

COVID-19 and Autism Research: Perspectives from Around the Globe

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Introduction

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Last year around this time, in preparation for the INSAR2019 meeting in Montreal, we asked members of the Autism Research editorial board as well as the Associate Editors to write short comments on what they

considered to be the major gaps in autism research. The resulting Commentary was well received with nearly 3000 downloads. The INSAR meeting scheduled for Seattle in 2020 was, of course, cancelled due to the coronavirus pandemic. The pandemic has forced the reorganization and rethinking of all science, including autism research. To get a sense of how autism researchers are dealing with this unprecedented situation around the world, we asked for short comments about the situation from editorial board members, Associate Editors and from the INSAR Global Senior Leaders in Autism Research Committee, a relatively new INSAR initiative chaired by Petrus de Vries (South Africa) and Declan Murphy (UK). We will present perspectives by World Health Organization (WHO) Region.

Before going further, we must acknowledge that over and above the hardships for autism researchers across the globe, the pandemic has cost so much more to the more than 400,000 families worldwide that have suffered the death of a loved one. We offer our condolences to those families and to those who will befall a similar fate in the future. We also acknowledge the global economic burden of the pandemic, both as a result of COVID-19 and as a consequence of lockdown. This too will have a major impact on everyone, and perhaps disproportionately so on families who live with disabilities and those in low- and middle-income countries.

The contributions that make up the remainder of this commentary are in equal parts frightening and inspiring. On the down side, they talk about the difficulties in conducting autism research when social distancing is in place and when participants must wear masks. How does one recruit young subjects if the ADOS cannot be done with masked individuals? There is also the concern that, given the overall frightening environment of the current situation, it may be difficult to interpret behavioural research results. For example, are measures of anxiety now reflecting a trait of an individual or the state of heightened angst resulting from dealing with the virus? Others worry that the enormous costs of dealing with

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DOI: 10.1002/aur.2329

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controlling the spread of the virus will eliminate academic positions and autism research funding in the future. This is a real concern. The state of California has gone from a \$14 billion surplus to a projected \$54 billion deficit. Public higher education in the state is now slated for a 10% reduction in funding.

There are also implications for prevalence of autism in the future. One of the prominent, proposed nongenetic causes of autism is maternal immune activation [Patterson et al., 2011]. Naturally occurring pathogen exposures offer the strongest evidence of environmental etiology. The best example is maternal rubella (German measles) infection during pregnancy. Before development and widespread dissemination of effective vaccines, major pandemics occurred every 10 to 30 years [Duszak, 2009]. The last of these was from 1963 to 1965 and infected an estimated 10 percent of pregnant women, resulting in more than 13,000 fetal or early infant deaths; 20,000 infants born with major birth defects and 10,000 to 30,000 infants born with moderate to severe neurodevelopmental disorders. Stella Chess, a child psychiatrist at New York University, studied 243 children exposed to rubella during pregnancy [Chess, 1971; Chess, 1977] and found that the largest category of neurodevelopmental disorder was intellectual disability, which affected 37 percent of the sample. Nine of these children were also diagnosed with autism; another, without intellectual disability, had a possible diagnosis; and eight a partial syndrome of autism. These numbers would translate to an autism prevalence of 741 per 10,000 rubella-exposed children, just over seven percent which was strikingly different from the 2-3 per 10,000 typically found at the time in the general population. It is concerning therefore, that a recent survey of two New York hospitals found that 15% of pregnant woman coming for the delivery of their child were positive for coronavirus [Breslin et al., 2020] and many of these were asymptomatic. Given the inadequate testing in many countries, the true number of pregnant woman infected with the virus may not be known for some time and the implication for the prevalence of autism will undoubtedly be the basis for much future research.

But, the contributions below also reflect an up side of resilience and resolve by the autism research community. Many investigators describe how testing and even clinical trials were rapidly converted from in person to telehealth strategies. Development of more efficient and technology driven assessment tools has been fast-tracked due to the pandemic. Could robots provide a mechanism for providing therapy without the risk of viral exposure? The use of teleconferencing platforms like Zoom have transformed how scientists are communicating their research results leading some to suggest that this may also be a strategy to reduce air travel and global warming in the future. Here

too the disparity between access to digital technology in richer countries relative to under resourced countries is amplified.

One hopefully positive take-a-way message relates to the importance of science in solving problems such as pandemics. The development of diagnostic tests, vaccines and medications related to COVID-19 highlights the work of the millions of scientists who labor, generally in obscurity, to gather knowledge about the natural world. We hope that you enjoy the thoughtful comments of many of our colleagues who are engaged in research dedicated to decreasing disability in individuals with autism spectrum disorder.

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PERSPECTIVES FROM THE AFRICAN REGION

COVID-19 in Africa: Magnifying Pre-existing Digital and Socio-Economic Disparities, but with Glimmers of Hope

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The year 2020 brought new challenges and terminology to the globe, as the COVID-19 pandemic started to spread, first in China, then Europe and the USA, before expanding to Africa. New words and phrases like “social distancing”, “the new normal”, and “lockdown” were introduced, and the whole world turned towards technology for information (true and fake), to connect with one another, for online classrooms, and for research, including autism research.

But, unlike the rapid technological transformation in high-income countries, in Africa the pandemic has simply magnified the pre-existing inequalities. In contrast to the UK or USA, only a small proportion of African households have internet access [World Bank, 2016]. Data costs are disproportionately high and speed disproportionately low. The World Bank refers to this as the “digital divide”. They have warned (long before the arrival of COVID-19) that this gap is increasing between Africa and high-income countries [World Bank, 2016]. The sudden drive towards technology during the pandemic has accelerated and magnified this digital disparity.

Of course, technology can improve access, availability, and quality of services and clinical research. In low-resource settings, technology can facilitate the delivery of empirically supported interventions by providers that do not have substantial prior training. However, for technology to be feasible and fair in diverse African settings, it should be tailored to the local context, integrated within existing systems, and be accessible and affordable. This is why autism research has to consider not only these digital disparities, but also the contextual and socio-economic challenges experienced by Africans.

South Africa, for example, is recognised by the World Bank as the most unequal society in the world, and this manifests in both economic and health disparities [Sullah and Zikhali, 2018]. Mindful of the pre-existing digital disparities, South African academic centres have been sensitive to the needs of staff and students during the time of COVID-19. They provided devices, data, and negotiated with mobile telecommunication companies for free access to academic websites. Yet, providing online access is only part of the answer. We still make many contextual assumptions. Many students and researchers have been severely affected by the contextual challenges of “working from home,” when “home” may be an environment very different from a classroom, clinic or laboratory. For example, staff have experienced significant difficulties with internet access during the lockdown, and a number of students had devices stolen after they received them from their universities. The contextual challenges of families participating in research have had direct impacts on the ethics of our research. How appropriate is it to conduct research during a pandemic (even if it may help

families), when many of them were struggling to feed their children?

Fortunately, Africa is a resilient and an innovative place, and good things have emerged. Many families have become more motivated and skilled to use internet-based training and remote coaching. Whatsapp support groups and Zoom coffee mornings have sprung up, and excellent online resources have been produced in record time. In one particular study, we struggled for many months in 2019 to encourage non-specialist facilitators to participate in online training. COVID-19 changed that for good and showed that these approaches might be feasible, but only with the right online and offline supports in place.

COVID-19 has magnified the disparities in African communities and emphasised the importance of context, not only for autism research, but for all health research in low-resource settings to ensure that we reduce, rather than increase, pre-existing disparities. The time of COVID-19 has forced autism researchers in Africa to reflect on our goals and methods for socially-responsive and socially responsible research.

Acknowledgements

We acknowledge funding from NIMH 5K01MH104370, NIMH 1R21MH120696 and from the South African Department of Social Development.

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The Effect of the COVID-19 Pandemic on Autism Research in Uganda

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The coronavirus disease 2019 (COVID-19) is described as the once-in-a-century pandemic of the 21st century (Gates, 2020), with over 6.9 million infections and 400,000 deaths globally to date (WHO, 2020). Governments and Ministries of Health have currently focused on the prevention and treatment of COVID-19 patients, with minimal consideration of other services especially for children with disabilities or chronic illnesses. These

children are also prone to the effects of social disruption and the lock down measures created as a means to curb the pandemic (United Nations, 2020).

While COVID-19 continues to spread across the globe, public health strategies to curb the pandemic including social distancing, public travel restriction measures that many countries including Uganda have implemented, have caused disruptions to daily routines [Uganda Ministry of Health, 2020]. For children with cognitive disabilities such as Autism Spectrum Disorder (ASD) and their families, such measures mean a lack of access to the resources they usually have through clinics, schools, habilitation or rehabilitation services. There is also a higher risk of children with ASD becoming frustrated and short-tempered when their daily routines are interrupted [Lee, 2020].

It is anticipated that the COVID-19 pandemic may create overwhelming havoc to the health and social economic sectors in Africa, in view of the challenges of weak health systems, inadequate health infrastructure, lack of appropriate medicines, inefficient surveillance systems and laboratory capacity and scarcity of trained personnel to adequately respond to the pandemic [Gates, 2020].

Everyone has had their lives changed as a result of the raging COVID-19 pandemic. However, the degree by which their lives are affected may vary from one person to another based on context and at what stage of the pandemic they are. It is also important to realize that children (especially those with cognitive disabilities) are less likely to adhere to some behavioural and hygienic practices such as routine hand washing that prevent, or reduce the risk of, infection or the consistent wearing of face masks due to their age, maturity and evolving capacities [Thompson, 1994].

In Africa, specialized centres that take care of patients with autism are few, quite expensive and commonly placed in the urban setting requiring those caregivers able to afford these services to often travel long distances in order to access them. In the health unit I work in, the patient turn up has shrunk by over 25%. The current restrictions on public transport, in addition to the poor road networks, a rudimentary ambulance system and existing poverty may further prohibit their access to the required medications and services during this time [United Nations, 2020]. For those with ASD, the added major interruptions in their children's usual health services, such as speech and language, cognitive behavioural or rehabilitation therapy may create feelings of helplessness and stress for both patient and caregiver with the potential risk of their deteriorating mental well-being [United Nations, 2020]. These circumstances may subsequently result in worsening of the existing chronic conditions as a result of not being properly managed, with the child developing severe complications [United Nations, 2020]. Measures to mitigate the risks of the pandemic and promote continuing chronic care to these children is hence critical.

Whereas Uganda had closed down due to the COVID-19 impact, and has begun to ease the lockdown, it is not clear what bearing this will have had on the weak healthcare systems with minimal emergency facilities and capacity like that found in many similar areas in Africa? What happens when contingency planning is almost absent and resources are inadequate? In particular, what happens to those children on chronic care management like those with ASD, how has the pandemic affected their care? What factors have facilitated or hindered access to care? What actions are needed to strengthen the health system to meet the needs of such vulnerable groups in times of pandemics?

COVID-19 effects extend beyond the pandemic and are expected to transform healthcare and subsequently research in various, many yet unknown ways. With social distancing becoming the mainstay for prevention, could telemedicine perhaps become the preferred communication channel between caregivers and patients? Implications for patients with ASD present a unique challenge within this transformation. How will some of our patients on the spectrum practice social distancing if they live in a one or two room dwelling in slum areas; are cognitively impaired and are unable to understand instructions or wash hands without clean water?

Telemedicine is the primary way of providing services for chronic conditions during the pandemic in many developed countries and is expected to expand beyond pre-Coronavirus era use. The question remains though, how can digital health care be employed as an accelerator for participatory medicine, including networked patients and families, as responsible drivers of their health in areas such as Africa where issues of internet connectivity are still a challenge?

Another challenge is how prepared is the health care system to handle the greater uncertainties associated with ASD related research during this outbreak? The potential acceptability of the various risks will definitely vary, depending on numerous factors including the type of research and the context in which it takes place. We should be cognizant of the fact that a "one size fits all" approach towards the implementation of ASD research may not be appropriate and therefore it is important that global priorities are contextualized, and protocols and planned interventions are adapted to local needs and experiences.

All these are important gaps for research that need to be explored as the COVID-19 pandemic rages on and radically disrupts the schedules and access to services that those on the spectrum have grown to rely on.

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PERSPECTIVES FROM THE EASTERN MEDITERRANEAN REGION

How the COVID-19 Crisis is Affecting Research on Autism in the Middle East and North-Africa (MENA)

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The definition of autism is highly related to social life. Covid-19 crisis, beyond the infectious aspects, brought a dramatic change in social life either through the lockdown for several weeks in many countries or through a drastic limitation of physical contact that will probably prevail for an important period of time. Therefore, studying the social impact of Covid-19 on autism seems compelling.

There is of course a fear that now that autism finally became important and popular in the region and starts to attract some means to research, that these resources are diverted to COVID research. However, beyond that general thought, three aspects attracted our attention out of the clinical practice during this period:

- Whilst many voices always denied negative impacts of the work of parents, especially the mother, on the outcome of children with autism, and tried to protect mothers' right to work against conservative and traditional assumptions trying to correlate the work of the mother to hypo-stimulation and affective deprivation in the child, we were surprised to see many children with ASD improving dramatically during the lockdown. Was it due to the reduction of social requests or to the important presence of parents at home?

Research can be crucial here to clarify evidence and protect mother's right to work

- The important change of social context and its diverse impact on autism is raising the question of putative « social part » in autism as a construct. In fact, three schematic subgroups emerged clinically during this period: 1. A group with severe autism that « took advantage » from social restrictions and showed less problems because it met their « needs », Group 2 with high functioning individuals who could integrate on a cognitive and social level the challenges of this period and coped generally well with it, and a Group 3 in between, who started to abandon core autistic behaviours in favour of more social networking but still needed the security of a structured and ritualized environment. We noticed that this group was the one with more behavioural disturbances and more communication regression. A research investigating the impact of COVID-19 on the light of this stratification seems interesting
- Prevention measures against COVID-19 involve many rituals. We noticed without surprise how easy to implement and efficient this was among many patients with autism since it met their ritualistic features. They became in many households the guardians of these measures, reminding everyone to keep shoes out, put on the mask, wash hands, physically distance etc. The question here is how to better use these skills in prevention strategies, especially in facilities attended by persons with ASD

PERSPECTIVES FROM THE EUROPEAN REGION

The Effect of the COVID-19 Pandemic on World Autism Research: A View from Spain

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The COVID-19 pandemic has had an enormous impact on our region, with notable repercussions on practically all areas of social and community life. The reports worldwide inform that no vaccination or cure for the COVID-19 will be available for at least the next 12-18 months. This fact is already changing the way that society is conducted and the autism communities which support people with ASD will be challenged to understand the situation and develop new ways of participating, alongside people with ASD, in social life while maintaining the physical distance needed for prevention.

The context has changed for research and although the research questions that have been raised previously will likely remain largely untouched, it is possible that some

topics will become more relevant than before (e.g. telehealthcare procedures in screening, evaluation and intervention). New questions will also arise due to this situation (e.g. research focused on situations of crisis). We are now witnessing a great proliferation of studies aiming to understand the experience of families in the context of confinement with limited access to community services [Kong, 2020; Narzisi, 2020; Stankovic et al., 2020; Szabo et al., 2020]. Furthermore, it will be necessary to adapt working procedures within labs to make them more hygienic as well as redoubling efforts to make people feel comfortable and trusted within the health services, research, and facilities.

Another aspect observed not only in our field, but in the field of biomedical and health research in general, is the risk of losing scientific rigor in these moments of crisis. It is true that we are living in times when science is asked to respond quickly by providing actionable information to help society deal with this situation effectively. However, It is a great challenge that should not lead us to fall into the real risk of throwing caution to the wind in such an exceptional situation, at the cost of overgeneralizing effective treatments tested on small samples or relaxing criteria for randomization procedures and blind systems in clinical trials in response to these circumstances [London & Kimmelman, 2020].

Lastly, the effect of this pandemic varies from country to country. Countries with less resources are affected especially regarding the provision of essential services. It is important to highlight the responsibility of researchers to create new networks of cooperation to develop research projects that can bring essential resources to where they are needed without overlooking the perspective of people with autism and their families. We hope that inclusive international cooperation efforts will be established in order to develop capabilities such as new, less costly evaluation methods, and intervention models that can be implemented with affordable technologies. Society will need to re-learn how to work together at a distance, even if it means reflecting on what has been done thus far, because it is paramount that we better understand our current and future situations and their changing needs.

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The Effect of the COVID-19 Pandemic on Autism Clinical Practice and Clinical Research: Reflections from Israel

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The COVID-19 pandemic presented ASD clinicians and clinical researchers with unique challenges. With social communication as the defining feature of ASD, both diagnostic examination and therapeutic intervention suffer in the absence of direct social contact in this era of social distancing. The need for diagnostic assessments (e.g., for educational placements or state-funded support) has not diminished, and the need for intervention may have even increased (albeit with changes in focus). In Israel, a central platform that has been widely used is video conferencing which has been harnessed for the provision of diagnostic and therapeutic services. This method presented clinicians with new challenges, which by themselves call for research examination.

Diagnosticians faced the challenge of real-time assessment of the client. How could gold standard instruments such as the ADOS [Lord et al., 2012] be administered online? How could non-verbal behaviours and social reciprocity be assessed this way? What constitutes a normative behaviour and what could be marked as abnormal? Could online platforms conceal subtle symptom manifestations that might have been tracked face-to-face?

Therapists of different disciplines, employing a wide variety of intervention programs, faced their own dilemmas, to name a few: How could an early intervention program be implemented without its trained team? How could treatments requiring clinic-based equipment be implemented? What does social-skills training look like at a time of social distancing?

Recently, Israeli clinicians have been allowed to meet clients face to face again. However, the lessons that could be learned from the current crisis may project far beyond its emergency context and extend the availability of diagnostic and intervention services for individuals with ASD even when routine is regained. If clinicians continue to use technological platforms for the provision of services, many families who are geographically distant, or are deterred

from coming to clinical centers could benefit from services that have previously been scarcely provided.

The provision of technology-based, or telehealth, training and therapy services for individuals with ASD and their families is not new, and its effectiveness has received some support by research [Antezana et al., 2017; Sutherland et al., 2018]. Another form of distant intervention is available through research supported technology-aided intervention programs, supporting skill acquisition in various areas of functioning [Steinbrenner et al., 2020]. With regards to diagnostic assessment, some work has supported the effectiveness of online screening of ASD [e.g., Halim et al., 2020] though others have warned against the sole reliance on online formats [Kanne & Bishop, 2020]. Indeed, research validating an online diagnostic assessment is still needed.

A major lesson of COVID-19 may be the need for the mainstreaming of online clinical services. To maintain high service quality, clinical research would need to provide better understanding of normative (and age and gender appropriate) online social behaviour, to provide artificial intelligence tools to support online clinical decision making, and to examine the efficacy of diagnostic assessments and interventions provided online, compared to research-supported clinic-based services. Contrary to raised worries, such services do not necessarily exclude clinicians from the picture, but could rather support their work, extend their reach, and provide high-quality services online, in sickness and in health.

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How Suddenly It All Changed: A Perspective from Belgium

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What struck me most is how sudden the whole situation changed. On Friday March 6, 2020, I gathered with about 300 fellow Belgian geneticists in a conference hall in the capital city of Brussels for our annual meeting. Except that perhaps fewer kisses were shared as a typical Belgian greeting ceremony, the meeting format was entirely like it always had been. Exactly one week later, on Friday the 13, I was lecturing to about 20 students, as teaching for smaller groups was still allowed (!), be it in a bigger hall to allow for the now famous social distancing. When teaching, the message came in that the University was about to close the week thereafter. From that moment on no more classes, no more internships, no more research. In a way, that message came as a relief as it concluded a week of uncertainty about how to respond to the tsunami of COVID-19-related messages. Until that communication by our University, we all had been in some sort of unrealistic state of mind that the virus would travel the world affecting remote societies but not our own lives.

But has this ended our research and teaching efforts? The work appears not nearly as affected as I would have anticipated. The bioinformatics work suffers least and continues as it always has. Fortunately, our University allowed us to continue our animal breeding, so that at least whenever we are allowed to restart, we can head off immediately. The same is true for some of our embryonic cell culture work, we are at least allowed to proceed with the maintenance of the cultures. In the remainder of the time, we continue to write our papers and manage administrative tasks that would otherwise perhaps never make it to the headlines of the agenda even though they should have made it there quite some time ago...

Physical meetings are replaced by telemeetings with mixed success. Rather than once a week in a physical meeting, our research unit of Cognitive Genetics now gathers twice a week in a much shorter and much more focused teleconference. We adapted the agenda and perhaps this format is at least as efficient as our physical meeting. Other meetings at our University that have not changed the format tend to become long and exhausting in my opinion, but perhaps they always were.

Teaching relatively smoothly changed to online. Conferences are now also being reformatted at amazing speed to online. My first online conference meeting is still to commence, but from colleagues around the world I have some positive feedback on this format. As we cannot travel, it is as if we connect more systematically with our colleagues inside or outside our institution by email or telemeetings.

I somehow feel our “common enemy” has created a feeling of worldwide solidarity.

While the damage done to our research seems repairable if the lockdown is not too persistent, telemeetings are only a partial replacement of the normal social interactions and this begins to count. At conferences online, there is no such thing as a virtual bar. As time progresses, we are more and more longing to return to our pre-Corona situation. Perhaps the best the virus taught us is how satisfied we all were with our lives at work.

Reflections on the Impact of the COVID-19 Pandemic on Autism Research Across Europe

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As of May 11th 2020, over 1.5 million coronavirus cases and 150,000 coronavirus-related deaths had been confirmed in Europe, making it one of the worst hit regions worldwide [World Health Organisation, 2020]. The AIMS-2-TRIALS network of 48 academic, charity and industry partners across Europe and the rest of the world are witnessing the impact of the COVID-19 pandemic on autism research first-hand.

Many AIMS-2-TRIALS researchers and autism representatives have been redeployed to essential frontline clinical work, stretching the resources available (e.g. time, personnel) to support ongoing research projects. The progress of projects has also been disrupted by site closures, as many European countries began to enforce lockdown policies from March 2020 to reduce the spread of COVID-19.

Evidently, site closures and physical distancing measures will impact the running of projects – particularly those reliant on in-person research participation - for some months to come. This issue is perhaps particularly relevant to autism research. For example, though certain research procedures can be conducted over the telephone/online, some autistic people find it difficult to communicate remotely, thus there is an elevated risk that these individuals may become excluded from current research efforts.

The welfare of autistic people and their families at this time is the primary concern of the global autism

research community. Research efforts to better understand and represent experiences of COVID-19, from the perspective of the autism community, are currently being led by many individuals and organisations from AIMS-2-TRIALS and collaborating networks. For example, Autism Europe have conducted a large-scale survey, investigating the emotional, social and financial impact of COVID-19. This research is incredibly valuable, since loneliness and uncertainty – both known to associate with anxiety and low mood in autism [Boulter, Freeston, South, & Rodgers, 2014; Hedley, Uljarević, Foley, Richdale, & Trollor, 2018] – may be particularly difficult for many autistic people at present. Indeed, UK charity Autistica is providing online resources to support the autism community with issues like social isolation and uncertainty due to coronavirus.

Nevertheless, research priorities such as developing mental health interventions and understanding individual variability in the developmental trajectories and outcomes associated with autism existed prior to the COVID-19 outbreak and will continue to be of utmost importance to the field beyond this period. The (essential) prioritisation of COVID-19-related research by funding bodies, ethics committees and scientific journals could mean further delays to the development and dissemination of novel autism research in the longer-term.

Despite these challenges, clinicians and researchers worldwide have shown incredible and rapid adaptability and innovation in these uncertain times. While face-to-face meetings and conferences are on hold, collaborative consortia like AIMS-2-TRIALS are maximising the use of technology to stay in contact, move research forward and continue to provide resources for autistic people and their families (see AIMS-2-TRIALS Consortium, 2020). At this time more than ever, collaborative national and international research partnerships are critical to ensure that best practices being implemented to overcome the challenges presented by COVID-19 are shared widely, with potentially long-term benefits for the future of autism research.

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Delays to Everything, but New Opportunities: A Perspective from Eastern Germany

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The COVID-19 pandemic is an exceptional situation and its impact on all people is enormous. It will automatically lead to delays in everything that was planned but will equally open up new opportunities.

It is a time where conferences get postponed to be held later in the year like the Wissenschaftliche Tagung Autismus-Spektrum (WTAS) which was originally planned for March 2020 in Göttingen and is now postponed to autumn 2020. Other conferences such as the Annual Meeting of INSAR in Seattle 2020 have been cancelled and the organisers are looking into online formats such as webinar talks and ePosters to be held online in June 2020.

More than ever, we rely on technology and the internet for exchange with colleagues, and we are all faced with new (technological) challenges as we are working from home and meetings are held online *via* Zoom. As hours in front of screens increase and face-to-face contacts at work and in free-time decrease, new routines get established and people are starting to feel tired and unbalanced.

Research projects are put on hold in the middle of data collection, nobody knows for how long. New research projects are postponed unless they focus on the effect of COVID-19 pandemic, and researchers have to think about how they can deal with the confounding effect of COVID-19 on their research. New safety regulations are put in place for appointments. Face-to-face contacts are to be reduced, people are advised to keep a distance to others of at least 1,5 – 2m and to wear masks covering mouth and nose.

At the clinic, patients and their parents cancel appointments or may not come because they are afraid to catch the virus in the waiting area or on their way to the clinic by using public transport. Adhering to safety regulations in appointments with adults may well be possible, however keeping distance to children and wearing safety masks e.g. in the context of early intervention is not possible. The interventions are designed to be done in close contact and wearing masks can be irritating for the children.

In Germany, we are lucky. So far, COVID-19 pandemic regulations never had to be as strict as they were in countries such as Italy or Spain and at the time I am writing this (beginning of May 2020), infection rates have already decreased and restrictions relaxed. Intervention studies can start again, colleagues can return to the office by observing rules of distancing and taking turns in office use and at least some meetings can be held again in person.

Overall, the time during the COVID-19 pandemic was a time where people had to be creative and look for new ways of conducting research online, networking online and where researchers might have started to rethink traditional ways e.g. the need for travelling around the world to be at a conference in person or whether there are other ways of exchanging ideas and starting collaborations, such as this commentary.

PERSPECTIVES FROM LATIN AMERICA

Huge Shifts in Many Domains, Including Health, Education, Work and Family Life

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Historically, autism research infrastructure and funding in Latin America have been quite limited. Full-time research positions and research-oriented organizations are largely lacking, and the great majority of ASD researchers are clinicians as well, dedicating more time to their clinical work than research.

The COVID-19 pandemic has imposed a huge shift in many domains, including health, education, and work in many Latin American countries. During lockdown, families have been asked to stay at home, schools were closed, universities were closed, organizations were closed, companies and workplaces were closed, and hospitals had to cancel almost all of their non-COVID-19 related-activities.

Health professionals have been forced to change to telehealth practices, rapidly having to learn ways of delivering support for individuals with ASD and their families in ways they were not used to. There has been a surge of videoconferences, “lives” in social networks, online training courses in online learning platforms, telepractice involving different disciplines such as psychology, psychiatry, speech therapy, occupational therapy, etc., and other activities conducted remotely in order to offer support, guidance, treatment when possible. However, not all individuals and families can access technology-mediated support, and in the many places in Latin America where there is no connectivity or where families do not have technological devices that allow remote communication (e.g. smartphones), supports are non-existent.

Researchers have been forced to adapt their existing projects to online formats or to switch their research focus altogether. Research related to the impact of the pandemic on individuals with ASD has clearly taken a central role, and for example, REAL (Latin America Autism Spectrum Network) researchers developed an online survey to assess how children, adolescents and adults with ASD, and their family members are coping during the pandemic in different Latin American countries, as well as profile of access to services, telehealth use, management of challenging behaviours and other support experiences they are having, etc. Unfortunately, the use of online research methods probably enhances existing disparities in research participation, as many families cannot complete online surveys due to lack of technological devices and/or connectivity.

A final reflection is related to the perceived importance of parent-mediated interventions and caregiver training in this context where families have to stay at home and cannot receive in-home therapeutic support from outside. The current situation may be an interesting opportunity to study if families who have participated in caregiver training programs have more tools and less stress than families who have not. Lastly, it would be important to investigate the effectiveness and impact of remote treatment and caregiver training, as this could have significant implications for the future.

PERSPECTIVES FROM NORTH AMERICA

Impact of COVID-19 on Clinical Trials in ASD

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The COVID-19 pandemic and accompanying emergency measures (EMs) have had enormous impact on research activities across areas of discovery. Clinical trials/intervention studies in ASD have been particularly affected, as they include therapeutic interventions for vulnerable populations, but also, as EMs may pose specific challenges for participants with ASD. In addition, regulated trials have had unique problems given their obligations to regulatory agencies.

Different jurisdictions, hospitals and research institutes have handled the implementation of EMs differently, when it comes to trials. Some settings declared regulated trials essential service and allowed access to hospital/research sites, whereas others shut down access to physical spaces where efficacy and safety assessments were to be conducted. Such challenges and the reluctance of many families to visit hospitals during the pandemic have resulted in an effort to convert most assessments to virtual. Sponsors, principal investigators and regulatory agencies

have been grappling with how to properly handle this dramatic change. Of particular concern to ASD are:

1. The virtual administration of measures that are only validated as face-to-face instruments, which at a minimum will increase noise in measurement, and render the original power analyses and sample calculations inadequate. In addition, and of relevance to also many non-regulated, psychosocial studies, the ability to code live social interactions (e.g. child-parent dyads), is significantly impaired.
2. The effect of pandemic related stress on pre-specified outcomes, such as anxiety, emotion regulation and repetitive behaviours, rendering baseline assessments problematic.
3. The effect of EMs on the ability to demonstrate improvement in outcomes that require settings no longer accessible, such as schools, extracurricular spaces, employment environments. Outcomes related to socialization, have been particularly impacted.
4. The effect of EMs on the ability of investigators to collect biomarker data, such as imaging / EEG. Given the heterogeneity of ASD, a large effort over recent years to include biomarkers that may identify more biologically homogenous subgroups in trials e.g. ^{1, 2} has come to a halt.
5. Delays in recruitment, impacting both existing protocols but also decisions about when to start new protocols given potential upcoming waves of COVID-19.

Although a detailed discussion of potential approaches to dealing with such challenges is beyond this commentary, the US Food and Drug Administration (FDA), the European Medicines Agency (EMA) and Health Canada published specific guidance^{3,4,5}, and several organizations have conducted a series of regulatory consultations (e.g. ISCTM⁶) to allow for some common principles for incorporating virtual assessments into trials during this time and contemplate potential methodological and statistical approaches to handling the variability introduced by the change of administration of measures, large number of protocol deviations and potential direct effects of COVID-19 and related EM on outcomes of interest.

Lastly, in the midst of the devastating disruptions caused by this pandemic, there may be opportunities for innovation, such as the validation of virtual versions of outcome measures of interest as well as biomarkers, digital and otherwise, that may amenable to remote collection, novel methods for remote safety assessment etc. Innovation in this space is likely to have significant impact on both research and health care systems.

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2. <https://clinicaltrials.gov/ct2/show/NCT03887676?term=arbaclofen&cond=Autism+Spectrum+Disorder&draw=2&rank=4>
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The Many Hidden Costs of COVID-19

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In clinical research, lab closures and restrictions preventing in-person visits have altered study procedures and, in many cases, severely limited or precluded data collection. Beyond these more visible impacts, there are many “hidden” costs that have important long-term consequences for our field.

Many in the autism community are profoundly affected by the pandemic. In recent SPARK surveys, the majority of autistic adults and caregivers of autistic children report negative impacts in almost every domain of their lives. While many are coping and even have positive experiences to share, 82% of families reported negative effects on their child with ASD’s mental health, while 95% of parents and 93% of autistic adults reported negative impact on their own mental health [Chung, 2020]. These statistics are an important reminder that even if studies have continued with online data collection, the dramatic differences in “pandemic life” threaten interpretation of behavioural data for many intended purposes (e.g., clinical trial outcomes) and delay scientific advancement. More concerning, however, is the ways in which the pandemic’s negative outcomes will endure and lingering concerns of recurrent outbreaks will continue to affect autistic individuals. Will physiological responsivity be altered after months of acute distress? How do new and evolving norms and concerns about exposure further complicate their navigation of everyday social situations? How do persistent pandemic-related changes, and resultant disruptions and stress, affect developmental trajectories and outcomes? There is no question that the pandemic affects the data we collect. However, it remains to be seen whether this public health crisis will be a catalyst for a fundamental shift in research priorities to focus on understanding and addressing the most pressing needs of the autistic community.

With both academic and medical institutions facing economic crisis and hiring freezes, limited financial

resources and lost training opportunities will likely have less visible, but dire consequences for graduate students and postdoctoral fellows. Junior faculty who struggled to find work-life balance before COVID-19 are now faced with what feels like an impossible feat, balancing homeschooling, care for children or other dependents and COVID-related requests (e.g., procedural adaptations), while trying to provide telehealth clinical services or pivot labs to function virtually. Yet, it is not just the physical challenge of balancing more responsibilities in less time, but internal and external pressures that many experience to maintain scholarly productivity. Whether intentional or inadvertent, casual comments about newfound “free time” and “encouragement” to submit a manuscript or respond to a new grant opportunity weigh heavily on their mental health as they face their own personal challenges brought about by the pandemic.

The ability for autism research to advance depends on the autistic community and researchers themselves. This pandemic has profoundly altered the daily lives and experiences of many in each of those groups, perhaps exponentially for those who find themselves in both. The effects of COVID-19 on autism research threaten those with the greatest stakes in the field and could dramatically shape the “next generation” of autism research in many ways.

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COVID-19 Pandemic Offers Unique Challenges and Opportunities that Transcend Borders

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The COVID-19 pandemic has significantly impacted ASD clinical research across the globe. This impact is being felt both in high-income countries such as the United States and in low- and middle-income countries such as South Africa. While the pandemic is causing many stresses and challenges for both researchers and those affected by ASD, this unprecedented event has a silver lining that could have an impact on a global scale. As scientists hurry to find ways to continue their research, many have found feasible solutions to support remote diagnosis, assessment, and treatment that may improve

access for all and increase the representativeness of participants in clinical research. In the midst of the pandemic, clear and rapid guidance from universities and institutional review boards facilitated adaptation of in-person diagnostic evaluations, assessments, and behavioural interventions to an online platform. At the Duke Center for Autism and Brain Development, an NICHD-funded study examining the impact of combination medication and behavioural treatment in young children with co-occurring ASD and ADHD was transitioned to an online format within 1 week of university guidelines being issued. Both caregiver coaching sessions and caregiver-child observational outcome measures were successfully transitioned to a remote delivery model. On the other side of the globe, similar plans are underway to adapt an NIMH-funded study based at the University of Cape Town in South Africa. This study aims to assess implementation and clinical outcomes of a caregiver coaching intervention delivered by non-specialist providers. In-person coaching will be transitioned to a hybrid remote delivery model.

The pandemic offers a unique opportunity to understand and document the challenges and successes of research conducted online. Are observational measures able to be reliably assessed remotely at home? Does delivery of a caregiver-coaching model at home lead to improved generalization of outcomes? What is the impact of variable access to technology and the internet by participants? Are researchers able to recruit a more diverse population of participants? During the pandemic, we have a chance to better understand how remote assessments and treatments should be adapted to provide reliable scientific results, while maximizing the contextual and cultural fit within each service setting, accounting for preferences of end-users. It is critical that our study adaptations and their feasibility be documented. Careful tracking of study modifications that have facilitated rapid transition to online platforms could inform the development of new assessment and intervention approaches that have broader population-based applicability and ultimately increased community impact worldwide.

Conflict of interests

Dr. Dawson is on the Scientific Advisory Boards of Janssen Research and Development, Akili Inc., LabCorp, Roche Pharmaceutical Company, and Tris Pharma; is a consultant to Apple Inc., Gerson Lehrman Group, Guidepoint Global, LLC, Axial Ventures, and Teva Pharmaceuticals; and is CEO of DASIO, LLC. Dr. Dawson has received book royalties from Guilford Press, Oxford University Press, and Springer Nature Press. In addition, Dr. Dawson has the following patent applications: 1802952, 1802942, 15141391, and 16493754. Dr. Dawson has developed technology that has been

licensed and Dawson and Duke University have benefited financially. Dr. Howard has served as an advisory board speaker for Roche.

Funding

We acknowledge funding from NICHD 1P50HD093074, NIMH 5K01MH104370, and NIMH 1R21MH120696.

Consequences of SAR-CoV-2 (COVID-19) Pandemic on ASD Epidemiology

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The population effects of the SAR-CoV-2 pandemic are far reaching, providing unique opportunities in autism epidemiology to investigate environmental, psychosocial, and genetic mechanisms in autism over the life course. The pandemic, however, is impacting our research capability and possibly its future course.

The pandemic has direct relevance to two large research areas in autism epidemiology: immune dysregulation and air pollution. ASD epidemiologists have considered investigations of air quality and ASD *via* a global natural experiment involving sharp declines in air pollution due to world-wide stay-at-home orders. Similar to work in Beijing before, during, and after the 2008 Olympics, epidemiologists will 1 day be able to track the incidence and presentation of ASD across the time span of this natural experiment. However, unlike the Beijing Olympics, air quality changes coincide with the spread of a highly infectious virus with quite variable physiologic effects, ranging from mild to serious, often fatal, illness following a massive immune response. Given known neurodevelopmental consequences of other viral infections (e.g. Rubella, Herpes Simplex, Zika) during pregnancy, there could be neurodevelopmental consequences to SAR-CoV-2 exposure, and such exposure has been reported in 15% of pregnant women at delivery [Sutton et al., 2020]. While effects of exposure to air pollution toxicants might seem distinct from infection, the two risk factors actually share at least one etiologic mechanism hypothesized for ASD - maternal immune activation during pregnancy [Bilbo et al., 2018]. Thus, competing ASD risk factors could be occurring simultaneously, requiring strong multidisciplinary expertise to measure and extraordinary analytic care to disentangle.

Equally important in the pandemic is the psychosocial stress arising from fear, social disruption and shocking socioeconomic uncertainty, likely affecting persons with

autism and their families beyond perinatal exposures. A life course epidemiologic approach will be needed to study a multitude of possible effects, such as sudden removal of services impacting the developmental trajectory for children with ASD. Heightened psychosocial challenges may lead to elevated personal and family stress and physical and mental comorbidity, including suicidal behaviour. The long-term consequences of the social, psychological and physical hardship on the global pandemic scale are unknown, but can be glimpsed in epidemiologic studies of the long-term effects of large scale-famine and war [Heijmans et al., 2008; Susser and Lin, 1992; Zimmer et al., 2018].

ASD epidemiology, prior to Covid-19, had productive collaborative cohorts and population registry-based research teams working on both environmental and genetic hypotheses. With the pandemic, in-person data collection, bio-specimen collection, and research travel has been stopped or suspended. Some collaborative efforts, even when based on existing data, have been disrupted when data access requires on-site presence. Sequencing and other -omics laboratories have paused or decreased capacity. Training programs have been affected, potentially limiting new researchers entering the field. Compounding these professional challenges, many researchers are juggling family care with reduced capacity to carry out research, even remotely. Finally, the funding landscape is uncertain given the pandemic's economic toll and the need to divert finite funds towards pandemic response and recovery. Consequently, the rate of research productivity for heavily impacted ASD epidemiological studies will likely be diminished for an unknown duration.

On the other hand, the research infrastructure in response to the pandemic has mobilized to assess child development effects and offering an unforeseen opportunity to advance our understanding of the often-overlapping causes and consequences of adverse neurodevelopment, including ASD and related phenotypes. The ultimate challenge will be to build upon the knowledge we have gained from population-based research into the causes of ASD and the challenges facing persons with ASD and their families to address new and compelling research questions linked to the pandemic which can only be addressed with a public health perspective.

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- Impact of COVID-19 on Autism Research: Reflections from Alabama**
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Research in Alabama has been hit hard by COVID-19 related “shelter in place” orders in the State, as is the case across the world. While writing this commentary, the number of reported cases in Alabama is 20,054, with 688 dead (Center for Disease Control COVID-19 Data Tracker). Although reopening has begun, cases continue to rise across this largely rural (82% of counties, ADPH) and high-risk state (i.e., age and poor health status). Universities and colleges in Alabama were moved to limited business or closed in mid-March, and affiliated ASD research laboratories across the state have experienced several operational roadblocks. Alabama has limited ASD services and existing intervention programs, thus research is one of the few avenues for families to join interventions. COVID-19 has significantly impacted the progress of grant-funded research and prohibited many families from receiving services and intervention *via* research studies. In addition to stalled data collection of funded projects, states closing and reopening at different times will result in asynchrony in multisite research projects. Families describe how the virus upended the routines and lifestyle of their children and report exacerbated anxiety, interrupted progress on social skills training, and language development, and regression in adaptive functioning. Thus, some studies

have transitioned research and parent-mediated intervention to telehealth, though, according to the US Federal Communications Commission (FCC), an estimated 35% of Alabamians lack broadband access, which limits research opportunities among rural families. Data loss is also significant, with parent fidelity reduced due to families experiencing increased caregiving and implementation of school curriculum at home. Several laboratories have shifted to consider online pilot/preliminary data collection, with adjustments requiring substantial additional effort, including IRB amendments, developing online surveys, etc. amidst limited and restricted university operations. Other indirect aspects (e.g., the nature of research meetings, lack of childcare) have affected the pace of research and research productivity. Impact on university finances and operations has resulted in freezes in recruitment, hiring, spending, and travel affecting research. Within functioning research projects, potential participants' safety, comfort, and ability to participate is variable. Without graduate or undergraduate trainees on campus, the research workforce is reduced, halting and/or delaying project elements, including large-scale data processing, testing participants, and scoring clinical data. Students relying on data collection for degree-earning projects are late in meeting milestones towards graduation. Clinical training has been paused, negatively impacting completion of research reliability on gold standard measures for ASD and the overall development of clinical skills in diagnosing ASD in the community. Although the challenges have been great, there have been unexpected benefits of this hiatus in human subjects research. Research teams utilized time in lockdown to refine data management and analysis, coordinate team procedures, and prepare the dissemination of manuscripts of research findings. Alabama researchers have strengthened networking within the state and across the country to share innovations and solutions to support individual and shared research goals. Finally, research teams and their institutions have been forced to explore alternative strategies for research, which may result in improved family-centred research (e.g., reduced travel time gained by telehealth) post-COVID.

The Consequences are only Beginning to Ripple Through the Autism Research Community

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There is no shortage of problems that this pandemic has caused, and the consequences are still only beginning to ripple through the autism research community. I direct a human social neuroscience lab, and the majority of our research requires face-to-face interaction, by design, and/or utilizes specialized equipment (e.g., eye tracking,

fMRI). Because of this, many of these studies cannot easily be adapted for virtual testing. I also direct our university's neuroimaging research facility, and all scanning has been paused since mid-March, disrupting research progress and impacting future plans. I am especially concerned about the particularly severe and potentially lasting consequences for longitudinal projects.

As we all adapt and develop procedures to ensure the safety of our participants, students, and staff, we can only hope that research is able to return to pre-pandemic levels sooner rather than later. One of the big unknowns is the willingness of participants to come into the lab as states continue to open up and as universities resume and expand human subjects testing. Our research cannot continue without participants, and I worry their continued participation is in jeopardy for the foreseeable future.

At the same time, although data collection has stopped, research progress has not. In our lab, we have concentrated on analyzing our existing data along with publicly available neuroimaging datasets (e.g., ABIDE, NDAR, ABCD). There is no shortage of data available, nor analyses to be run. We have also been developing new projects that involve minimal or no face-to-face interactions and have been fostering new collaborations with colleagues at other institutions. Perhaps most paradoxically, these colleagues suddenly feel a whole lot closer, maybe because even our close colleagues are now physically distant, and remote interactions have become the norm.

So, while ongoing autism research has certainly been affected, new opportunities and scientific progress will arise from this and science, including autism research, will continue to advance.

An Opportunity to Think Creatively and Learn from Individuals with Autism and Their Families

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COVID-19 has threatened the status quo of our daily lives as well as many facets of autism research – clinical, neurobiological, medical, to name a few. Yet, if we can think creatively about how to connect with and learn from individuals with autism and their families at this time, we may also have an unprecedented opportunity to learn how stress, mental health comorbidity and autism intertwine. In particular, it may be critical to examine similarities and differences in the ways in which individuals with autism are impacted by, express and respond to acute and chronic stress in the short and long term. In the past decade, a focus on mental health comorbidity in autism research has helped us better understand heterogeneity in autism while enhancing available treatment options and quality of life for those on the spectrum. Though

acute and chronic stress are known causes of psychopathology, the extent to which they contribute to the high rate of mental health comorbidity in autism is unclear and understudied. As we move forward in autism research during the COVID-19 crisis, there may be a unique opportunity to address this gap and potentially to innovate how we conceptualize and treat mental health conditions in autism.

Coming Together in This Time of Need: Reflections from Africa and Utah

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I spent a month in Africa in August 2019. I had my temperature checked at local airports and land border-crossings. I wore protective clothing and took anti-malarial medication every day. I got tangled up in mosquito nets every night. I hiked near the border of the Democratic Republic of Congo (DRC) where Ebola was still an emergency and outbreaks of polio were occurring. I spent time in 3 rural clinics because of a broken leg. I observed mothers and fathers with their very ill children, people languishing on the Clinic steps waiting to be seen, and charts on the Clinic walls recording cases of Malaria. I was, for that month, in the midst of highly prevalent serious infectious diseases that people in other countries live with (and die from) on a daily basis. I realized *the World* was my home. We are all inter-connected. And when I described autism to our uniquely gifted Maasai guides, they said, yes, the children are there.

In late February 2020, I spent 10 days with the now grown-up children participating in our autism research at the University of Utah. The 100+ young people with ASD were once again generously volunteering their time, being scanned and assessed for the 6th wave of our 20-year longitudinal study. I met with mothers and fathers very concerned about their children with ASD, adults with ASD languishing rather than flourishing in life, and reviewed data describing the large proportion of individuals with persistent severe functional impairments. I read about the Coronavirus outbreak in China and the *potential* risk to the rest of the world.

Two weeks later, on March 13th, we stopped all participant scanning and on-site assessment because of the COVID-19 emergency. Five days later, on the morning of March 18th, my cell phone alert buzzed: a text from the University of Utah announcing a magnitude 5.7 earthquake just outside of Salt Lake City: Drop, Cover, and Hold On! The World is our home, and the instabilities and uncertainties of the larger World are now here.

Our research team quickly and flexibly shifted work to home, in-person assessments to phone interviews, expanded electronic data collection, and shifted our predominant focus to data analysis, with the hope of completing MRI scanning in the future. Dr. Erin Bigler is working to convert neuropsychological tests to reliable online platforms. Spread across four universities for the past 20 years, we are used to working together in an integrated, highly collaborative manner.

In the midst of the COVID-19 Pandemic, we have reflected on our research responsibilities. Do what we can to keep our participants safe. Scientifically, go after the most important questions that need to be answered. Develop new methods of data collection that will be minimally disrupted by future unexpected events. There is a new urgency. With the still mammoth research challenges autism presents, should we learn from the Maasai people of Maasai Mara, and *Come Together in this time of need* to elucidate ASD biology and empower and create opportunities for people with autism?

COVID-19 and Autism Research: Revealing Gaps and Convergences

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COVID-19 has exposed latent fault lines and points of convergence in the study of social competence in autism spectrum disorders (ASD). Most notably, experiences of mandatory isolation highlight how little we know about how individuals with ASD experience – and are impacted by – social isolation [den Houting, 2020]. Indeed, we know very little empirically about the real-world social behaviours of those with ASD, particularly patterns of isolation. COVID-19 has accelerated the move towards innovative, *in vivo* methodologies to capture these data directly, including ecological momentary assessment [Gerber et al., 2019], and digital behaviour logs. We likewise know little about whether and how virtual social behaviour can be a substitute for live interaction in both demands and opportunities. Additionally, the diversity of interaction types must be operationalized. Playing online games, being in a Zoom chatroom, texting/messaging, and posting on a Facebook page are all likely to be very different in terms of the functions they serve and the needs they meet; we must understand what role these play in supporting the social needs of those with ASD. Finally, COVID-19 causes us to reflect on how to assess the experience of transition back to “usual” social life for those with ASD, especially when that experience may represent fewer or different opportunities relative to peers.

COVID-19 has also afforded opportunities for unexpected inversions of how we typically think about questions of social behaviour and cognition in those with ASD. For instance, while most individuals with ASD are likely – like everyone – struggling as a result of the compulsory isolation experience, some may be able to cope with (or even benefit from) some elements of isolation due to reduced social and executive functioning demands presented by stay-at-home orders. For instance, an individual who typically requires special work accommodations for reduced in-person hours may experience a more level playing field when everyone is working from home. We should take this opportunity to better understand potential unique adaptive strengths of those with ASD. Relatedly, COVID-19 offers a unique opportunity to learn more about what is and is not atypical in processing social information among those with ASD by examining the challenges typically-developing individuals are now facing. For instance, in burgeoning lay discussions about “zoom fatigue” [Degges-White, 2020], hypotheses abound about how this may arise from difficulties processing faces in an unnatural way, the requirement of using top-down mechanisms to engage with social cues, and difficulties keeping up with social stimuli that “feel” out-of-sync. Upon inspection, many of these hypotheses appear quite close to those we typically make *about* those with ASD and their challenges with processing social information. It is possible that the experiences typically-developing people are now facing (figuratively and literally) are more like those experienced in the daily life of those with ASD. If so, this should be detectable, and is worthy of careful study, as it may help us better understand the many ways in which we are alike – rather than so different – when faced with a myriad of social demands for which we feel unattuned and underprepared.

Acknowledgements

We acknowledge relevant funding from NIMH 1R01MH110585, 1R01MH114906, and the Stony Brook OPR COVID-19 Seed Grant Program.

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Research on Adults with ASD: Making Some Lemonade from the Lockdown Lemon

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Research everywhere has been disrupted by the limitations imposed by the need to reduce the spread of COVID-19. At my own university, clinical research enrolment was halted, except for already enrolled patients who might be harmed by the sudden stopping of trials. In my lab, the lockdown came just as we were about to begin a trial of a new therapy for social anxiety in intellectually able adults with ASD. The inability to start the research was both frustrating and disappointing, especially for trainees.

With the halting of the laboratory research, our lab has pivoted to an adapted protocol using telehealth as the medium of delivery. Given the current wide use of telehealth services, it is worthwhile to determine whether telehealth is comparable to face-to-face modalities in treatment of mental health conditions in adults with ASD. This new arm of the research seems to be working nicely and will actually add a useful comparison to the original research plan, which uses new virtual reality (VR) technology.

Psychotherapy delivered through telehealth has been found to be as effective as treatment as usual in a number of studies (e.g., Scogin et al., 2018). In our experience so far, all but a few autistic adults have been receptive to the use of telehealth. One individual has sensory sensitivities to screens and is uncomfortable in that modality. Another lacks access even to a smart phone, and must participate in the protocol by phone (audio) only. These experiences remind us that while telehealth opens opportunities for many to receive services more easily, it presents barriers to others, who may be disadvantaged by this modality.

From the researcher's point of view, the most difficult aspects of delivering the manualized treatment have been those connected with technical problems, whether at the participant end or the therapist's: slow internet connection speed or failures, limited capacity equipment such as phones, and the need for instruction in using the video-conferencing software. For research on participants with ASD, in particular, the limited window often prevents observing behaviours such as gestures, and poor lighting may reduce visibility of facial expressions. For research on social anxiety, the interposition of the screen between participant and therapist has unknown and possibly variable effects on the relationship between the two.

As this is written, my institution has begun to open up clinical research again, but it remains to be seen how comfortable my adult research participants will be with

coming into the lab. The mandatory wearing of masks may well render certain observations impossible, and may also affect the research itself in unknown ways. However, if as it seems the future includes increased use of remote and virtual interactions, we will need to know their effects on both research participants and the research itself.

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COVID-19 and Scientific Conferences

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COVID-19 presents many challenges for scientific endeavours, including autism research. One of these is that scientific meetings have been cancelled worldwide, including the International Society for Autism Research (INSAR) 2020 conference slated for the first week of May 2020 in Seattle. In response, INSAR and other scientific societies have quickly moved to make conference content available through webinars and other “virtual conference” programming. INSAR 2020 virtual webinar, for instance took place on the 3rd June 2020. It had approximately 2000 attendees and a recording of the meeting is now freely available on the INSAR website. The shift to virtual conferences has occurred as a problem-solving response to a public health crisis. However, as is often the case, problem-solving leads to new ideas and perspectives that are unanticipated. In this case COVID-19 has accelerated the process of considering the costs and benefits of the traditional “conference” model to achieve the sharing of research findings, networking, and serendipitous interactions essential to the vitality of science and scientific societies [Goodman et al., 2020; Lindeblad et al., 2016].

The benefits of conferences are well known to members of INSAR and other societies [Sohn, 2018]. They offer an annual event that is engaging and informative. For students it is a uniquely important opportunity to step beyond the boundaries of any one research training program to develop an identity within a large community of peers and established scientists. For the latter it is an especially important opportunity to keep abreast of new information and engage in structured and impromptu interactions that lead to new ideas and collaborations. Thirdly, conferences provide an event that raises the

visibility of a science in ways that, hopefully, also have a positive impact on society. All of those benefits are difficult to replicate in other media.

However, the flaws of conferences are also clear. No matter where a conference is held in the world, inequities arise for a very large number of students and scientists for whom travel to the conference is too costly, takes too much time and effort, or is complicated by nation to nation travel restrictions. Moreover, climate change and the carbon cost of airline travel can be a disincentive for distant conference attendance for students and scientists. Of course, conferences can also be overwhelmingly stimulating for many attendees. Including more web based streaming of content provides one response to these problems that INSAR and other scientific societies have been considering, but will likely move forward with more rapidly because of the impact of COVID-19.

This could have many benefits for more global dissemination and sharing of science that benefits students and scientists world-wide [Viglione, 2020]. It can provide more opportunities for researchers world-wide to benefit from conference content, but can also provide researcher with the option to “stream in” to attend, present data, and answer question at a conference. INSAR experimented successfully with the latter in the 2020 INSAR Regional Conference in Chile. Of course, with any change comes with new questions and issues to consider. For example, would streaming content reduce attendance at a conference? Would conference programs become decentralized and involve content from panels that are streamed from different points in the world. Would streaming conferences become smaller but more frequent events throughout the year? COVID-19 and technology have ushered in the need to think about new paradigms for scientific conferences. In 2020 subsequent conference we will begin to explore these paradigms, and they will likely be fully realized during the careers of the current generations of students and early career scientists.

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Impact of COVID-19 on Animal Research

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The impact of COVID-19 on animal-based research related to autism spectrum disorder (ASD) will be multifaceted. Clearly, response to an international pandemic must take precedence over pre-clinical research that will take some time to translate into humans who are at risk now. There are, however, long-term consequences that bear consideration. We have already experienced the loss of time in our experiments stopped due to COVID-19. In preparation for this pause, mouse colonies were reduced to only save critical lines. Ramping colonies back up means waiting months for test subjects to be old enough to use in experiments. Thus, a two-month pause on benchwork is at least a four-month loss, if not more, in data collection. Further delays will occur due to benchwork being conducted under social distancing practices.

As researchers, we have been crafty in our endeavours to stay productive. The time away from the bench has allowed us to analyze data sets that have sat on shelves as “rainy day” projects. These data sets are perhaps less exciting, but at least we can finally see them through to publication. We have also considered the early publication of studies that are incomplete, a consideration made in the context of a long delay in completion. The decision to publish these incomplete studies hinges on hopes of future funding and a desire to share results with the broader community.

We have also used the time away from the bench for grant writing, although the future of ASD funding, or funding of any research, seems uncertain. Clever researchers have already pivoted toward looking at the impact of COVID-19 during pregnancy on the neurodevelopmental outcomes of offspring, a logical pivot for research on disorders of neurodevelopmental origin. This potentially represents a shift of much research on neurodevelopment and ASD toward maternal immune activation models.

Perhaps the most concerning impact of COVID-19 within the realm of animal research is the potential loss to the field of trainees, early-career faculty, and even more-established researchers whose research enterprises exist hand to mouth, like many people who are vulnerable to COVID-19. The U.S. National Institutes of Health (NIH) and other funders internationally have provided reassurance that researchers' efforts will still be covered if researchers are unable to do precisely what was outlined in a funded grant proposal. This does not mean, however, that more money will be provided to do the work when we are able to be back in the lab. Research funding is attached to projects and cannot be built up in a reserve account for times of need. For early-stage researchers on fellowships or career development (K) awards, this is particularly problematic and could result in people deciding that their goals are no longer attainable. We need

to think now about how to sustain researchers and labs whose expertise would not take months to replace, like our lab animals, but years to bring back, potentially resulting in a generational loss to autism research and a delay in our understanding of pathophysiology and downstream intervention.

How COVID-19 Could Shape ASD Genetics Research

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There is no doubt that modern genomics has made an enormous contribution to our understanding of the pathology, development, and evolution of devastating diseases such as ASD and now COVID-19. While deciphering the genetics of a human disorder such as ASD is an ongoing process that started two decades ago [Buxbaum et al., 2012], in the case of a viral disorder such as COVID-19, researchers have been able to generate the sequence of the full viral genome within days, develop test kits within weeks, and line up candidate drugs and vaccines in clinical trials within months. This unprecedented rapid progress was the result of unrestrained collaborations between different fields of science.

COVID-19 has brought collaboration between scientific communities across the world to produce the highest calibre of population-level research like never before. The rapid growth of data repositories and standardized resources developed and shared by diverse scientific communities through this time of COVID-19 can, in turn, help advance ASD studies as well. And those of us carrying out genetic research should pay attention to lessons that can be learned from these approaches. The field of ASD genetics has been generally cooperative with investigators contributing samples to increase sample sizes of large databases and promote data sharing (Buxbaum et al., 2012; Feliciano et al., 2018; Fischbach et al., 2010; Lajonchere et al., 2010; Yuen et al., 2017). However, the scale of fruitful international collaboration is unparalleled in the realm of ASD genetics. For example, there is still much more to know about the possible interplay between disease-related variants and environmental factors in modulating ASD risk among populations in many parts of the world. The positive environmental effects of behavioural changes in response to COVID-19 might have downstream epigenetic effects on ASD risk. In contrast, there might be unknown deleterious epigenetic effects during foetal development with exposure. Both of these potential scenarios can be studied in the upcoming years by those scientists carrying out epidemiological studies of ASD. Our home state of Texas has been relatively less affected (for now) by COVID-19 compared to other US regions. It would be interesting to determine the longitudinal, population effects on how ASD-risk is altered at the epigenetic

level in a post-COVID environment in a region like Texas *versus* other regions in the US.

The immunology and neuroscience fields both study heterogeneous populations of cells, the distinct molecular mechanisms within different cell types, and genetic and environmental factors involved in relevant diseases. In having common fundamental issues regarding cell types and methodological approaches, the genomics knowledge and tools used in both fields have been universally beneficial, enabling both fields to co-evolve. As knowledge of diverse symptoms associated with COVID-19 increases, the need for precision medicine becomes more imperative. Accurate assessment of the genetic risk architecture of each person may be ultimately beneficial for a diverse patient population. Such an approach is what the ASD field is currently striving for and what COVID-19 patients also desperately need.

In summary, the ongoing lessons of how the scientific community can rally to understand and fight COVID-19 should impact our “battle” with ASD. These lessons are not just for the diseases we are currently facing today but, for also for those that await us in the future.

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While the World Around Us has Changed Dramatically, the Needs of Families Grappling with Autism Have Not

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While all families are struggling to adapt to the “new normal” of distance learning, children with autism who need stability and insist on “sameness” are finding their routines completely upended. Special education students, many of whom have severe behavioural issues and are used to

working 1-on-1 with a highly trained teacher, are now at home with their parents. Adults with autism can no longer go to their workplaces or access needed services. Physical therapy, occupational therapy and social skills training protocols are hard to replicate on zoom.

Supporting families and adults with autism is crucial, but at the Autism Science Foundation (ASF) we are paying particularly close attention to another important stakeholder group - autism researchers. With laboratories and universities shuttered, the research world has changed overnight, and many talented scientists are in limbo as they try to make sense of how to continue their important work with limited facilities and without access to people with autism to participate in clinical trials.

The ASF recently launched a new funding mechanism, called Pivot Grants, to help research teams modify existing studies or to launch new ones directly related to the pandemic. The expedited grants will go through a rapid review process; scientists have been forced to adapt on the fly and we want our funding mechanisms to match this nimbleness. ASF also hosted a “virtual research fair” that brought families and scientists together to talk about studies that families can participate in online from home. A recording and associated powerpoint slides are available on the ASF website. We also hosted a “Research Re-Group” webinar for early career investigators and have created a facebook group called “WE-CARE” (Workgroup for Early Career Autism Researchers) so that they can continue to interact and share ideas and best practices as they move through COVID-19 challenges. These materials are also available on the ASF website.

One ongoing concern we have is around our ability to raise money to support autism research in this challenging environment. Right now the world is full of “needs” and we have been reluctant to seek donations from our families as they are struggling not only with autism, but with illness and unemployment. We see this as a time for us to give back to our family and scientist stakeholder groups, and to provide needed resources. We’ll resume fundraising when this crisis is over.

Finally, I missed seeing all of you at INSAR. It’s the first time in over 15 years that I have not spent the first week of May with the smartest, most-dedicated scientists in the world. I look forward to seeing all of you in Boston in 2021!

Autism Research in the Time of COVID-19

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The University of Washington Autism Center, located in Seattle, has faced first-hand the challenges of the COVID-

19 outbreak, as a training and research centre that also clinically serves the broader community of autistic individuals and their families. The slowly emerging information about COVID-19, in many ways, did not keep pace with the urgency at our centre to make immediate decisions about clinical service needs and research protocols. Decisions about how research procedures, including behavioural assessments, MRI, eye tracking, and EEG, should be modified to protect participant and staff safety were made incrementally and, at first, with minimal guidance. Fortunately, in making these difficult decisions, we have had the full support of our broader institution, families, and staff.

Two weeks before Washington State's "Stay-Home, Stay-Healthy" order by Governor Inslee on March 24th, 2020, we quickly brought all in-person clinical and research activities to a stop, prioritizing public health and giving ourselves time to strategize about how to move forward with research goals and clinical services in a rapidly changing landscape of health guidelines, social norms, and individual family and staff needs. Telehealth clinical services were implemented within weeks, surprisingly beneficial to many but sometimes leaving younger and minimally verbal individuals with inadequate support. The pandemic posed particular challenges to our ongoing research and forced innovative approaches to adapt to these new circumstances.

As part of a broader Infant Brain Imaging Study (IBIS) NIH ACE network, we are engaged in longitudinal research studying early brain and behavioural development in siblings of children with ASD, who themselves have elevated likelihood of developing ASD. Addressing our research questions requires continued adherence to strict age-windows for our assessments because, at 6, 12, and 24 months of age, brain and behavioural development unfolds rapidly. Public health and university guidelines required developing a new remote data collection protocol. Shifting to phone interviews and on-line questionnaires has allowed continued recruitment and longitudinal assessment of families already enrolled. Importantly, this has also positioned the network to rapidly resume in-person brain and behavioural assessments when the pandemic subsides. Additionally, we are using this opportunity to fine-tune systems that are integral to our research, including our databases and data quality control. New avenues to assess the impact of COVID-19 have also been implemented.

Although this time of pandemic has brought many (many) challenges to the families that rely on us for direct clinical services, to research families who rely on us to monitor the development of their young children, and to our staff, who like many others have found themselves juggling home-schooling with working from home, there have also been bright spots. As a clinical team and research network, we have come together more frequently to strategize, albeit remotely,

and have strengthened our working relationships through facing this COVID-19 challenge together. Adaptation is what humans do best, and this is how we are working to move forward as researchers, as an autism community, and as a society.

Effects of the COVID-19 Pandemic on Research with Early Intervention Providers and Families

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Our research aims to improve outcomes for toddlers with suspected ASD by increasing their access to evidence-based ASD intervention within the Part C Early Intervention (EI) system. Part C is a publicly funded program across the USA serving toddlers from birth to age 3 with developmental delays or disabilities. EI providers typically work directly with toddlers and their caregivers in their "natural environment," which is most often the family's home. Our clinical trials provide training to EI providers in the use of a naturalistic developmental behavioural intervention and measure its effect on toddlers' social communication development.

The pandemic, and resulting need for social distancing, has had a major impact on the manner in which EI providers interact with families as well as on our own ability to collect and interpret research data. EI providers no longer work directly with families; instead they conduct "virtual" home visits (for those families with Wi-Fi access). Likewise, we clinical researchers (who place great stock in measuring toddlers' social-communication behaviour through face-to-face interactions) have stopped conducting in-person evaluations for our ongoing studies.

Enrolment of EI providers within the original study timeline is difficult, as many are struggling to learn how to interact with families online and as well as dealing with personal issues related to child care, home schooling, and/or COVID-19-related health and financial concerns. The implications of these changes for adhering to study protocols are enormous; data collection time points are now asynchronous across study conditions, standardized interactive measures for endpoint diagnostic evaluations cannot be used, and new training models that do not involve face-to-face workshops must be developed.

However, if we shift our focus from a "micro" to "macro" lens, we may discover that COVID-19-related challenges also bring some unique opportunities. For example, now may be the time to pivot our attention and efforts toward the expansion of web-based distance learning models. This technology has shown promise for maximizing dissemination and scalability for training providers and parents on evidence-based practices, as well as for addressing health disparities associated with the lack of access to ASD-specialized services in

rural and traditionally medically underserved areas. Whether or not social distancing will become the “new normal,” why not take this opportunity to adopt telehealth more broadly and embrace the benefits that it can confer? Our lab’s first step toward this end is to collect qualitative data to identify providers’ and families’ current goals, needs, and “pain points” as they transition to virtual sessions. In applying this user-centred approach, we hope to make enhancements to current tools and training curricula to improve the way that intervention services and assessments are delivered remotely, and more broadly, to families in need.

Closing Down Our Research Programs in Boston

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The doors of our Center for Autism Research Excellence (CARE) at Boston University closed on March 18th 2020 and a week later we snuck in one last toddler with ASD who was taking part in an ongoing randomized controlled trial for post-intervention testing. Since then all the students, post-docs, and staff have been working from home, doing their best to keep the momentum going by continuing to train, plan, code, and devise research projects using data that have already been collected. Despite these efforts the impact of COVID-19 on our work at CARE, which includes five large-scale active research programs, has been devastating.

The most significant impact has been on our families. In addition to the ongoing randomized controlled trial mentioned earlier, we have two more intervention studies that were on the cusp of enrolling families seeking novel behavioural treatments for their children and adolescents with ASD. Now these families’ lives have been completely upended and they are isolated with minimal supports and education for their children. For these families COVID-19 means the loss of unique opportunities to partner with us to explore the efficacy of interventions that could make a real difference in the lives of their children with ASD.

Closing our lab means that some of our studies will be delayed, others put on pause, but the most significant impact may well be on our longitudinal study of brain and behavioural development of infants at risk for ASD. Longitudinal research is intensive and unforgiving. The schedule of visits timed closely around the infants’ ages means that during this period when we cannot see our participants we will have missing “data points.” These are accumulating at an increasing rate now and even with our attempts to patch the study with newly designed remote data collection, which required substantial time to go through institutional review board (research ethics) approval, we will only be able to collect some behavioural data (substituting parent report measures for most of our direct observational methods) and will still have a substantial gap in our EEG data set. This may

end up costing us the ability to analyze our data using growth modelling approaches, which have shown the most promise in our prior work.

A final major concern that keeps me up some nights is the effect that all of this will have on my doctoral students and post-docs. All but one is depending on our ongoing or planned new data collection for their dissertations and research training. What will happen to them now with our lab closed perhaps for several months? Will they be able to recover from this waiting game? Will there be support for them when this is over to allow them to extend their training for another year or two?

There is no doubt that COVID-19 has been a major and immediate setback on our research. There is great uncertainty about if and when families will be willing to return to CARE; understandably their top priority must be to protect their health. Looking to the future, what will be the longer-term impact of all that we are going through on autism research? Shutting the doors of labs in Boston and around the world for a few months may ultimately translate into setting back the progress we are making in autism research for years to come.

Considerations for Conducting Telehealth Research with Latino Children and Adults with ASD in the US

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The COVID-19 pandemic halted access to intervention services for countless individuals with autism spectrum disorder (ASD). However, shortfalls in ASD service access existed prior to this crisis, particularly among Latino families in the United States. Multiple cultural, linguistic, and socioeconomic factors affect when and if individuals in Spanish-speaking households access quality ASD care, including: differences in parenting views, availability of Spanish-speaking providers, transportation or employment challenges, access to information about ASD, and health insurance coverage [Stahmer et al., 2019]. Telehealth models for ASD offer promising solutions for closing the gap faced by Latino families, gaps that are now intensified by COVID-19 [Juárez et al., 2018]. As more professionals adopt telehealth, the research community has an opportunity to strengthen this tool for Latino families of children and adults with ASD. Here, we outline several considerations for providing telehealth services to culturally and linguistically diverse families as we work together to bridge these disparities [Bernal, Jiménez-Chafey, &

Domenech Rodríguez, 2009; Juárez et al., 2018; Kaonga & Morgan, 2019; Langdon, 2009; Stahmer et al., 2019].

Rapport. In the absence of face-to-face interactions, pay special attention to rapport-building. Establish credibility by showing licensure to families; invite the whole family to participate, encouraging them to brainstorm how they would like to be involved; make friendly small talk before and after sessions; clearly explain the roles of participants in the context of telehealth, including any interpreters; use moderators to manage online groups; check in with families through phone calls; and genuinely listen to family's perspectives with an open mind about cultural differences.

Language. Provide services in the preferred language through a bilingual provider or interpreter. Help the family make well-informed decisions about the bilingual development of their child with ASD, noting that exposing children with ASD to two languages is not detrimental and carries many possible benefits.

Dissemination. Ensure that information is family-friendly and explained in multiple formats to increase understanding. Brainstorm creative ways to virtually disseminate information, such as through the community's TV, radio, or social media. Consider eHealth literacy and the benefits of a "navigator" who can help families manage technology and search online material.

Support. Diverse families have reported feeling isolated due to the cultural stigma of ASD, feelings which are likely exacerbated in the age of social distancing. Provide resources that will raise awareness about ASD and help families feel connected, such as online support groups and hotlines.

Technology. Offer several options for service provision, ranging from low tech options, like phone calls, to more advanced technology, like teleconferencing, games, and phone apps. Explain to families how their confidentiality will be protected and ensure that the technology is reliable.

Scheduling. Offer telehealth sessions at flexible times to accommodate families' work and childcare schedules, including shorter or pre-recorded sessions that families can access at their convenience.

We hope that the research community will view the COVID-19 pandemic as a time to establish strong telehealth practices for Latino families so that, as in-person practices are reintroduced, the telehealth model can remain in place for families who would otherwise struggle to access high-quality ASD services.

Acknowledgments

We acknowledge funding from the National Center for Advancing Translational Sciences, National Institutes of Health, through Grant Award Number UL1TR002489. The content is solely the responsibility of the authors

and does not necessarily represent the official views of the NIH.

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Challenges of Conducting Longitudinal MRI Studies in the Time of COVID-19

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Our research team, comprised of multiple faculty members, postdoctoral fellows, and research assistants, collectively made the decision to pause our research involving human participants on Friday, March 13 2020. The state of California issued a shelter-in-place order less than one week later. In hindsight, the ominous date marked the beginning of a roller coaster ride in terms of research productivity, and it is not at all clear yet how this wild ride will end.

Our research program revolves around the UC Davis MIND Institute Autism Phenome Project (APP), a large-scale longitudinal study initiated in 2006 that involves neuroimaging and comprehensive behavioural and medical assessments in over 400 children followed at 4 time points from 2-3 years of age through middle childhood. We have enrolled children continuously over the past 14 years and thus have participants at various stages of data collection across all ages and time points. In 2014, we initiated the Girls with Autism Imaging of Neurodevelopment Study, which was aimed at increasing representation of females in the APP cohort. The cohort now includes about 100 autistic girls, with many at the late childhood time point at 5-6 years old and some aging into the middle childhood

time point at 9-11 years. More recently, we have targeted enrolment of children with the specific subtype of disproportionate megalencephaly to further explore clinical and neurobiological features of this autism phenotype.

For neuroimaging at the early childhood time points, we acquire scans during natural nocturnal sleep, and we have a dedicated team that typically scans 3-4 nights per week. For older children scanned while awake, particularly those with more severe impairments, the protocol often involves several mock MRI visits prior to attempting an actual MRI scan.

Thus far, 48 MRI scans and an additional 61 behavioural visits for 51 participants were cancelled or postponed due to COVID-19. The ramifications of these missed visits will be felt for many months after research resumes. Some children will have aged out of the time windows for longitudinal scanning, others who are travelling from further distances will face other obstacles that might make it harder for them to return for longitudinal visits. In addition, with all research studies scrambling to make up for lost time, we anticipate challenges in finding time on the scanner and assessment rooms.

The biggest challenge, however, will be in figuring out *how* to resume MRI scanning in sleeping toddlers and in older children with severe autism in a way that mitigates viral exposure risk for the child, their family, and research staff. It turns out that while shutting down research was painful, resuming research will be the more challenging task.

Still, in spite of all of these challenges, there have been some silver linings. Without the pressures of data collection, our team has had time to work on data cleaning projects and the lists of things that come up during lab meetings that should be done, but fall by the wayside due to other imminent priorities. We have also had a chance to step back to focus on data analyses and collaborative projects. And finally, without a work schedule that includes scanning sleeping children at all hours of the night, our research team has finally caught up on some much needed rest.

PERSPECTIVES FROM SOUTH-EAST ASIA

Research in the Time of COVID-19: A view from India

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We are part of an important autism project in India as work being conducted through a public health research not-for-profit called Sangath [www.sangath.in]. This work is the

culmination of a body of evidence we have been generating since 2009 around the experience of families of children with autism in low resource settings. Early qualitative work revealed the struggle of families to get evidence based services which were affordable and accessible. We responded by adapting the UK PACT intervention [Green et al., 2010] which we evaluated and expanded over two pilot trials with colleagues in the UK and Pakistan [Divan et al., 2019; Rahman et al., 2016]. The key adaptation in the *Parent mediated intervention for Autism Spectrum Disorders in South Asia Plus* [PASS Plus], was around creating a training and supervision cascade which allowed us to deliver this mechanistically informed intervention through non-specialist counsellors – a process called task-sharing [Padmanathan & De Silva, 2013]. This process addresses the barrier of the scarcity of skilled manpower in most low-and middle-income countries. Our pilot trials revealed that most families accepted a low intensity video-feedback intervention delivered by a non-specialist. The counsellor works to transfer key strategies to the parent, which when adopted mediate change in their child's social communication environment and supporting the management of co-occurring problems, making the parent their child's therapist.

The *Communication centred intervention for autism spectrum disorder in South Asia* [COMPASS] is an effectiveness-cost-effectiveness investigation being conducted in the capital New Delhi a collaboration between the University of Manchester and the Harvard Medical School. COMPASS has liaised with the state health mission and recruited and trained a small group of frontline health worker, called the Accredited Social Health Activist [ASHA] to deliver the PASS plus intervention. The aim is to demonstrate that the frontline workers are capable of delivering an autism intervention to fidelity giving low resource settings a scalable cost-effective model.

Our research trial has a number of components which the COVID-19 pandemic has affected. Prior to the pandemic, we had aimed to minimise disruptions to families and designed our evaluation battery to have home administered questionnaires, which are now being adapted to focus on primary outcomes and minimise direct contact with families. The intervention delivery itself has been interrupted since New Delhi has been in complete lockdown since late March 2020. However, the fact that the fundamental delivery methodology uses video feedback, has given us the opportunity to begin the implementation of a protocol that allows the parent to take videos of themselves playing with their child which is then used by the non-specialist during a virtual session. As we evolve to build resilience around this research; an important problem is emerging; the digital divide [Van Dijk, 2017]. The families we were hoping to reach with a low-intensity evidence-based home-delivered intervention are exactly those in whom digital access is limited;

either due to the absence of smartphones, low digital literacy or limited data connectivity.

As predictions on the pandemic suggest a prolonged course over the next few years; we as researchers are going to have to consider approaches which allow us to conduct more of our work virtually, design assessments and interventions in ways that have “direct” reach to families. But also insure that the work which we are invested in does not add to the burden on already vulnerable families.

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PERSPECTIVES FROM THE WESTERN PACIFIC REGION

Reflections on the Impact of COVID-19 on Autism Research in Australia

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At the Olga Tennison Autism Research Centre in Australia, research has been impacted by COVID-19, much like elsewhere in our region. As the virus threat increased in early 2020, physical distancing and other imposed restrictions meant that universities drastically altered their operations. Alongside requiring staff to work from home, limits were imposed on the nature and

extent of research that could take place on campuses and elsewhere. Revenue losses across the sector have also been significant. Although higher education was one of the first Australian sectors impacted by COVID-19 given reliance on international students, to date, it is one of few to not receive financial assistance from the Federal Government, with thousands of teaching and research positions at risk.

Research grants have been especially affected, with researchers employed on them unable to undertake data collection, particularly with young children where it is impossible to maintain physical distance. This has led to both delays in data collection and loss of recruited participants who move out of the eligible age-range. However, some treatment studies involving children have continued, as therapists moved to delivering parent-mediated intervention remotely. The benefits of this shift include facilitating skill generalization into the home and reduced travel. Indeed, the move to telehealth and online research will be particularly beneficial for underserved communities and those living in rural and regional areas here and elsewhere.

Participant recruitment is also impacted. With parents now supporting the remote learning of children and lost income in many families, fewer are volunteering for research. Moreover, recruitment that is reliant on the medical and health sectors has been severely impacted as these sectors face increased stress and demand. Research students working to strict timelines and international students with visa restrictions are especially impacted. Some have had to change their projects entirely, jeopardising their research progress.

Research is continuing at our Centre and elsewhere when it can be executed safely. For example, studies with autistic adolescents and adults involving online questionnaires or interviews are progressing, albeit with fewer completions than usual. However, we are exercising caution with studies on mental health and wellbeing. Given the widespread impacts of COVID-19 on the mental health of ordinary citizens, these studies are suspended until we reach “normalcy.” Legacy impacts are also of concern, as some form of restrictions are likely to remain in place for the foreseeable future while COVID-19 remains a threat.

There has also been the inevitable impact on the dissemination of research findings at conferences, particularly amongst our students and early career researchers who rely on sharing their science. Many conferences, such as the annual International Society for Autism Research meeting, have been cancelled. While opportunities to present virtually are welcome, face-to-face contact with collaborators and colleagues, and the opportunity to meet potential future employers, is especially impactful on junior colleagues. Moreover, the changing landscape has impacted researchers’ career progression, with many trying to maintain their research output and attract external funding while also caring for young children at home. Remaining competitive in the COVID-19 environment

requires scientists to be nimble, resilient, strategic and innovative which will ultimately serve to expand their future contributions to the autism community.

COVID-19 and Autism: A View from Japan

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The Japanese government announced a state of emergency over COVID-19 on April 7 2020 and partially lifted it on May 14 2020, during which time it seems that everything has changed including research activities and clinical practice in ASD field. What vulnerable individuals such as those with ASD and/or other neurodevelopmental disorders, as well as their caregivers have been experiencing in this situation remains unknown. Uncovering this information and improving support systems should be a research priority. As nationwide school closures have continued for nearly 3 months, children with ASD have lost an important component of everyday life, although some children may feel relieved to be away from school. In response to the closure, both therapeutic interventions and school education have started to be delivered online. However, many individuals who are most in need, and for whom disadvantage seems to have a vicious cycle of its own [Editorial, *Lancet Psychiatry*, 2020] may have been left behind (digital poverty) [Holmes et al., 2020]. The short- and long-term impact of the ongoing pandemic on individuals with ASD, including the most vulnerable group (with low IQ, psychiatric comorbidities) must be uncovered by nationwide research.

The COVID-19 situation simply accentuates pre-existing gaps in current autism research [Editorial, *Lancet Psychiatry*, 2020]. In the Commentary article in *Autism Research* [Amaral et al., 2019], I emphasized two points of view. First, that when treating autism, the therapeutic goal should not only be to reduce autistic symptoms themselves but to improve overall mental health, which will result in enhanced lifelong functions. Thus, intervention research should be undertaken in the context of a comprehensive mental health framework including that of caregivers. Second, a long-lasting period of confinement at home may aggravate the distress of parents of children with ASD, resulting in a deterioration in the quality of parent-child relations. Therefore, parenting programs that are easily available and target behavioural and developmental problems as well as the parent-child relationship should be promoted. For both issues, the refinement of digital technology is required for the purpose of monitoring behavioural and physiological indices, and to enable timely and interactive interventions. Given this, the efficacy of its dissemination and use in communities should be examined.

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The Need of Autism Research Using Robotics for Combating COVID-19

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Social distancing is essential to prevent the spread of COVID-19. Using robots instead of humans can help us with social distancing. Robot workers can help people feel less lonely while living in isolation. Given such potential, the introduction and use of social robots has spread rapidly in various fields such as nursing, education, and medical care.

We have conducted a lot of research on using social robots for children with autism spectrum disorders (ASD) [Kumazaki et al., 2018a; Kumazaki et al., 2018b; Kumazaki et al., 2019]. Unlike human beings, robots operate within predictable and lawful systems, and thus offer children with ASD a highly structured learning environment that can help them focus on relevant stimuli. Children with ASD have a higher degree of task engagement while communicating with robots than while communicating with human trainees, and also exhibit social behaviours toward robots [Pennisi et al., 2016]. Robots can provide consistent and continuous support even during the COVID-19 pandemic because they have the advantage of providing opportunities for these children without increasing their risk of infection. Thus, expectations for social robotics in supporting children with ASD seems higher than before.

However, using robots for children with ASD during the spread of COVID-19 also has harmful impacts. As children with ASD are required to stay at home to prevent the spread of COVID-19, this may justify their interactions with robots rather than with humans. This, in turn, can lead to the exacerbation of social withdrawal. The longstanding concern that the use of robots for children with ASD may cause them

to become addicted to interacting with robots is heightened during the COVID-19 pandemic.

During an emergency such as COVID-19, tools that have the potential to help deal with such situations attract a lot of attention. However, related concerns tend to be neglected, and this may cause serious problems, such as the addiction of children with ASD to robot interactions, causing them to interact only with robots and not humans in the future. In the field of ASD support, long-term perspectives, such as the idea that children with ASD can grow up to lead successful and independent lives, are especially important. We would like to advance research on using social robots for children with ASD while also addressing related concerns based on long-term perspectives.

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Hard Decisions will Come, But Science will Continue to Make Meaningful Change to the Community

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The immediate effect of the COVID-19 pandemic on autism clinical research has been both deep and broad. In the first instance, many clinical trials of new or existing interventions have needed to be either paused or prematurely ceased. This is an area of great research need, and among the most encouraging autism research trends over the past decade has been the considerable increase in the publication of rigorous clinical trials. The infrastructure, staffing and funding to undertake these trials can take months or years to develop, but in many cases, much of this capacity has been eroded very quickly by the ramping down of activities during the pandemic. Unfortunately, for many teams, it will not be a matter of simply restarting clinical trials once the COVID-19 threats subside, but a years long process of rebuilding trial capacity.

A related consequence is the impact on early career researchers. Momentum counts for a lot in the early phases of a research career, and standing still can often mean going backwards. There will be certainly be instances where the chances of an early career researcher securing a longer-term research career – which, of course, includes their hopes and dreams and their livelihoods – will be impacted by the significant reduced research activity caused by the pandemic. These effects may be more acute for clinical researchers, where face-to-face interaction with research participants is simply not possible during this time.

In many ways, it is likely that the immediate effects of COVID-19 will not be as large as the medium-to-long term effects. The scaling down of research team capacity, the reduced opportunities for emerging researchers, and the likely diminished research funding from grant agencies, will all contribute to a significant change in the research landscape. The challenge for both established and emerging autism researchers during this rebuild is to always keep autistic people and their family as our focus. Hard decisions will come, but by having these individuals at the centre of our decision-making, we will find a way to continue using science to make meaningful change to the community.