

Impact of the SARS-CoV-2 Pandemic on Acousticians

By Traci Neilsen and Bonnie Lau

When the worldwide SARS-CoV-2 pandemic began in early 2020, our normal routines were disrupted and life changed dramatically for most of us: schooling moved online, the fortunate started working from home, childcare options became more restricted, and online video conferencing replaced in-person meetings. In December 2020, the Women in Acoustics Committee of the Acoustical Society of America (ASA) decided to conduct a survey of how the pandemic has impacted those working in acoustics.

We designed a pandemic survey centered on five topics: 1) work productivity, 2) communication, 3) work enjoyment, 4) career advancement opportunities, and 5) dependent care. The survey, consisting of five rating questions and three open-ended questions was administered online 11-22 February 2021 and distributed through the ASA email listserv. In total, 893 responses were obtained, which are summarized in Figure 1. A breakdown of the groups responding to the survey is presented in Table 1.

In the shorter version of this report—published as a column in *Acoustics Today* <https://doi.org/10.1121/AT.2021.17.2.78>—we present general trends from the survey and highlight the groups that have been most negatively affected. Across the five focus areas, the restrictions of the pandemic have resulted in improved conditions for some participants while many have been severely negatively impacted. For a subset of participants, work and dependent care conditions have remained the same. The distribution of responses across questions were similar across career stage, gender, and employment setting (academia versus industry), with a few notable exceptions, which are described below. From the open-ended questions, we summarized several themes from the comments: 1) what we collectively have missed, 2) what has been difficult, and 3) who we have supported. We also spotlighted some silver linings and lessons that need to be remembered as we emerge from this pandemic.

The same general format is followed in this longer version, but more quotes from the survey respondents are included. These quotes—selected from more than 1600 submitted comments—capture the experiences and emotions of many during the first year of the pandemic before vaccines were widely available. We include these quotes to hopefully help us realize how different our individual experiences have been, what we can learn as we move forward, and how we can help those most negatively impacted by the pandemic.

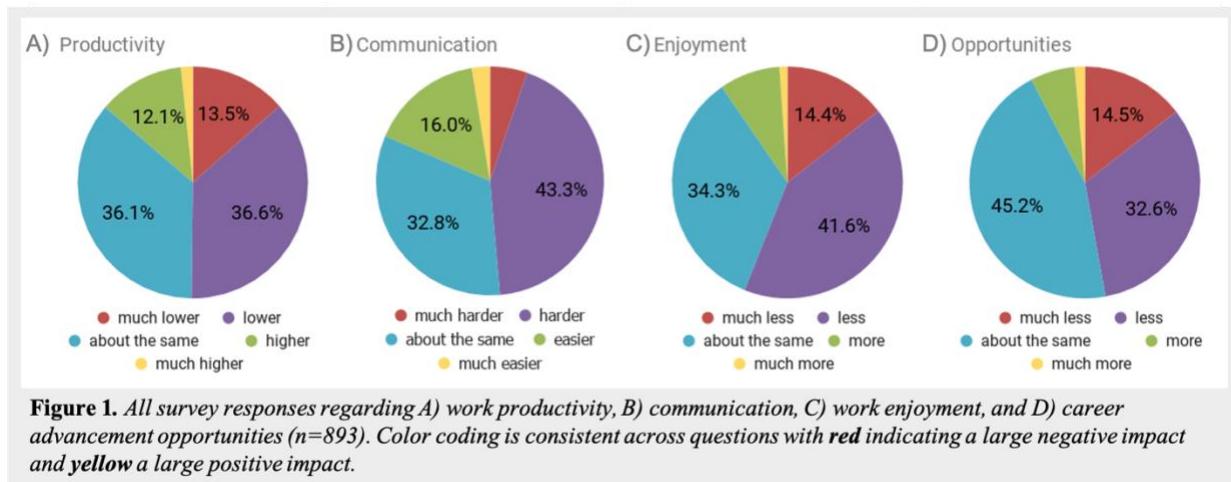


Figure 1. All survey responses regarding A) work productivity, B) communication, C) work enjoyment, and D) career advancement opportunities ($n=893$). Color coding is consistent across questions with red indicating a large negative impact and yellow a large positive impact.

Career Stage			Gender			Employment		
	%	Count		%	Count		%	Count
Student	8	65	Male	60	453	Student	8	70
Early career	13	96	Female	37	288	Academia	33.5	277
Midcareer	28	211	Nonbinary	1	5	Industry	34.5	286
Mature career	40	307	Undeclared	2	15	Other field	14	114
Retired	11	83				Unemployed	1	10
						Retired	9	76
Total	100	762	Total	100	761	Total	100	833

Although a total of 893 survey responses were received, not all respondents completed questions regarding career stage, gender, and employment.

Survey Data Results

The survey centered on five questions.

- Q1 - How has your work productivity changed due to the pandemic?
- Q2 - How has the ease of work communications changed due to the pandemic?
- Q3 - How has your work enjoyment changed due to the pandemic?
- Q4 - How have opportunities for advancing your career changed due to the pandemic?
- Q5 - How has the level of dependent care changed due to the pandemic? (consider both children and elderly or sick people you care for)

While the exact number of responses varied slightly for each question, Table 1 shows the number of responses received for the questions regarding career stage, gender, and employment. While the exact counts fluctuate for the five primary questions, the percentage in each career stage, gender category, and employment status remained approximately the same. Percentages for different categories of participants are reported throughout if they are substantially different from the overall results.

The overall results for the four questions are shown as pie charts in Figure 1. For all the questions, the colors represent the same idea: red = large negative impact from the pandemic, purple = negative impact, blue = same as before, green = positive impact, and yellow = large positive impact. The results from each question as well as comments made about the question are now provided to document the conditions of living under the first year of the pandemic.

Work Productivity

Work productivity declined during the pandemic for over 50% of the survey participants. (See Figure 1.) The career-stage subgroup that expressed the largest reduction in productivity were students, with 66% of students (n=65) reporting decreased work productivity. In terms of gender differences, 57% of nonstudent women (n=251) and 44% of nonstudent men (n=426) reported lower productivity. In terms of employment, 60% of full-time academics (n=229) reported decreased productivity compared to 42% of those employed full-time in industry (n=334).

Some survey participants continued going into their workplace with extra precautions and feel they have experienced little change during the pandemic, as described in this comment:

I work for a defense contractor, I am considered an essential employee, and I cannot work from home. My company does a good job of enforcing social distancing; it requires all employees to wear masks; it has installed touchless door openers, hand sanitizers, and soap dispensers; it sanitizes workspaces regularly; and it encourages us to use caution away from work, etc. As a result, I have missed no workdays and know very few fellow employees who have contracted COVID-19. I feel incredibly blessed that I have not suffered physically, emotionally, or financially during this pandemic. My heart goes out to those not as fortunate as I am.

Others felt they thrived, and their productivity was increased by working at home:

When I am working at home, with my dependent at childcare, I can be incredibly productive and sneak in cooking, laundry and cleaning during less crucial meetings. My ability to multi-task has greatly improved and I feel I get more done in a working day than I would in a typical office setting.

Most of the comments, however, focused on the significant changes that took place because of the pandemic. Challenges with motivation, Zoom fatigue, and mental health issues due to isolation and pandemic concerns were reported as factors impacting productivity. Productivity was particularly affected during the initial months of the pandemic. As one survey responder summarized the experience of many:

Productivity changed a lot initially because being unaware of how to manage the pandemic at first, I isolated myself significantly. From this isolation, my mental health dropped. I wasn't in the lab, so progress on experimentation stopped. Took time to figure out how to use the time effectively working on other aspects of the work.

While some found strategies to be productive working from home, many were stymied by factors beyond their control, such as restricted access to laboratories and cessation of field work and human subject testing:

All field work was cancelled, so I've been able to write more than I would have otherwise but miss collecting data and doing science!

Collaborative projects and equipment development have suffered from the inability to be in the lab together and from difficulties in building human connection.

Biggest technical challenge has been training new staff about research practices unique to our project. We have also been obliged to develop methods for remote assessment--not quite crowd-sourced but on that dimension. This was an unforeseen cost and a delay.

Doing auditory research without the control of headphones, timing, etc. on lab computers is very difficult. EEG research has stopped altogether.

Some had more comfortable spaces to work at home than others:

My home office is not very good ergonomically, which is a problem when trying to work at home for full days. I spend a lot more time working on my own, going longer without feedback. Also, I lose time just searching for the right work file--I brought home what I need but don't have file cabinets to store it in. Sounds like little things but they add up to make it harder to work, and the harder it is the less enjoyable.

My partner and I have to use the same room for meetings, conferences etc. which decreases productivity and increases extraneous noise.

Many reported significant increases in mental health challenges:

Cabin fever, depression, and issues with ADHD have drastically slowed my work and enthusiasm.

Some noted increased work productivity but with a cost.

The move to online data collection for my research has made data collection happen faster. However, it is harder to ensure data quality and other crunches on my time have made it very difficult to disseminate.

I work significantly more now working from home, and because I am also a graduate student, I feel like each day is a 10-12 hour day every day. Also, the stagnation or lack of movement on a day-to-day basis has negatively impacted my health.

Working from home, you get trapped behind the computer 16+ hours per day, 7 days a week. So, my productivity has gone through the roof. I feel I worked 2 years in one. Maybe also because of zero commute to work for the entire year and no work-related travel, no field work. All data analysis, student papers and theses, grant proposals. Extremely productive but not enjoyable.

The most common reason some noted an increase in productivity was not having long commutes to their workplace.

I have learned that I like living my life in one place instead of two, with a one-hour commute between.

Some survey respondents commented on how the decrease in traffic noise impacted productivity:

I do my experiments in musical acoustics in a lab in my suburban home (situated on a relatively busy corner right next to a stop sign). There was a big reduction in traffic noise (from school buses, etc.) in the early months of the pandemic that made it easier to do my experiments.

The quarantine and lockdown has allowed me to do a survey never thought of before, which is to study the changes in the soundscape. What was going to be a short-term study of noise analysis became a long-term research project, because I have had a monitoring station on the roof-top of my office since before the pandemic. Investigating the sound evolution before/after the lockdown order allowed me to survive intellectually to the impossibility of having social interactions.

I work in the field of transportation noise and vibration. Our analyses are dependent on accurately characterizing the existing noise and vibration environment. Field data collection has been very difficult due to travel restrictions, and, we have to consider that the existing noise conditions in cities around the country this past year include fewer daily commuters and, perhaps, transit service interruptions.

An acoustical consultant mentioned the increased awareness of noise from people working from home:

The biggest change at work due to the pandemic (beyond the lack of face-to-face meetings) has been the number of calls we receive from homeowners. This has more than doubled for us from a year ago and the amount of time spent communicating with each individual has also increased. It

seems that not only has the pandemic raised people's awareness of the noise around them, due to being stuck at home constantly, it has also greatly increased their need to have a person to vent their frustrations to.

Different areas of work are more productive and other less so, as reflected in this comment:

Depends how you define it. 1) My productivity in terms of publishing papers, collecting research, dissemination of scholarly outcomes has been extremely difficult if not impossible, 2) My productivity in terms of creating novel online learning/lectures has been over the top, working night, days, and weekends to revise each class I teach for online delivery. No prep time, just moved courses directly to online. 3) Productivity in my own areas of independent work has evaporated due to university demands for budget cut decisions, determining COVID-19 procedures for on-campus health clinics, and multiple meetings and training related to COVID-19 and disparities.

Others feel their productivity has been impacted by that of the colleagues:

Productivity for me has not changed as I was fairly organized and self-motivated before. The impact has been that other coworkers have been impacted and, therefore, the work falls on those of us that can be productive. All our clients/architects now call and have meetings more frequently, which has impacted the ability to get stretches of quiet focus time. Also, as a manager, having to virtually QC all of the work has made things more difficult.

Many worry that it will take a while to recover from the decrease in productivity:

The approval process is longer now; I was waiting for an REB [ethical review board] approval since June. The process slowed down a lot due to COVID. Everyone is trying hard to stay positive, but some international projects are moving very slowly with no travel permission.

The university increased my course load and railroaded me into taking on an administrative role. Even though I got a grant last year and took on this administration, I will still be teaching four courses this year. The stress is higher, and I am not able to spend very much time on research. I expect that the pandemic will have set back my publishing, grant writing, and research by about 2 years by the time it is done.

Considering the impact that the pandemic has had on the productivity of more than half of our survey participants—many for factors beyond their control—two questions need to be carefully considered both by individuals and institutions: 1) What can we learn from those who have maintained or even increased productivity under these circumstances? and 2) how can we encourage and support those whose productivity has been negatively impacted? These questions are discussed more below.

Communication

Ease of communication at work has also been reduced for many during the pandemic, with 49% of survey participants responding that work communications are more or much more difficult than prior to the pandemic. (See Figure 1.) Again, student members (n=65) were the most affected by remote interactions, with 63% reporting greater difficulty communicating. For nonstudents, the gender difference was 44% of men (n=428) and 51% of women (n=251), reporting more communication challenges.

Although some were already using electronic communication extensively, recent advances in video technology did help us connect better than we could have even a few years earlier. Businesses, universities, government agencies invested in and all began to rely primarily on video conferencing. Screen sharing,

comment boards, breakout rooms, etc. all made it feasible to transition to online meetings and classes. However, many felt that these virtual meetings still reduced the ease of communicating:

Zoom is great, but it's just harder to get across information and to collaborate. Also, newer employees don't get exposed to nearly the amount of information regarding normal workflow and exposure to upper-level engineers.

I cannot discuss problems with coworkers at a whiteboard. We cannot go to lunch and discuss problems.

Miscommunications are common with and among coworkers. Many more individual meetings are required to keep track of everything going on and make sure everyone feels heard.

It is much harder to have casual and frequent conversations with colleagues, and harder to read subtext by zoom.

I feel the absence of a common workspace acutely. It's very difficult to troubleshoot technical issues remotely, and not having organic conversations with colleagues is hard.

Although communication access has been enhanced by increased opportunities for video conferencing, I feel overwhelmed by all the different online platforms I have to jump between: Zoom, GoToMeeting, Teams, Google Meets, Skype, WebEx, and others. I also have 6 different cloud platforms I have to go to, login separately to access information for each project/group I'm working with. It's a nightmare keeping track of all the different platforms that I have to jump between in a single day.

For some, the effectiveness of the virtual communication depended on whether the participants knew each other before the pandemic:

Meetings with not too many participants (up to about 20 or 25) work surprisingly well IF (and only if) most of the participants know some of the other participants personally quite well from pre-pandemic times.

Others had to overcome a general reticence to talk on the phone or online:

The largest challenge is overcoming my hatred of the phone and zoom calls!

Many students' comments reflected the delays encountered because of difficulty communicating:

It is difficult to make meetings to get work done with my advisor. Everything takes longer, which is frustrating.

Communication has been more difficult. Before the pandemic, I could easily go to my supervisor's office and ask him a quick question. Now, we have to email and set up a video chat. Also, talking to colleagues at lunch breaks or in the hallway was an asset before the pandemic. It was easier to check in with them or ask them a quick question before the pandemic. Now, it takes more effort/organization to reach out.

Depending on the number of courses and number of graduate students, some professors feel swamped with emails—

I get so many more emails from students and more emails in general. It's overwhelming. It was bad enough before the pandemic, but now I feel as though I'm spending at least 4 hours each day on email (before it was 2 to 3). I miss the small social interactions one has with students, staff, faculty, baristas, you name it. I was hoping to get more grant proposals written, but that's pretty much impossible.

—while other professors worry about lack of communication with students:

Communication with my graduate students, although we connect by Zoom, all of the spontaneity, and joy of working with students has been eliminated by the structure of online interactions that are scheduled and time limited, I can't drop-in on my students to see how they are doing, I can't have a discussion after class with a student who had a particular interest in a topic beyond what was covered in class, I miss hearing their laughter down the hallway.

Work productivity and communication were significantly impacted by the lack of in-person meetings. Previously, I relied on short in-person meetings in office and lab space to keep tabs on research and professional advancement of students and staff. Now everything must be scheduled. This is much less efficient and impacts brainstorming and concept generation that happened in those meetings. We have adapted, but it is not the same.

The pandemic has made it increasingly obvious that good internet connection makes a big difference:

In relation to the classes, in Latin America not all people have the same accessibility to the internet. In addition, the responses to students by email are often overwhelming because they need great immediacy (students need answers to move forward and queries arise at any time of the week, they are not limited to class time).

At the same time, some have had an easier time with communication since the pandemic began:

It is much easier to contact colleagues who are working from home and not traveling - it is easy to answer emails quickly when you're sitting at your computer all day. Video calling has made it easier to network and collaborate over large distances, so I have talked to more people this year than in the rest of my career combined.

There are fewer conflicts with colleagues because we just email to do business, and Zoom meetings are quicker with less interruptions (only one person can talk at once, so it seems people don't interrupt unless it's important).

Work communication is much easier in the pandemic! Older colleagues at my office are now readily embracing new technology like Slack and Bluebeam for coordination, which can speed up our workflows.

The best thing to happen is that meetings that were previously mostly in person with a few remote callers have been replaced by Webex/Teams meetings where all attendees are on equal ground and participation is much more dynamic by all.

Others have felt more connected to long-distance and international collaborators:

One positive is that interactions are much less dependent on distance, so we've had people join our lab meetings from all around the country.

Those who were working from home before the pandemic found an improvement in communication because everyone had to experience communicating online:

I work remotely normally. Having my coworkers join me remotely for a while allowed everyone to experience the things that didn't work so well and work together to improve them. Our communication across the company has vastly improved as a result, even now that many of my coworkers have returned to the office.

One survey respondent, explained how video conferencing is beneficial for those with hearing impairment:

Communication is actually improved because I am hearing impaired and video conferencing offers high signal-to-noise ratio (like using an FM) and automatic captioning (unless people are hosting using a platform without automatic captioning).

These comments can lead to reflections about communication moving forward. Now that most of us have experienced significantly more online communication and institutions have upgraded capabilities for video conferencing, how can these investments be used to improve communications in the future? What can we, collectively, learn from the experiences of those for whom online communication was easier? Are there ways in which we can keep video calling an option open for those who find it improves their ability to communicate? Perhaps calling into a meeting when you need to stay home because you or a dependent is sick or providing flexibility when a personal or family situation demands one work from home for a time? On the other hand, how can we be mindful of those for whom video calling and online communication is very difficult?

Work Enjoyment

Approximately half of the survey participants (56%) reported a decrease or large decrease in work enjoyment, with 53% of nonstudent men (n=428) and 57% of nonstudent women (n=211) reporting less work enjoyment. A larger percentage of students (67%, n=65) reported decreased enjoyment at work, however, the largest negative response came from early career participants (79%, n=96). With regards to type of employment, full-time academics reported the largest decrease in work enjoyment: 79% for women (n=109) and 70% for men (n=117), caused in a large part due to the increased demands to deliver courses online.

Those who identify as extroverts in their comments typically report more dissatisfaction with remote work:

Enjoyment for me is significantly diminished, I like the spontaneity of encounters with people, I liked the informal intellectual stimulation from colleagues throughout the day, I miss the casual lunches and breaks with colleagues. I'm particularly high-risk for COVID-19 and consequently I've had to especially isolate myself more than other faculty/researchers, and it has grown wearisome now that we are a year into it.

I'm a fairly social person normally and find the company of colleagues energizing and motivating. For a long time, during the first part of the pandemic I didn't leave the house for long enough that my emergency brake mechanism essentially fused themselves in place to the car and the battery on my car died while I was working from my room. My most important communication with my supervisor before that point was informal drop-in visits when he happened to be in. The accompanying social loss very much decreased my enjoyment of that job.

Communication is definitely harder, especially quick in-house check-ins/collaborating.

I am a people person and enjoy interacting with people in real life. Also getting to hear people's voices is interesting. Some of the people [I talk to on video calls] I have never met in real life. Hearing them on different systems or microphones picks up different resonances in their voice. This has led me to realize I don't understand what this person actually sounds like in real life, which makes me sad.

While some introverts prefer the routine—

I do not like working at home, even though I do it now. During the fall semester, I got very little done, because the teaching/working balance was extremely stressful. Even though I am a very introverted person, I would much prefer to be in my campus office, working alongside colleagues and students, leaving the house every day. The lack of that routine (and the different environment of working from home) reduces my productivity.

—others experience less stress working and communicating from home:

As usual, my introversion is a superpower . . . so I am calm where many are not (and I already had a solo life).

I focus a little better in my home office setup, and I can set things up exactly as I like them.

Less meetings! No commute! Pajamas! I'm more comfortable working at home on my own schedule; going into campus and interacting with people all day is enjoyable but tiring, so I would normally pack those days with meetings and reserve a day or two to work from home. Now I can arrange my schedule how I like, fit meetings in as needed without slowing down my other work.

No need to be in a loud office, no commute time/stress, long-distance collaborations are much easier now, online conferences make life easier, too.

Others find a range of ups and downs:

Work enjoyment on average is the same, but the range is bigger - home work can be really relaxing and nice, but fieldwork got a lot more stressful.

Work enjoyment has been highly variable. Very up and down, peaks and troughs, highs and periods of depression.

On a positive note, getting to work from home makes our two dogs very happy! I have learned that trying to create some sort of routine is critical to getting anything done, but it is still really difficult to do regularly.

Career Advancement Opportunities

When asked about how the pandemic has impacted opportunities for career advancement, 47% overall (n=770) indicated a decrease, with 45% for nonstudent men (n=347) and 43% for nonstudent women (n=205). Students again are the group with the largest concern over decreased opportunities (67%, n = 57), followed closely by the early career survey participants (62%, n = 95):

As a PhD student, I feel I missed out on valuable hands-on experience in my lab.

I have also not accepted various service activities that could help me get to the next stage of my career because I can't even keep up with the work I have.

I have not been able to collect data over the last year so that will ultimately affect the advancement of my career. My next concern is collecting pilot data for grant submission.

Significant challenges have been experienced by those who started a new job just before or during the pandemic:

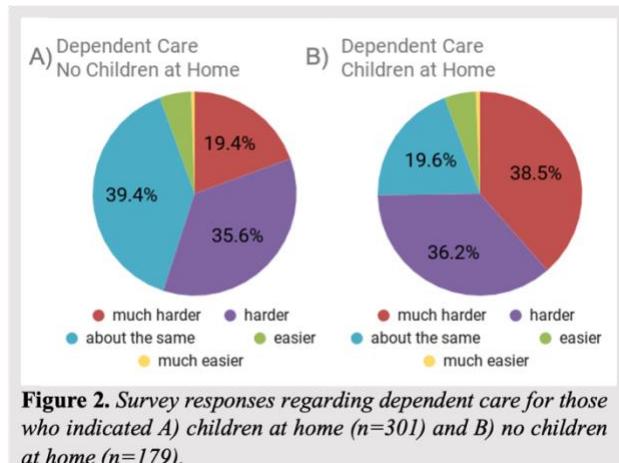
Figuring out whether/when to move to a new city for the new job that will be remote until the pandemic is 'over' was super difficult. You can't predict anything right now, so the pandemic is especially difficult for people just starting out a career or who are otherwise not yet settled.

I just started a new tenure-track job straight out of grad school in August 2020. I feel like I still don't know how my department works on many levels. Quick questions to colleagues in the hall aren't possible. Everything has to be an email, and I don't want to send them constant questions, so I still feel very out of the loop. It feels like I'm not truly an assistant professor yet.

I definitely don't recommend living on your own during a pandemic. I've been miserable. I also don't recommend starting a tenure-track job during a pandemic; my university has been extremely stingy with startup funds, which I know will (and has already) negatively affect(ed) the start of my tenure-track career.

Dependent Care

The final survey question focused on the difficulty of dependent care--caring for children or the sick, elderly, or disabled. The results for this question are shown in Fig. 2. Of the 301 participants who indicated that they have children at home, 75% responded that dependent care was harder or much harder than before the pandemic. Of the remaining 179 respondents who indicated they had dependents but no children at home, 56% indicated that dependent care was harder. In contrast, 5% of participants in both groups reported that dependent care was easier than before the pandemic. For both groups, with or without children, 61% of nonstudent men (n=241) responded that dependent care is harder than before the pandemic and 79% of nonstudent women (n=135).



Whether dependent care was more difficult during the pandemic was also affected by the age of children at home. The highest percentage of participants reported increased difficulty with at least one child between

2-10 years of age (~88%, n = 164) compared to 76% of those with a child 0-1 years of age (n=37), 79% with a child 11-15 years of age (n=67), and 49% with a child 16-18 years of age (n=37). Some of the survey comments shed light on how the pandemic has impacted the lives of parents, especially those with young children.

Due to no childcare, my stress level has been extremely high and constant multi-tasking has reduced my work productivity and work enjoyment.

It is more difficult to arrange conversations with colleagues because we must all arrange our schedules around caregiving.

We lost our village -- school, after school programs, babysitters, trades with friends, playdates all ceased. As a result, we not only lost childcare but also have found our child needs more attention due to the stresses and lack of stimulation, so even our usual multitasking strategies currently fail.

As school-age children remained home across much of the country, parents took on the responsibility of homeschooling/tutoring and monitoring online class work. Many found it impossible to balance their child/children's virtual learning with getting their work responsibilities.

I spend much more time working from home while caring for my small children. For many months I became their full-time caregiver, homeschool tutor, and maintained my full-time job. I still spend more than half of my professional time working from home while simultaneously providing childcare and supervision.

I have had much more responsibility for my children. This has taken time away from my work and left me perpetually behind on things like grading and teaching responsibilities. This leaves less time for research which has less of a hard deadline.

My kids are no longer in school full-time, so I need to be there for them to help with virtual schooling. This means I have less time to work during the day. In addition, I don't have as much time to meet with other people, so I cannot do as many things which really hinders my ability to advance my career.

For those fortunate to have childcare or in-person schooling, intermittent quarantining also presented significant challenges:

My kids' school schedules are constantly in flux, making it hard to have any regular schedule; we overlap both in time and place at home all needing different things, which makes it challenging.

I have had to take more time off work to care for dependents (children). This includes extended periods (e.g., quarantines), where I can only work about half time, and more frequent intermittent disruptions (sniffles now mean that my children have to stay home for the day).

Many parents worry about the impact of the pandemic on the emotional and mental wellbeing of their children:

Middle school and high school children learning from home and coping with anxiety, grief, learning differences, etc. have taken significantly more time and energy than in non-pandemic times.

The pandemic has also impacted the well-being of parents and other aspects of the parent-child relationship:

I enjoy my work very much but now have little time to work. I do it mainly at night and sleep very little.

I feel that I am neglecting the children when they are out of school and I have to work most of the day.

Managing screen time for a teenager and supporting outdoor exercise are [work] time interruptions.

Many have expressed difficulty in scheduling meetings because of variable childcare:

I'm very happy when I 'get' to work, but it is super hard to schedule any student meetings on a regular basis because I don't always know what the childcare will be from week to week. Therefore, I schedule student meetings when I KNOW I have childcare and that means that other things (writing papers, reading new research, learning new stats) gets lower priority. I now do more work in the evenings but that's not a guaranteed slot and not when I can think well for 'real' work.

Some, however, especially those with babies, appreciated the flexibility of working from home:

I had a baby during the pandemic, and it has allowed me to spend much more time with her because I'm working remotely. It has been a silver lining.

Many students and early-career professionals are worried that the impact of working from home and juggling disrupted childcare will have a long-term impact on their career trajectory:

We have a preschool-aged daughter and both me and my wife work, so I ended up working six hours per day. I work for the federal government, and this was an acceptable level of work. However, those two hours per day are something I'll never get back, so doing the work to advance my career probably suffered overall.

My wife and I had to take turns to take care of our daughter. This situation diminished the time I could spend working. In terms of advancement of my career, I feel that working virtually has [caused] a slowdown of career advancement.

I have three kids (ages 17, 12, 9) and they are currently all being schooled virtually. This means that I have to be available to help them during regular working hours. In turn, this means that I have not been able to participate in Department and Institutional affairs, which has led to being passed over for leadership positions.

Some survey participants responded that caring for aging relatives was easier during the pandemic.

Working from home I could take care of my grandmother in my home for a few months. Also, I could take more time to care for my mother when the lockdown measures were lower.

However, many reported that the increased stresses for those caring for elderly relatives also impacted work productivity and opportunities for advancement.

The stress of everything related to the care of my mother (elderly with comorbidities) can be crushing sometimes, which lowers my productivity and probably has not helped advance my career.

Though I am currently living with my aged parents during the lockdown period, their health and safety have become of great concern to me. Also due to the long closure of the research institutes, both experimental work, as well as future job prospects, have been seriously hampered.

I don't have dependents at home, but when my elderly mother was in the hospital and rehab facility, she was dependent on me to coordinate her care. It was hugely problematic that she could not be visited by family for a month and a half; it complicated home care and having to interact with health care workers put every member of my extended family at risk for COVID. My work productivity has plummeted. I find that I can't devote 8 hours a day to sitting in front of a computer—my body gets restless, and my brain gets fogged. Now that meetings as well as writing happen via computer, I don't get the alternative venues, movement, and human interaction I need to do the same level of work.

Similar responses were given by those who are caring for other members of their family with different needs:

[I] have 2 special needs kids and a special needs husband. Both my university and the kids' schools are operating virtually. Managing their school, their needs, and my work is impossible. I have not been able to get out any publications; the university is closed, so subject testing is on hold.

Considering all these layered difficulties, how do we individually and collectively respond to the fact that, overall, the pandemic has had a larger impact on people caring for dependents,? The website LinkedIn has added Stay-At-Home Parent as a job title as a beginning of providing more flexibility in describing activities during career gaps. (<https://fortune.com/2021/03/30/linkedin-stay-at-home-mom-caretaker-titles-profile/>) Although some wondering if it is wise to admit to taking time away from your career for family reasons (<https://www.forbes.com/sites/kimelsesser/2021/04/15/linkedin-adds-stay-at-home-parent-to-job-titles---research-says-dont-use-it/?sh=2fd7aa65459b>), many hope that this can be the beginning of reframing the hiring conversation and facilitating options for people to pause their career and then re-enter their careers when the timing is right.

This survey comment summarizes the need to support parents who have significantly struggled due to disruptions in school and childcare, which is also applicable to all with dependent care responsibilities.

It's challenging to have the lines of work and life blur this much. I had both of my kids while I was on the tenure clock. (I've been tenured for 8 years and am now Full [Professor].) The way I managed to be productive was to have very strict lines drawn about when and where I work, and when and where I carry out the rest of my life. The pandemic has shattered that strategy for being productive because time and place completely overlap between work and life. That has been hard for me. I feel lucky that my kids are able to do schoolwork independently for the most part now. I can't imagine doing this when they were toddlers or infants. I'm very concerned about how we are/are not supporting junior faculty right now, especially those with caregiving responsibilities. I don't know how I could have carried on with young children and a newly independent research program during a pandemic. That is something I have yet to see discussed in any fashion in my department or university beyond offering 1-year extensions on tenure clocks.

Discussion

In addition to providing the statistics and some comments about the five main topics of the survey, the comments provide insights into many other aspects of life during the first year of the pandemic. Some of these comments are included here and grouped as follows: 1) What we have missed? 2) What has been difficult? 3) How have we helped others? 4) Have there been silver linings? and 5) What have we learned?

What we have we missed?

Since the start of the pandemic, we (individually and collectively) have missed out on a lot of things that we thought would happen in 2020 and even 2021. The most common things mentioned by the survey respondents were those that we plan ahead of time: travel, conferences, trade shows, visiting appointments, post-doctoral positions, etc.

Many also missed out on experiments, field work, site inspections, and subject testing.

Everything is just harder, particularly because I can't travel to the site and see the acoustic issues directly. Everything is viewed through the lens of a camera.

In industry, the lack of in-person meetings with clients caused many difficulties:

I feel like I am working in a bubble. A lot of the industry relies on in-person contact and has not shifted well to working online or in a distanced manner. I feel like it is harder to understand what the advancements in the industry are and collaborate.

Zoom and Teams cannot replace face-to-face customer contact.

In addition to these missed events, most of us truly missed in-person interactions. Simple things like dropping in to chat with new trainees, brainstorming sessions, and other informal interactions have been missed:

I miss being around my colleagues. It's much harder to think creatively as a team when we're not physically together.

Before the pandemic, the conversations that would occur naturally from face-to-face interactions were a fulfilling and rejuvenating part of my job. I miss these natural conversations and communications with my colleagues.

One source of enjoyment that I have is having casual conversation with co-workers. Often these conversations are inspiring. However, since we are all remote now, I feel that I don't get many if any of those conversations.

In our lives in general, many have missed visits with family and friends, seeing smiles in person, and hugs. Another elusive thing that has been missed is having a routine; the lack of routine has been particularly difficult for those who relied on their routine as a key tool to coping with stress, anxiety, depression, etc. The things we've missed are directly connected with what has been difficult about the pandemic.

What has been difficult?

Many difficulties have arisen because of the pandemic in our professional and personal lives. Concerns expressed regarding work include delayed or modified data collection plans,

The pandemic has delayed and modified community noise data collection.

transitioning to online teaching,

The workload has increased tremendously at the university just to keep teaching responsibilities afloat, so grant writing and paper writing are on hold.

I have mixed feelings about online teaching. On the one hand, it has taught me how to be more organized and it has introduced me to many new tools including some that I plan to use after the pandemic. But on the other hand, spending more time online has also made it harder to be productive in my research. With all the time I already spend behind the screen, I don't have as much energy to work on my research (which involves spending even more time behind the screen).

limited or no access to laboratories,

The largest challenge has been being unable to maintain my research productivity in the lab. Projects that were near completion have been at a standstill for nearly a year.

no in-person conferences and limited interactions with colleagues,

I am an extroverted person who comes up with new collaborations better in person, so virtual conferences have made coming up with new ideas feel more onerous and less creative.'

Reduced contacts with peers (e.g., limited conferences, travel etc.) reduces visibility. Other's awareness of my work and opportunities are therefore more restricted.

budget problems, lay-offs, salary freezes, technical issues with video conferencing, as well as Zoom fatigue.

Small businesses have been hit particularly hard by the pandemic:

The largest challenge was the initial financial desert of Q1 and Q2. Work contracts were delayed until July-August of 2020, and I didn't start seeing revenue until September 2020. I am EXTREMELY grateful for Canadian government benefits (specifically CERB) that stepped in to save entrepreneurs and contract workers. Changing regulations were mildly difficult to follow, and sometimes guidelines were difficult to decipher when working inter-provincially. More challenging, though rarer, was working with other contractors or individuals that displayed little to no concern for safety precautions. In some cases, the mitigative safety options I had to apply due to poor behavior of others, cost my business financially.

The pandemic has pretty much gutted our small business. We had just opened our doors about 2 years ago. We hit the ground running and started quickly growing, but around the time we finally started making a profit instead of merely covering our expenses the pandemic hit. Our clients started dropping like flies. I'm not sure we'll make it to 2022, and it's frustrating because it's through no fault of our own. We had a well-planned and executed business model, and we were seeing steady growth. Then it all ended.

Isolation from families and friends was difficult:

I feel like I'm in solitary confinement. Coping strategies (e.g., pretending like I'm living on the International Space Station) are beginning to lose luster. The biggest challenges have been related to isolation.

This is the longest I have ever gone without seeing my parents or brothers and this has been very difficult, personally. Missing and worrying about my family, and struggling with the decisions about possibly going to visit or not has caused a lot of anxiety and depression (which I already take medicine for) that has taken a toll on my ability to work, focus, be productive, happy, etc. I'd say that has been the largest challenge...the isolation from our loved ones.

I got stuck in the institute campus for three months before returning home. During this period, I was having a very anxious (because of my parents who live far away) and lonely time, but also I became more self-confident, and during the free time I learned to cook as well as managed to practice music more.

Many survey participants reported that mental health challenges have been exacerbated by the pandemic. Separation, and in many cases isolation, has increased feelings of loneliness, anxiety, and depression, with the latter two being further strengthened by concerns over the pandemic and the socio-political events of the past year.

I needed to adjust to working from home, which was difficult. Political and cultural events also made this a particularly challenging time to try to be productive. I feel overwhelmed all of the time, and nothing is getting better. It is hard to find enjoyment when I am constantly worried about what will come next for me.

I have more free time to do work, but the stress of the pandemic is making it difficult to complete any work or find motivation to do work. Pandemic stress makes everything less enjoyable overall.

The pandemic has introduced a new form of stress into my life that I have been unable to shake. This stress has made it more difficult to focus at work and has resulted in projects taking longer to complete than they used to.

Others felt truly restrained by the pandemic precautions:

I regularly find it difficult to put in a full day's work. If, each day, I can accomplish one or two of the most important or urgent activities I have to regard that as a successful day.

I am spinning my wheels and can't concentrate, and I have zoom fatigue- too many online meetings.

I feel I am not entirely free as a human being. I sense a lack of liberty. This has impacted on productivity, communication, and enjoyment of my profession.

Feelings of treading water and that life is hold on were expressed by many survey respondents:

Basically, my research has been shut down (can't collect data in person), so I'm essentially paused on addressing the aims of my NIH grant.

Students felt it:

It is difficult to make meetings to get work done with my advisor. Everything takes longer which is frustrating.

and advisors worried about not being able to adequately mentor and provide opportunities for their students:

All experiments were interrupted. My PhD student's original plan had to be changed to something else.

With the overall increase in workload that has come with being a virtual teacher and researcher, it's impossible (and seemingly selfish) to devote time to career advancement (my next promotion), as my time and energy are focused on helping my graduate students position themselves professionally for what I fear will be an atrocious economy for years to come.

Specific challenges regarding working from home were also identified including the presence of many distractions at home, sharing space with multiple people in the household, and being in continual flux about childcare and schooling situations. Many commented on the difficulty establishing work-life separation while working at home:

It feels like personal and professional life blur together a lot more, so it can be harder to transition between them.

The work week is no longer defined by weekends and workday schedules.

For almost 30 years, I separated my career (involving acoustics) from my home life. The pandemic forced the two together to the benefit of neither.

Exhaustion is common feeling a year into the pandemic:

The inefficiency of working from home has caused emotional and social energy drain.

Everything is just so much harder due to the PPE [personal protective equipment] and anxiety levels of the people I supervise/work with. I'm much more exhausted and have less energy.

The lack of our normal out of work social life has simply worn me out, which has made completing work (especially new activities) really difficult.

My focus has been on maintaining the status quo, rather than advancing new initiatives.

I'm reluctant to volunteer for more difficult/demanding assignments at work because I don't have the energy anymore to go the extra mile on such things. Whatever reserves I once had have long since been depleted.

Spending almost all day on video conference calls with very little breaks is exhausting. There is no time between meetings, whereas before we had to be given time to physically navigate to different rooms and buildings between meetings. I am much less active (less walking) and pretty much have to sit in the same place all day, which has really decreased my work enjoyment. There are no informal chats before/after meetings because there isn't time.

Managers or people in administrative positions had increased difficulties with the time required to make decisions and implement precaution required by the pandemic:

I'm a department head, and I now spend all of my time on filling out spreadsheets about pandemic course scheduling for the dean's office, making sure people upload proof of their vaccination or weekly mandatory COVID test, working out policies, and fighting budget cuts. This has cut back on effectiveness in supervising graduate students and research. Teaching is much more stressful when it's all online and the students are stressed out. Communication is difficult because the number of emails to get anything straightened out has multiplied, and I can't just talk with my colleagues, at the same time as the number of new policies and procedures I need to convey to my department has gone up exponentially. It's also much harder to manage faculty meetings in a way respectful toward all on zoom.

As an administrator, I am given the impossible task of being both infinitely accountable to the people above me and infinitely flexible to the people I oversee (including students, postdocs, and the faculty and staff I supervise). This is an impossible situation that has resulted in a near-constant state of anger and resentment.

The group most negatively impacted overall are those who are unemployed (n=10). They felt that any potential jobs and opportunities that were a possibility before the pandemic were closed as economic uncertainties caused job openings to close and potential opportunities to be retracted.

Around the world, different countries have been experiencing additional difficulties, which are made worse by the pandemic:

Poor government support for the people here in Chile. Poverty is on the rise and the rich even richer as it happened elsewhere. We acousticians of the third world are also poor.

The difficulties associated with the pandemic have been real. Each person has experienced a different set of difficulties based on their situation and temperament. As we move forward, we need to have opportunities to discuss our individual difficulties without judging others or ourselves. This pandemic has created many unexpected challenges, and we need to understand that some people will be dealing with the consequences for a long time.

For more details on the impact of COVID-19 on women, see the 2021 study by the National Academies of Sciences, Engineering, Medicine: <https://www.nap.edu/catalog/26061/the-impact-of-covid-19-on-the-careers-of-women-in-academic-sciences-engineering-and-medicine>

How have we helped others?

Even with all these difficulties, our survey participants have done our best to support and serve others. In a professional sense, some small businesses were able to help their customers:

As a person who has worked in a home office for about 15 years, I was not disrupted as much as my clients were, and I was able to help them in adapting to the changes.

Managers have spent a lot of time trying to support those they work with:

I think [the pandemic] has emphasized how important my role as a leader is - I've been very focused on the mental health and progress of my PhD students and other lab members, and while I'm a bit frustrated at the lack of progress in my own research, I feel like I have prioritized correctly and with a bit more awareness than during normal times.

The survey participants have done shopping for others, cared for the medical needs of elderly or disabled relatives, and helped encourage and lift family members near and far.

It has made me realize how fortunate I am and that there are many people a lot worse off. One way I became more productive with my own work was to add new things into my day to create a structure. One of these things was volunteering to deliver meals to people who were far less fortunate than me. It gave me a purpose that would then motivate me to and increase my productivity on my academic work.

In helping with the emotional needs of family and friends, several respondents mentioned the difficulty of caring for those in live-in care facilities, which could not admit visitors. Several made comments about how the isolation was particularly difficult on those with early-stage dementia who couldn't understand why people stopped coming to visit. A few mentioned how the isolation appeared to hasten the progress of the dementia.

Significant time and effort have gone into caring for children, especially those with anxiety, depression, as all have coped with grief for missing out on so much, especially the teenagers. Supporting kids doing home or online schooling has taken an amazing amount of energy and has been especially challenging for students with learning difficulties. Through all the ups and downs, we have tried to support others as best as we can within the constraints of the pandemic.

Have there been silver linings?

Amidst the hardships, we asked survey participants to consider whether there have been silver linings to the pandemic.

While many have found more distraction at home, some had fewer distractions:

I have had the time and mental space to complete a previously unplanned grant application. (I have no dependents to care for.)

The office I worked in was a busy open-plan office environment that had many distractions. At home, my office is in a spare bedroom, so while there are still plenty of distractions from my two kiddos, I now have a door that I can shut to limit those distractions.

Others enjoyed the flexibility:

I enjoy working from home because I can take an exercise break during lunch.

While virtual conferences are reportedly not as enjoyable or beneficial for most, for persons in countries farther removed from conference locations or those otherwise constrained by budget restrictions, the ability to attend virtual conferences has been astoundingly positive.

I was able to attend many seminars and online workshops, which made me more linked to the acoustic realm.

The only positive thing I can think of--and it's a pretty big positive-- is the ability to attend meetings (like ASA meetings) via zoom that I would not have attended if I had to travel and pay travel and hotel costs. Also, the pandemic has inspired all sorts of freely available zoom lectures from universities, etc., that pre-pandemic would have required in person attendance.

One of the greatest positives identified by respondents is that the pandemic has made working remotely more acceptable. This change was particularly noted by participants who were already working at home before the pandemic.

I was already working from home. I find my clients are more understanding of my situation now. They don't get frustrated by my children's noises in the background.

I worked largely remotely before but now that everyone is, some things are easier/less weird (no pressure to meet in person at the office). I've also been able to attend several meetings and conferences I would have skipped before, including the recent ASA, which has been nice.

Scheduling meetings online is more common and often easier to arrange, especially for international collaborations.

All companies have invested heavily in remote working tools including [video conferencing] facilities, making it much easier to communicate globally.

In addition, most everyone received a crash course in video conferencing and online learning, which can offer flexibility for individuals and families. For examples, one can start a new job without immediately moving the family or perhaps transition to doing some work remotely when personal health concerns or dependent care are easier if working from home.

On the positive side, the pandemic has made remote work easier. It opened up new career opportunities for me (i.e., being able to work remotely without having to move our entire family in a different city/country).

Because I was mostly working from home anyway, I was able to spend three 1-month chunks living with my elderly parents in a different state from where I normally live and work.

Many expressed appreciations for the increased time with family:

I love spending more time with my kids and have found a really positive groove working at home with them. The day-to-day is manageable, but the one-off things like program reviews can be really tough. I've learned to ask for help within my network of family and friends, and to provide help where I can. It's been a growth experience that has really highlighted what is and isn't important. I wouldn't trade the increase in family time, despite the challenges that have come up from the pandemic.

Many were happy to have the hours they used to commute to the office each week. Others were happy to have less travel expectations.

Pre-pandemic, I would travel weekly or every other week for work. Now that I'm not traveling, my work times are a bit more consistent. The number of scheduled meetings has increased substantially. However, there is also more time for focused work without interruptions.

One of the career positives that have come out of this is a more level playing field for funding collaborations and communication. Specifically, there are no expectations for travel and avenues for virtual interaction are now paved so new collaborations can still be developed rather quickly/seamlessly.

While some may need more distance from this time of lockdowns and quarantines to see silver linings, some can already feel pride at how they have navigated the pandemic:

Learning to do experiments online has been quite an interesting challenge that will have long-term benefits.

The pandemic was a great motivator to figure out how to conduct remote testing and move away from in-lab MATLAB based experimental procedures.

It is very rewarding to be able to keep things going - even though conditions are not ideal. It has been very rewarding to be able to work with my mentorship students to also keep things going. Think of my mentorship students as the farm system as their projects are the planted seeds and research that will evolve down the road towards research that goes on for many years. It has been great, but I have been blessed with good students that are both very helpful and careful.

What have we learned?

Finally, many of the comments addressed the lessons participants have learned throughout the course of the pandemic. One respondent mentioned

The pandemic provided some disruption to my usual routine and enabled me to look at my life from a different perspective. What do I really want? What options do I have to achieve that? How do my family and work come together? And so on.

Several mentioned learning to work more independently, to adapt to uncertainties, be more flexible and understanding about technical difficulties, and trying to make the most of whatever situation arises.

I've learned that it's okay to have less day-to-day oversight of those who report to me; giving the performers of my projects more independence has allowed them to grow technically and has not negatively impacted our productivity.

Most agreed with the comment,

We have all learned to use remote meeting technology more effectively. BUT it is clear that social distancing interferes with the processes of bonding with colleagues that is critical to our collegial professional work.

and understand how helpful it is to regularly work together with others:

I employ a large number of undergraduate researchers, primarily to help with field work. With aggressive safety protocols (100% masking plus distancing, even with the work being 100% outdoors), I saw how much value there was in live human interaction. More than one of my research students has later admitted that the data collection sessions were what kept them steeled and focused and committed to 'making it through' the horrible online learning pivot and subsequent online learning semesters.

Some teachers mentioned how the transition to online learning in the middle of a pandemic has modified their teaching styles:

The largest challenge has been keeping my student's motivation during 2020. My best success has been improving my lessons and turning to project-based learning even in subjects with about 150 students.

I feel like I became a Youtuber! I'm trying to produce teaching material in a more relaxed way, because I believe students need gentle treatment. Another good thing is I started to ask more questions to my students and colleagues—because the situation is rough and nothing is predictable, it's faster to just ask. This made my work easier and more relaxed.

Our hearing-impaired colleagues hope the pandemic will increase awareness and empathy as normal-hearing people now have experience struggling to understand voices muffled by masks:

The pandemic has radically changed the experience of living with hearing loss. We no longer need to navigate noisy crowds, but we have to deal with face masks muffling sound. Normal-hearing people who are now struggling to hear people with masks have a greater appreciation for good communication practices. I hope that those lessons translate into better accessibility even after the pandemic.

For many, the pandemic has been a time for reflecting on things we previously took for granted:

I hope that the pandemic causes us to think more about things we previously took for granted. I am motivated to more carefully cultivate friendships and in-person interactions. I also hope that the pandemic helps us further appreciate the privilege that many of us have when it comes to the flexibility of our work, since much of the acoustics work we do can be done on a computer anywhere. [Thinking of those who work] for a manufacturing company—where there are folks that HAVE to be present at the place of business to do their job—really drove home the privilege I have in being able to work from home.

Life can change in an instant and attempting to even predict how your work-life will be a month in advance is a challenge. Flexibility is key to adjusting and moving forward, realizing that striving for perfectionism is a luxury and can't always be attained; sometimes good enough is good enough to keep things moving forward successfully.

Many survey respondents expressed hope that some degree of remote work will be allowed:

Lessons learned - we will adopt a much more hybrid model of working once the pandemic is over.

Turns out one can do acoustical consulting successfully from home, with only limited visits to the office. I hope employers see this too and do not try to force us back to 100% in person working.

Hopefully our individual and collective experiences during the pandemic will help us be more compassionate and understanding:

I have greater appreciation for my younger colleagues that are balancing home and family/children. Life goes on, you just look for opportunities in the chaos.

A large challenge is convincing my employer that decreased productivity is NOT due to working from home but instead due to living through a global pandemic. To get to an annual review and hear, 'It seems like you've lost focus. What happened?' is tough. What happened is that there's a global pandemic.

The extra layer of stress, for everyone, as we are trying to live through a pandemic is something that needs to be given its proper respect. Most of the people I know, myself included, are trying to just keep going with work and feel guilty for being less productive...but it's such a uniquely stressful situation that, as whole society, we need to recognize that just surviving is the accomplishment. We need to be able to cut ourselves some slack—but that requires individuals with power to do the same for those who are struggling below them. I worry that once the pandemic is over academia will snap back to judging folks solely by their productivity, which will have huge consequences for those of us at early stages in our careers and women who have picked up more of the caregiving burden than male counterparts.

Conclusions

The pandemic has changed the world and impacted the lives of acousticians worldwide. Acousticians have shared their experiences with work productivity and enjoyment, communication, opportunities for career advancement, and dependent care as the pandemic has impacted their lives. We thank all who participated in the survey.

Several things were evident from the responses. First, we need opportunities to share with others what our individual pandemic experience has been like. Second, we need to listen nonjudgmentally, understanding that this pandemic has impacted people very differently. While the majority have experienced increased hardships, some have felt productivity, communication, enjoyment, and dependent care are better now than before the pandemic. Every experience is valid and should be respected as we listen to each other's stories.

After considering the dataset from different angles, several subgroups stand out as having been most negatively impacted by the pandemic: students, early career acousticians, those whose research or other work has been put on hold, those unemployed, and those with children at home. Students reported the highest negative changes in work productivity and communication. Students and those in the first five years of their career expressed the most negative impact in terms of opportunities for advancing their careers. Many researchers and labs have experienced shut-down or significant delays due to the pandemic restrictions. Respondents who are currently unemployed ($n=10$) are struggling the most in all areas. With regards to gender, more women than men reported increased difficulties with work productivity, work enjoyment, opportunities to advance, and dependent care. The closure of laboratories, restrictions on human subject testing, lack of in-person meetings for collaborations, networking, and sales have had a significant impact on many. And finally, those with children at home have in many cases felt overwhelmed by the continual flux and overall lack of childcare and/or the demands of remote schooling.

This survey highlights our collective need to share our individual pandemic experience and the need to understand that the pandemic has affected everyone in very different ways. While the majority have experienced increased hardships, some report more positive outcomes. We encourage each of us to consider how we can support those most impacted by the pandemic and what lessons we can take with us to improve life beyond the pandemic. Moving forward, we will each have an opportunity to develop increased understanding and empathy as we respectfully discuss the individual, institutional, and societal impacts of the pandemic.



Traci Nielsen is an associate professor at Brigham Young University. She enjoys teaching and mentoring student on research in underwater acoustics. Her primary research involves discovering how to apply machine and deep learning techniques to ocean acoustics. She is finishing her three-year term as the chair of ASA's Women in Acoustics Committee. See <https://womeninacoustics.org/> for information about the Committee.



Bonnie Lau is a research assistant professor at the University of Washington. She studies development of the human auditory system using psychoacoustics and neurophysiological methods. She is a member of the Women in Acoustics Committee as well as the Psychological and Physiological Technical Committee of the Acoustical Society of America.