International Women Online Journal of Distance Education

April, 2023 Volume: 12 Issue: 1 Article: 02 ISSN: 2147-0367

A JOURNEY IN PURSUIT OF THE BRASS TACKS: ADA LOVELACE AND SUSAN HERRING, COMPUTER SCIENCE VISIONARIES

Michelle KULYK
michelle.kulyk@gmail.com
Athabasca University, Canada

Susan BAINBRIDGE
susanbainbridge@athabascau.ca
Athabasca University, Canada

Received: 14.03.2023	**Accepted:** 02.04.2023

ABSTRACT

The mainspring of this comparative inquiry was to examine two female pioneers who significantly impacted the agency of distance learning as it advanced within computer delivery: Susan Herring and Ada Lovelace. Ada Lovelace was a younger peer of the 19th century inventor, Charles Babbage. An aristocrat and amateur mathematician, she is often credited with writing the first computer program. Susan Herring is a contemporary linguist, and is considered the primary architect of the field of Computer-Mediated Discourse Analysis. She describes herself as "best known for my research on discourse and language use in online communication. Some people say that I am the founder . . . maybe even the leading person in the world in that area" (Bainbridge & Wark, 2023, p. 173). My prescription for this examination was to explore the field of study of each woman, their unique contributions, their shared commonalities and characteristics, and finally, their contemporary relevance to computer facilitated distance education. The journey was not straightforward.

Keywords: Computers, computer program, linguistics, mathematics, Sketch of the Analytical Engine, Computer-Mediated Discourse Analysis, online communication, gender

INTRODUCTION: OVERCOMING TRAVEL PREPARATION ANXIETY

My early considerations and reading brought doubt and insecurity; how could I possibly contribute to existing knowledge or further the understanding of the impact of these women in either their disciplines or on the development of computer science and distance education? This insecurity was amplified after reading Daniel P. Mc Carthy's rejected submission, "Offprints of Ada Lovelace's translation of Luigi Menabrea's account of Charles Babbage's Analytical Engine, Incorporating an Offprint by Babbage." In the postscript, Mc Carthy includes the sharp assessment by peer reviewers for *IEEE Annals of the History of Computing,* who concluded that Mc Carthy's analysis "[did] not add much to the Babbage literature, and its engagement with that literature [was] limited." Further, the reviewers questioned "how relevant [was] this manuscript to the readers of this periodical? [Did] it increase the reader's understanding of the development of computation, the computer industry, the application of computers, or some other aspect of history?" (2016, p. 17). This rejection slap undoubtedly stung Mc Carthy, and it cautioned me to ask the same questions: how relevant would my examination be, and could my narrative increase readers' understandings of the significance and contributions of these women beyond existing literature?

Early stages: Investigating travel routes

Initially, I instinctively siloed Herring and Lovelace, as I beheld them in their distinct disciplines, one the linguist and the other a mathematician. I worried that to support any suppositions I hoped to unearth would require competent exploration into varied fields of linguistics, mathematics, computation, symbology, and so on. I cannot claim any credibility on these topics (one Facebook friend's son commented that my confusion on binomial distributions was at a grade six level). When I realized that the nature of this examination required comparison, I was tempted to knit Herring and Lovelace together via parallel threads in personal biographies: imagining unverifiable connections or regurgitating the musings and fanciful theories of others. I sought to discern analogies of personality, interests, methodology, aptitude, and even motivation. I rationalized this would not require that I consider the specificities of their disciplines, but rather the manner in which they, as women, undertook work in their fields and how they happened to venture into unique territory.

Upon appreciating that I may not be qualified to determine commonalities, a revised approach became evident, by which I viewed my task in a critically reflective manner. I came to consider: what if my contribution is not to further the body of knowledge, but to further constructivist and educational pursuit? What if my offering is the space of paper or binary breadth that is taken up with recounting not only my findings, but also recounting my journey of inquiry and exploration? What if the relevance is not through expanding the circle of knowledge of their fields, but rather in highlighting Lovelace's and Herring's process of pursuing what interests them with the passion for making sense of it–driven by induction to deductive pursuits. Ah–a voice, Susan, my co-author and mentor, tells me that this, my exploration, echoes that process.

> [T]here are a variety of epistemological positions that coexist in the literature on how we construct knowledge–many using the same constructivist label . . . Common to each position is a belief that we construct knowledge based on what we already know (there is no tabula rasa) and that learning is an active rather than a passive process. (Kanuka & Anderson, 1999, pp. 4-5)

INTO THE JOURNEY–SETTING OUT WITH AUGUSTA ADA KING, COUNTESS OF LOVELACE

Coming through the portal of online education, I did not have any knowledge of the evolution of computer science or the logistics of computer delivery–what I call the "technical side." Within my framework of distance education, I had never heard of Ada Lovelace. I had no idea what the Difference Engine or the Analytical Engine, designed by Charles Babbage, were and, even more, I had never read any poetry by Ada's father, Lord Byron; I was completely ignorant of Lovelace's story. Hollings et al. (2017) conservatively commented that "her life, as much as her scientific work, has inspired numerous biographies and creative endeavours" (p. 222). Ada's story has become fictionalized in everything from children's books to Sydney Padua's graphic novel, *The Thrilling Adventures of Lovelace and Babbage* (in which she has become a crime fighting heroine), and scrutinized in numerous biographies and intense appraisals of her work and contribution(s). An excess of accounts and opinions range from dismissive to over exuberant–controversy abounds. Hollings et al. note that "the search for heroines presents a distorted view of the overall development of computing . . . [and that] references to Lovelace far outweigh those to others with a much greater claim to influence" (p. 225). As I read, I again wondered how I could add anything to this soup that would be noticed amongst abundantly piquant narratives. I forged on.

The First Leg: Ada's Pre-story

Born Augusta Ada Byron in 1815, Lovelace was the only daughter of Anne Isabella Noel Byron and bad boy poet, Lord Byron. Hollings et al. (2017) claim that "early Lovelace biographers focused on the Byron family and then other later biographers analyzed her abilities and argued her intellectual and mathematical competence" (pp. 224-225). Quick Google searches of Ada (when married, she became Ada King, and then Countess of Lovelace) primarily describe her existence in relation to two men: first her father and his peripheral influences on her life, education, development, temperament, and "work," then on the other side of the fulcrum, she is defined by her curious relationship with Charles Babbage. Literature on Lovelace is abundant with analyses, critiques, controversy, fantasy, and mathematics. In her review of Padua's book, *The Thrilling Adventures of Lovelace and Babbage*, Etelka Lehoczky notes that as Lovelace has "become more widely recognized, even lionized, some scholars have dismissed her" (2015, para. 3).

Ada Interpreted by Contemporary Guides

I sought out credible authority from the 2015 University of Oxford Podcasts', "Ada Lovelace Symposium–Celebrating 200 Years of a Computer Visionary." Alexander Wolf, President of the Association for Computing Machinery and Imperial College London, introduced the symposium with the following comment:

> **ACM . . . owes a lot to people like Ada Lovelace for creating a discipline that has had amazing impact and whose impact . . . whose bounds I don't think we yet know or can appreciate. Ada Lovelace is clearly one of the heroes of computing and her name has really become synonymous with the birth of computing. (Wheeler & Wolf, 2015, 10:18)**

This two-day marathon of 18 presentations, delivered by computer scientists, authors, poets, historians, and mathematicians, was "aimed at a broad audience of those interested in the history and culture of mathematics and computer science, . . . scholarship on Lovelace's life and work, and linking her ideas to contemporary thinking about mathematics, computing and artificial intelligence" (University of Oxford Podcasts, 2015). Topics ranged from the story of Ada and Charles Babbage and the computing machines, to Lovelace's impact on women in science, with titles like "Notions and Notations: Designing Computers before Computing," "Turning Numbers into Notes," and "Enchantress of Numbers," ending with the panel discussion "Enchantress of Abstraction and Bride of Science: Can Women Scientists Escape Being icons, Role-models and Heroines?" (These podcasts are available at: https://podcasts.ox.ac.uk/series/ada-lovelace-symposium-celebrating-200-years-computer-visionary)

In "Charles Babbage and Ada Lovelace: Two visions of computing," (Swade, 2015) presenter Doron Swade recounts how Ada met Babbage at a society event when she was 17 and was intrigued with his coffee table model of the Difference Engine. Swade sped past biographical details (the affordances of a privileged social position, society life, marriage to King, motherhood, rumoured gambling, financial woes, illness, and early death) to focus on Ada's grasp of Babbage's Difference Engine and her subsequent involvement in promoting the Analytical Engine. The British government advanced Babbage development funds, but the coffee table size model of the Difference Engine was all that Babbage ever produced, since he redirected his attention to the Analytical Engine. Of the Analytical Engine, his efforts yielded blueprints and drawings, written explanations, mathematical notations, and ambitions. Swade juxtaposes Babbage's writings on his engines with 26-year-old Lovelace's only published work, the 1843 translation of L. F. Menebrea's, *Sketch of the Analytical Engine Invented by Charles Babbage*. This sketch includes Ada's famous

extended notes in which she, more proficiently than Babbage, describes the never realized mechanical computing machine.

Full Stop Diversion from the Lovelace Symposium into Adjacent Territories

Distracted by Swade's reference to a contemporary model of the Difference Engine at the Computer History Museum in Mountain View, California, I innocently diverted to YouTube's *A Demo of Charles Babbage's Difference Engine* to watch Alan deliver a hypnotic demonstration of a model of Difference Engine No. 2 (Scoble, n.d.). When Alan traces out an equation to demonstrate the principle of finite differences, which was central to the design of the Difference Engine, I realized that, to understand the engines, I would need a sense of "the math." What started as a cursory look resulted in redirection through pre-calculus math, binomial distribution, the principle of finite differences, the history of binary code, industry in the Romantic era, jacquard loom evolution, player pianos, and even the history of IBM. My learning became "active" as I strayed in oblique directions.

Constituent Means/Engines: Jacquard Loom and Punch Card Technology

Joseph-Marie Jacquard patented the mechanical Jacquard loom in France in 1804. The loom used punch cards to reproduce designs in woven cloth. Punch cards controlled the loom using binary code–simply hole or no hole equated to raise or do not raise warp yarns. Christine Jeryan of Greenfield Village Museum provided me with a simple illustration of this technology in the video *How an 1803 Jacquard Loom Led to Computer Technology* (The Henry Ford, n.d.). F.G. Heath, in his 1972 account, "Origins of the Binary Code," tells us that "in a similar way Jacquard's loom is the ancestor of the many digitally controlled machine tools employed in modern technology. A more recent ancestor is the player piano" (p. 72).

In chronicling binary code use in digital computers, Heath explains that, for the design of the Analytical Engine, Babbage borrowed punch card technology, which was essential for programming: "that was a genuine application of binary coding" (The Henry Ford, n.d., p. 80). Punch card technology came to dominate information technology "with its 1928 redesign by IBM . . . [and] for nearly 50 years, it remained the primary vehicle for processing the essential facts and figures that comprised countless industries, in every corner of the globe" (IBM100, n.d.).

Ada's Math Voyage

Many biographers have examined and critiqued Ada's mathematical education and competency. Ada was schooled in mathematics first by her mother, then governesses and tutors. Hollings et al. (2017) detail her interest in natural sciences, astronomy, Victorian mechanical technologies, geometry, and mathematics, referencing correspondence with tutors and her mother's friend, physician William King:

> **Even in these childhood letters, we see an intelligent, inquisitive and tenacious mathematical learner . . . [and] what she needed, she said, was a course in pure mathematics, by which she meant basic arithmetic, algebra, and geometry: the extent of mathematical education for most men who went to university, and a level reached by very few women. (p. 226)**

For his *Wired* article "Untangling the Tale of Ada Lovelace," Stephen Wolfram, like Swade, had access to many original documents and letters at the Oxford History of Science Museum, Bodleian, and other archives. He observes that "Ada's encounter with the Difference Engine seems to be what ignited her interest in mathematics" (Wolfram, 2015).

After 1840, Ada began to receive calculus and higher mathematics instruction from British mathematician and professor, Augustus de Morgan (Hollings et al., 2017, p. 222).

A Brief Tour of the Analytical Engine

In her presentation, "The Thrilling Adventures of Lovelace, Babbage and the Analytical Engine," at the 2017 Lamba Days conference in Krakow (February 9-10), cartoonist and author, Sydney Padua, describes the Analytical Engine: "this machine is famous as the first design for computer. It had a memory, was programmed with punch cards, and it had basically a CPU. This is the machine that Ada Lovelace also became obsessed with" (Erlang Solutions, 4:53). In the "Sketch of the Analytical Engine–Notes by the Translator," Ada stresses that "of course the cards must be made out accordingly" (1843, p. 692) and that the programmers must be skilled or, if not, then someone must know the *program* (mathematical law) that the engine is being requested to perform. Sydney Padua, in her blog post, "The Marvelous Analytical Engine–How It Works," presents a simulation of how the Analytical Engine would have worked; her computer animated model shows the "elegance" of the engine comprised of the mill, racks, store; and animates how the punch card, *holes or no holes*, do or do not activate the levers to read the numbers off on the store (Padua, 2015).

Charting the Bernoulli Equation and Note G

Ada is most famous for her additional extended Notes A and G that follow her translation of the sketch, or "Memoir," as she called it. In Note G, Ada uses a "mechanical notation" format to chart, or "trace," the operations or mechanical processes as they would be performed by the Analytical Engine to solve a Bernoulli equation. Swade argues that Babbage had previously developed this mechanical notation: "now, Babbage was sufficiently advanced in his, [*sic*] with the design ability to start programming in 1837, and between 1837 and 1840 he wrote twenty-four programs" (2015, 25:47). Attributed to Lovelace, Note G is considered by many to be the first computer program, but in his analysis, Swade rejects this, saying that:

> This is what the fuss is all about. This is Ada's program of the Bernoulli's number solution... The seemingly dismal conclusion is that it is very difficult to identify features [in] Lovelace's Bernoulli example that do not have precedence in Babbage's earliest programming examples, or the derivative example to Menabrea. (34:13)

Note A: Imagining Future Directions

Ada's thorough grasp of the mechanics of the Analytical Engine and her broad vision across disciplines, enabled her to speculate or imagine the range of applications of a machine of this nature. Swade argues that Note A, "which was philosophical" (2015, 34:06), was her main contribution to computer science and that this prescience is her greater legacy, rather than the much-celebrated Note G (Swade, 2015). In Note A, Lovelace asks:

> [M]ight [it] act upon other things besides *number*, were objects found whose mutual fundamental relations could be expressed by those of the abstract science of operations, and which should be also susceptible of adaptations to the action of the operating notation and mechanism of the engine. Supposing, for instance, that the fundamental relations of pitched sounds in the science of harmony and of musical composition were susceptible of such expression and adaptations, the engine might compose elaborate and scientific pieces of music of any degree of complexity or extent. (1843, p. 694)

Ada is contemplating the endless opportunities for "operations" and the multitude of possible applications of the Analytical Engine. This vision is Lovelace's real contribution.

Weaving Patterns, Not Discovering Them

During his symposium presentation, Doron Swade repeats Lovelace's famous quote from the sketch (p. 696): "we may say most aptly that the analytical engine *weaves algebraic patterns* just as the Jacquard loom weaves flowers and leaves." But here Doron deviates from popular narrative by commenting that:

> **This is usually taken as some poetical flourish, but there's an absolutely fundamental idea which is not usually associated with the Jacquard loom that I believe Lovelace . . . absolutely grasps. There's the notion of universality and of specificity of function . . . The idea is, the machine, the loom can make any pattern. What specific pattern it produces is in the software, is in the cards. And Lovelace understands that the notion of a universal machine, and specificity of function–is contained in software in programs . . . And so, when she says the analytical engine weaves algebraic patterns, she's talking about a generalized algebra machine that can do any form of mathematics provided the machine can be programmed to do so. A poetic flourish it is. (2015, 23:02)**

Ada was clear that "the only truth herein is that the machine will duplicate and express the law without error–it cannot and will not test the law or prove the law, it must be programmed" (1843, p. 692). Hollings et al. (2017) note Alan Turing's challenge to Ada's assessment with "in his 1950 paper on whether a machine can think, Alan Turing challenged this view, which he called 'Lady Lovelace's objection'" (p. 222). Turing himself states that "the evidence available to Lady Lovelace did not encourage her to believe that they had it [the ability to think for oneself]" (1950, p. 450).

Ada Lovelace's Prophetic Vision: The Progression of Computation and Computer Applications

Why was Lovelace's contribution so important; what did Ada do? First, she had the interest and the perseverance to figure out if the Analytical Engine would work. In her notes, she undertook to follow the plans as devised by Babbage. She analyzed the drawings, the mechanisms and the "operational sequences"; she traced the programs, and then championed the Analytical Engine with a persistence abandoned by Babbage. Wolfram says that "Ada had an idea of what the Analytical Engine should be capable of" (2015). She foresaw its universal applications.

Swade asserts that:

> **Lovelace's three contributions are . . . firstly, the transition . . . from calculation to computing. . . It was Lovelace who articulated for the first time that number could represent [an] entity other than quantity. . . number could represent letter of the alphabet, note of music. . . Secondly . . . she wrote that the analytical engine does not occupy common ground with mere calculating machines, it holds a position wholly its own. Finally, . . . Lovelace is asking, what does this machine signify? And to what extent is what it signifies important? Nowhere in his published writing or any of the manuscripts that I've looked at does Babbage right [*sic*] in this way (2015, 00:40:33).**

Another symposium presenter, Lovelace researcher, and author, Betty Toole, describes years spent reading and contextualizing Ada's available journals and letters. In her presentation "Ada Lovelace Lives Forever: Ada's Four Questions," Toole goes further in her interpretation of Ada's vision, stating "that it should be more important for scientists and,

let's say computer specialists, to have imagination than it is for anyone else. It's primarily the discovering facility" (2015, 15:35). Toole continues to reference Ada's correspondence with a questioning letter Ada wrote to Babbage: "that letter, August 14th, I think is one of the most important letters . . . 'If the way I do things, she says, is for the benefit of mankind'" (24:49).

Toole continues:

> **[P]rophetically Ada's writings reveal a deep understanding of how much computing will change our society. . . In 1843, she once again implored Babbage and she did it in many ways. 'Stop being so tied up with this machine. It isn't really just about you. When we think about the future of computing, we need to ask ourselves whether we are using these amazing machines to create a better world' (2015, 00:27:57).**

Thus, despite Lovelace's assertion that the engine could only do what you program it to do, Douglas R. Hofstadter, in *Godel, Escher, Bach: An Eternal Golden Braid,* believes that "Lovelace . . . was profoundly aware that with the invention of the Analytical Engine, mankind was flirting with mechanized intelligence" (1979, p. 25).

CHANGING DIRECTION: A LINGUISTICS EXPLORATION WITH SUSAN HERRING, ARCHITECT OF CMDA

Unlike Lovelace, Dr. Susan C. Herring is very much alive and not yet the subject of romanticized speculation or idolization (such as Lovelace in 'Enchantress of Abstraction and Bride of Science: Can Women Scientists Escape Being Icons, Role-models and Heroines"; University of Oxford Podcasts, 2015). Born 140 years after Lovelace, Herring is a distinguished "American linguist and communication scholar who researches gender differences in Internet use, and the characteristics, functions, and emergent norms associated with language, communication, and behavior in new online forms such as social media" (peoplepill, n.d.).

As with Ada Lovelace, I had never heard of Susan Herring, nor do I have any prior experience in the study or field of Linguistics. I had only heard of Computer-Mediated Communication briefly and just assigned it a perfunctory definition of having to do with the nature of communicating online. It was nothing to pay too much attention to–as it is something most of us do every day without considering it or the implications of it. When interviewed for *The Encyclopedia of the Female Pioneers of Online Learning,* Herring tells Bainbridge & Wark that "Computer-mediated communication is centrally involved in online learning, both formal and informal" (Bainbridge & Wark, 2023, p. 173).

Herring, a professor of information science and linguistics, is described as a data-driven researcher (Crumm, 2016). With little linguistics knowledge, this surprised me, as I had not really considered that systematic, methodical research is characteristic of the field of linguistics. Olivia Sammons, Assistant Professor Indigenous Languages and Linguistics, First Nations University, explained in a Zoom session to me that "linguistics is the scientific study of language, so it is data-driven" (Personal communication, January 07, 2022). The Linguistics Society tells me further that:

> **[L]inguists are scientists who apply the scientific method to questions about the nature and function of language . . . [they] conduct formal studies of speech sounds, grammatical structures, and meaning across all the world's [*sic*] over 6,000 languages . . . Linguists examine the relationship between written and spoken language as well as the underlying neural structures that enable us to use language. (The Linguistic Society of America, n.d.)**

Herring's Pre-story

When interviewed by Bainbridge and Wark (2023), Herring describes starting her postsecondary education by "studying foreign languages . . . a French major as an undergraduate . . . I ended up studying twelve different languages, so I guess you could say that I was a language person. I went to grad school for Linguistics, and my interest in Linguistics was languages" (p. 176). Herring's curriculum vitae (CV) on the Indiana University website lists her academic accreditations as Ph.D.–University of California, Berkeley, Linguistics, June 1991, M.A.–University of California, Berkeley, Linguistics, June 1982, and B.A.–State University of New York, Potsdam, French, May 1976, with her professional academic career starting as Graduate Student Instructor in 1981, and progressing from Associate Professor through to her current positions as Founder and Director of the Center for Computer-Mediated Communication, and Professor in the Department of Information and Library Science, School of Informatics, Computing, and Engineering, Indiana University, Bloomington (Herring, 2021).

Susan Herring Social Science Researcher: How the Path Emerged

Unlike Lovelace–whose only published work is her translation and notes on the Analytical Engine–Herring is a prolific author (she has authored or contributed to over 150 academic publications), primarily focusing on a real-world evolving and extensive study of computer-mediated communication. In her autobiography, anthropologist Zora Neal Hurston expresses that "research is formalized curiosity. It is poking and prying with a purpose. It is a seeking that he who wishes may know the cosmic secrets of the world and they that dwell therein" (1942). Herring's early research topics reflected her study of languages, but her curiosity was also situationally resultant; she found herself studying Tamil at UC Berkeley and then in India. A Fulbright fellowship followed and Herring "did [her] dissertation research on oral storytelling . . . in Tamil . . . it was something completely different from what I ended up doing later on" (Bainbridge & Wark, 2023, p. 176), but signaled that interest and circumstance would guide the choices of Herring's future research topics of interest. As C. W. Mills concludes in the *The Sociological Imagination*:

> On Intellectual Craftsmanship: You must learn to use your life experiences in your intellectual work: continually examine and interpret it. In this sense craftsmanship is the center of yourself and you are personally involved in every intellectual product upon which you may work. (1959, Appendix)

Herring explains how her work in CMC emerged out of lived experiences. She recounts that she was an early Internet adopter in the 1980s when she returned to Berkeley:

> Around 1985 I was using email and other forms of computer-mediated communication . . . My ex-husband was a research assistant in the cognitive science program; they had a server . . . he got me an account . . . By the late 1980s CMC was really expanding, and in particular, email mailing lists, or 'listservs' as they were called then, were starting to come into use in academic disciplines. (Bainbridge & Wark, 2023, p. 176)

When Herring started getting emails from the Linguistic Society of America in an "email distribution list," she very quickly started to notice:

> [I]nteresting gender patterns . . . [and] what was to become known as the 'flame war' conflict between followers of Noam Chomsky . . .and his generative linguistic paradigm on the one hand, and researchers who looked more at the social, contextual, and psychological aspects of language on the other hand. The argument was about who 'owned' the term 'cognitive linguistics'. (Bainbridge & Wark, 2023, p. 177)

This "noticing," or sourcing, from her life experiences (e.g., the online email conflict), led Herring to her first study on gender differences in computer-mediated communication. She prepared a questionnaire that was distributed to the participants in the list, and "collected all of the logs, the transcripts of the conversation, and conducted a discourse analysis of the transcript" (Bainbridge & Wark, 2023, p. 177). The data collection and subsequent analysis resulted in her research study "Gender and Participation in Computer-mediated Linguistic Discourse." In her research paper, which was presented at the Annual meeting of the Linguistic Society of America in January 1992, Herring writes, "[I]t is concluded that gender-based communication preferences may inhibit women from participating in even professionally beneficial activities. Adoption of the rhetoric of male success is seen as a more participatory alternative" (Herring, 1992, Abstract). The response to this work was varied and unexpected, ranging from dismissal to hostility, with admonitions that Herring was pointing out bad behaviour by senior male scholars. One attendee even cautioned, "You are very brave" (Bainbridge & Wark, 2023, p. 178). Fortunately, as Herring was merely a junior linguistics scholar, many of the male scholars whose discourse she was analyzing did not attend her presentation.

Exploring CMC and Gender Differences in Online Communication

In those early years, "people didn't really think that studying online communication was Linguistics because it was somehow more associated with popular culture, and linguists don't usually analyze popular culture" (Bainbridge & Wark, 2023, p. 179). When Herring's 1992 paper received more attention than her previous work in Tamil oral storytelling, it propelled her onto a path focused on CMC (p. 179). Herring recalls being influenced to work in the field of CMC by Sara Kiesler's work on "social-psychological effects of computer-mediated communication" as well as the work of linguist Kathleen Ferrara's "early pioneering study of the language that people used when they were communicating through a chat platform" (p. 179), and by the 1978 book, *The Network Nation: Human Communication via Computer*, co-authored by Starr Roxanne Hiltz and Murray Turoff.

Herring is considered a pioneer in CMC and is often consulted as an expert in the area of online gender CMC issues. From 1992 to the current day Herring has been interviewed for or quoted on this topic in 30 publications. In this condensed list of publications, we can trace how her research on gender-related topics has evolved, keeping real-time pace with ever changing online platforms and social media:

- **"Gender and Democracy in Computer-mediated Communication," 1993**
- **"Politeness in Computer Culture: Why Women Thank and Men Flame," 1994**
- **"'This Discussion is Going Too Far!' Male Resistance to Female Participation on the Internet," 1995**
- **"Posting in a Different Voice: Gender and Ethics in Computer-mediated Communication," 1996**
- **"Participation in Electronic Discourse in a 'Feminist' Field," 1998**
- **"Designing for Community: The Effects of Gender Representation in Videos on a Web Site," 2002**
- **"Searching for Safety Online: Managing 'Trolling' in a Feminist Forum," 2002**
- **"Women and Children Last: The Discursive Construction of Weblogs," 2004**
- **"The More Things Change, the More They Stay the Same: Gender Differences in Attitudes and Experiences Related to Computing," 2005**
- **"Being the Same Isn't Enough: Impact of Male and Female Mentors on Computer Self-efficacy of College Students in IT-related Fields," 2007**
- **"Implications of Gender Consciousness for Students in Information Technology," 2008**
- **"Gender, Communication, and Self-presentation in Teen Chatrooms Revisited: Have Patterns Changed?", 2011**

- **"Gender and (a)nonymity in Computer-mediated Communication," 2014**
- **"Teens, Gender, and Self-presentation in Social Media," 2015**
- **"Animoji Adoption and Use: Gender Associations with an Emergent Technology," 2020. (Herring, 2021)**

Forging a Distinct Approach: Computer Mediated Discourse Analysis

In the 1990s, Herring recognized that CMC required a revised approach by which to study discourse. Herring explains that she created the "Computer-Mediated Discourse Analysis [CMDA] paradigm, which is a methodological tool kit that can be used to analyze online discourse from a variety of language-focused perspectives . . . I adapted methods of linguistic analysis to the specifics of different kinds of online communication" (Bainbridge & Wark, 2023, p. 181). In the 2004 chapter, "Computer-Mediated Discourse Analysis: An Approach to Researching Online Behavior," Herring explains the need for, and the characteristics of the CMDA's unique mixed approach within the framework of the scientific method:

> **[I]t may be supplemented by surveys, interviews, ethnographic observation, or other methods; it may involve qualitative or quantitative analysis, . . . can be used to address macro-level phenomena, [and the] CMDA approach allows diverse theories about discourse and computer-mediated communication to be entertained and tested. Moreover, . . . it is not a single method, but rather a set of methods from which the researcher selects those best suited to her data and research questions. (pp. 339-340)**

When interviewed by graduate student, Flavio Souza, Herring advocated for the CMDA paradigm and methods, as they provided alignment with established praxis of scientific inquiry but, at the same time, she promoted exploring inductive and grounded approaches: "borrow from tried-and-true language focused methodologies; take what is useful from them. At the same time don't be overly reverential toward them; feel free to modify existing methods as needed to address new phenomena, or innovate new methods. Sometimes you need to let your methods emerge from the data" (Souza, 2015, p. 352).

Herring promotes CMDA's qualitative research nature. She says:

> **CMDA research does not take as its point of departure a paradigm, but rather observations about online behavior as manifested through discourse. . . a researcher is more likely to become interested in studying patterns of message exchange (for example), and then select conversation analysis as a useful methodological tool. In this sense, the approach is inductive—the phenomena of interest are primary—rather than deductive, or theory-driven. (Herring, 2004, p. 253)**

Shifting the Research: Critical and Multimodal CMDA Study Exploration

Herring's methodical examinations and research into computer-mediated communication in multiple contexts highlights that human communication is far more than words or text; she acknowledges that the CMDA paradigm was created with a focus on the text-based platforms of email, chat, and text-messaging. As online platforms have become increasingly rich across media, her work has evolved to appreciate the multimodal possibilities for communication and adapt the paradigm to analyze those varied multimodal communications (Bainbridge & Wark, 2023, pp. 181-182). Herring's research interests expanded "to online language use more broadly, and then to the use of other semiotic systems–for example, graphical icons, what I call 'graphicons,' like GIFs, emoji, stickers, image memes, and so forth" (Bainbridge & Wark, 2023, p. 183). Concurrently from the mid 1990s, Herring's field of inquiry broadened to include online subjects concerned with

ethics, diversity, contemporary culture or zeitgeist, Internet access, and educational access. The sampling of topics below illustrates these shifts:

- **"Linguistic and Critical Research on Computer-mediated communication: Some Ethical and Scholarly Considerations," 1996**
- **"Pedagogical Implications of Synchronous Computer Chat: Coherence *or* Equality?", 1999**
- **"Computer-mediated Communication on the Internet," 2002**
- **"Content Analysis for New Media: Rethinking the Paradigm," 2004**
- **"Collaborative Authoring on the Web: A Genre Analysis of Online Encyclopedias," 2005**
- **"A Longitudinal Content Analysis of Weblogs: 2003-2004," 2006**
- **"Questioning the Generational Divide: Technological Exoticism and Adult Construction of Online Youth Identity," 2008**
- **"Project-based Learning and Student Knowledge Construction During Asynchronous Online Discussion," 2010**
- **"Functions of the Non-verbal in CMC: Emoticons and Illocutionary Force," 2010**
- **"Cultural Bias in Wikipedia Articles About Famous Persons," 2011**
- **"Ebooks, ereaders, and ebook Device Design," 2014**
- **"Multimodal Communication on Tumblr: "I have so Many Feels!", 2014**
- **"ISIS vs. the U.S. Government: A War of Online Video Propaganda", 2015**
- **"Historical Insights for ebook Design," 2016**
- **"The Future of Robotic Telepresence: Visions, Opportunities and Challenges," 2016**
- **"Nice Picture Comment!" Graphicons in Facebook Comment Threads," 2017**
- **"Exploring Presence in Online Learning Through Three Forms of Computer-mediated Discourse Analysis, 2019**
- **"Do Emoji Sequences Have a Preferred Word Order?", 2020**
- **"Prompt-rich CMC on YouTube: To What or to Whom do Comments Respond?", 2021 (Herring, 2021, Curriculum Vitae).**

WHERE THE ROADS CONVERGE: LOVELACE AND HERRING COMMONALITIES AND SHARED CHARACTERISTICS

In resisting the temptation to artificially weave Herring's and Lovelace's narrative together in a biographical manner, I looked instead to commonalities in their approaches to their disciplines. This required me to consider how they approached their inquiries; both women are motivated by what interests them. They seek to get to the core, or what I refer to as "the brass tacks," of a problem. They are not interested in merely recording or interpreting data, but rather in figuring things out at a fundamental level. Hollings et al. (2017) make note of "Lovelace's emerging mathematical strengths of attention to detail, interest in big questions, and desire to tackle problems from first principles" (p. 222). Both Herring and Lovelace are driven by induction to deductive pursuits. Wolfram suggests that Ada was able to imagine across disciplines…with a keen sense of industrial or operational process (Wolfram, 2015, pp. 5-75), as well as poetical science and imagination. Herring also pursues multi-disciplinary research into digital technologies, information science, CMC, linguistics, education, journalism, and social media (Bainbridge & Wark, 2023, p. 184). She continues to position herself and her research interests within the intersection of emerging technologies, semiotic systems, and ethnography.

CONCLUDING THIS NARRATIVE JOURNEY

Initially it appeared that it would be difficult to find connections between these women, not because of a void in contributions, but because the anchor points and circumstances for each are so distinct; it was hard to discern where their sets overlap. By the nature of her methodology, Herring collects data for linguistic analysis. Hers is a deep dive into how

electronic computerized communication has manifested, to identify probabilities and find patterns, and to explore the conjunction between the delivery system, the message, and human society. Lovelace's realm was in operational imaginings and tracing untested possibilities through math and cogs. She imagined, correctly, that via mechanism, the engine held the promise to take abstractions, mathematical formulas, musical compositions or communications, and make them concrete and replicable. Herring carries on with the realities of Lovelace's imaginings.

At some point in this inquiry (I am not quite sure when or where), I experienced a fleeting metaphor of insight and satisfaction–much as when you stir the cream into the coffee and get just the right colour–in which I visualized Herring and Lovelace together in the centre of this complex diagram, their sets overlapping. In this intersection, I saw the linguist and the mathematician wondering together about the evolution of computers; about communication conceived and interpreted by human minds, but produced and delivered with symbols and electronic mechanism; about the possibilities that digital technologies afford for digital and human advancement. Alan Turing concluded "Computing Machinery and Intelligence" with "we can only see a short distance ahead, but we can see plenty there that needs to be done" (1950, p. 460). I imagine Herring and Lovelace each surveying the short distance, then simultaneously re-focusing their lenses to consider future possibilities emerging from a broader, longer landscape. Individual interest is piqued for each as they seek to make sense of phenomena or processes that others don't yet even see; then they turn and set off on their pursuits.

REFERENCES

Bainbridge, S., & Wark, N. (2023). ***The encyclopedia of the female pioneers of online learning*****. Routledge.**

Crumm, M. (2016, June 15). I asked a Linguist to analyze OKCupid usernames. This is what she found. ***Huffpost*****. https://www.huffpost.com/entry/linguist-okcupid_n_7665600**

Erlang Solutions. (2017, February 28). The thrilling adventures of Lovelace, Babbage and the analytical engine: Lamba days [Video]. ***YouTube.*** **https://www.youtube.com/watch?v=fYY8uIWKDcI**

Heath, F. G. (1972). Origins of the binary code. ***Scientific American, 227*****(2), 76-83. https://www.jstor.org/stable/10.2307/24927408**

Herring, S. (1992). ***Gender and participation in computer-mediated linguistic discourse.*** **ERIC Clearinghouse on Languages and Linguistics, document ED345552. http://ella.slis.indiana.edu/~herring/participation.1992.pdf**

Herring, S. (2021, January 24). ***Curriculum Vitae: Susan Herring.*** **Department of Information and Library Science, Indiana University, Bloomington. https://info.sice.indiana.edu/~herring/cv.html**

Herring, S. C. (2004). Computer-mediated discourse analysis: An approach to researching online behavior. In S. A. Barab, R. Kling, & J. H. Gray (Eds.), ***Designing for virtual communities in the service of learning*** **(pp. 338-376). Preprint. http://doi.org/10.1017/CBO9780511805080.016**

Hiltz, S. R., & Turoff, M. (1978). ***The network nation: Human communication via computer*****. Addison-Wesley.**

Hofstadter, D. R. (1979). ***Godel, Escher, Bach: An eternal golden braid.*** **Basic Books Inc.**

Hollings, C., Martin, U., & Rice, A. (2017). The early mathematical education of Ada Lovelace. ***BSHM Bulletin: Journal of the British Society for the History of Mathematics, 32*****(3), 221-234. https://doi.org/10.1080/17498430.2017.1325297**

Hurston, Z. N. (1942). ***Dust tracks on a road. An autobiography*** **[ebook]. J. B. Lippincott, 1942 [1st ed.]. https://gutenberg.ca/ebooks/hurstonzn-dusttracksonaroad/hurstonzn-dusttracksonaroad-00-h.html#chapter10**

IBM 100. (n.d.). The IBM punched card. ***Icons of Progress.*** **https://www.ibm.com/ibm/history/ibm100/us/en/icons/punchcard/transform/?mhsrc=ibmsearch_a&mhq=punch%20card**

Kanuka, H., & Anderson, T. (1999). Using constructivism in technology-mediated learning: Constructing order out the chaos in the literature. ***International Journal of Radical Pedagogy, 1*****(2), 1-25. http://radicalpedagogy.icaap.org/content/issue1_2/02kanuka1_2.html**

Lehoczky, E. (2015, April 23). 'Lovelace and Babbage' is a thrilling adventure. ***NPR book reviews.*** **https://www.npr.org/2015/04/23/400178749/lovelace-and-babbage-is-a-thrilling-adventure**

Linguistic Society of America. (n.d.). ***T*****he science of linguistics.** ***linguisticsociety.org*** **https://www.linguisticsociety.org /resource/science-linguistics**

Mc Carthy, D. P. (2016). ***Offprints of Ada Lovelace's translation of Luigi Menabrea's account of Charles Babbage's Analytical Engine, incorporating an offprint by Babbage*** **[unpublished article]. School of Computer Science and Statistics, Trinity College. https://www.scss.tcd.ie/misc/kronos/A_Lovelace_offprints_IEEE_plus_postscript.pdf**

Menebrea, L. F. (1843). Sketch of the analytical engine invented by Charles Babbage, Esq. Translated, with notes, by Ada King, Countess of Lovelace, daughter of Byron "Article XXIX". ***Scientific Memoirs*** **(Vol. 3, pp. 666-731). https://repository.ou.edu/uuid /6235e086-c11a-56f6-b50d-1b1f5aaa3f5e#page/26/mode/2up**

Mills, W. C. (1959). ***The sociological imagination.*** **New York Oxford University Press. https://www.imprs-demogr.mpg.de/courses/01ws/TSI.pdf**

Padua, S. (2015, May 31). The marvelous analytical engine–how it works. ***The thrilling adventures of Lovelace and Babbage.*** **http://sydneypadua.com/2dgoggles/uncategorized/the-marvellous-analytical-engine-how-it-works/**

peoplepill. (n.d.). ***Linguist: Susan Herring*****. https://peoplepill.com/people/susan-herring**

Scoble, R. (n.d.). A demo of Charles Babbage's difference engine [Video]. ***YouTube*****. https://youtu.be/BlbQsKpq3Ak**

Souza, F. (2015). Interview with Susan Herring. ***Palimpsesto 21*****(14), 347-353. https://www.academia.edu/20757750/Interview_with_Susan_Herring**

Swade, D. (2015, December 17). Charles Babbage and Ada Lovelace: Two visions of computing. [Podcast recording]. ***Ada Lovelace Symposium–Celebrating 200 Years of a Computer Visionary*****. University of Oxford. https://podcasts.ox.ac.uk/charles-babbage-and-ada-lovelace-two-visions-computing**

The Henry Ford. (n.d.). How an 1803 Jacquard loom led to computer technology [Video]. *YouTube.* https://youtu.be/MQzpLLhN0fY

Toole, B. (2015, December 18). Ada Lovelace lives forever: Ada's four questions. [Podcast recording]. *Ada Lovelace Symposium–Celebrating 200 Years of a Computer Visionary.* University of Oxford. https://podcasts.ox.ac.uk/ada-lovelace-lives-forever-adas-four-questions

University of Oxford Podcasts. (2015, December 17). *Ada Lovelace Symposium–Celebrating 200 Years of a Computer Visionary.* University of Oxford. https://podcasts.ox.ac.uk/series/ada-lovelace-symposium-celebrating-200-years-computer-visionary

Wheeler, L., & Wolf, A. (2015, December 17). Introduction to the Ada Lovelace symposium. [Podcast recording]. *Ada Lovelace Symposium–Celebrating 200 Years of a Computer Visionary.* University of Oxford. https://podcasts.ox.ac.uk/introduction-ada-lovelace-symposium

Wolfram, S. (2015, December 22). Untangling the tale of Ada Lovelace. *Wired.* https://www.wired.com/2015/12/untangling-the-tale-of-ada-lovelace/

BIODATA and CONTACT ADDRESSES of the AUTHORS

Michelle KULYK Michelle currently works remotely as an Instructional Designer for First Nations University in Canada. As a department head at an Arts College in Halifax, Michelle found a passion for adult education. This led her to acquire a Certificate in Adult Education from Dalhousie, then a Graduate Diploma in Instructional Design, and is currently completing a Masters in Online and Digital Learning through Athabasca University. Michelle's academic interests include how to use multiple modalities to connect with diverse online learners. As an Instructional Designer, Michelle is also committed to supporting instructors in effective online course design, and encourages maximization of the affordances of digital delivery.

Kulyk, Michelle
Athabasca University
Address: 1 University Drive, Athabasca, AB Canada T9S 3A3
Phone: 1-800-788-9041 ext. 6179
E-mail: michelle.kulyk@gmail.com

Dr. Susan BAINBRIDGE is an instructor and co-supervisor with the Centre for Distance Education graduate/postgraduate programs at Athabasca University in Canada. She holds a Doctor of Education in Distance Education obtained at Athabasca University in 2013. She earned her MA in applied linguistics at the University of Southern Queensland in Australia, and her BA in religious studies at Laurentian University in Canada. Her research interests include online learning in underdeveloped countries, leadership, online pedagogy and design, as well as gender issues in education.

Bainbridge, Susan (Dr.)
Athabasca University
Address: 1 University Drive, Athabasca, AB Canada T9S 3A3
Phone: 1-800-788-9041 ext. 6179
E-mail: susanbainbridge@athabascau.ca
URL: https://cde.athabascau.ca/ourpeople/instructors/sbainbridge.php