# Interview with Joan Garfield

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**Beginnings**

*AR: Hi, Joan. Thanks very much for agreeing to this interview. I want to start by asking about how you've come to devote so much of your professional life to statistics education. Let's take those two – statistics and education – in separate questions. First let me ask which came first: your interest in statistics or your interest in education? And how did you start on that path?*

JG: As long as I can remember, I wanted to be a teacher. I took a short detour in college when I began as an anthropology major, but that didn't last beyond my freshman year. After contemplating art education and early childhood education, I settled into elementary education. However, my first teaching job was a middle school mathematics position, which I qualified for because of a mathematics minor I had carped together. After the initial shock of realizing all the challenges involved in trying to engage and motivate adolescents to learn mathematics, I realized

I needed to learn more about the specific methods of teaching mathematics. That led me to a Master's program at the University of Minnesota, which had been headed by a leader in activity-based instruction in mathematics, Donovan Johnson. I loved his textbooks and writings, and wanted to study with the guru. However, he retired just before I arrived, so I worked with his former student, Dr. Robert Jackson, instead.

I began teaching remedial mathematics to students in the General College, an open-admissions unit at the university, to help support my tuition costs. I found that I really loved working with postsecondary students and was particularly drawn to the slow learners, those who still had difficulty mastering basic arithmetic. I was also intrigued by the topic of attitudes and anxiety, and conducted a study of mathematics attitudes for my master's thesis.

*AR: How did you find your way to statistics?*

As part of my graduate coursework I had to take a course in statistics, a course I had managed to avoid until the spring quarter of my first year in graduate school. My professor placed us in small groups to work on problems and homework, and I really enjoyed the group experience. I found that I really liked the real-world contexts involved in learning statistics and the practical applications of this "mathematical" subject. I decided to take the doctoral level sequence of statistics classes in the department of Educational Psychology even though they were not required for my masters' degree.

One day when I was talking with my statistics professor, Ray Collier, he encouraged me to apply to the Ph.D. program in educational statistics and to be his advisee. At the time I was single, and he told me that he was willing to take on the risk of advising an unmarried young woman who might leave the program to get married and start a family! I did get married while in the program but had my twins after I graduated.

I started the Ph.D. program and was then offered a job teaching introductory statistics to students in the General College, where I had taught the remedial mathematics courses. I will never forget that first course I taught, at 8 in the morning during winter quarter. I loved the class, loved the content, and loved the students. It was thrilling to see the students become interested in the subject, and to feel good that they could succeed in the course. I was sad when the quarter ended 10 weeks later.

I became intrigued with the challenge of making statistics engaging and meaningful to college students, a positive and successful experience for them. I tried to find ways to get students involved and doing activities, using data I collected from them, and sometimes working in groups. This was in 1978, before many activities were available for statistics students at any level.

When it came time for me to select a dissertation topic, I was surprised that my advisor, a statistician with a joint appointment in the School of Statistics, suggested I do a "curriculum" study in statistics, building on a paper he had written with several colleagues on the nature of problem solving in statistics (Chervaney, Collier, Fienberg, Johnson, and Neter 1977). I ended up developing two versions of a course based on this problem-solving model, designed

assessments to measure problem-solving, and taught the curriculum to four sections of students over two quarters. I learned a lot from that experience, and it enabled me to complete my degree. But when I looked for a way to publish my results, there were no venues at that time for a research paper on teaching statistics at the college level. In fact, there were very few research papers that I could find on this topic, and very few people who seemed to be interested. There was no field of statistics education at all. That was 1981. How times have changed in the last 30 years!

*AR: Can you say more about what your teaching of statistics was like at that time? Were you using real data and focusing on concepts? What sorts of technology, if any, were you using? Did you have any sense for whether your teaching was innovative then?*

JG: The real data I used came from chance devices like coins and dice and cards, or from the students themselves. I did not have any resources to go to for ideas until the first *NCTM Yearbook on Teaching Statistics and Probability* (Shulte and Smart 1981). What really helped me were the first books published in the Quantitative Literacy project. I was on the evaluation team for the project but quickly starting trying the activities myself. The first books on *Exploring Data* (Landwehr and Watkins 1987) and *Exploring Probability* (Newman, Obrernski, and Scheaffer 1987) had great activities and real data. I used every one of those activities. I created a course packet for my class that was all activities and study questions.

I think at the time I was innovative in two ways: I had the students read the book outside of class, guided by study questions, so I did not lecture to them or spend time working out problems in front of them. I spent class time having them work on activities and trying to sum up the big picture of the activities.

In terms of software, when I first taught, all that was available then were simple calculators. We used those to compute everything. All graphs were done by hand. However, when I learned about innovative tools that were being created for secondary school students (Cliff Konold's DataScope and Probability Simulator tools, Chris Hancock's TableTop software, and, Andee Rubin's Stretchy Histograms and Sampler programs), I brought those into my classes. When I began collaborating with Bob delMas in the last 1980s, he began designing tools that I could also use in my classes (CoinToss, Sampling Sim). I think at the time I was trying to find software tools that would allow students to develop concepts and cut down on computations.

## Early Connections

*AR: You mentioned that you felt that few people were interested in statistics education research at the time. How did you find people who were interested in this topic and in your work in particular?*

JG: I started trying to connect with people whose work I found. There were only a handful of people and it was hard to find them. Mike Shaughnessy was one I tried to meet, but he had changed his focus at that time to research on learning geometry. Cliff Konold was just getting started, so we formed a connection that has lasted all these years. At an American Educational

Research Association (AERA) conference I met Andee Rubin, who was doing interesting work involving rescanning with technology at the secondary level.

My colleague Chick Ahlgren and I had decided to write a big grant proposal to study the teaching and learning of statistics at the college level. Based on the literature review for that grant proposal, Chick and I were invited to give a talk at the Second International Conference on Teaching Statistics (ICOTS) in 1986 at Victoria, British Columbia. We were also invited to write a chapter in a book on probability education research (Ahlgren and Garfield 1991), edited by Ramesh Kapadia. Some of the contributing authors met at ICOTS 2 to discuss the book, and that is where I met fellow researchers Manfred Borovnik and Rolf Biehler. I was asked to be part of some special projects focused on statistics education research at the University of Wisconsin and another that might have been part of NSF or NCTM on Technology and Statistics. I usually volunteered to write reports and chapters or set up data bases or newsletters, so I got even more involved in helping to expand the field of statistics education research.

I had found out about a small group of international researchers that was formed in the early 1980s and was being connected by a newsletter written by David Green in the U.K. I got in contact with David, and he asked me to take over the group, which we called the International Study Group on Learning Probability and Statistics. I started writing and copying newsletters that I mailed out three times a year. I got to know many more people by doing this, such as Efraim Fischbein, Carmen Batanero, Ruma Falk, and Marie-Paule Lecoutre. I think that is how I also met Iddo Gal. The network began to grow and grow, and I tried to keep people connected via updates on who was doing what research and where it was being done. Eventually this led to a regular Research Report in the journal *Teaching Statistics* and to the eventual formation of the *Statistics Education Research Journal* (SERJ).

*AR: That must have been a very exciting time. Can you say more about one or two of these connections? In particular, let me ask about Cliff and Andee. How did you meet them, and how did you come to form collaborations with them? And what was it like to know that you were among the few people with a research interest in learning/teaching statistics? Did you have any sense at the time that you were helping to create what would blossom into the much larger and quickly growing research area that exists today?*

JG: At first I was frustrated that there were no places for researchers to gather or publish. At the meetings I went to (mostly mathematics education research conferences), there were only a handful of us interested in statistics education research. Once I met Cliff at a PME conference in 1986 we started talking on the phone and planning collaborations. I got a small grant to bring him to Minneapolis to demonstrate the "Pair Problem Solving" method he was using in teaching remedial mathematics classes at the University of Massachusetts, Amherst. We used that opportunity to discuss and plan future projects. His first grant, to create the DataScope and ProbSim software, included me in the evaluation team. As part of that work we developed student assessments, and I have continued in that line of work on his subsequent grants, and my own research. At one point Cliff told me he could not imagine writing a grant that I would not be involved in, which I took as a very high compliment. It was at a first meeting for Cliff's project that I met George Cobb, who later invited me to be part of the MAA focus group that led

to a chapter on teaching statistics and the 1992 guidelines referred to as the Cobb Report (Cobb 1992).

With Andee, I began to use her software tools in my classes as well as some assessment items she had developed and was using in her research. Andee also became involved in Cliff's new project and we had opportunities to get to know each other at his project meetings in Amherst, and then later, as part of the Technology and Data project. In 1990 Cliff, Andee and I met at ICOTS3 in New Zealand, where we spent time together and then traveled together afterwards. Andee still complains that I woke her in the morning to discuss assessment strategies I was thinking about for Cliff's project.

**Influencing Statisticians**

*AR: One thing that strikes me about the folks you listed above: I suspect that few of them would consider themselves foremost to be statisticians or even teachers of statistics. I first became aware of your work in 1992, when you gave an invited address at the ASA Winter Conference in Louisville, which was focused on the theme of teaching statistics. I was in my third year as a college teacher of statistics, and this conference made a big impression on me, and your presentation in particular captured my attention and interest. You gave an overview of what the research literature suggested about how students learn statistics, and you also provided a list of suggestions for teachers based on those research findings. I believe that this talk led to the publication of your article "How Students Learn Statistics" in the* International Statistical Review *in 1995. My impression was that this conference gave you a forum to bring educational research findings to the attention of statisticians and others who consider themselves primarily teachers of statistics, rather than education researchers. Is my impression accurate? Was this conference presentation as big a deal for you as it obviously (based on this long and rambling question!) was for me and I think many other statistics teachers? And how did your presentation at this conference come about?*

JG: That talk at ASA was a real turning point for me, and I remember it well. I had never met David Moore before, but he invited me because he had read an article I wrote with Chick Ahlgren that was published in 1988 in the *Journal for Research in Mathematics Education* (Garfield and Ahlgren 1988) on difficulties students have learning statistics. I had never given a talk to so many people before, so it was overwhelming. But I was gratified by the interest people showed in the topic and the connections I made at that meeting. I had actually first met many of the SLAW (Statistics in the Liberal Arts Workshop) folks the summer before that winter meeting, when Laurie Snell invited me to a planning meeting at Dartmouth for the Chance project. Tom Moore, Robin Lock, Jeff Witmer, Rosemary Roberts, and Gudmund Iverson were at that meeting, along with Laurie, Bill Peterson and Peter Doyle. I met many of these people again at the 1992 ASA Winter meeting. Dick Scheaffer had just gotten an NSF grant to create Activity-Based Statistics (Scheaffer, Gnanadesikan, Watkins, and Witmer 1996), and he invited me to be on the advisory board. We met right after the ASA meeting, and that is where I first met Dennis Pearl and Judy Singer. So 1992 was the year I connected with the exciting group of statisticians who were interested in education and in applying research to improve teaching and learning.

I think Tom Moore was the one who asked Laurie to invite me to that first Chance workshop, and Tom had learned of my work through the MAA focus group that George Cobb had chaired. I really owe Tom a tremendous amount because the first trip to Dartmouth led to many years of collaboration and friendship with Laurie Snell and my wonderful friends who were part of the Chance project team. And that is how I met Beth Chance, at the first Chance workshop in 1995!

I think it was that 1988 article that drew attention to my work, and led me to be invited to give talks, be on advisory boards, and be part of new projects. The irony of that publication is that it came from the unsuccessful NSF proposal that Chick and I had written, but it led to so many great connections and experiences. It helped me move from the mathematics education world where it was hard to get people interested in statistics education research to the wonderful communities of ASA and now CAUSE.

*AR: You've been involved in so many influential curriculum development projects over the years. You just mentioned two of them: the Chance project led by Laurie Snell at Dartmouth and the Activity-Based Statistics project spearheaded by Dick Scheaffer and others. Looking back on these projects after almost 20 years, what would you say was so special about them, and how would you describe their long-term impact?*

JG: I think these two projects were quite innovative in different ways. While Activity Based Statistics gathered, created and refined activities geared to particular learning goals, Chance looked for ways to bring everyday and important news stories into the statistics class to motivate learning concepts. Both projects offered ways to liven up the classroom, move away from lectures, engage students in discussions, and activities, and motivate them to learn statistics. I also think both projects demonstrated that statistics was more than or different than mathematics, and had real world applications and uses.

In terms of the long range impact, I think both projects live on. The activities introduced in ABS are still used by many instructors today. I think this project set the bar for what a good activity and associated lesson plan could look like. Chance News, created as part of the Chance project, still shares news stories that have statistical ideas that can be used to engage students in discussions or illustrate concepts.

The other project from the 1990's that I think was quite innovative and has had a big impact on teaching statistics is your own *Workshop Statistics*. I remember going to visit you at Dickinson College in 1994 to help evaluate the project. I was quite excited to see an entire course based on students discovering statistical concepts and ideas. I used your materials in many classes and workshops that I taught, and I know many people who have integrated your activities and applets into their classes, to help students discover and explore abstract statistical concepts.

**Recommendations for Teaching Statistics**

*AR: Thanks. I was very impressed and delighted that you were willing to come to my campus to meet with my colleagues and me as we were getting started with our project. You also mentioned being part of the MAA focus group that George Cobb chaired. That produced the recommendations for teaching introductory statistics:*

*(1) teach statistical thinking;*
*(2) more data and concepts, less theory and fewer recipes;*
*(3) foster active learning.*

*What was that process like? Did these recommendations emerge quickly, or did a long process lead to them? Was there widespread agreement within the group, or lots of different opinions?*

JG: It's hard to remember. We had several rounds of email dialogues, each resulting from a set of questions that George posed. Different people chimed in at different times. There was a lot of debate about decreasing formal probability. I remember advocating for active learning and fewer lectures, and I remember that some people had a hard time imagining what that would look like. We shared several examples of classes we were teaching that were more nontraditional, and those descriptions ended up in an appendix to the book chapter and report. I think George did a masterful job of pulling out themes and recommendations from our discussions. When I saw the three recommendations I was very excited, especially by the last one which I had been pushing for in every round of discussion.

I remember that there were some strong opinions and heated debates. But George kept things going and handled things in a graceful and diplomatic way, and everyone was pleased with the results.

Looking back at those recommendations, I recall that I had never really thought about or defined "statistical thinking" before this focus group, and it took a while after it for the conception of statistical thinking described in the report to really sink in. I still think that teaching statistical thinking is very hard to describe or even do. I now believe that it's something we have to help students develop and practice.

*AR: What is your sense for how widely read and how influential those recommendations were? Do I recall correctly that you conducted a fairly extensive survey to investigate their impact?*

JG: I think the report was well read and well known by people interested in statistics education. I am not sure that mathematicians and statisticians who were not part of this community knew about it. When I conducted a survey in the late 1990's, it did seem like not a lot had changed except for the use of technology. Lectures still predominated, although there was some use of activities, and several attempts to use projects and other types of nontraditional assessments.

I do think that the report helped us shift away from an emphasis on formal probability, and David Moore's textbooks helped that happen as well. The other change that I saw was an introduction to the topics of data collection and data production, which had not been part of the traditional course in the past. There was also more of an emphasis on exploring data, which could have been supported by the Cobb Report.

*AR: The Cobb report was published in 1992, and then in the early 2000s you took the lead in forming the group that produced the ASA-endorsed GAISE recommendations for introductory statistics courses at the college level. Why did you think that the Cobb group's recommendations needed updating? Were you pleased with the GAISE recommendations, and have you been satisfied with their impact?*

JG: When we proposed the GAISE project to ASA, we were hoping to shake things up a little. It seemed that many people thought they were teaching reform classes, and yet, there did not seem to be big changes in the way introductory statistics courses were being taught. In addition to the six endorsed recommendations, we had a list of the statistical literacy outcomes we thought were important, regardless of which type of course was being taught. We were aware of two types of intro stats courses, the more literacy oriented course and the more applied course (I think you talked about them in your USCOTS keynote as Stat 100 and Stat 101.)

We also tried to clarify what we meant by "statistical thinking" and ways we thought it could be developed. At the time we disseminated the report, some of our writing team thought it might be viewed as too radical. But it didn't seem to shake things up much at all. I've seen textbooks claim to be GAISE-aligned, but I haven't seen big changes in course content, use of technology, or activities. So, while I was very pleased with the report and its positive reception, I am not sure it really led to major changes in the introductory course.

The major changes I *have* seen since the GAISE report seem to be triggered by George Cobb's 2005 talk at USCOTS, the same year the GAISE recommendations were endorsed. These changes have to do with content and use of technology. And I think these changes are very exciting!

**Teaching Statistical Thinking**

*AR: Oh my, there are so many directions that I'd like to take our conversation in, but I suppose I'll have to choose one at a time and hope to remember the others. First, about the impact of GAISE, I think you might be underestimating things a bit. I confess that I was a bit of a skeptic at first about the need for GAISE, because I thought that the Cobb report made excellent recommendations and expressed them very well, and I liked the simplicity of the three suggestions in that report. But now in hindsight I firmly believe that the GAISE report has provided a great service to the profession, in part for the reasons you've mentioned but also because my sense is that it has become extremely widely read, discussed, and acted upon. It seems that almost every conference presentation about teaching statistics cites the GAISE guidelines, and as you mention, many textbooks claim adherence to them, and I've heard many faculty members say that their department's curriculum discussions focus on the GAISE report. So, I think you deserve a great deal of credit for leading the effort that produced such influential recommendations. Following up on your mentioning a desire for major changes in the introductory course, can you give some examples of what you have in mind, either from what you and your colleagues are doing at Minnesota or what you have in mind for your "pie in the sky" course?*

JG: I have been thinking about this a lot lately. Our CATALST course here at Minnesota is one approach to changing content and pedagogy. But I have been thinking about what it is in this class that is so different from others. Yes, we use real data, technology, activities, etc. So, what is unique about our approach?

One change is moving away from teaching a set of concepts that we know are connected, but that students perceive as taught in isolation of each other. For example, today we learn graphs, tomorrow we learn measures of center, next week we learn the normal distribution, another unit is on methods of collecting and producing data, etc.

In our CATALST course, we are teaching a core way of thinking about concepts that is always linked to an approach for answering research questions. This approach introduces a common way of thinking about statistical inference, and consistently uses that approach throughout the course. For pretty much every example of judging an observed result, we ask the students to think of a null or chance model to use to generate simulated data, to examine a distribution of a statistic from these simulated samples, and to see how far in the tails the result lies. We build on George Cobb's three tiers of Randomize, Repeat, Reject (2005, 2007). We spend a lot of time developing and using this consistent way of approaching problems. When we do examine estimation, we adapt the approach to use the sample as a model to simulate more data to construct an interval estimate.

A second feature is that a large amount of time we spend developing the ideas of model, simulation, and variability of sample statistics. We spend almost half our course developing these ideas. So when you look at our course content, we have eliminated much of what is in other introductory statistics classes, and spend a lot of time on these abstract but important ideas and ways of thinking about data and inferences based on data.

It's possible that another course could be based entirely on the idea of linear models, with those ideas developed very slowly and carefully, and again, eliminating a lot of traditional content. What is key is going deep on some core ideas, introducing a common way of thinking about problems, and using that way of thinking consistently to solve a variety of problems. We find that using a technology tool (in our case, TinkerPlots software) is a way to support and enable this approach to problem-solving and statistical thinking. We find that the challenges of this approach and the way we use the software tool to develop the students' thinking, gives students strong motivation to work in groups on in-class activities. People who have observed our classes find a striking difference in the nature of group work and discussions in our CATALST course as compared to the use of other activities in other courses, which may be enjoyable and active but don't require the same degree of group effort or collaboration.

*AR: You mentioned statistical thinking earlier, in conjunction with the MAA Focus Group report, and this description of your CATALST course focuses on statistical thinking. Also, the "ST" in your ARTIST project stands for "Statistical Thinking," and you and your colleagues have pioneered classifying statistical knowledge in terms of literacy, reasoning, and thinking. You also mentioned earlier that statistical thinking is hard to define. As an aside, when I'm asked to define statistical thinking, I sometimes give the flippant answer that has famously been applied to pornography: "I can't define it, but I know it when I see it." But let me ask you for a better answer than mine: How do you define statistical thinking? And the more important question: What advice do you have for helping students to learn how to recognize and implement statistical thinking? Feel free to point me and our readers to some articles, but I'm also curious to hear how you respond to this in a conversational style.*

JG: I will never forget a talk I heard in 1998 at ICOTS in Singapore. Maxine Pffankuch presented the work she had done with Chris Wild on statistical thinking (and Chris just happened to be sitting next to me in the session). I was electrified by the exciting and novel work they presented, that suggested a model of statistical thinking based on observing and interviewing statisticians. Their groundbreaking work was published in the ISR in 1999 and I still think of it as one of the must-read papers for anyone in our field. Until that time, all the talk about statistical thinking seemed to be opinions offered by statisticians The Wild and Pfannkuch study (1999) was empirically based, and offered a model of a cycle of inquiry that made sense and seemed to be something to guide future teaching and research. A few years later Beth Chance used this model in her AERA talk that became a *JSE* paper (Chance 2002) where she offered practical strategies for teaching and assessing statistical thinking, another great resource for statistics educators.

When I worked on the ARTIST project (Garfield and delMas 2010) with Bob delMas and Beth Chance, we defined statistical thinking as "an understanding of why and how statistical investigations are conducted. This includes recognizing and understanding the entire investigative process (from question posing to data collection to choosing analyses to testing assumptions, etc.), understanding how models are used to simulate random phenomena, understanding how data are produced to estimate probabilities, recognizing how, when, and why existing inferential tools can be used, and being able to understand and utilize the context of a problem to plan and evaluate investigations and to draw conclusions."

We were trying to get at learning beyond understanding concepts, reasoning about concepts, or applying a procedure. We tried to develop assessment that would evaluate students' ability to think about the big picture, consider aspects that affect data analysis or interpretation and how they relate to a research question.

Today, I consider statistical thinking a way of approaching a problem that goes beyond following procedures or routine steps or flow charts. We have been comparing statistical thinking to know how to "really cook" rather than just follow a recipe well. I don't believe people develop statistical thinking in one course, or even in two, but that it comes with much experience with data and statistical problems. However, I think we can begin to develop some aspects of statistical thinking in first courses, by teaching a way of thinking about statistical questions or inferences that students can apply to different contexts and problems, and by using technological tools that promote this kind of thinking. We may not be able to turn our students into iron chefs, but we can give them a sense of what it's like to really cook something rather than just following a recipe.

*AR: Thanks very much. Toward the end of this interview I'll ask about hobbies, and I suspect that we might hear more about cooking then. For now let me follow up by asking: How important do you consider the distinctions among statistical literacy, reasoning, and thinking? Are they something that teachers should pay much attention to? Also, you've played a major role in establishing the Statistical Reasoning, Thinking, and Literacy (SRTL) research forums that meet every two years. Would you say that these literacy/reasoning/thinking distinctions are more important for teachers or researchers or both?*

JG: That's a good question. I used to think these distinctions were quite important, and that we should design assessments that evaluate the three kinds of outcomes. I guess I still think that a big part of introductory statistics is teaching literacy and reasoning, so that implies we should assess these outcomes. The SRTL forums, while originally broad in scope, have narrowed to focus on a particular type of reasoning. It's been great to come together every two years and see what we can learn from studies across age levels, countries and even languages, about developing a particular type of reasoning. Most recently we have focused on informal inferential reasoning. Two special issues of journals (*SERJ*, Vol 7, Number 2, 2008 and *Mathematical Thinking and Learning*, Vol. 13, Number 1/2, 2011) have been devoted to this topic. That doesn't mean that literacy and thinking are not important, but perhaps it's been more interesting to focus on a particular type of reasoning and what it looks like and what we can do to help it develop. Those are obviously research questions, and they can lead to better approaches, materials and activities that can be used by teachers to promote positive learning outcomes.

**Assessing Student Learning**

*AR: Another aspect of statistics teaching that you are known for is assessment. The ARTIST project is all about assessment, you've co-edited a book on assessment, and assessment has been the topic of many articles that you've written. One of the best pieces of advice that I've ever received is your admonition to "assess what you value." I want to ask several questions about assessment, starting with: How did you come to be so interested in assessment? What led you to value this component of instruction so highly?*

JG: Maybe I fell into it with Cliff's first grant, when he asked me to develop an assessment of statistical reasoning to evaluate the impact of the DataScope software. That first effort led to the Statistical Reasoning Assessment (Garfield 2003), which has been used widely around the world.

I studied educational and psychological measurement as part of my doctoral program and I analyzed assessment data as a research assistant at the Minnesota Statewide Testing program. That is where I first met Chick Ahlgren, who had developed an attitude test (Minnesota Attitude Assessment, or MAA) that was given throughout the country. One of my jobs was to analyze the data and generate reports for schools. When I took my first course in measurement, I used data from the MAA and used it in a semester-long project, analyzing reliability and validity evidence. Chick later offered me a research job using my results to revise and improve the MAA. So perhaps that experience stimulated my interest in assessment and the need to develop good measures. I also learned from that experience how difficult it is to develop good assessments.

Right after completing my doctorate, I became the Director of Research and Evaluation for the General College at the University of Minnesota, where I had begun a position as Assistant Professor. The Dean sent me to a conference on assessment in higher education and that also had a big impact on my interest in student assessment. In the late 1980s I wrote a paper (Garfield and Corcoran 1986) with a senior colleague (Mary Corcoran) on the history of assessment in higher education, as background reading for an assessment conference we put on at the University of Minnesota.

I became part of some working groups on assessment organized by NCTM and learned about alternative methods of assessment and approaches to authentic assessment. That led to my work with Iddo in organizing a workshop on assessment in statistics education that later led to our edited book on this topic.

After moving to the Department of Educational Psychology in 1995, I taught a course on survey design and especially enjoyed teaching about item writing and survey construction. So I guess that carried through to my assessment work. Later on, I developed and taught a course to pre-service teachers on classroom assessment. I guess I have been involved in some aspect of student assessment for the past 30 years! I now have a new NSF grant with Dennis Pearl (e-ATLAS) that involves assessment of both students and statistics teachers! So I just can't get away from assessment.

*AR: How has assessment of student learning in your own classes changed over the years?*

JG: When I began to teach, I created quizzes and exams that looked a lot like the homework I gave students to do. But then I began to create and assign mini projects and then bigger projects that seemed more authentic than computational or procedural problems. I began to add assessments like article critiques and reflection papers or journals. I was striving for a mix of assessments that would provide a more complete picture of what students were able to do, how well they could communicate and solve problems, etc.

I haven't taught statistics for several years now, since losing my central vision in 2001. But I think if I did, I would still use a variety of assessments (an assessment portfolio) to capture what students had learned.

*AR: What was your motivation behind the ARTIST project, what were its primary goals, and how well do you think the project meets those goals?*

JG: I had done some thinking about and writing about assessment before the NSF launched a new division on student assessment at the college level. I had been invited to a planning session for this new program but was not able to attend. But because I had been invited, I gave some feedback and was later sent the first call for proposals for this new division, Assessment of Statement Achievement (ASA!)). Bob delMas and I had worked on some assessments for our previous NSF project, Tools for Teaching and Assessing Statistical Reasoning, and we had a sense of what was needed and what we didn't see in terms of assessments of student learning. We had given a symposium at AERA a few years earlier with Beth Chance and Deb Rumsey where we outlined our ideas about literacy, reasoning, and thinking and how they could be assessed.

I guess we just moved forward, building on those preliminary ideas, and offering to create a data base of items as well as a standardized test of student outcomes. When we wrote the grant, we weren't really sure how we would accomplish what we set out to do, but we utilized our great advisory board, hired a wonderful graduate research assistant (Ann Ooms) and it ended up being a terrific project that we were all proud of (Bob, Beth, Ann, me, and our advisory board). Our goals were to produce an item data base of high quality items that instructors could use to create

their own tests, to create the CAOS test (delMas et al. 2007), and to create a website of assessment resources.

I feel that we achieved those goals and that the materials have been well received and utilized by the statistics education community. We even received two supplements to the grant that allowed us to do a thorough evaluation of the materials produced as well as start on a new assessment of teachers (Statistics Teaching Inventory). Our current e-ATLAS grant builds on both the CAOS test and the STI.

**Development of Statistics Education Research**

*AR: I think ARTIST is a great example of an NSF-funded project that has generated tremendous "bang for the buck." My sense is that the ARTIST website and assessment items are much used and appreciated, and CAOS has become a very widely used research tool. Let me take this opportunity to move our conversation from teaching back to research. You mentioned at the outset that when you were working on your dissertation, there wasn't much research being conducted in statistics education, and what little was being done was not well coordinated. Needless to say, this situation has changed considerably over the past 25 years, and you've played a central role in this development. How would you summarize the current state of statistics education research, and what would you cite as the major accomplishments of the past 25-30 years?*

JG: I think the biggest accomplishment is the establishment of *SERJ* as the first journal devoted exclusively to research in statistics education, and made an official journal of the ISI. Another accomplishment is the SRTL research community that has been going on for 11 years and has produced two books and several special issues of journals, as well as helped establish the careers of several young researchers. The third is the research arm of CAUSE, which has established resources on CAUSEweb.org and mentored two rounds of new collaborative research groups who are contributing to the knowledge base in statistics education.

In terms of statistics education research today, I think we have come a long, long way. Not only do we have *SERJ*, we have research articles published in *JSE* and *TISE* (*Technology Innovations in Statistics Education*) as well as Teaching Statistics. We have a website on IASE that posts new dissertations in statistics education that has been incredibly helpful for new researchers as well as graduate students. We have a plethora of research sessions at ICOTS when there used to be just one strand of research back in 1986 and 1990. We have good relationships and collaborations with both mathematics education and statistics, so many more teachers and researchers are aware of the existence of statistics education research, our publications, and our scholars. And, as mentioned before, we now have assessments that can be used in research studies, an important component of most research programs.

If someone wants to find out about statistics education research, or get started in scholarship in this area, there are so many sources of information, people and communities to connect with, and publications to study. I am currently working with Dennis Pearl to release a report of research priorities for statistics education that resulted from a research retreat in 2010 and a writing retreat in 2011. We hope this report will also help move our field forward.

*AR: What do you think needs to happen next in statistics education research, in order for the field to continue to grow in reputation and in numbers, and also in order to have broader impact on statistics teaching?*

JG: I think that we are ready to make a more concerted effort to coordinate research and to study the teaching of statistics at a deeper level. I think we are ready to move forward in developing and studying research based curriculum that are built on a solid foundation of theory and accumulated scholarship in our field. We have focused a lot on pedagogical methods, such as use of activities or technology tools, but we haven't looked at the more complex questions of how to develop statistical thinking, and how to prepare students to use what they have learned in other settings. There are questions about transfer and retention of learning that are important to explore, and to identify the most important features of a curriculum that lead to the desired outcomes. I think we need to look at content and pedagogy together in light of the most important outcomes and together with how curricula are actually taught and teachers' beliefs and perceptions. I also think we are at a point where we can study effective ways to bring about real change in the teaching of statistics, and what types of experiences for teachers are most effective in bringing about real change in what and how they teach.

I think that we need to continue to develop and investigate assessments that can be used in research studies to measure the things we care about, such as statistical thinking, or transfer. And we need to gather data using these instruments to have some baselines for comparing results of new innovations.

*AR: Two limitations of statistics education research studies, particularly because the field is just getting started, are that most of the studies are done on small convenience samples and do not involve random assignment to treatments. Do you agree that these are legitimate concerns? If so, do you think the field is getting closer to conducting studies with multiple sites, perhaps even involving random assignment to treatments? Or do you not see this as an important direction to move in? If the latter, can you make the case that these studies nevertheless have much to offer in terms of helping teachers to make decisions about how best to help their students learn statistics?*

JG: I think the studies that have been informative so far have helped us to better understand the complexities involved in learning or reasoning about particular concepts. They have been more exploratory and descriptive in nature, along the lines of stage 1 and stage 2 studies in the SMER report (Scheaffer and Smith 2007). I am not sure randomized studies make sense in higher education. There are too many confounding variables as well as constraints. So it's not like assigning a drug and a placebo in a medical study, because the school, teacher, students, etc. all play such a big role. These studies have helped us define some constructs like informal inferential reasoning, or distributional reasoning. They have created tasks that can be useful in assessing students learning and reasoning.

So what can we do in statistics education that will allow us to generalize beyond a single class or course? That is a good question. I think in my own case, we are looking at several people who are teaching the CATALST course in different schools, settings and with different types of

students. They are all making some modifications, so it's not like a treatment is being rigorously applied. But nonetheless, we can learn a lot by what the students are able to do on some assessments at the end of the semester. We don't have control groups for comparison, but we are trying to gather some comparison data from the same institutions where a non-CATALST course is taught. We will be looking at the student outcomes for these two situations, knowing the CATALST courses are not all the same, and certainly not expecting the non- CATALST course to be the same. However, if we find some compelling evidence that students are performing better on the assessments from the CATALST courses, that suggests we are on to something, and that others may want to look into this curriculum and try it themselves.

I also think it would be great to be able to compare students who experience the CATALST course with students who take classes with some of the core components that we think are fundamental to developing statistical thinking. That would also help us learn more about what seems to be making a difference in achieving students outcomes. We won't be able to establish cause and effect, like in a randomized experiment, but we can learn more than we know right now about what seems to help students develop statistical thinking and other important outcomes of an introductory statistics course.

*AR: You mentioned the research arm of CAUSE and in particular its collaborative research clusters in an earlier answer. For anyone who might not be familiar with this effort, can you describe how these research groups are formed and supported, what kinds of projects they're working on, and how others can become involved?*

JG: This was a project of the CAUSE Research Advisory Board (RAB) from 2007-2011. As part of our mission, we wanted to help develop researchers and stimulate productive research in our field. We put out a call before the 2007 USCOTS to see if anyone was interested in participating and what their research background and interests were. RAB carefully reviewed the applications and selected 12 individuals, who came to USCOTS, participated in research sessions and cluster activities, and got to know each other and us. By the end of USCOTS we formed three research clusters, each linked to 3 RAB members as liaisons. We gave them a structure to follow for two years, and they did it! We asked them to spend the first six months reading and discussing research related to a common interest or question, and to have monthly conference calls with the RAB members.

The next step was to develop some preliminary research questions based on the literature that they could use to collect some classroom data. We met with the clusters at the end of a year in person and during the year via big conference calls for all clusters and RAB. At the end of two years we were pleased to see that they had formed strong collaborative research groups with a clear focus and already some impressive projects (publications, grant proposal, presentations). We launched a second set of clusters at the 2009 USCOTS and used the same structure, again with very positive results. We felt that this structure promoted a sound approach to research: a thorough review of the research related to their question, critical discussions of the research, a gradual refinement of research questions in light of preliminary data, and the establishment of a positive and productive research group. Also, the cluster structure built on the collaborative classroom research model that had worked so well for Bob, Beth and me (delMas, Garfield, and

Chance 1999). We are pleased to see these groups still working together and producing good results.

The first two clusters (and USCOTS) were supported by an NSF grant that has now ended. Therefore, we did not form a new set of clusters at the 2011 USCOTS. However we hope to publish a paper on the structure and process we used to facilitate other researchers forming clusters and following this approach. I should add that some of the literature reviewed was on educational research methods and how to write a critical review of the literature. Dennis Pearl and I are planning to submit a new proposal to NSF in January that would include a new set of research clusters each year for five years, so if funded, we hope to offer this opportunity again. This plan would also offer some summer institutes for aspiring statistics education researchers which we think would be useful to those wanting to begin education research without a background in the use of these methods.

**Graduate Program in Statistics Education**

*AR: Speaking of developing and supporting new researchers in statistics education, you and your colleagues at Minnesota are the first in the U.S., I believe, to institute a graduate program in statistics education. How did this come about, what challenges have you encountered and overcome, and what is the current status of this program?*

JG: I moved to the Department of Educational Psychology in 1995 and was soon permitted to advise graduate students. I had a few MA students with an interest in statistics anxiety or assessment, but they had no coursework in the field or any formal way to prepare to do this type of research. There were three areas in my program Quantitative Methods in Education, Statistics Measurement and Evaluation. Students had to specialize in one of these areas. I talked with my colleagues in QME about introducing a fourth area, statistics education, and building a graduate program so I could recruit students to do research with me. They were very supportive and endorsed my suggested program and courses.

I advertised the program and the first course (Becoming a Teacher of Statistics) in fall 2001, and offered this first course in the fall of 2002. My first student was Andy Zieffler, and without him there would be no program. For the first two years the program was just Andy and me! A few years later Bob delMas transferred to my department and began to co-advise students with me. Michelle Everson had been hired as a lecturer, and she took over one of the courses and also began to co-advise students with me. Andy has been a lecturer in QME since he graduated, and now he also advises students. I can hardly believe that we have 4 statistics education faculty and at the moment, 8 students! These students come from five different countries: Korea, Iceland, México, and Brazil, as well as the U.S. We also have students in statistics and mathematics education earning a statistics education minor as part of their doctoral program in another department.

We have been fortunate to provide funding for students through TA and teaching jobs and RA jobs with the grants we have. I feel so fortunate to work with such great colleagues and such wonderful students. It feels like a family! Everyone works incredibly hard and we have produced some great projects, articles, courses, and presentations. We have grown a terrific

program, and I couldn't be prouder! I hope the program continues after I retire, and that other programs will develop that offer graduate coursework and advising in statistics education as well as opportunities for students to collaborate with each other and with faculty, in teaching and in research. The ASA-endorsed guidelines for Graduate Programs in Statistics Education (http://www.causeweb.org/research/programs/GradProgram.pdf) should be a great resource for new program and course development.

*AR: Do you have a core set of courses required for your graduate students? If so, what's included in the core? What are the prerequisites for entering the program, and what kinds of backgrounds do most of your applicants have? Do your graduate students typically come in with a good bit of statistics knowledge, and do they also take grad courses from the Statistics Department? Do your students typically intend to pursue a teaching career, or a research focus, or both, or something else? (And finally: Do you think I've set a record for asking the most questions before finally giving the interviewee a chance to respond??)*

JG: There are no prerequisites for applying for the program. We look for students with strong backgrounds in statistics, good academic records and letters of support, some teaching experience, and interests aligned with our program. We also look for students we think would make good TAs and RAs for our courses and research projects. We do have three sets of requirements for the PhD in statistics education! First students have to complete all the requirements for a PhD in Educational Psychology. In addition, they have to fulfill the requirements for students in QME, and finally, they have to fulfill requirements for Statistics education. Their programs include courses in cognition and learning, educational research methods (quantitative and quantitative), three courses in educational measurement, advanced coursework in statistics, and three courses in statistics education including a teaching internship. They also take coursework outside the department including a course in mathematics education. Some take courses in the statistics department, biostatistics, or psychology statistics. As part of their degree requirements they complete three research papers, an oral exam, and a dissertation.

Several of my current students entered the program with a master's degree in statistics. I think all students getting a PhD in statistics education should have the equivalent of a masters in statistics, as suggested in our Grad programs guidelines (Garfield, Pantula, Pearl, and Utts 2009). While students tend to come to our program because of their passion for teaching statistics, we try to make it clear that we are a research program and that they need to develop into researchers as well as excellent teachers. I would hope that all our graduating students would continue their development as teachers and researchers. Now, did I manage to answer all of your questions?

*AR: Yes, well done, thanks! But let me go back and press you a bit on a previous question. Can you give an example of a challenge or obstacle that you've overcome in developing your graduate program? I think others might be encouraged to know that you haven't experienced smooth sailing from the outset, unless you really have had calm waters the whole time.*

JG: I must say that there were no obstacles on the part of my department. As long as I met all of the departmental requirements, then I could add on extra ones for my students! Many students not in the statistics education program took my classes and served as TAs and instructors for our statistics courses, and had positive experiences that they reported back to their advisors. Since I

haven't had many students graduate yet, I can't talk about the obstacles they face getting jobs. I hope that won't happen.

Looking back, the biggest challenge I faced was to get students to apply for the program and to enroll in my statistics education courses. The fall that Andy started, I offered my first statistics education course (Becoming a Teacher of Statistics). I needed ten students or it would be cancelled. I sent out mailings via email and via mail to all the high schools and colleges in the Twin Cities area! I was able to somehow get 8 to enroll: Andy, another student in Educational Psychology, a student in Public Health, two teachers at colleges in the area, and three AP High school teachers. My department allowed me to offer the class despite low enrollment because it was a required course for the program. The next time I offered it I enrolled 14 students, which was quite exciting. When I first offered the doctoral research seminar, I needed five students or it would be cancelled. So I worked hard to find graduate students in addition to Andy that I could get to take the class. My new strategy to overcome these enrollment constraints is to change the course each time its offered and then encourage my students to take the courses multiple times! That has helped keep enrollments up, keeps the classes from being cancelled, and also allows us to focus on new research and topics each year.

I have also learned some lessons along over the 9 years that our program has existed. One was to insist on adequate course work in statistics, beyond the required QME courses. Another is to require students to have a research experience in statistics as well as in statistics education. A third lesson learned is to require students to either earn a Master's degree before the PhD or to come in with a Masters degree, something that is not required by our department. However, I think it's really important for our students so in the future, we will not be accepting new students in a Ph.D. program who do not have a Master's.

**"Pop Quiz"**

*AR: Now we begin what I'll call the "pop quiz" segment of the interview, where I'll ask very specific questions and will ask you to limit your responses to 2-3 sentences per question. First, what hobbies do you have outside of statistics and education?*

JG: Two or three sentences for that one? OK, here goes. Cooking, quilting, photography, running, traveling, hiking, reading, creative writing, and babysitting my grandson!

*AR: What are 1-3 books that you've enjoyed reading in the past year?*

JG: Three of the best I have read in the last year are: *Intuition*, by Allegra Goodman, *Blood Bones and Butter* by Gabrielle Hamilton, and *The Woman Who Walked into Doors*, by Roddy Doyle.

*AR: What are 2-3 of your favorite places that you have traveled? Maybe you could mention one place that you've travelled for professional reasons and one that was purely for pleasure.*

JG: Paris is my favorite city, and I also love to travel to Ireland and México. Professional travel has taken me to wonderful places like Morocco and Singapore and last spring, Tokyo (where I was on the ground at the airport when the earthquakes struck last March).

*AR: That must have been quite an experience to be in Tokyo during the earthquake. The conference in Morocco in 1994 was my first international travel experience, and you were very kind about sharing advice and information. You mentioned your grandson a few questions ago, and you mentioned having twins near the beginning of this interview. I've played tennis several times with your husband and Beth Chance and John Holcomb. Please tell us a bit about your family. (I'll double the 2-3-sentence restriction for this one.)*

JG: I met Michael in graduate school and we have been married for 31 years. He was getting a PhD in Psychology (Behavioral Genetics) and was doing a twin study for his dissertation. Then we had our own set of twins, Harlan and Rebecca (now 28). Harlan is married to Paula and they have the adorable, one-year old Davis who is the center of my universe right now! Rebecca lives in Portland, Oregon with her partner Laurel, and is earning her MBA with a focus on nonprofit management and finance. Michael is founder and president of Professional Data Analysts which has grown from a company of 1 to 18 people over the past 25 years. Harlan is a senior programmer for the business and Michael's right hand in running PDA.

*AR: Name something that JSE readers will probably be surprised to learn about you.*

JG: I am learning to play Irish fiddle! Or, I wrote a memoir/cookbook about my life and food.

*AR: Wow, both good ones! I for one am surprised. How can we order a copy of your memoir/cookbook?*

JG: It's called *Stone Soup Cooking* and it's self-published, so I give it to friends on request. I'll be happy to send one to you! I may put it on Amazon when my supply dwindles and then people who want to can order it and learn far more about me and my passion for food than they want to!

AR: *Sure, please send me a copy, thanks! Now let's pretend that I'm arranging for a lavish dinner and opportunity for hours of lively discussion for you and three others. While we're dreaming, I'll even arrange for the dinner to be held at your favorite restaurant in Paris. Who would you like me to invite to join you for this dinner and discussion?*

JG: Of course George Cobb, my favorite person to enjoy fine French food with! And of course, Rob Gould (who dined with me in Paris this past summer at the most amazing restaurant)! And Andy Zieffler, with whom I always enjoy sharing meals, conversations, and ideas. And if you had magical powers to arrange this, I'd want Laurie Snell there as well. What an amazing dinner in Paris that would be! There are many others I would like to have at the dinner as well so it's hard to limit it to just three.

*AR: What is (or was) your favorite course to teach?*

JG: My favorite course used to be the introductory statistics for beginning graduate students in my department. They were so eager, enthusiastic, hard working and scared. I loved helping them realize they could learn statistics and that is was enjoyable. Then I moved on to teach "Becoming a Teacher of Statistics" and used to be amazed that I was paid to have so much fun each week in this class.

*AR: The theme of the USCOTS conference held earlier this year was "the next big thing." What do you think the next big thing in statistics education is? (You can have as many sentences as you like for this one.)*

JG: That's a hard question. It seems like there is lots of interest in randomization and bootstrap methods, there's a big interest in computing and data base skills, and there's an interest in the huge data sets out there that are being created and used all the time to record our lives. There is also an increasing amount of research in cognition about the brain and what it looks like to think and reason or learn new information. I'd like to think that the next big thing is a better connection between research and practice, with research addressing practical questions that can be used to inform decisions teachers make, and that teachers will be aware of and utilize this research. So perhaps, the next big thing is the maturity and recognition of statistics education as a research-based discipline!

**Connections and Collaborations**

*AR: I hope you're right. Speaking of connecting research and practice, can you describe the recent book that you and Dani Ben-Zvi wrote on that topic? (I think the "pop quiz" is over now, so take as many sentences as you'd like.)*

JG: Dani and I wrote *Developing Students' Statistical Reasoning: Connecting Research and Teaching Practice* (Garfield and Ben-Zvi 2008) over a three-year period. Our goal was to try to summarize the research that related to teaching and learning statistics in one book, offering strategies for building students' reasoning about important statistical ideas. Several colleagues helped write parts of the book, which really helped us out. We also had chapters on technology, assessment, collaborative teaching, etc. We think there's a lot of good information in the book but our thinking has developed and we are now interested in topics and learning sequences that are not included in the book. So unfortunately, it already feels a little out of date.

The book was closely related to an NSF grant we had here called AIMS, where we developed activities and lesson plans based on the research literature. We taught an AIMS course for many years but have now moved on to our current CATALST curriculum because we felt certain things were lacking and some important outcomes were not being achieved. So while the book represented our best take on connecting research to practice a few years ago, and while many of the ideas and activities are still good, I now feel that the curriculum described above is more appropriate for a pre-college level course or sequence of courses.

*AR: One aspect of your career that George Cobb has remarked about to me is your tremendous ability to bring together people with different backgrounds and talents, forming teams and inspiring them to be creative and productive in many different ways. I certainly don't want to*

*put you on the spot or embarrass you, but can you comment on your secret to this success? Do you have any advice to share that might help others to develop this ability?*

JG: To try to answer this question, I went to my colleagues Bob and Andy and asked them what they thought we do to connect people to work on projects with us. They suggested that we do two things. One, we keep our eyes open for people who seem to be doing interesting things or have good ideas, and we try to get to know them, and then often try to get them to work with us on a project. Another is that we are often trying to connect the people we meet to other people, to form networks and communities that know each other and can work together. In addition, I think I am naturally a dreamer and an optimist, so I like to come up with grand ideas and then I bounce these ideas off the people I like to work with, so that together we can brainstorm and create projects. So my advice would be: if you have an interesting or exciting idea, don't hold on to it and work on it alone, start sharing it with people who you value and like to work with, and encourage them to move forward with you. Then it becomes a shared effort, creation or product. Also, keep your eye open to people you have not met before by reading the statistics education journals and going to conferences and seek out people who seem to have new ideas or who are doing interesting things. Get to know them and consider inviting them to work with you in ways that build on their interests and talents. And finally, dare to dream. Don't worry about whether an idea is feasible or how others will respond. Just move forward on things that are interesting and exciting and see what happens!

*AR: Speaking of your propensity to dream and come up with grand ideas, I'm reminded of something that Roxy Peck once said: Joan shows that you don't need to have ordinary vision in order to have extraordinary vision. You mentioned earlier that you have not taught since developing vision problems a decade ago. I'm curious to know how you've dealt with these problems and managed to remain so productive.*

JG: What a nice remark by Roxy! Back in the summer of 2001 when I realized that I would no longer be able to read, drive and see people's faces, I was devastated. I thought I would actually go blind, have to retire, and lead a life of darkness and inactivity. That did not happen, at least not yet! In many ways, the vision loss led to many gifts in life and I am grateful for the way things have turned out over the last 10 years. I am able to do some reading on the computer with the ZoomText program that enlarges what I see on the screen, but since I am using peripheral vision this is tiring and I can't do it much. I also miss a lot of detail, and I know I make lots of typos when I write and send emails. Bob delMas often laughs when he sees some of the corrected words my spell checker comes up with (e.g, profane instead of profound).

At first, I tried to keep on doing everything: teaching, research, writing, etc. I did not want to admit that I had changed and that I needed to adapt my life. Life was very stressful and on top of things, I lost my father quite suddenly, my children moved to opposite coasts, and I suffered some health problems. A very helpful therapist suggested I request a partial disability leave and think about a realistic plan for spending my time. I applied for and was granted a 1/3 time leave, so I now work 66.7% time. I negotiated that to include one small seminar a year in my area of statistics education, and no change in my levels of research and service. I now come to campus two or three days a week and work at home the other days, where I can take breaks to rest my eyes and spend time on my non-professional interests. I must admit this is a pretty great

schedule, and I have more balance in my life than I ever had before the vision loss, where I tended to work days and nights without constraints.

I find too that I have to rely on others more, and I am getting better about asking for help from my colleagues, students, and staff. The University provides me an "access" student to help me with vision-related tasks for five hours a week and that has really helped me.

On the down side, it's hard for me to give talks and to attend big conferences or meetings because I can't recognize people, see what is projected on screens, or find my way around. When left on my own I have wandered into the men's restroom, started talking to people I thought were someone else, or gotten lost, all embarrassing situations. Now I only give talks with a colleague or student who runs the show and I can chime in when I want to. A pretty enjoyable way to give talks! Perhaps not being able to see the details has allowed me to look more at the big picture, and imagine projects and follow ideas that appeal to me. That also leads to finding people to work with me and help bring these ideas to life, fostering productive collaborations.

**Parting Thoughts**

*AR: Thanks for sharing that. I suspect that many teachers and researchers are seeking better balance in their lives and would be delighted to achieve this without waiting for a vision or health problem to intervene. We can all be inspired by your example. I greatly appreciate all of the time and thought that you've put into answering my questions, and I have just two more. First: Among your many accomplishments in statistics education, which one are you most proud of?*

JG: One? That's too hard. How about two? SRTL and our graduate program in Statistics Education! I am so proud of the researchers in SRTL who have been working together and contributing to a collaborative research agenda that has resulted in two books and six special issues of research journals! Seeing my students grown and develop as teachers and researchers is also thrilling. I feel like a proud parent!

*AR: My final question is: What advice do you have for* JSE *readers who are fairly new to statistics education?*

JG: Get out and meet people. Read and learn what interesting and thoughtful people are doing and thinking and get to know them. Ask lots of questions. Initiate collaborations, and keep them flexible so you can add new colleagues. Pay attention to what your students are saying, writing, and learning, and reflect on what you learn from these observations. Dream, brainstorm with others, think big, and look beyond the practical and familiar.

**References Cited in the Interview**

Ahlgren, A. and Garfield, J. (1991). Analysis of the Probability Curriculum. In *Chance Encounters: Probability in Education* (R. Kapadia & M. Borovnik, Eds.) The Netherlands: Kluwer Academic Publishers, pp. 107-134.

Ben-Zvi, D. and Garfield, J. (Eds.) (2004). *Challenges in Developing Statistical Reasoning, Thinking and Literacy.* The Netherlands: Kluwer Academic Publishers.

Chance, B. (2002). Components of Statistical Thinking and Implications for Instruction and Assessment. *Journal of Statistics Education,* 10(3), http://www.amstat.org/publications/jse/v10n3/chance.html.

Chervaney, N., Collier, R. Fienberg, S., Johnson, P, and Neter, J. (1977). "A Framework for the Development of Measurement Instruments for Evaluating the Introductory Statistics Course," *The American Statistician,* 31, 17-23.

Cobb, G. (1992). Teaching Statistics. In L.A. Steen (Ed.) *Heeding the Call for Change: Suggestions for Curricular Action.* Washington: Mathematical Association of America.

Cobb, G. (2005). *The Introductory Statistics Course: A Saber Tooth Curriculum*? Presentation at United States Conference on Teaching Statistics. Columbus, Ohio, http://www.causeweb.org/uscots/uscots05/plenary/USCOTS_Dinner_Cobb.ppt

Cobb, G. (2007). The Introductory Statistics Course: A Ptolemaic Curriculum? *Technology Innovations in Statistics Education,* 1(1), http://repositories.cdlib.org/uclastat/cts/tise/vol1/iss1/art1/

delMas, R., Garfield, J., and Chance, B. (1999). A Model of Classroom Research in Action: Developing Simulation Activities to Improve Students' Statistical Reasoning. *Journal of Statistics Education*, http://www.amstat.org/publications/jse/secure/v7n3/delmas.cfm.

delMas, R., Garfield, J., Ooms, A., and Chance, B. (2007). Assessing Students' Conceptual Understanding after a First Course in Statistics. *Statistics Education Research Journal, 6*(2), 28-58, http://www.stat.auckland.ac.nz/~iase/serj/SERJ6(2)_delMas.pdf.

Gal, I. and Garfield, J., eds. (1997). *The Assessment Challenge in Statistics Education*. Amsterdam: IOS Press and International Statistical Institute.

Garfield, J. (1995). How Students Learn Statistics. *International Statistical Review.* 63(1), 25-34.

Garfield, J. (2003). Assessing Statistical Reasoning. *Statistics Education Research Journal*. 2(1), http://www.stat.auckland.ac.nz/~iase/serj/SERJ2(1).pdf.

Garfield, J. and Ahlgren, A. (1988). Difficulties in Learning Basic Concepts in Statistics: Implications for Research. *Journal for Research in Mathematics Education*, 19(1), 44-63.

Garfield, J. and Ben-Zvi, D. (2008). *Developing Students' Statistical Reasoning: Connecting Research and Teaching Practice*. New York: Springer-Verlag Publishers.

Garfield, J. and Corcoran, M. (1986). Assessment in American Higher Education: An Historical Perspective. Background paper for the Conference on Assessment in Higher Education, University of Minnesota.

Garfield, J. and delMas, R. (2010). A Website that Provides Resources for Assessing Students' Statistical Literacy, Reasoning, and Thinking. *Teaching Statistics*, 32(1), 2-7.

Garfield, J., Pantula, S., Pearl, D., and Utts, J. (2009). *Statistics Education Graduate Programs: Report on a Workshop Funded by an ASA Member Initiative Grant*. http://www.causeweb.org/research/programs/GradProgram.pdf

Landwehr, J. and Watkins, A. (1987). *Exploring Data*. Palo Alto, CA: Dale Seymour Publications.

Newman, C., Obrernski, T., and Scheaffer, R. (1987). *Exploring Probability*. Palo Alto, CA: Dale Seymour Publications.

Rossman, A. (1996). *Workshop Statistics: Discovery with Data*. New York: Springer-Verlag Publishers.

Scheaffer, R., Gnanadesikan, M., Watkins, A., and Witmer, J. (1996). *Activity-Based Statistics*, New York: Springer-Verlag.

Scheaffer, R. and Smith, W. (2007). *Using Statistics Effectively in Mathematics Education Research: A Report from a Series of Workshops Organized by the American Statistical Association with Funding from the National Science Foundation*. Alexandria, VA: American Statistical Association, http://www.amstat.org/education/pdfs/UsingStatisticsEffectivelyinMathEdResearch.pdf

Shulte, A. P. and Smart, A. P. (1981*). Teaching Statistics and Probability: 1981 Yearbook of the National Council of Teachers of Mathematics*. Reston, VA: National Council of Teachers of Mathematics.

Wild, C. and Pfannkuch, M. (1999). Statistical Thinking in Empirical Enquiry. *International Statistical Review, 67*(3), 223–265.

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