-charge reviews the prior workpapers to determine if the internal control system has changed and whether the changes are an improvement over past procedures. When this system determination had been completed, the next logical step is to test compliance with the current prescribed system. With appropriate sampling techniques and evaluation, the auditor-in-charge can establish a confidence level based on the sample results relative to the total population

tolerable error rate. This critical determination structures the remaining audit effort in terms of substantive testing of transactions. With appropriate evaluation of these compliance sample results, limits on audit testings are designed to consider the cost-benefit relationships involving audit fees and the resultant risk to third parties due to erroneous data.

Current Sample Error Rate The formulation of the basic research hypothesis lead to developing an experimental design which included a high and low level of sample error. It was assumed that the relative importance of error rates (high and low) would have a greater effect on the elicitation of subjective probabilities that the primary independent variable (information state). However, in the analysis of the experiment, it was noted that information state had more effect than the error rate which indicates that a modification of the anchor used by the auditor-in-charge had occurred. The direction of the shift to a more conservative position was related not to the type of information (that is, whether the current sample error rate is close to or distant from the prior year's sample error rate) but the fact that information was available. The current year's sample error rate did have significance (probability > F = .0012) and, as hypothesized, influenced the auditor-in-charge to a greater degree since the higher level was close to

exceeding the population tolerable error rate. The closer the sample error rate comes to exceeding the population tolerable error rate, the risk assessment by the auditor-in-charge will tend to require more rather than less substantive audit testing. In this case, it would be in the best interest of the audit firm to increase the scope rather than restrict it.

Heuristic Modification An outcome such as reported here reinforces the profession's insistence on adherence to standards especially the standards of field work. This confirmation of appropriateness should be viewed as an indication of the impact of the anchor and adjustment heuristic modified by the conservative approach usually associated with the accounting profession. Although the heuristic changes the subjective probabilities elicited, and there is is no apparent difficulty arising from the use of the heuristic, the profession would be prudent to consider a change from any subjective assessment proces to those that are statistically objective.

Limitation to External Validity

The extension of the conclusions drawn from any laboratory experiment beyond the bounds of the particular experiment are at the least, risky endeavors. However, in the professional world, one must take risks to develop

better markets and potential customers. The profession of auditing needs to continue to develop and mature as part of the business environment. To this end it needs the expanding capabilities of empirical research to show it the way. In doing so, the limits of science must be iterated in order that no reader mistakes the capability of any research effort including the present one. The laboratory has one inherent defect; it is not reality. No matter how realistic the attempt is to make the experiment replicate real life, it cannot. In this research effort the main problem with its realism lies in the fact that there was no interaction between the junior auditor requesting the determination and the pseudo auditor-in-charge. This particular aspect should be a major concern in any experimental situation, since auditors function in the audit environment as a team not just as individuals.

An additional aspect of this experiment which may limit its generalizability is the absence of any perceived penalty or reward associated with completing the experimental instrument. Although the experiment was conducted, for the most part, at the place of the auditors' employment, the participants were involved in a classroom situation. This type of environment may elicit what may be termed "textbook" answers rather than the auditors' true estimates of the population tolerable error rates.

Direction for Future Research Efforts

This continuing line of research into the effects of various heuristics on the audit judgment process is an important part of the profession future. At the time when the development of artificial intelligence is coming to the forefront in several areas, the need to understand and depict the decision making process becomes very significant. It will be from these examination of the decision processes that knowledge engineers will be able to construct the appropriate models for the artificial intelligence environment. The development of future decision support systems for audit management will parallel effort already underway in the systems management area. The current work needs to be extended to include additional significant variables in the audit judgment model. The potential is to lay the ground work for audit specific decision aids beyond those originally envisioned merely as rules for decision makers. Translation of this work into computer models for future research and development is required. Better definition and operationalization of the variables is another important aspect of this line of research that requires more intense research work.

AUDIT JUDGMENT EXERCISE

You have been selected to participate in an experiment designed to assist both you, as practitioners, and researchers understand precisely what affects the audit judgment process. In this exercise you have been asked to assist another auditor-in-charge during the course of an on-going audit engagement. The assistance that you will render will require you to make several decisions based on available information contained in the descriptive scenario. You are to use only the information given, please do not attempt to broaden the question by making assumptions about the engagement.

In addition to the experimental material, you are asked to complete the survey which follows the audit exercise. Please wait until you have completed the exercise, to fill out the survey.

AUDIT JUDGMENT EXERCISE

1. The first year auditor has just completed a review of the client's (a small manufacturer) accounts payable vouchers. The purpose of this review was to determine if vouchers were initialed by the preparing accounts payable clerk. The absence of the clerk's initials is to be considered an error. There has been approximately 4,000 vouchers prepared during the period.

(+ prior Information)
In reviewing prior year's workpapers you have noted that under similar conditions a sample error rate of 4.2% for a sample of 80 was acceptable to the auditor-in-charge.

You have concluded that a population error rate as high as 8% would not require extending audit procedures. However, if the population error rate is greater than 8% you want to extend the audit tests. Based on the sample results below, estimate the likelihood (between 100% and 0%) that the true population error rate is GREATER than 8%.

A sample of 80 vouchers with no errors - a sample error rate of 0%.

Your Chance Estimate: Based upon a sample of 80 vouchers with no errors, I believe that there is a _____ (between 100% and 0%) chance that the true population error rate is greater than 8%.

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A sample of 80 vouchers with three errors - a sample error rate of 4%.

Your Chance Estimate: Based upon a sample of 80 vouchers with three errors, I believe that there is a _____ (between 100% and 0%) chance that the true population error rate is greater than 8%.

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A sample of 80 vouchers with three errors - a sample error rate of 4%.

Your Chance Estimate: Based upon a sample of 80 vouchers with three errors, I believe that there is a _____ (between 100% and 0%) chance that the true population error rate is greater than 8%.

2. The junior auditor has completed a review of the adequacy of the allowance for uncollectable accounts receivable. In the properly aged schedule, the junior auditor points out a rather large (material) customer who is six months past due. The customer has returned a positive confirmation verifying the balance as correct. The junior accountant informs you that prior experience with this client shows that approximately 50% of the account balance past six months are recoverable. The junior also indicates that the controller believes that the entire account is collectable and no provision is necessary. Additionally the junior has obtained this description from the client's credit manager.

The customer is a rapidly expanding merchandiser of television, radio, stereo, and other consumer electronics equipment. It began as a single store operation in 1874 and now operates a total of 12 stores in three states. Further expansion is planned in the near future. Earnings growth has been strong since 1974. As the firm expanded, its average payment time on accounts receivable has steadily increased. This is due to an inadequate accounting system rather than to cash difficulties. A new computerized accounting system is presently being installed and is expected to remedy the firm's payment problems.

Your Probability Estimate: Based on the above information, what is your estimate_____ (between 100% and 0%) of the collectability of this account receivable.

3. The junior auditor has just completed an update of internal control in the accounts receivable area and the corrective items contained in last year's management letter have been fully adopted. The increase in the strength of the internal control has been from somewhat weak to very strong. Your consult the firm sampling manual for guidance and find the recommended sample size to be twice what was used in the prior year.

Your Sample Size Decision: Based on the above information you would:

a) Use the sample size from last year.

b) Use a sample size larger than the previous year's sample.

c) Use the firm sampling manual's recommended size.

a. How many years of experience in auditing do you have?

1. 0 to 2 years
2. over 2 to 4 years
3. over 4 to 6 years
4. over 6 to 8 years
5. over 8 years

b. Your professional certification is

1. CPA (Certified Public Accountant)
2. CIA (Certified Internal Auditor)
3. CMA (Certified Management Accountant)
4. None of the above.

c. Length of time with your current employer.

1. 0 to 2 years
2. over 2 to 4 years
3. over 4 to 6 years
4. over 6 to 8 years
5. over 8 years

d. Have you attended either a continuing professional education (CPE) program or an in-house (employer provided) training program during 1986?

1. Yes
2. No

e. With respect to statistical procedures (sampling and analysis) have you had:

1. undergraduate quantitative analysis courses (business oriented)
2. graduate quantitative analysis courses (business oriented)
3. undergraduate statistics courses (mathematics oriented)
4. graduate statistics courses (mathematics oriented)
5. audit sampling training (either CPE or in-house)
6. 1 and 2
7. 1, 2 and 3
8. 1 and 3
9. all
0. 3 and 5

f. Did you use satistical sampling on your last audit?

1. Yes
2. No

g. Did you use statistical sampling in any audit work done in 1986?

1. Yes
2. No

h. Do you know the provisions of SAS 39 (now included in Sec. 350 of the curent Codification of Statements on Auditing Standards)?

1. Yes
2. No

i. Have you used judgmental sampling procedures in any audit work done in 1986?

1. Yes
2. No

j. How many years has it been since graduation from your highest educational level?

1. 0 to 2 years
2. over 2 to 4 years
3. over 4 to 6 years
4. over 6 to 8 years
5. over 8 years

k. Please identify your firm and location.

Firm _____

Location_____

THANK YOU FOR PARTICIPATING IN THIS EXERCISE.

Appendix 3

PARTICIPANT DATA

	Yrs Aud	Prof Cert	Time with Empl	Cont Prof Ed	Stat Crs	Stat Sampling Last	Stat Sampling 86	SAS 39	Judgmntl Samplg 86	Years Since Grad
1	2	1	2	1	1	2	1	2	1	2
2	2	1	2	1	0	1	1	2	1	2
3	1	1	1	1	0	1	1	1	1	1
4	5	1	5	1	0	1	1	1	1	5
5	1	4	1	1	1	2	1	1	1	1
6	1	4	1	1	0	1	1	2	1	1
7	1	4	1	1	1	1	1	1	1	1
8	5	1	5	1	0	2	1	1	1	5
9	2	1	2	1	8	2	1	2	1	2
10	3	1	3	1	0	1	1	1	1	3
11	5	1	5	1	0	2	1	1	1	5
12	2	1	2	1	8	1	1	1	1	2
13	5	1	5	1	1	1	1	1	1	5
14	5	1	5	1	0	1	1	1	1	5
15	1	1	1	1	3	1	1	1	1	1
16	3	1	3	1	0	1	1	1	1	3
17	1	1	1	1	3	2	1	1	1	1
18	1	4	1	1	5	2	1	2	1	1
19	1	1	1	1	1	2	1	1	1	1
20	3	1	3	1	0	2	2	1	1	3
21	5	1	5	1	0	2	2	1	1	5
22	5	1	5	1	0	2	2	2	1	5
23	2	1	1	1	0	1	1	1	1	2
24	2	1	2	1	0	2	2	1	1	2
25	2	1	1	1	8	2	2	1	1	2
26	2	1	2	1	0	2	2	1	1	2
27	2	4	2	1	0	2	2	1	1	1
28	3	1	3	1	0	2	2	1	1	3
29	5	1	5	1	9	2	2	1	1	5
30	2	1	2	1	9	2	2	1	1	2
31	2	1	2	1	0	2	2	1	1	2
32	3	1	3	1	0	2	2	1	1	3
33	3	1	3	1	0	2	2	1	1	3
34	3	1	3	1	0	2	2	1	1	3
35	2	1	2	1	0	1	1	1	1	2
36	2	1	2	1	0	1	1	1	1	2
37	3	1	3	1	0	1	1	2	1	3

Appendix 3

	Yrs Aud	Prof Cert	Time with Empl	Cont Prof Ed	Stat Crs	Stat Sampling Last 86		SAS 39	Judgmntl Samplg	Years Since 86 Grad
38	1	4	1	1	0	1	1	2	1	1
39	3	1	3	1	0	1	1	2	1	3
40	2	1	2	1	0	1	1	1	1	2
41	2	1	2	1	0	1	1	2	1	2
42	1	4	1	1	0	2	1	2	1	1
43	3	1	3	1	0	2	1	2	1	2
44	3	1	3	1	1	2	2	2	1	4
45	1	1	3	1	3	1	1	1	1	1
46	3	1	3	1	0	1	1	1	1	3
47	1	1	1	1	3	2	1	1	1	1
48	1	4	1	1	5	2	1	2	1	1
49	1	1	1	1	1	2	1	1	1	1
50	5	4	5	2	7	1	2	2	1	5
51	2	4	2	2	2	2	2	2	1	3
52	2	4	2	2	8	2	2	2	1	5
53	5	4	5	2	9	1	1	2	1	5
54	5	4	5	2	0	2	1	2	1	5
55	5	5	5	2	9	2	2	2	2	5
56	5	4	5	2	5	2	2	2	1	5
57	1	4	5	2	7	2	2	2	1	5
58	5	4	5	2	1	2	1	2	2	5
59	4	4	4	1	9	2	2	1	1	2
60	5	1	4	1	0	1	2	1	2	5
61	5	2	5	2	5	2	2	1	1	5
62	5	1	1	1	3	1	1	2	1	4
63	5	4	5	2	0	2	2	2	2	5
64	5	4	1	1	8	1	1	1	1	5
65	5	4	2	2	1	2	2	2	2	5
66	5	4	5	2	4	2	2	2	1	4
67	4	1	4	1	7	2	2	2	1	2

Appendix 4

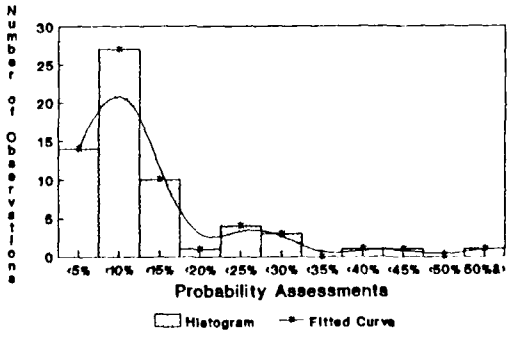
CHI SQUARE GOODNESS OF FIT TEST

The chi square goodness of fit test was performed to determine whether the sample data relating to probability assessments were from a normally distributed population

(H_0: this random sample represents observations on a normally distributed random variable with the mean and variance developed below).

This was accomplished to choose between parametric and nonparametric statistics for the analysis of the experimental data. To begin with, an inspection of the raw data in histogram format depicts what may be a log linear relationship of the data (see figure below).

Figure A4-1
Histogram



From the sample data at Exhibit 4-1, the following were calculated:

Sample/rows and columns	c1	c2	r1	r2
mean	5.4	12.5	6.1	10.5
standard deviation	4.7	12.2	6.4	10.98
number of observations	31	31	21	41

With this information the following quartile distribution table was constructed:

Appendix 4

	Quartile			
	1	2	3	4
c1				
Observed (O)	7	18	2	4
Expected (E)	7.75	7.75	7.75	7.75
c2				
Observed (O)	6	16	3	6
Expected (E)	7.75	7.75	7.75	7.75
r1				
Observed (O)	6	9	4	2
Expected (E)	5.25	5.25	5.25	5.25
r2				
Observed (O)	5	27	1	8
Expected (E)	10.25	10.25	10.25	10.25

The formula for calculating the test statistic (T) is given as:

T = summation (from 1 to 4) of $(O - E)^2/E$

For c1 = 20.37

For c2 = 12.38

For r1 = 5.09

For r2 = 37.29

$T = 3.841$ (alpha = .05 with 1 degree of freedom)*

* The test statistic follows a chi square distribution with c - 1 - k degrees of freedom, where c is the number of classes (in this case 4) and k is the number of population parameters estimated using the sample data (the mean and standard deviation). With the value of the T statistic calculated, H_0 can be rejected at the .001 level

with 1 degree of freedom ($T > 10.83$). Additionally, this may provide for overconfidence if the estimates of the population parameters were faulty. Even with this constraint, H_0 can be rejected at the .01 level of significance with 3 degrees of freedom ($T > 11.34$) for all experimental conditions except r1 - no information (Conover, 1971).

Appendix 5

Analysis of Variance

This experiment was designed as a 2 x 2 factorial model with the intention of having balanced cell data. With this design, the appropriate method for analysis was the ANOVA procedure. Two circumstance changed which made the application of the ANOVA inappropriate. First, the number of experimental participants fell short of having balanced cells. Second, when the raw data were initially processed it became apparent that the data were non-normal.

To rectify the first problem, the experimenter decide that it was proper to continue the analysis using the General Linear Model procedure which is in effect a regression procedure but was capable of handling unbalanced cells. To properly interept the results of this procedure, the type III sum of squares must be computed, since this unbalance experiment nullifies the ability to use the additive model of the ANOVA.

The second problem (i.e. non-normal data) caused the experimenter to change the analysis from parametric to nonparametric methods in particular the Friedman F_r statistic. Even though the main body of the dissertation contains the results of the appropriate statistical analysis procedure, it is of considerable interest to review the parametric ANOVA results which follow:

Appendix 5

Exhibit A5-1

Source	df	sum of squares	mean square	F value	Prob > F
Model	3	1229.847	409.949	5.07	.0035
Information State	1	297.145	297.145	3.68	.0601
Error Rate	1	545.073	545.073	6.74	.0119
Interaction (IS*ER)	1	135.376	135.376	1.68	.2007
Error	58	4687.137	80.813		
Corrected Total	61	5916.984			

The results depicted in the above exhibit, make it apparent that provision of information has had an impact on the probability assessments of the participants. The probability of .0601 would be tangible evidence even though it exceeds the normal experimental level of .05. It can also be seem from these results that the interaction of the two independent variables is less than significant.

Appendix 6

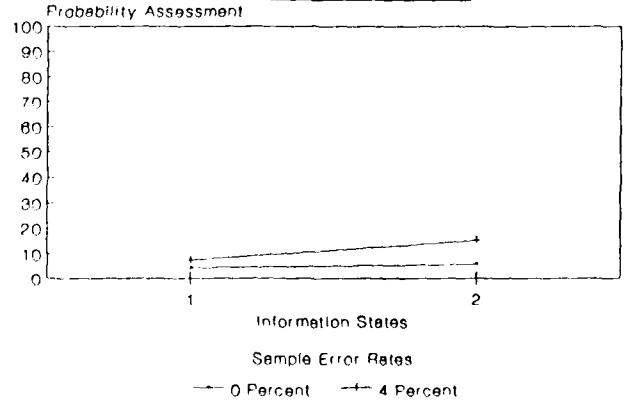
Rationale for Selection of Tests for Hypothesis 2

The null hypothesis developed for the second research question stated:

H_0: There will be no differences between the probability estimates from participants who received favorable prior year information and those that received unfavorable prior year information.

In the experimental environment that was developed for this experiment, the effect of interaction of the dependent variables was believed to be significant in terms of the variables combined effect on the participants' estimates of the population tolerable error rate. However in all analysis performed on the data, the lack of a significant interaction was apparent (see appendix 5) and can be graphically demonstrated as shown in the figure below.

Figure A6-1



Appendix 6

In fact, the probability of exceeding the calculated F value approached .5 if one considers there to be three information states (no information, favorable information, and unfavorable information) rather than just two (with information and no information). For our purposes, this lack of interaction lead to the consideration of tests other than ANOVA to determine if there was a statistically significant difference between favorable and unfavorable information. The use of t-test is a conservative approach to the comparison of two sample means.

BIBLIOGRAPHY

American Institute of Certified Public Accountants (AICPA), "Proposed Statement on Auditing Standards - Audit Sampling", AICPA Audit Standards Division, File 5000, September, 1979.

----------, "Statement on Auditing Standards, Number 39, Audit Sampling", AICPA Audit Standards Division, June, 1981.

----------, Codification of Statements on Auditing Standards, Numbers 1 to 44, American Institute of Certified Public Accountants, 1983.

Ashton, A., "Does Consensus Imply Accuracy in Accounting Studies of Decision Making", The Accounting Review, April, 1985, Vol LX, No. 2, pp 173-185.

Bereson, M., Levine, D., & Goldstein, M., Intermediate Statistical Methods and Applications, Englewood Cliffs, N.J.: Prentice-Hall Inc. 1983.

Blocher, E., "Auditor Error Detection Performance", From Symposium on Auditing Research V, University of Illinois, Eds. J. J. Schultz, Jr. and C. E. Brown, University of Illinois, Board of Trustees, 1983.

Brownell, P., " A Field Study Examination of Budgetary Participation and Locus of Control", The Accounting Review, October 1982, Vol LVII, No. 4, pp 766-777.

Brunswik, E., The Conceptual Framework of Psychology, Chicago: University of Chicago Press, 1952

Burton, J. C., Palmer, R. E., and Kay, R. S., (eds) Handbook of Accounting and Auditing, Boston: Warren, Gorham & Lamont, 1981, updated 1983.

Butler, S. A., "Anchoring in the Judgmental Evaluation of Audit Samples", The Accounting Review, January 1986, Vol LXI, No 1, pp 101-111.

Campbell, D. T., and Stanley, J. C., Experimental and Quasi-Experimental Designs for Research, Chicago: Rand-McNally, 1963.

Chesley, G. R., "Elicitation of Subjective Probabilities: A Review." The Accounting Review, April 1975, Vol L, No 2, pp 325-337.

----------, "The Elicitation of Subjective Probabilities: A Laboratory Study in an Accounting Context." Journal of Accounting Research, Spring 1976, 14, pp 27-48.

----------, Subjective Probability Elicitation: The Effect of Congruity of Datum and Response Mode on Performance." Journal of Accounting Research, Spring 1977, 15, pp 1-11.

Conover, W. J., Practical Nonparametric Statistics, New York: John Wiley & Sons Inc., 1971

Corless, J., "Assessing Prior Distributions for Applying Bayesian Statistics in Auditing", The Accounting Review, July 1972, Vol XLVII, No 3, pp 556-566.

Einhorn, H. J., and Hogarth, R. M., "Behavioral Decision Theory: Processes of Judgment and Choice", Journal of Accounting Research, Spring 1981, 19, pp 1-31.

Felix, W. L. Jr., and Kinney, W. R. Jr., "Research in the Auditor's Opinion Formulation Process: State of the Art", The Accounting Review, April, 1982, Vol LVII, No. 2, pp 245-271.

Grinaker, R. L., and Barr, B. B., Auditing The Examination of Financial Statements, Homewood, IL: Richard D. Irwin, Inc., 1965.

Hax, A., and Candea, D., Production and Inventory Management, Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1983.

Hogarth, R., "Beyond Discrete Biases: Functional and Dysfunctional Aspects of Judgmental Heuristics", Psychological Bulletin, September 1981, Vol 90 (2), pp 197-217.

Holmes, A. W., and Burns, D. C., Auditing Standards and Procedures, 9th ed., Homewood, IL: Richard D. Irwin, Inc., 1979.

Joyce, E. J., and Biddle, G. C., "Anchoring and Adjustment in Probabilistic Inference in Auditing". Journal of Accounting Research, Spring 1981, Vol 19, No 1, pp 120-145.

Kinney, W. R., Jr., and Uecker, W. C., "Mitigating the Consequences of Anchoring in Auditor Judgment", The Accounting Review, January 1982, Vol LVII, No. 1, pp 55-69.

Lewis, B., Shields, M., and Young,S., "Evaluating Human Judgments and Decision Aids", Journal of Accounting Research, Spring 1983, Vol 21, No 1, pp 271-285.

Libby, R., Accounting and Human Information Processing: Theory and Applications, Englewood Cliffs, N.J.: Prentice-Hall, 1981.

Libby, R., Artman, J. T., and Willingham, J. J., "Process Susceptibility, Control Risk and Audit Planning", The Accounting Review, April 1985, Vol LX No 2, pp 212-230.

Libby, R., and Lewis, B. L., "Human Information Processing Research in Accounting": The State of the Art in 1982", Accounting, Organizations and Society, 1982, Vol 7, No. 3, pp 231-285.

McGuigan, F. J., Experimental Psychology: Methods of Research, Englewood Cliffs, N.J.: Prentice-Hall Inc., 1983.

Moriarity, S., and Joyce, E., Decision Making and Accounting: Current Research, Norman, OK: the University of Oklahoma, Center for Economic and Management Research, 1984.

Northcraft, G. B., and Neale, M. A., "Experts, Amateurs, and Real Estate: An Anchoring-and-Adjustment Perspective on Property Pricing Decisions", Organizational Behavior and Human Decision Processes, No 39, 1987, pp 84-97.

Trottman, K. T., Yetton, P. W., and Zimmer, I. R., "Individual and Group Judgments of Internal Control Systems", Journal of Accounting Research, Spring 1983, Vol 21, No 1, pp 286-292.

Tversky, A., and Kahneman, D., "Judgment Under Uncertainty: Heuristics and Biases", Science, 1974, Vol 185, pp 1124-1131.

Uecker, W. C., and Kinney, W. R. Jr., "Judgmental Evaluation of Sample Results: A Study of the Type and Severity of Errors Made by Practicing CPAs", Accounting, Organizations and Society 1977, Vol 2 No. 3.

Waggoner, J. B., Nonsampling Risk: Auditor Detection of Compliance Deviations, Ph.D. Dissertation, University of Cincinnati, 1986.

Wright, W., "Cognitive Information Processing Biases: Implications for Producers and Users of Financial Information", Decision Sciences, April 1980, Vol 11, No. 2, pp 284-298.