To: Chan Zuckerberg Initiative

From: Maryanne Wolf

Re: Report on the Workshop on Neuroscience and Global Literacy

It is a singular pleasure to send this report on the Workshop on Neuroscience and Global Literacy held at Stanford's Center for Advanced Study in the Behavioral Sciences (CASBS) on January 11 and 12, 2018. It was consensually agreed that this was one of the finest scholarly workshops ever attended by the participants, and the CASBS Workshops Coordinator, Christy Duignan, said it was the best workshop ever held at CASBS in twenty years. In this report I wish to thank the Chan-Zuckerberg Initiative for funding this endeavor and to describe both the goals and the deeply gratifying, still emerging outcomes of the workshop that have already begun to yield new directions of cross-disciplinary research on the uses of different mediums and on digital-based, global literacy initiatives.

Goals. The three underlying goals of this workshop were to yoke basic theoretical and applied questions about: 1) the impact of print and digital mediums on cognition and on reading; 2) the role of human-technology interface; and 3) the contribution of the research in these latter areas on applied issues in global literacy interventions and on dyslexia interventions. Till now these areas have been largely unconnected. The overarching aim was to connect scholars and experts in each of these three areas, so as to contribute towards a more informed understanding of the development of reading in different mediums. Such knowledge will help to preserve the multiple positive affordances of both mediums, while helping to redress potential negative impacts of digital mediums on the next generation. It is our belief that this is an opportune moment to use our collective knowledge bases to evaluate what needs to be preserved and what needs to be addressed in the reading brain's development before the inevitable changes to its circuitry are calcified in the next generation.

Attending Participants. Towards those ends, the workshop brought together three dozen of some of the world's leading scholars focusing on basic developmental and cognitive neuroscience research on reading (in print and digital mediums), on technology design, and on literacy initiatives in developed and developing countries. Our original design for the workshop involved 24 scholars, but the interest in the workshop was so intensive that we allowed 15 additional scholars to attend who paid their own expenses. We literally were forced by space constraints to turn away multiple groups from Europe and China who wished to attend. In addition, upon learning about the workshop's content, Nicholson Baker, a well-respected writer and journalist from *The Atlantic* attended the workshop in order to write an article for the magazine on these topics. A list of participants and their brief bio-sketches is in the attachment labelled "Participant Bio's."

Structure of the Meeting. The two-day workshop consisted of brief presentations in four sessions, followed by disussions led by some of the leading researchers in the fields of

neuroscience and technology, including Brian Wandell, Robin Morris, Marti Hearst, Maria Louisa Gorno-Tempini, and Ken Pugh.

Sessions included:

Topic One: Impact of Print and Digital Mediums on Cognitive Processes in Reading Development.

Topic Two: Human-Technology Interface and Issues of Technology Design for Literacy Initiatives.

Topic Three: Global Interventions and Insights from Dyslexia Interventions.

Topic Four: Yoking Basic Research on Impact and Human-Technology Interface with Global, Digital-Based Interventions.

At the end of the workshop, the Chair led a discussion of how the proceedings could provide a foundation for specific research directions and new forms of convergent, applied scholarship.

All proceedings of the meeting were recorded and transcribed and are now available, along with the powerpoint presentations, on the workshop website made by CASBS for this group.

See https://stanford.box.com/v/Maryanne-Presentations and https://stanford.box.com/v/Maryanne-Reading-Materials for access to powerpoint presentations and the many reading materials pertinent to the presentations by the authors.

Although the brevity of a "report" does not allow for in-depth descriptions, Appendix A is included below to provide a more detailed description of key points in various presentations that have particular relevance to the CZI mission. For example, some of these key issues are the following:

- **How can engineers improve reading on tablets? Next generation will involve bendable electronics.**

Will the digital medium create changes in attention, change background knowledge, analogy, and critical analysis, and empathy?

- **How can we transform the way we use technology currently towards deeper and more critical thinking for the next generation? No evidence for now that current technology achieves this**.

- **How we can lift up the ideals of democracy in technological age?** ***{NOTE from MAW: This became a major theme at the workshop that is often neglected elsewhere, particularly***

***with regard to issues surrounding concerns about empathy and critical analysis when reading on screens*}**

- **What is needed is a neuroimaging study in which two groups of people read digitally and in print and then are scanned to determine differences. *{NOTE from MAW: This is a major question at the workshop and represents a major need in the research and a potential area for CZI funding in future}***

- **There is often no input from reading researchers into how to develop technologies for reading.**

- **The more emotionally-savvy technologies are, the better they are at estimating the child's knowledge.**

- **Medium mentorship - how do we build skills in adults to guide children around media and to make better technology choices?**

- **How can we use smart technology to answer why some interventions work?**

- **How does technology adapt to culture?**

- **What is a gold standard for developing reading apps that involve scientific measures, criteria for apps?**

- **Medical community was previously excluded from the field of reading intervention.**

- **How can new research in genetics and neuroimaging be used to inform practice?**

- **The promise of neuroscience: you can see the brain markers before you see the behavioral markers and therefore intervene earlier.**

- **All children regardless of their backgrounds need to receive the same basic components of the reading brain circuit as a framework or scaffolding for reading intervention. Yet there continues to be a failure of professional development for training teachers in these basic principles of reading instruction.**

- **Can we create a corps of Global Literacy in Action (GLIA) Fellows who are trained graduate students and can volunteer in ongoing literacy initiatives directed by these participants in vulnerable places around the world? Can we develop an international infrastructure to implement known best principles of our collective research/intervention efforts?**

Finally, all participants agree that the UN Sustainable Development Goals need to be addressed both by the research community and this group so that literacy is conceptualized as *a basic human right.*

Outcomes of the Workshop. A Survey Monkey was created by Fumiko Hoeft from UCSF after the meeting to capture both the responses to the workshop and to describe specific outcomes and efforts that emerged from this meeting. The overall responses to date were overwhelmingly positive, with various researchers emphasizing the uniqueness and importance of the meeting's convergence of areas usually unconnected. Multiple scholars wrote and asked whether this could be the beginning a series of workshops devoted to these newly overlapping areas. Indeed two of the participants, Fumiko Hoeft (UCSF) and Jason Yeatman (University of Washington), sent a letter to all the participants inviting them to continue the goals of this workshop through a pre-convention set of symposia on these topics at the October, 2018 meeting of the International Dyslexia Association. A summary of the most significant outcomes follows:

1. Subgroups: The first and potentially most long-lasting outcome concerns the creation of new subgroups of scholars. An international subgroup on the study of various mediums on cognition and reading behaviors has just been formed as a result of the workshop. Led by Naomi Baron at American University and Norwegian scholar Anne Mangen who directs the European E-Read Network, this group consists of scholars from Europe, Israel, and the US. They have now begun to share research and to plan a White Paper this coming year that will include a meta-analysis of known findings. Lisa Guernsey, Naomi Baron, and Maryanne Wolf will meet in Washington D.C. in March, 2018 to establish an Executive Advisory Group and a working group, based on the considerable interest by participants in this topic.

2. A subgroup of young scholars from University of Washington and U.C. Berkeley have expressed interest in creating a working group on Big Data and Human Technology Interfaces. Their aim is to establish a database with guidelines that would connect the multiple, but largely unconnected global literacy initiatives.

3. Neuroscience. One of the more exciting aspects of the workshop was to connect scholars who had never known each other before the meeting. For example, neurologist Maria Louisa Gorno-Tempini from UCSF and Brian Wandell from the neuroscience department at Stanford met for the first time and have already begun new proposals to CZI around their shared interests. A major leitmotiv concerns the need for a series of neuroimaging studies to understand the different impacts of various mediums on the reading brain circuit.

4. Dyslexia. Boston pediatrician, Barry Zuckerberg, who co-created the pediatricians' literacy initiative, *Reach Out and Read*, decided on the basis of the meeting to write a summative article on dyslexia for the journal *Pediatrics*, and solicited the help of participants, Ken Pugh (director of Haskins Laboratory at Yale), Jason Yeatman (University of Washington), and Maryanne Wolf. This newly formed group hopes to disseminate some of the new research on dyslexia presented at the workshop in other venues. As mentioned, a pre-convention set of symposia will continue the themes in this workshop at the annual meeting of the International Dyslexia Association.

5. Implementations with Students. One of the recommendations that emerged from the workshop was the creation of a GLIA (Global Literacy in Action) corps, in which PhD students working in these areas could apply their knowledge in ongoing global literacy initiatives by participants around the world and in our various communities at home. One-third of the participants are participating in deployments in every populated continent. The first contribution towards the development of such a corps of students has recently been given to Maryanne Wolf by a major funder in the neurosciences. The first group of students to be funded will be at UCLA, in the new Center for Dyslexia, Diverse Learners, and Social Justice, directed by Wolf, and at Chapman University.

6. Sharing of Resources. A completely unexpected outcome of this workshop concerns the connections made not only between and among the participants, but also with other CZI projects. Two participants, MIT social roboticist Cynthia Breazeal and Maryanne Wolf from this workshop will meet with the Reach Every Reader group at MIT and Harvard, sponsored by CZI, to ensure that resources from the workshop and from the new Center for Dyslexia, Diverse Learners, and Social Justice are shared with this new initiative. Thus, an immediate outcome of this workshop on neuroscience and global literacy is to link two CZI initiatives whose shared research could have significant potential for changing the acquisition of literacy in this country. At some point in the future, therefore, we will consider with CZI how best to connect the work done by this workshop's participants more systematically with the Reach Every Reader initiative.

Summary: This was one of the finest working groups ever to address both the deeply important theoretical questions about the impact of digital and print mediums on cognition and the applied questions on how to yoke this information with ongoing global literacy initiatives and with research on human- technology interface. The consensus of this workshop is that we must deepen our individual and collective efforts so as to help the world around us conceptualize literacy both as a basic human right, and as one of the most important keys to decreasing poverty and increasing health and well-being in children around the globe.

For Notes and Key Points in CZI Workshop on Neuroscience and Global Literacy

CASBS at Stanford University

See APPENDIX A