NEWSLETTER OF THE INTERNATIONAL STUDY GROUP FOR RESEARCH ON LEARNING PROBABILITY AND STATISTICS

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Notes and Comments

After each newsletter is sent out, I receive a flurry of messages and comments from some of the study group members. This is one of the best parts of my job as newsletter editor: hearing from members and finding out what they are doing. I want to encourage those I haven't heard from to let me know what you are doing and what you think of the newsletters and study group activities. Please send me any papers you have written or any relevant papers or articles you have come across that I have not yet mentioned in the newsletter. Also, if anyone no longer wishes to be on the mailing list to receive this newsletter, please let me know. Postage costs for mailing overseas are high, and are covered by my department at the University.

Please note that I have a new email address, one that seems to be easier to access than the old one. It is: jbg@vx.acs.umn.edu or on bitnet: jbg@umnacvx. I hope to hear from many of you soon, either via email or regular mail!

Information about Members

Brian Greer, who is at the School of Psychology at Queen's University in Belfast, Ireland, is currently working on two projects connected with Data Handling. The first is a short project funded by the Northern Ireland Curriculum Council to:

1. Carry out a survey of primary and secondary school teachers' knowledge about, approaches towards, and attitudes about teaching data handling.
2. Write a literature review
3. Compile an inventory of resources.

He would be very interested in hearing from anyone working on anything similar, particularly in relation to the first component. The second project involves developing textbooks to cover the whole of the national curriculum for ages 11-16. Brian is working with colleagues on the Data Handling materials for this curriculum, and has just completed a draft of the first of 15 projected short books. He would be happy to send a copy to anyone interested.

His email address is: PYG0051@V2.QUB.AC.UK

Andee Rubin announces that some of the ELASTIC software from her Reasoning Under Uncertainty project is currently available as the Statistics Workshop, from Sunburst Communications. The software is a powerful, easy-to-use tool for entering, manipulating and displaying data, for students grades 6 through college. It includes the Stretchy Histogram and Shifty Lines programs, and comes with a Teachers Guide with references and ideas for classroom use.

Susan Friel is co-directing a new NSF-funded project, TEACH-STAT, at the Mathematics and Science Education Network at the University of North Carolina. This project tackles the problem of how to develop statistically literate teachers. The main goals of the three-year project are to develop and implement a comprehensive program to prepare teachers and to research the teaching and learning of statistics in the elementary grades throughout the state of North Carolina. Specifically, the project is designed to:

1. Develop a statistics professional development curriculum designed for inservice education of elementary teachers.

2. Assist elementary teachers in using statistics and data analysis as an organizing framework for the elementary mathematics curriculum and as a tool for integrating mathematics with other disciplines, particularly science and social studies.

3. Involve University and College faculty participating in TEACH-STAT as a Community of Research Practitioners (CORP) in school-based program evaluation and research.

For more information on TEACH-STAT contact Dr. Susan Friel, Mathematics and Science Education Network, The University of North Carolina, 201 Peabody Hall, CB #3345, Chapel Hill, NC 27599-3345, USA. E-mail: sfriel@ecsvax.bitnet

New Members

I recruited some new members at the recent Winter Conference of the American Statistical Association, where I gave a presentation on how students learn statistics. The theme of the conference (which

attracted 650 participants) was statistical education. I welcome these new members to our group. They are:

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Chance Encounters is Finally in Print!

After five years of planning, writing, discussing, and endless rewriting, *Chance Encounters: Probability in Education* has finally been published! Jointly edited by Ramesh Kapadia and Manfred Borovcnik, with chapters written by members of this study group, it is published by Kluwer Academic Publishers as Volume 12 in the Mathematics Education Library. The editors note that the book was written to fill a substantial gap in the current literature in mathematics education, and provides a broad range of perspectives on the topic of probability: educational, probabilistic, empirical, curriculum, classroom, computer, and psychological. The chapters and authors are:

"The Educational Perspective" by R. Kapadia and M. Borovcnik
"A Probabilistic Perspective" by M. Borovcnik, H.-J. Bentz, and R. Kapadia
"Empirical Research in Understanding Probability" by M. Borovcnik and H.-J. Bentz
"Analysis of the Probability Curriculum" by A. Ahlgren and J. Garfield
"The Theoretical Nature of Probability in the Classroom" by H. Steinbring
"Computers in Probability Education" by R. Biehler
"Psychological Research in Probabilistic Understanding" by R.W. Scholz

Papers from PME

The following papers were presented at PME-NA last October, in Virgaina.

"Novices Views on Randomness", by Clifford Konold, Jill Lohmeier, Alexander Pollatsek, Arnold Well, Ruma Falk, and Abigail Lipson.

Abstract:
Novices and experts rated 18 phenomena as random or non-random and gave justifications for their decisions. Experts rated more of the situations as random than novices. Roughly 90% of the novice justifications were based on reasoning via a)equal likelihood, b)possibility, c)uncertainty, and d)causality.

"Evaluating Students' Understanding of Statistics: Development of the Statistical Reasoning Assessment", by Joan Garfield

Abstract:
This paper describes the development of the Statistical Reasoning Assessment, an instrument designed to assess students' understanding of probability and statistics for the purpose of evaluating the effectiveness of new curricular programs and materials, A review of the literature related to assessment of statistical knowledge was used to determine the components and framework for this instrument.

"Toward an Understanding of Mean as 'Balance Point'", by Janice R. Mokros and Susan Jo Russell.

Abstract:
Twenty-nine children and adults were given problems in which they constructed data sets that could be represented by a given mean. Many of them felt that the notion of "balance" was an important one. As they attempted to construct a data set which "balanced," they explored symmetrical balancing, balancing the sum of the data on each side of the mean, and finally, balancing deviations around the mean.

Recent Papers and Presentations of Interest

Inconsistencies in Probabilistic Reasoning of Novices", by Clifford Konold, Alexander Pollatsek, Arnold Well, Jill Lohmeier, and Abigail Lipson.

Abstract:
Performance on problems included in the fourth administration of the NAEP suggest that roughly half of secondary students believe in the independence of random events. In the study reported here, about half of the subjects who appeared to be reasoning normativel on a questions concerning the most likely outcome of five flips of a fair coin gave a logically inconsistent answer on a follow-up questio about the least likely outcome. In a second study, subjects were interviewed about various aspects of coin flipping. Many gave contradictory answers to closely related questions. We offer two explanations for inconsistent responses: a) switching among incompatible perspectives of uncertainty, including the outcome approach, judgment heuristics, and normative theory, and

b) reasoning via basic beliefs about coin flipping. As an example of the latter explanation, people believe both that a coin in unpredictable and also that certain outcomes of coin flipping are more likely than others. Logically, these beliefs are not contradictory; they are, however, incomplete. Thus, contradictory statements (and statements at variance with probability theory) appear when these beliefs are applied beyond their appropriate domain.

"The Concept of Chance in Everyday Teaching: Aspects of a Social Epistemology of Mathematical Knowledge", by Heinz Steinbring. *Educational Studies in Mathematics 22*: 503-522, 1991.

Abstract:
The paper analyzes the relationship between the epistemological nature of mathematical knowledge and its socially constituted meaning in classroom interaction. Epistemological investigation of basic concepts of elementary probability reveals the *theoretical* nature of mathematical concepts: The meaning of concepts cannot be deduced from more basic concepts: meaning depends in a *self-referent* manner on the concept itself. The self-referent nature of mathematical knowledge is in conflict with the linear procedures of teaching. The micro-analysis of a short teaching episode on the concept of chance illustrates this conflict. The interaction between teacher and students in everyday teaching produces a school-specific understanding of the epistemological status of mathematical concepts: the concept of chance is conceived of as a *concrete generalization*, which which takes "chance" as a fixed and universalized pattern of explanation instead of unfolding potential and variable conceptual relations of "chance" or "randomness" and developing the *theoretical* nature of this concept in an appropriate way for students' comprehension.

"Using Computers in Teaching Statistical Analysis: A Double-Edged Sword" by Andee Rubin, Presented to the AAAS, 1991.

This paper discussed how the computer fits into the developing view of statistics education. Two questions are addressed: 1) are there other more powerful ways in which computers can facilitate students' learning of statistics, and 2) are there any drawbacks to uses of computers in statistics classes? In answering the first question, descriptions of several pieces of software are included. In answering the second question, some of the problems with using computers are addressed, such as leading students to become

confused or adhering to conventional forms rather than exploring alternative representations.

"A Closer Look at the Probabilities of the Notorious Three Prisoners," by Ruma Falk. To be published in *Cognition*.

Abstract:
The "Problem of Three Prisoners," a counterintuitive teaser, is analyzed. It is representative of a class of probability puzzles where the correct solution depends on explication of underlying assumptions. Spontaneous beliefs concerning the problem and intuitive heuristics are reviewed. The psychological background of these beliefs is explored. Several attempts to find a simple criterion to predict whether and how the probability of the target event will change as a result of obtaining evidence are examined. However, despite the psychological appeal of these attempts, none proves to be valid in general. A necessary and sufficient condition for change in the probability of the target event, following observation of new data, is proposed. That criterion is an extension of the likelihood-ratio principle (which holds in the case of only two complementary alternatives) to any number of alternatives. Some didactic implications concerning the significance of the chance set-up and reliance on analogies are discussed.

"Randomness-- an Ill-Defined but Much Needed Concept," by Ruma Falk. This is a second commentary on the article, "Psychological conceptions of Randomness, by Ayton, Hunt, and Wright (1989). In the last newsletter I mentioned another commentary by Pollatsek and Konold, "Randomness is well enough understood to be misunderstood." In Falk's commentary, she concludes that despite the problems concerning ideas of randomness, we should not abandon the concept. She suggests that we should continue to use the term "as a heuristic construct that is not well defined, but which does strike a common cord of understanding in the minds of many people and facilitates communications. "

Update on Proposed Research Roundtable

In the last newsletter I proposed a one-day research roundtable to be held August 10 in Quebec. I asked people to let me know if they were interested in participating. I had a good response: about 12

people from several different countries indicated they would like to participate by sharing their research and/or discussing others' research. However, some difficulties arose. One, was the time and location. I did not realize how many conferences were going on, some with overlapping times and all meeting in different areas. The ISI roundtable conference on "Introducing Data Analysis in the Schools" is scheduled for August 10 - August 14 in Lennoxville, Quebec, Canada (about 2 1/2 hours by car from Quebec City). ICME-7 is scheduled for Quebec City August 17 - 23, and PME is to meet in New Hampshire August 7- 11. The multiple conferences caused some difficulty in setting a location for the roundtable. In addition, several people asked if funding were available to help pay for travel. Unfortunately, I was unable to locate funding. However, I was advised that if I had more lead time (i.e., about 2 years) it might be possible to secure travel grants. Therefore, it seems to me that I should postpone the proposed research roundtable, possibly 3 years, until the next ICOTS meeting, (ICOTS 4 in Marrakesh, Morocco, in early August 1994).We could perhaps meet immediately before or after that conference In the meantime, I will explore sources of funding for travel grants for participants.

I am sorry to have to cancel this research roundtable, and hope that with more time to prepare and plan for such a meeting, it will be even more productive. If any of you have any suggestions that will help me in organizing and planning such a meeting, please let me know.