Personal Cyber-Data Literacy Plurality in Routinized-Prescriptive and Relational-Holistic Cyber-Regimes

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Abstract

Ursula Franklin encouraged all who would listen to act in ways that are socially useful and personally satisfying. Over two decades ago, in her Massey Lectures on *The Real World of Technology,* she warned about the unsustainability of prescriptive bitsphere technology regimes determined by precisely routinized compliance. She advocated for alternative holistic regimes determined by care-full relational consideration. Cyber-data literacies are defined as allowing individuals to use and benefit from data associated with their digital practices. Routinized literacies are being mis-afforded by behaviour manipulation through learning systems built on cyber-surveillance and broken personal data markets. This critical essay calls for a re-imagining of cyber-data literacies as socially useful and personally satisfying relational digital practices rather than merely routinized digital media utilization skills. A meta-synthesis of neuro-cognitive and hermeneutic theory is used to frame a comparison of cyber-data literacies afforded by cyber-regimes of exclusive compliance and inclusive consideration. Inspired by Hanah Arendt's concept of human plurality, the essay analyses how personal cyber-data literacies are constrained and afforded by human diversity. Personal cyber-data are conceptualized as lifeworld givens, entangled with personal knowledge and experience, oriented and determined by data cognitive artifact constraints and affordances, and filtered through individuated foresight and insight. Despite foresight plurality, a capacity for distributed cognition and intelligence arises from a shared human biology and shared bio-psycho-social-relational determinants of mind/brain architecture consequences. This critical essay describes opportunities and benefits that could arise from promoting cyber-data literacy plurality, grounded in personal data, made meaningful to both people and machines through meta-cognitive narratives constructed using personal cyber-data by people the data are about. Those affordances are illustrated with the case of affording ownership rights in healthcare learning systems to persons health system cyber-data are about. The essays concludes that meaningful communication and learning involving personal cyber-data requires assertion of personal ownership of personal cyber-data.

Introduction

I am a Professor Emeritus at the University of Toronto (UofT). I arrived at UofT in 1985, soon after Ursula Franklin retired from the Faculty of Engineering. I became aware of her through her post-retirement project to challenge the broader academic community to apply themselves in ways that are personally satisfying but also publicly useful. Cyber-data literacies are defined as allowing individuals to "better engage and make use of their personal data generated by their own digital practices" [1]. In her 1989 Massey Lectures, Ursula Franklin reminded her audience of dangers associated with the inevitability of ignorance when new technologies are used in new contexts [2]. In the expanded second edition (1999) of those lectures [2], she highlighted that idea with additional chapters commenting on uncertainties around interactions with an emerging, asynchronous bitspheres, in existence when today's Millennials were born (1981-96).

Franklin's analysis foreshadowed how bitspheres would continue to evolve towards its current asynchronous embodiment with entrenched information asymmetry [3]. She warned of a need to recognize how human modes of communications, concerning both the function of things (mechanisms) and how function and structure of things interact relationally in discrete things (organisms). This critical essay [4] suggests that such recognition requires ways of critically evaluating what is being communicated in data, especially regarding personal data [2].

Pangrazio and Selwyn [3] called for a critical literacy approach to understanding consequences of broad access to personal data bitspheres. The present critical essay [4] explores implications of cyber-data literacy plurality promoted through inclusive design principles [5,6,7]. It also describes how that plurality can act to foil manipulative and unsustainable prescriptive technology regime designs built around the experience of fear and dominance. Those designs are allowing self-dealing data brokers [8] to drive prescriptive e-commerce regimes powered by behaviour prediction technologies, that are dependent on barely legal cyber-data surveillance [8,9,10].

Ursula Franklin contrasted prescriptive technology regimes of routinized compliance, that dominated her life-course (1921-2016), with alternative holistic technology regimes of personally satisfying, socially useful, relational practices [1,2]. Her core idea of "technology-as-practice", was inspired by her experience as a physicist, metallurgist, researcher, feminist, and pacifist [1,2]. That idea anticipated recent recognition, in studies of human computer interaction (HCI, [4,11]) and information systems (IS, [12]), of inseparable *entanglement* of materials, structures, practicalities, and relations determining empirical and heuristic consequences of data-driven human interactions with technologies.

Through her physical archaeology research, Ursula Franklin recognized how people, and other agentic/communal entities demonstrated, through their shared practices, capacities for

exhibiting, appreciating, and building upon the intelligence of others within the context of thinking, working, socializing, and relating together [1]. Chu and Martin [13] have observed that ascription of personality traits of both agency and communality are used by people to ascribe human-like social intelligence in behaving artifacts, with recognition of communality predominating in explaining the observed correlation.

Nils Nilsson defined intelligence heuristically as "a quality that enables an entity to function appropriately and with foresight in its environment" [14]. Appropriate foresight, and insight, affords and constrains expectations and explanations derived from data concerning interaction possibilities and estimation of the probabilities of those possibilities becoming real [15]. Explicit and tacit foresight and insight about risks with single definitive possibilities and probabilities, can be discerned from routinized prescriptive sorting of data. However, problematic knowledge of plural conditional probabilities and/or possibilities give rise to uncertainty, ignorance, and ambiguity [15]. In the face of problematically incomplete knowledge, both bounded agentic rationality and bounded communality relationality afford wide intelligence [16,17] needed to function efficiently and acceptably with foresight in a complex world.

Plurality
Ursula Franklin was a fan of Hannah Arendt [18] and phenomenology in general [2]. Instances of lifeworld phenomena [12,19,20] can be discerned using personal: foresight, insights, decisions, and rationalizations derived from processing lifeworld data [11,17,19-23]. Hermeneutic and phenomenology philosophies, and related qualitative research methods, aim to reveal interpretive and descriptive meanings related to the experience of being. That experience is a holistic phenomenon encompassing interactions with physical, social, cultural, and mentally-constructed (imagined) worlds we humans are immersed in [20, 21]. We are entering an age where those phenomena can be described in mechanistic, non-metaphysical terms that can be processed by machines and machine learning algorithms, as well as by empirical scholars, and people in general [21].

Hannah Arendt's [19] "post-foundational" hermeneutic philosophy was grounded beyond metaphysical foundations. Her hermeneutic philosophy considered a human condition that enables mutual appreciation of different ways of being, knowing, acting, and making meaning. That condition was conceived as being determined by a given person's labour, work, and action experienced as the phenomena of life, worldliness, and plurality. Her philosophy allowed personal, pluralistic appreciation of those dimensions to be contemplated, shared, and acted on. Her concept of plurality recovered appreciation of the human traits of interpersonal agency and communality. Those traits seem to be key phenomena used by human beings in ascribing intelligence in other people, entities and things [13]. Hannah Arendt challenged representations

of the experiences of intelligence as being singularly agentic. She celebrated the relationality of plural communality as a significant outcome of human intelligence [23].

Plurality is a holistic concept specifying states of individuated but relational interactive engagement with other labouring, working and acting beings intermediated by things in their shared world [19, 23]. Arendt observed how "Only where things can be seen by many in a variety of aspects without changing their identity, so that those gathered around them know they see sameness in utter diversity, can worldly reality truly and reliably appear" [19, p.57]. Information that is authentically empowering can be distinguished from inauthentic dis-empowering misinformation only when "reality truly and reliably appears", to a plurality of literate people, groups, persons, and entities.

Human actions and interactions, as specified by Arendt's concept of plurality, are fundamentally political, shaping and being shaped by commonly and uncommonly sensed reasoning, biases, character, and orientations of people, groups, persons, and other entities humans interact with. Appreciation of plurality will be oriented by a variety of recognized interpretive aims expressed to different degrees in different persons and in ways determined by a given person's specific temperaments, orientations, traits, and states. People have different ways of knowing, becoming, and behaving, reflecting being embedded in bitsphere and biosphere ecologies. Amalgams of people, materials and systems remake each other through their mutual entanglements [11,12]. Franklin's studies of pre-historic amalgams anchored her views of prescriptive and holistic technology regimes [2].

Lifeworld cyber-data literacies concerning data entangled with lifeworld phenomena will be determined by the plurality of people that data are about. That plurality in turn will be afforded and constrained by relational human behaviour [12,17,21-23]. Hence, cyber-data literacy affording inquiries concerning using data about self and the self of others will be bounded by recurring forms of data, and their utility as evidence concerning specification of authentic phenomena [15,21-26]. Hannah Arendt explained the benefits of developing explicit understanding and explanations [19,27] of human plurality, and of its accommodation in ecologies of relational communality systems of mutuality.

Plurality Cognition and Neuroscience

My academic career has been embedded in the disciplines of pharmacology, physiology, biophysics, and neuroscience. I am inspired by new neuroscience models of human cognitive capacities suggesting how cognitive artifacts [17] affording intelligence and self-control constructs, emerge from shared brain architectures mediating relational reward/risk-mitigation orientations [27,28]. Those architectures and associated artifacts generate synchronized brain

network architecture [24,27-30] individuated via a diversity of existential phenomena, instances, roles and identities, mutually recognizable as human condition plurality.

Gibson's information ecology and Valera's neurophenomenology approaches to psychology advanced a non-representational view of how human minds process contextual affordances and constraints [17,20-22,30,31]. That empirical, non-representational, relational, mutualistic understanding has led to an expansion of ways of recognizing cognition as distributed beyond the brain. Worldviews (or life stances) are stable personality traits [32,33]. Mindsets or motivational orientation states emerge from worldviews. Together these traits and states generate enacted contextualized selves [33,34] expressing preferred expectations (e.g., humanistic vs normative [34], growth *vs* fixed [35]) as well as preferred explanatory heuristics [21,27,36] (e.g., utilitarian-hedonic vs relational-eudaimonic [37]). Selves are entangled with common brain network state dynamics that individuate a person's capacities and behaviours and ground human plurality [24,27,29,30].

Distributed Cognition and Plurality

Distributed (meta)cognition is a branch of cognitive science that proposes cognition and knowledge are not confined to an individual; rather, cognitive phenomena are distributed across objects, individuals, artefacts, and tools in the environment [17,38,39]. One early example was Nonaka's [40,41] Socialization-Externalization-Combination-Internalization (SECI) model describing cyclic knowledge growth within an organization. That cycle starts with tacit knowledge socialized through routine organizational practices that becomes explicitly externalized through articulation leading to the possibility of it being explicitly combined with other forms of externalized knowledge. Combined externalized knowledge drives innovations that become tacitly internalized through use, and again tacitly socialized in ways that evolve and grow with changing contexts and learning.

Distributed cognition will be modulated by explanations and expectations derived from literacy-driven learning and worldview-driven meta-narratives (knowing), constructed from lived phenomena (becoming) [21,27]. These will be moderated by stable but malleable personality and ideology traits [32,35]. For example, people seem to prefer to associate with others who are perceived as sharing ideological and physical attributes with themselves. Survey evidence points to how left-right political polarization is correlated with measurable worldview differences [34]. In the absence of instructions, study participants assigned randomly to groups wearing different coloured shirts can be observed to "spontaneously" self-aggregate when asked to walk a circuit together slowly and silently [42]. There seems to be a human preference to "self"-associate. Clusters of observable foresight and insight biases, appear to be general features of any type of both biological and synthetic entities that demonstrate signs of intelligence. Those biases promote a variety of possible interactions with social/ecological

affordances as well as constraints conditionally advantageous to survival in the face of plural conditional options. For example, behavioural differences in fruit flies have been linked to the pleotropic influences of a particular gene (forager) embedded in a complex gene regulatory network. However, that pre-programmed gene regulatory network complexity leads to plurality in context dependent adaptive behaviour [43].

Interactions with environmental affordances and constraints affect consequences of foresight and insight observed in human and other autonomous entities. These will be determined by commonly expressed, but biased, meta-narratives, worldviews, explanations, and expectations. Those biases can be predicted and exploited through dark pattern strategies aimed at shaping consumer choices [8-10]. Dark-pattern strategies are driving increasing dominance of coercive digital marketing strategies for segmenting e-commerce markets. In contrast, inclusive design applies social/relational models of (dis)ability in support of inclusive accommodation of diversity for social good [5-7]. With prescriptive technology regimes, biases are commanded and controlled. With holistic technology regimes those biases are respectfully deliberated and accommodated. In bot types of biases are material, consequential, directional, and malleable.

Moving forward, cyber data literacy regimes designed to augment foresight and insight regarding human plurality will need to accommodate and represent circumstantial biases in context. Prescriptive regimes of predictive compliance emphasize adaptation to routinized constraints, holistic regimes of accommodating consideration emphasize affordance of human plurality. Those two technology poles will foster distinctly biased approaches for augmenting human foresight and insight through cyber-data literacies. Prescriptive regimes of agentic compliance afford interpretive orientations that reflect normative power structures guiding prediction through fear. Holistic regimes of relational consideration, and associated mutualistic communality, afford interpretive orientations reflecting humanisation of technologies-as-practice favoring resilient peaceful human plurality without fear [2].

Framing Holistic-Entangled Cyber-Data Literacies
Holistic cyber-data literacies center and entities literacies through interpretation and interactions with entanglements of the physical materiality of an entity's life's labours, operational formation of worldly works, executed efficiency of plurality actions, and entangled finality of an entity's epistemological intuitions within the bitpheres and biopheres they inhabit. Those dimensions guide entity literacies responsible for conditional entity epistemologies concerning their interactions with physical, emotional, spiritual, and mental phenomena. Plurality is shaped in explicit meta-narratives such as placemaking [44] and wayfinding [45] that are deliberately constructed through explicit externalization and combination. Tacit meta-narratives, like gender [46] and ageism [47] are constructed via tacit internalisation and socialization. Meta-physical meta-narratives produced by a persons mind can nevertheless affect physical health [44-47].

Cognitive theory now emphasizes dependence of cognition on factors that happen outside an entity's brain that does the work of its mind. Cognition is recognized as being variously: embedded, embodied, enacted, and situated [17,20-22,30,31]. Knowledge nature can be tacit or explicit and knowledge types can be completely or incompletely known or unknown (i.e., unproblematic, or problematic). These knowledge forms can be examined along four cardinal axes of inquiries: embedded place, embodied making, enacted finding and situated way.

Andy Stirling, in his essay, "Keep it Complex" [15], specified the concept of risk analysis as an assumption that knowledge of probabilities and possibilities can be discerned unproblematically to yield single definitive estimates of uncertainty. For example, some instrumental errors can be expected to sum linearly allowing uncertainty to be bounded and acceptable levels of risk calculated. However, when ways of measuring uncertainty are known to be problematic, plural conditional probabilities and possibilities of uncertainty need to be considered. In contrast, ambiguity arises from problematic framing of knowledge in terms of disputed sets of definitive questions, assumptions, values, and intentions bounding the knowledge. In the face of the incomplete knowledge of ignorance both measurements and framing are recognized as problematic and provisional. In all cases, technology supported service value is enhanced through engagement of, and partnership with, service recipients and their plurality [48].
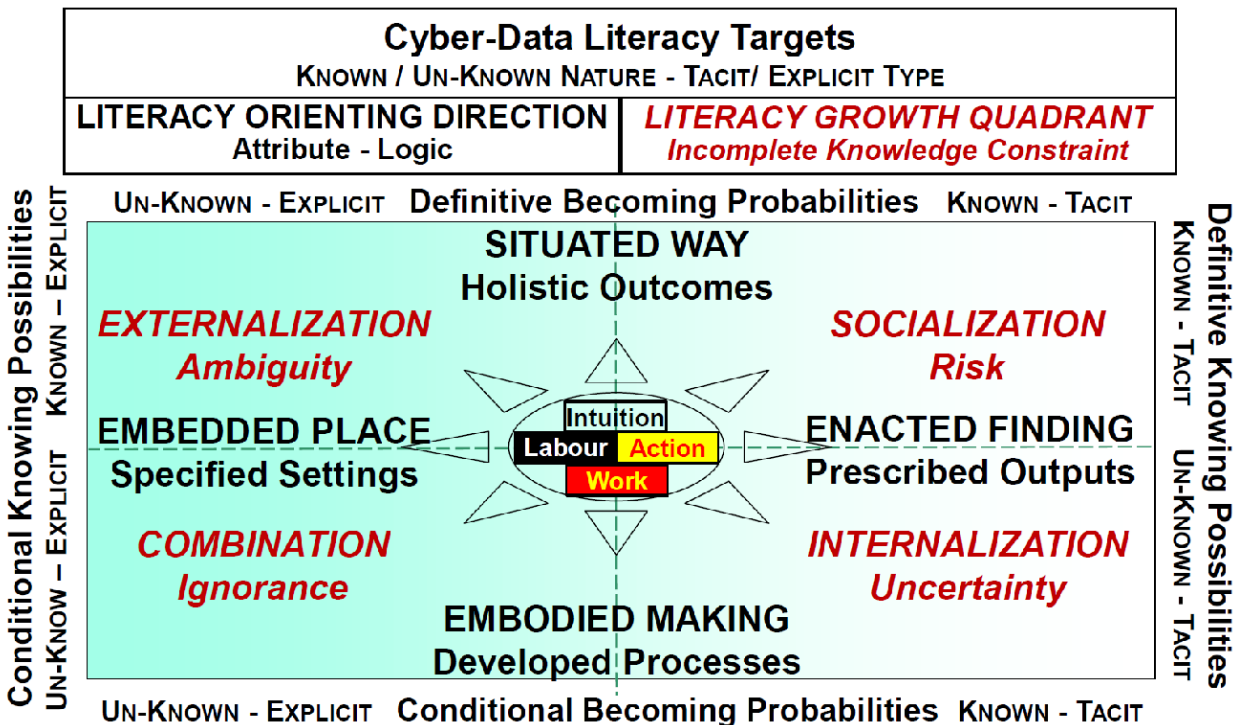

Figure 1. Illustration of a Place-Finding-Way-Making Literacies Framework

Even if translation of knowledge to action is recognized as requiring risk analysis, expectations of single-definitive science-based recommendations can be misleading, and worse,

misinforming [15]. Figure 1 presents a Place-Finding-Way-Making framework. It aims to structure relational articulation of theory-model-effect schemas and empirical evidence for supporting deliberative actions in the face of incomplete knowledge. It frames human centered affordance of deliberative inquiries about a whole person entangled in the human condition of labour, work actions and intuition. The framework affords distinct cardinal axes of inquiry directionality in the face of the plurality of ways that the real world of personal cyber-data complexity causality is ascribed. Inquiry orientations for dealing with ascribed risk will be different than for dealing with ascribed ignorance, ambiguity, and/or uncertainty. Those types of incomplete knowledge in turn will require different strategies determined by literacy target types consisting of becoming-probabilities and knowing-possibilities that can be perceived as conditional or definitive in ways that are known or unknown and explicit or tacit.

Those constraints will determine literacy aims such as navigating incomplete knowledge concerning personal data to attain implicit or implicit appreciations of the data that are: sensibly material, satisfactorily formal, pragmatically efficient, and intelligibly final. Those targets and aims will bound and specify literacy orienting directions and literacy growth quadrants. Those quadrants correspond to the knowledge growth quadrants specified by Nonaka's SECI model: explicit combination in the face of ignorance, tacit internalization in the face of uncertainty, tacit socialization in the face of risk and explicit externalization in the face of ambiguity. They also highlight the distinction between known knows and unknown unknowns corresponding to the incomplete knowledge domains of risk and ignorance. While the framing uncertainty that represents ambiguity corresponds to unknown conditional becoming probabilities associated with known but conditional knowing possibilities. While the unknown definitive possibilities associated with known definitive probabilities characterize uncertainty.

Case Study: Publishing Private Personal Data Research
In this section implications of the prescriptive and holistic regimes are critically examined for the case of using private personal data within person-centred healthcare learning systems [49]. Healthcare services represent a complex system of interacting technologies, people, and places. Analysis of contextualized, personal, small data promises to transform health system transactions [50,51] and deliver person-centered learning health system value [48].

Operations of modern health care technology regimes are guided by collecting personal data allowing for both precisely customized, user-centered compliance regimes (e.g., precision medicine) and holistically generalized person-centered emancipatory regimes (e.g., narrative medicine). Prescriptive, normative, compliance regimes will be concerned with analytically optimizing how health care institutions and businesses can "make" prescribed outcomes happen. In contrast, holistic, humanistic, emancipatory regimes will be concerned with respectfully and inclusively engaging diverse participant relationships, accommodating plurality

[2,18]. That holistic plurality is intuitively understood as influenced by bio-psycho-social modifiers of health, wellbeing, and (dis)ability [36].

Prescriptive technology regimes will compromise those freedoms by prioritizing standard practices aimed at routinizing engagement. Adaptation is accomplished through surveillance and behaviour modification outside the control of the behaving person. In contrast, holistic technology regimes would empower participants via inclusive mutuality practices [2-7,48].

Private data related to effects of personal health/wellbeing care services increasingly are associated with networks of standardized and readable data objects (DOs) [52]. Those standard practices allow a plurality of DO type specific content to be interpreted interchangeably by computer systems made up of standardized hardware, software, network, and actor/agent elements. Like oil, the value of data resources increases through refinement. Data, embodied as collections of DO elements, power computer-system supported transactions that dominate private and/or public economies. By definition, a given DO instance is different from all other possible DOs. Accordingly, physical embodiment of DOs as recorded DO bit streams on a machine-readable media will artifactualize the DOs as unique material properties, with definable property rights, associated with persons the data are about [53].

New policies are emerging globally (e.g., GDPR) stipulating a requirement for users of DOs associated with a given person to obtain consent for that use from the person the data is about. Those policies establish that persons have ownership rights over DO containing data-about-them [53-55]. For example, technologies are emerging for allowing patients to meaningfully search, access and retrieve PHR, EMR and related data generated by devices, services and quality systems used in delivery and payment of healthcare services [56,57]. An evolving ecosystem of diverse personal data collection-access platforms and policies allow both health system administrators and people data-are-about to access, artifactualize, and communicate personal DOs [53-55]. This sets the stage for personal curation of artifactualized personal DOs [52].

Often that data has been collected in sophisticated ways using expensive methods not accessible to the person the data are about. Access to those resources, leveraged through patients exerting their data property rights, will benefit both patients and health [52,56]. In some cases, DOs are primarily technical in nature, having a single definitive meaning necessary for completion of well understood technical tasks. In other cases, the data have a plurality of conditional interpretations requiring adaptive pragmatic choices regarding DO interpretation. In both cases, the data are expressed as circumstance specific values interpretable using machine learning schemas.

Knowledge derived from direct patient insight and foresight commentary, based on intuition concerning complex data-about-them, could and should transform how personal DO resources are interpreted or re-used in a learning health system [49,53]. Funders of both medical science research and medical services are investing in coordination of digital research data infrastructure utilization. Inter-operable standards are emerging for specifying/enabling the authentication, accessioning, curation, and use of research data processed by the infrastructure.

The International Committee of Medical Journal Editors (ICMJE) stipulates that all authors of medical research publications must be accountable for the accuracy/ integrity of any part of a publication and various schemes are emerging to systematize that responsibility [58]. Accountability for publication of research based on healthcare data could be transformed by active authorial input from persons healthcare data are about. Patients have intrinsic plural capacities for objective research skill-based and subjective capacity-based inquiry that can be applied systematically and collaboratively in sorting hidden and evident circumstantial aspects of data-about-them. Moreover, contributions as authors would ethically and legally assert patients consent and control over publication of data-about them. Barriers to pre-print publication of medically related findings are falling (e.g. www.medrxiv.org/).

Relational behaviour is made up of more than what can be observed by others. It includes events observed privately by a person including thoughts, perceptions, emotions and mental simulations and models [see 59]. That private behaviour can be externalized in the form of meta-narratives grounded in machine readable authentic data owned by persons data are about. This in turn will allow relational articulation of theory-model-intervention schemas of empirical evidence for supporting deliberative actions in the face of incomplete knowledge and promote rhetorical citizenship [60]. It also will promote more straightforward risk analysis in learning health systems.

Discussion

Over my career I attended many of Ursula Franklin's public lectures. She consistently challenged her audience to bias their research in ways that advance a "peace that is not just the absence of war but the presence of justice and the absence of fear" [1]. I retired shortly after her death in 2016. This essay is a response to that call to action. Like Hannah Arendt, Ursula Franklin was more interested in *vita activa* than *vita contemplativa*. This critical assay was produced in the hope that it will inspire both action and contemplation. The essay advances the idea that intersubjective relationality of shared human understandings believed to be true that can be anchored and derived from authentic cyber-data literacies plurality rather than merely prescribed. It situates responsibility and accountability for being human now in policies and politics that cultivate and appreciate cyber-data literacy plurality. It suggests that socially useful

and personally satisfactory literacy will promote relational peace through absence of fear and intuition concerning experience phenomena of selves and other selves.

Four cardinal directions of cyber data literacy plurality are justified: embedded places literacies for framing disciplined explanations, embodied makings literacies for synthesizing declarable expectations, enacted findings literacies for justifying normative stances, and situated ways literacies for articulating consolidated meta-narratives. Lifeworld cyber-data externalized as a common pool resource [53] centered on plurality meta-narratives will foster rhetorical citizenship [60]. The aim is not for homogenization but rather harmonization of inclusive authentic belonging [61] through characterization and accommodation of plurality. Achieving that aim will involve engaging coherent authentic autonomy, connected as significant relevant competency, empowering purposeful belonging through relatedness and generating comprehensible meaning-in-life [62] and self-determination [63] wisdom.

A recent study [64] of cognitive and neural correlates of standardized psychometric measurements of loneliness and wisdom constructs seems relevant. That study empirically demonstrated how the negative trait of loneliness predicted distraction by an angry face in a cognitive performance task. In contrast, the positive trait of wisdom was not affected by an angry face, while the happy face enhanced task performance. There was a strong negative correlation between measures of wisdom and loneliness [64].

Perhaps that empirical observation is a consequence of loneliness being linked to social isolation and associated with hyper vigilance against threats [64]. Wisdom, on the other hand, is linked to accommodation of incomplete knowledge. Prescriptive regimes of exclusion are designed to satisfy needs of socially isolated individuals who prioritizes agency in the face of adversity. Holistic regimes of inclusion are designed to satisfy the needs of wise individuals who prioritizes accommodation of communality in the face of adversity.

Justifications of trusted knowledge derived from data and information today are increasingly recognized to be the product of biased mindsets [65,66] that are deeply dependent on the culture of the scholars involved in generating those justifications. Leveraging Arendt's concept of human plurality [18,23] might help mitigate those cultural bias by allowing the plurality of people the data-are-about to build personal stories grounded in a "sameness" of artifactualized machine-readable data that remains meaningful to themselves regardless of how facticity of that data is interpreted by others. Indeed, one can imagine a future where AI driven assistive devices and services function (and are regulated) as emancipatory assistants [10] that are relation building extensions of the persons and communities they serve rather than mere consumer products and speculative assets to be sold, bought, and managed prescriptively.

Ursula Franklin was a woman of faith who appreciated the divine voice coordinating interactions and relationships of people acting together. In keeping with her Quaker practice, she warned against fundamentalism, and its over reliance on the "letter" [2, p136]. Her expanded edition of the *Real World of Technology* warned against mechanistic, prescriptive logic encouraged by asynchronous access to information enabled by the cyber-infrastructure of bitspheres. She asserted that "the struggle to understand and steer the interactions between bitspheres and the biosphere is the struggle for community in the broadest ecological sense" [2, p179].

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