

Stonehill College Institutional Review Board Application Form

Please return one typewritten, signed original and seven copies of this form to:
Bonnie L. Troupe
Director, Academic Development
Duffy 119

Basic Information:

Date submitted: 1/17/2006 Date approved: _____

Name of researcher: Robert Carver

Stonehill Employee: Yes: No:

Contact Info (phone and email): 508-565-1130 rcarver@stonehill.edu

Faculty/Staff Sponsor if different: _____

Title of Research Project: Ambiguity Intolerance: An Impediment to Inferential Reasoning?

Type of Review: You must make a preliminary judgment about the level of review required for your application (see pp. 4-9 of the policy and procedure document of the Stonehill College Institutional Review Board). The IRB chair will then determine the level of review.

Please check one:

Full Review: Expedited Review: Exempt Review:

Nature of the Study:

Does the research involve:

	<i>Yes</i>	<i>No</i>
a. Drugs or other controlled substances?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
b. Payment or other compensation for participation?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
c. Access to participants through a cooperating institution?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Does the research involve:

	Yes	No
d. Participants taking internally or having externally applied any substances?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
e. Removing any fluids (e.g. saliva, blood) or tissues from participants?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
f. Participants experiencing stress (physical or psychological) above a level that would be associated with their normal, everyday activities?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
g. Misleading or deceiving participants about any aspect or purpose of the research?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
h. Participants who would be judged to have limited freedom of consent (e.g. minors, mentally retarded or ill, aged)?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
i. Any procedures or activities that might place the participants at risk (psychological, physical or social)?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
j. A written consent form?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
k. Data collection over a period longer than 6 months?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
l. Sensitive aspects of the participant's own behavior, such as illegal conduct, drug use, sexual behavior, or alcohol use?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Explanation of “Yes” responses in the “Nature of the Study “ section.

b. *Payment or other compensation for participation?* As an incentive for honest answers and genuine effort on performance tasks, students will be offered minor extra credit for some of the elements of this project. Specifically, there is a pre- and post-test developed by researchers at the University of Minnesota (see Appendix B) that I have required in the past on the first and last days of class. This year, I will offer extra points on the final exam depending on how much student improve between the pre-and post-test. The incentive will be announced prior to the post-test, to discourage underperformance on the pre-test, and there will be no penalty for poor performance on the post-test. Similarly, the U.Minn. working group also has developed some topic-specific scales to assess understanding of statistical topics. Prior to a course quiz on the subjects, I will encourage students to go on-line and complete an assessment as quiz preparation, and will offer minor homework credit for their effort.

g. *Misleading or deceiving participants about any aspect or purpose of the research?* Though there will be no deliberate, active substantive misleading or deception, I do intend to withhold disclosure of the connections between activities within the project. Most of the data collection is course-embedded and has a natural place within the course, but there is the risk that students' knowledge of the precise research questions could bias the study, either by having students distort their efforts either to conform to my hypotheses or otherwise engage in strategic behavior. So for example, the Tolerance of Ambiguity scale will be presented as an example of psychometric measurement, but students will not initially learn that their scores on this instrument will be the principal independent factor in the study. That fact will be suppressed until the debriefing.

- j. A written consent form?* See Appendix C for a copy of the form, to be distributed early in the semester. Please note: it is not entirely clear that written consent is necessary, but I have provided a draft of a consent form that I could distribute. I would appreciate advise from the IRB.

Lay Summary: Please attach to this form a description of your research so that the IRB may assess its risks and benefits. Describe your research project using lay language—language understood by a person unfamiliar with the area of research. The summary should address any ‘yes’ responses in items a-l above. In addition, address each of the following areas:

- A. Rationale and Aims—the research question; why this needs to be addressed
- B. Procedure and Protocols—include a detailed description of participant’s experience
- C. Description of Participants—study population, inclusion criteria, how recruited
- D. Procedures for Obtaining Informed Consent
- E. Potential Risks and Benefits
- F. Safeguards Against Risk
- G. Debriefing Procedure

Additional Items:

Please attach additional items that may help the IRB committee fully understand the research project, if applicable. These may include:

- A. Grant proposal for the research, if applicable
- B. Informed consent form—required in most cases
- C. Debriefing statement—what participants will be told after completing the procedure
- D. Agreements from other participating institutions

Certification:

1. I am familiar with the policies and procedures of Stonehill College regarding human participants. I subscribe to the standards in the Stonehill College IRB document and will adhere to the policies and procedures explained therein.
2. I am familiar with the published guidelines for the ethical treatment of participants associated with my particular field of inquiry (e.g., as published by the American Psychological Association, American Sociological Association, NASW Code of Ethics).
3. I am familiar with and will adhere to official policies in my department concerning research activity (e.g., Psychology Department, Biology Department).

4. I understand that upon consideration of the nature of my project, the IRB may request a full application for review of my research at their discretion and convenience.
5. If changes in procedures involving human participants become necessary, I will submit these changes in writing to the IRB for review before initiating the changes.

SIGNATURE: _____ DATE: _____
Investigator(s)

SIGNATURE: _____ DATE: _____
Investigator(s)

ALL STUDENT APPLICATIONS AND APPLICANTS FROM OUTSIDE THE COLLEGE MUST HAVE A COLLEGE SPONSOR

SIGNATURE: _____ DATE: _____
Research Sponsor

Lay Summary:

A. Rationale and Aims—In an introductory statistics course, many students struggle with the concepts and techniques of *statistical inference*: the process of forming judgments about a population or an ongoing process from a sample of observations drawn from the population or process. At the heart of statistical inference is the inconvenient fact that we often need to make decisions or draw conclusions without benefit of *all* the relevant facts. Statistical inference, then, represents an approach to decision-making in ambiguous or uncertain situations.

Research in statistics education is replete with investigations of techniques, technologies, pedagogical innovations, classroom activities, assignments and the like that may or may not improve student learning in the area of inference. Other research has focused on students' cognitive and affective characteristics vis a vis mathematics. A great deal of progress has been made, but little of the research has considered students' individual predisposition towards as an explanatory factor in learning to apply the techniques of inference. The major goal of this research is to determine if intolerance of ambiguity is an impediment to learning about statistical inference.

B. Procedure and Protocols—in this phase of the research, participants will be the approximately 45 students enrolled in my two sections of BA206 Quantitative Analysis. Early in the term, students will be asked to complete a paper-and-pencil survey (see Appendix A) which attempts to measure tolerance of ambiguity. At several points during the semester, students will also complete assignments, quizzes, and instruments that measure initial knowledge and developing skills in quantitative reasoning, including statistical inference. Some of these tasks are normal course components (homework, quizzes, exam questions) while other parts will be assigned as either required non-credit tasks (e.g. ARTIST pre-test and post-test; see Appendix B) or opportunities to earn extra homework credit for participation.

C. Description of Participants— participants will be the approximately 45 students enrolled in my two sections of BA206 Quantitative Analysis. These are all Stonehill students. Approximately 18 of the students are taking the course as part of a Learning Community at Stonehill; the rest are fulfilling the Departmental requirement in Quantitative Reasoning.

D. Procedures for Obtaining Informed Consent— Students will complete the consent form enclosed as Appendix C. In addition, the course QuickPlace website (http://quickplace.stonehill.edu/cp_rcarver_ba206) contains the following disclosure prominently displayed:

Disclosure of Research Participation

During the term, you will be asked to participate in some surveys or other data gathering activities as part of a larger research study that I am conducting. Participation in the study will not adversely affect your course grade; however there are incentives to participate. By the end of the course I will explain the nature of the study, but I cannot do so early in the course because that might bias the study.

E. Potential Risks and Benefits—There are no meaningful risks to participants beyond issues of privacy that ordinarily exist in courses. Potential benefits include clearer understanding of the process of measuring intangible characteristics or attitudes, as well as better understanding of research design, both of which are course goals.

F. Safeguards Against Risk— To vouchsafe student privacy, survey instruments will be handled by the instructor only and treated in the same manner as examinations. All documents containing student names, ID numbers, scores and grades will be held in strict confidence.

G. Debriefing Procedure—In the late weeks of the course, students report to the class on their semester-long research projects. At that time, I will similarly report to them on my research investigation, explaining the nature of the project in the language of the course: estimation and hypothesis testing. I will provide a written explanation of the research questions, the procedures, the statistical techniques used, and the preliminary results (some of the outcome measures will be embedded in the final examination, so the final results will not be available during the term).

NOTE: This research is being submitted for presentation in August at the annual international Joint Statistical Meetings in Seattle. The following abstract will be submitted to the peer-review process to be included on a panel in the Statistics Education track at the conference. Here is an excerpt from the Abstract Submission confirmation, provided by the American Statistical Association (ASA); note that abstracts are limited to 900 words.

Abstract Information

Abstract Type:	Contributed
Sub Type:	Papers
Sponsor:	Section on Statistical Education
Title:	Ambiguity Intolerance: An Impediment to Inferential Reasoning?
Abstract:	In an introductory statistics course, undergraduate students often struggle with the concepts and techniques of statistical inference. At the heart of inference is the inconvenient fact that we often need to make decisions or draw conclusions without benefit of all the relevant facts in ambiguous situations. There is reason to think that students vary in their attitudes and openness to ambiguity in general, and that an individual's discomfort with or intolerance of ambiguity could impede one's learning of inferential reasoning. Yet little research has directly considered ambiguity tolerance as an explanatory or moderating factor in learning to apply the techniques of inference. This paper reports on empirical classroom research to investigate the extent to which intolerance of ambiguity is an impediment to learning about statistical inference.

Appendix A: Ambiguity Tolerance Scale

MSTAT-I: Multiple Stimulus Types Ambiguity Tolerance Scale¹

This survey assesses your individual tolerance for ambiguity. Please complete each question frankly. For each of the following 22 questions, check one box indicating whether you Strongly Disagree (StD), Moderately Disagree (MD), Slightly Disagree (SID), Neither Agree nor Disagree (NAD), Slightly Agree (SIA), Moderately Agree (MA), or Strongly Agree (StA)

	StD	MD	SID	NAD	SIA	MA	StA
1 I don't tolerate ambiguous situations well.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2 I find it difficult to respond when faced with an unexpected event.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3 I don't think new situations are any more threatening the familiar situations.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4 I'm drawn to situations which can be interpreted in more than one way.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5 I would rather avoid solving a problem that must be viewed from several different perspectives.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6 I try to avoid situations which are ambiguous.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7 I am good at managing unpredictable situations.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8 I prefer familiar situations to new ones.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9 Problems which cannot be considered from just one point of view are a little threatening.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10 I avoid situations which are too complicated for me to easily understand.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11 I am tolerant of ambiguous situations.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12 I enjoy tackling problems which are complex enough to be ambiguous.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13 I try to avoid problems which don't seem to have only one "best" solution.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14 I often find myself looking for something new, rather than trying to hold things constant in my life.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15 I generally prefer novelty over familiarity.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16 I dislike ambiguous situations.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

¹ McLain, D.L. (1993). The MSTAT-I: A new measure of an individual's tolerance for ambiguity. *Ed18ucational and Psychological Measurement*, 53: 183–189.

StD MD SID NAD SIA MA StA

- | | | | | | | | | |
|----|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 17 | Some problems are so complex that just trying to understand them is fun. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 18 | I have little trouble coping with unexpected events. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 19 | I pursue problem situations which are so complex some people call them "mind boggling." | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 20 | I find it hard to make a choice when the outcome is uncertain. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 21 | I enjoy an occasional surprise. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 22 | I prefer a situation in which there is some ambiguity. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Identification:

Please supply the information provided below. This information will be held in strict confidence, and will only be used to correlate data between surveys in this course and to confirm your participation in this activity. Your identity will be known only to Prof. Carver.

Name:

Intended major field:

Appendix B: University of Minnesota ARTIST Project scales:



The CAOS test

CAOS - ARTIST Comprehensive Assessment of Outcomes in a First Statistics course
Many statistics course assessments contain examples of poor statistics and probability questions, which are a misleading reflection of what we value for our students to know. For example, items can focus too much on the calculation in an artificial setting, with no explanation or interpretation required of the students. Other items ask for identification or manipulation of definitions, rather than probing students' thinking and reasoning about statistics. An important component of the NSF-funded ARTIST project is the development of a set of items that can be administered as an online test to evaluate the attainment of desired student outcomes. Working with our advisory group and other colleagues teaching statistics, we have developed a set of items that can be used in first year statistics courses across different courses and institutions. These items are designed to represent not all topics in the introductory course but the big ideas and the types of reasoning, thinking and literacy skills deemed important for all students across first courses in statistics. The unifying focus of the items is on reasoning about variability: in univariate and bivariate distributions, in comparing groups, in samples, and when making estimates and inferences.

We hope that once the test has been extensively revised and validated, that it may be a useful instrument for research and evaluation purposes. We do not advocate using this as a final exam or as a way to assign student grades. However, we think that the information it provides will be very informative to teachers about what their students have learned and not learned in an introductory statistics course.

Online testing format

Our online forced-choice testing format allows for quick summaries of the results to be sent via email to instructors, as well as a spreadsheet of student records.

Pilot testing and revisions

Early versions of this instrument have been piloted and the data gathered were used to revise, delete, and create new items. We are now preparing for a large scale pilot testing at the end of fall semester. After revisions based on this pilot test, we plan to administer the CAOS test in both pre and post course formats this spring. The data we gather will be used to estimate reliability, item difficulty, and item discrimination. Pre to post course gains will be used to validate the instrument. If you would like to help pilot the CAOS test in your course, please contact Ann Ooms at ooms0001@umn.edu

ARTIST Topic Scales

There are 11 scales, consisting of 8-12 multiple-choice items, to be administered online. Our goal is to develop high quality, valid and reliable scales that can be used for a variety of purposes (e.g., research, evaluation, review, or self-assessment). The topics for the scales are: Data Collection, Data Representation, Measures of Center, Measures of Spread, Normal Distribution, Probability, Bivariate Quantitative Data, Bivariate Categorical Data, Sampling Distributions, Confidence Intervals, and Significance Tests.

During the winter and spring of 2004, we will be collecting a large amount of student data, administering these scales in as many classrooms as possible. This information will be used to estimate the reliability, item difficulty, and similar indices.

In order to collect measurement information, the administration of the scales must be done in a systematic way (e.g, administered in class on computers). We will also need to gather some information about your course and students. In return, we will provide you with detailed information on your students' correct answers and misconceptions. We can also provide some comparison information based on student responses across many courses and institutions. If you are interested in participating as an assessment scale tester, please contact Ann Ooms by email (ooms0001@umn.edu).

Please note: The ARTIST research group supplies the following statement concerning all of their on-line scales:

IRB Approval for the ARTIST Test project

The University of Minnesota Institutional Review Board has approved this project for use by human subjects. The IRB did not require that students complete a consent form for several reasons:

- The tests are administered as part of the regular course.
- There are no experimental conditions that students are being subjected to.
- We are only using identifying information to report scores back to instructors. After scores have been reported, we will strip names from our data files so that student scores are anonymous.
- All results will be reported in aggregate so that no individual student can be identified.

If you have any questions regarding the use of human subjects in this project, please contact Joan Garfield at jbg@umn.edu

Appendix C: Informed Consent Form

STATISTICAL INFERENCE STUDY CONSENT FORM

You are invited to be in a research study of how students learn about statistical inference.

You were selected as a possible participant because you are now enrolled in a Quantitative Reasoning Course. Please read this form and ask any questions you may have before agreeing to be in the study.

This study is being conducted by Professor Robert Carver.

Background Information:

The purpose of this study is to better understand how individual students develop their understanding and skill in the tools of statistical thinking. All of the subjects in this study are your fellow students enrolled in two sections of BA206 this semester, and this particular project is part of Prof. Carver's work to improve statistics education here at Stonehill and at other colleges. This study is not funded by any agency or organization outside of Stonehill.

Procedures:

If you agree to be in this study, you will be asked to complete a few surveys and questionnaires during this semester. As part of the study, some of your responses to these surveys will be analyzed in conjunction with your performance on required course assignments like tests and homework. Participation in the study cannot adversely affect your grade or performance in the course, though participation may improve your grade (see "Compensation" section below).

Risks of Being in the Study:

This study has the following risks: *None.*

Compensation

Minor extra credit will be offered to students who participate in the study. The specifics of the extra credit will be explained at each stage of the study, but in general they will involve up to 5 extra points for homework credit for completing a survey or similar extra credit on a major exam. You will always be informed when extra credit is available.

Confidentiality.

The records of this study will be kept private. In any sort of report I might publish, I will not include any information that will make it possible to identify a participant. Research records will be kept in a locked or password-protected file; only the researchers will have access to the records.

Raw data will be retained but all identifying information will be removed by:

June 30, 2006

(date)

Voluntary Nature of the Study.

Your decision whether or not to participate will not affect your current or future relations with Stonehill College. If you decide to participate, you are free to withdraw at any time without affecting those relationships. Your class credit will not be altered if you decide to withdraw.

Contacts and Questions:

The researcher conducting this study is:
Professor Robert Carver

You may ask any questions you have now. If you have questions later, you may contact them at
Phone: 508-565-1130 or rcarver@stonehill.edu

[If the researcher is a student, include advisor's name and telephone number here.]

You will be given a copy of this form to keep for your records.

Statement of Consent:

I have read the above information. I have asked questions and have received answers to these questions. I consent to participate in the study.

Signature: _____ Date: _____

Signature of Parent or
Guardian (if minor): _____ Date: _____

Signature of Investigator: _____ Date: _____

Signature: _____ Date: _____

Debriefing: At the end of the study, I was given a full explanation of the study and any questions that I had were answered fully.

Signature: _____ Date: _____