Computer-Supported Collaborative Learning (2015)

Naomi Miyake: 1949–2015

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Figure 1. Photo by Cindy Hmelo-Silver, Tokyo, 2012.

We pay tribute to Naomi Miyake who was a founding member of the International Society of the Learning Sciences (ISLS) and played a leading role in the development of the field of learning sciences. Miyake distinguished the learning sciences from the cognitive sciences in terms of culture. As President of ISLS, she described learning scientists as eager "to learn from each different culture collaboratively" (ISLS, 2007). Miyake exemplified this possibility in her research, developed it in her constructive interaction perspective and followed it in her personal interactions.

Miyake was sought after as a keynote speaker and leader in multiple international organizations focused on the learning sciences (Figure 2). She served on the board and/or as president of the Cognitive Science Society, the Japanese Cognitive Science Society, the International Society of the Learning Sciences and the International Association for Cognitive Science. She encouraged constructive interaction among the participants, thus strengthening the ties among them.

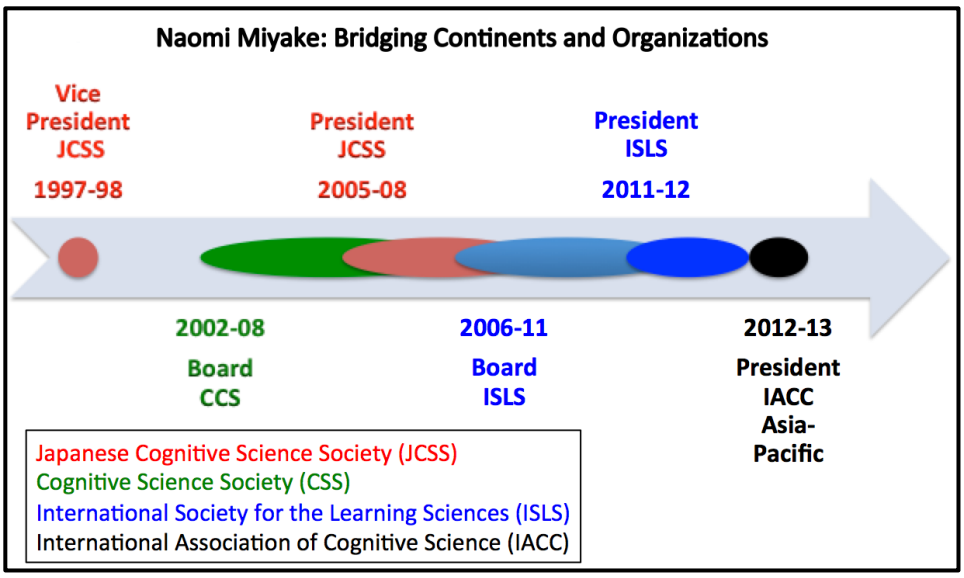

Figure 2. Timeline of international leadership.

Starting with her early work on child development, Miyake stressed the role of culture. In one study of young children, she observed that the American collaborators contributed tasks and analyses that resulted in clear patterns of findings in the American sample but confusion in the Japanese sample. Conversely, the Japanese collaborators contributed tasks and analyses that resulted in clear patterns of results for the Japanese sample but confusion in the American sample. Miyake commented, "This was my first experience of realizing the complex, intricate, yet profoundly intriguing nature of the interaction between the workings of the human mind and its culture, history and current, dynamic situation" (ISLS, 2007).

Miyake was born and raised in Japan. She completed a MA at the University of Tokyo before heading to the University of California, San Diego, to study for her Ph.D. with Donald Norman, earning her degree in 1982. Starting with her dissertation research, Miyake was interested in how people find ways to talk about things neither of them understands, and in how to make these conversations productive. Her initial study—"To ask a question, one must know enough to know what is not known" (Miyake & Norman, 1979)—investigated question asking. Her advisor recommended that she avoid this complex topic. However, she persisted in exploring the conditions under which people pose questions. She found that people ask questions the most when they are aware, to some extent, of the gaps in their understanding. Nevertheless, she felt that she had not yet discovered how people come to know what it is they do not know.

Miyake continued to explore how two people can talk about something neither of them understands, yet come up with a plausible explanation by exchanging ideas. Typically, the tasks she studied involved exploring some physical system like a sewing machine (Miyake, 1986). Focused on such a set of tasks and situations, she studied how individuals came to ask questions about what they did not know.

Miyake brought this perspective to her groundbreaking work on collaborative cognition, especially as it contributes to learning (Miyake, 2008). In her first study of constructive interaction, she explored how pairs jointly discuss "How a sewing machine makes its stitches," which grew into her doctoral dissertation. In her detailed protocol analysis, she showed how two individuals could discuss a problem and deepen each other's understanding. In the case of the sewing machine, she noted participants were connecting explanations of the machine's function to its mechanism. Because individuals usually understood the function before they understood the mechanism, conversations often involved partners who had different levels of understanding. Each member of the pair motivated the other to delve more

deeply into the problem due to their differing perspectives. Miyake showed how this mismatch could lead to constructive interactions that clarified the ideas of both partners.

Miyake returned to Japan after earning her Ph.D. She served as a faculty member at Aoyama Gakuin Women's Junior College, Chukyo University and the University of Tokyo. Miyake researched and refined the framework of constructive interaction across academic and industry settings. She extended her work into diverse fields including education, psychology, engineering, software design, robotics and child development. She studied adults, college students, precollege students and very young children. She sought to encourage constructive interaction across culturally varied participants.

To advance her agenda she developed methods for automated dialogue analysis. She experimented with this approach in what she called the Knowledge Construction Jigsaw. She showed its benefit for partnerships involving teachers, researchers, government officials and industry representatives.

Most recently, she experimented with robots as good listeners and learning partners for very young children. She found that conversing with robots enabled children to externalize their thoughts in unique ways. As the robot responded using automated dialogue, the children developed understanding of things they did not previously understand. She compared a humanoid robot taking on a moderating (teacher-like) role to one with a scaffolding role featuring active questioning. She found that the scaffolding robot was more effective in improving the quality of learning and increasing active engagement. Overall, her research suggested how robots might influence discussions among children to strengthen learning outcomes and improve social behavior.

Miyake was not just an innovative researcher; she was also a wonderful friend and inspirational colleague. As Marcia Linn recalls,

> We shared the goal of promoting what we both called knowledge integration—a process of reconciling alternative views of complex phenomena. Naomi designed supports that encouraged constructive interaction, for example, with robots as good listeners. I found her approach helpful for design of effective guidance in science instruction.
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> Naomi and I also engaged in constructive interactions to integrate our interests in good food. We each enjoyed introducing the other to just the right restaurant during visits in Japan and California. At one point, we even engaged in constructive interactions to create a meal at Naomi’s home in Japan. This enabled us to truly learn about each culture collaboratively. Whether determining appropriate ways to chop vegetables or negotiating the complex process of serving and eating, we both deepened our understanding of the role of culture.

In her personal life, Miyake applied this process of constructive interactions to her parenting practices as well. Her son, Masaki, explains:

> When I was in elementary school, I was known to ask too many questions and to break rules. Since both my parents were psychologists, I had a unique experience. For example, in Japan in the morning, elementary school students walk to school in designated groups. I never joined the other students and always made my own way to school. Many teachers and other parents thought that my lack of regard for rules was a bad influence on the other children. My mother knew about my morning solo walks and about some of my other mischievous activities, but she never confronted me about them. She knew I was not following the rules, but she thought that I was acting my age.
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> She followed her own advice and was a great listener. She always listened to my stories with enthusiasm. When I was a child, I was confused about numbers. I could see that when ten pennies are combined you get a dime. I could also see that when ten dimes were combined you get a dollar. But I felt frustrated by the fact that when a hundred hundreds of pennies are combined, you get a one-hundred-dollar bill. Apparently, I was very upset by this fact and I told my mother about it. Not only did she tell me that my perspective was interesting, but she told one of Japan's renowned mathematicians about my ideas. My mother told me that the mathematician said I had a unique way of seeing numbers. I remember feeling proud, but not

understanding what it meant to be unique. All I had done was honestly tell my mother about my confusion. I see now that my mothers' openness and enthusiasm to what I had to say is what allowed me as a child to speak to her candidly and without hesitation. This made me enjoy all of our conversations.

This was a reoccurring story. As an adult, we continued to talk about how children learn mathematics. She was able to use our conversations as inspiration for her research. At the same time, she was able to share the wonder of how we perceive numbers. Now that I think about it, the fact that she was able to think and feel simultaneously was the reason why she was an incredible communicator. I also believe that this ability was the driving force behind her research.

Miyake's approach to collegial and familial interactions followed from her research perspective. She engaged people from widely varied cultural backgrounds and fields in constructive interaction. She enabled researchers in multiple fields to interact with each other to further our understanding of collaboration in particular and the learning sciences in general.

We all have many fond memories of conversations with Naomi. We believe that she would have wanted her conversations with each of us to inspire everyone to keep learning and growing. We invite her friends and colleagues to continue the tradition of constructive interactions.

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