On-the-Spot Feedback: Scientist Experience

Summative Evaluation Report

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Table of Contents

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BACKGROUND

Study Purpose & Methods

Evaluation within the On-the-Spot Feedback (OTSF) project focused on two major questions to help the team understand in greater depth the process and experience of scientists as they encountered, learned about, and decided to use (or not use) the OTSF approach in their public engagement activities. While the project's research efforts focused on understanding how scientists were changing their practices, confidence, and perceptions, in response to learning the OTSF approach; the evaluation zoomed in on the experience of the journey of learning and applying the technique, including dynamics that may advance or hinder uptake of the model broadly.

Stages of the OTSF Learning Journey

Encountering — Conceptual introduction to OTSF

Learning — Formal Training: learning tactics, applications, practice

Planning — Training & After: How they could use OTSF

Applying — Post-Training: Using OTSF in real setting

Evaluation Question 1

How is the process of encountering, learning, planning, and using the OTSF approach experienced by scientists?

Evaluation within the OTSF project centered around one overarching question, which was to better understand what happens during the learning journey that scientists take when encountering the OTSF approach for the first time. While the project's research thoroughly addresses how scientists change their practices, mindsets, confidence, and ability to apply these techniques, the evaluation focused instead on: **the process and experience of encountering, learning about, planning with, and ultimately using (or not using) the OTSF approach in their public engagement work.**

From this lens, the evaluation explored how the scientists reacted to and made sense of each stage of this journey, particularly what they found rewarding or valued, as well as what they found challenging or became a barrier at each step of the process.

Evaluation Methods

The primary method for this evaluation was **one-on-one interviews** with a sample of 59 scientists who participated in OTSF trainings about 2-3 months after their training. This time frame allowed participants time to have potentially applied the tactics, but recently enough that they could still recall the training experience with sufficient clarity. Each interview lasted about 30 minutes, and participants received a small incentive.

In addition, we were able to draw on some of the **data collected from the immediate post-workshop survey**, which was distributed to participants at the end of a training experience. This was primarily a formative evaluation tool, to give the trainers feedback about how they might improve the next iteration. However, some questions had value for understanding the immediate reaction to the training, in aggregate, for all sessions together.

Both methods are described in detail on the next page.

Methods: Evaluation Question 1

Post-Workshop Survey

An immediate post-workshop survey was created primarily to support formative evaluation of the training, and help the PD team refine their approach. This tool was modified slightly between sessions, and results reported quickly to the team.

Within that survey, there were several questions that provided some useful feedback for the summative evaluation, reflecting scientists' immediate reactions and response to the experience of learning about the OTSF approach and tactics. The data collected in response to those questions were aggregated and analyzed descriptively to support this summative evaluation report. Descriptive analysis of these survey data are presented as immediate reactions to training.

The survey was distributed to every participant in the trainings upon completion of the last session. In total 134 participants responded to the survey; a response rate of roughly 72% (based on estimated enrollment numbers). Because questions were sometimes changed between rounds, lower samples in the results that follow indicate a question that was added later in the process.

Interview Sampling

Recruitment of scientists for interviews was done to ensure the full range of training formats were represented: month-long virtual trainings, two-day virtual trainings, and two-day in-person trainings. Between 4 and 9 individuals per training were interviewed (depending on the size of the training).

In addition, we purposefully recruited interviewees to represent a range of engagement levels with the training and OTSF methods. While engagement was not a quantifiable measure, we considered program records, including attendance, homework, and completion of the research self-report. We also eliminated any scientists who had already agreed to be part of the research team's qualitative study (observations and interviews), so as not to over-sample their perspectives. From the remaining scientists, we recruited individuals who had shown high levels of participation, and paid close attention to inviting those who showed signs of *not* having used or fully embraced OTSF (e.g., not completing the self-report or final homework), in order for the study to encapsulate the full range of attitudes about the model.

Interview Participants & Analysis

In total, 59 scientists who had attended an OTSF training participated in follow-up interviews. Interviews were conducted by Zoom or telephone, audio recorded, and transcribed for analysis.

A coding framework was developed after the first round of interviews, in order to categorize the experiences of scientists according to the journey stages of learning OTSF – encountering the model, learning the tactics, planning, and using (see prior page). Within each stage, we identified emerging themes about the benefits and challenges scientists experienced at each stage. After each round of interviews, the codebook was applied to the new interviews and further refinements were made, as more data revealed more nuance in the categories. The team received an interim report of high-level themes periodically.

At the end of data collection, we re-analyzed all transcripts, making final revisions and tightening of code categories, to ensure they reflected the full body of data and were consistently applied in the final dataset. The frequency with which themes arose are presented descriptively in this report.

Evaluation Question 2 & 3

The second branch of the summative evaluation considered the perspectives of stakeholders who could, ultimately, become critical "gatekeepers" who can promote or inhibit the rapid spread of the OTSF model in the broader landscape. These stakeholders are professionals who work as science communication or outreach trainers (or for organizations that provide such training), many of whom were identified within the OTSF proposal and were even project advisors.

This strand of the evaluation focused in two main areas: (1) **Reactions to the content and approach of OTSF** (its value, fit, and points of disconnect); (2) **Feedback on usability or barriers** (in the context of their experience with science communication programs and needs). This report summarizes relevant highlights; the full report was shared with the team in November 2022.

1 Demonstration Workshop

In order to provide feedback, stakeholders needed some introduction to the OTSF model and workshop topics. To achieve this, participating stakeholders were provided with pre-reading about the model (a draft version of the project Guide for scientists), and then attended a 50-minute live demo session, led by the OTSF trainers, via Zoom.

2 Focus Group Discussion

Immediately after the demonstration workshop, trainers departed the session, and the project evaluator facilitated a group discussion to capture stakeholders' candid feedback and reactions to the model, guided by our two evaluation directions (see left). The focus group discussion lasted about 40 minutes; discussions were coded thematically.

3 Stakeholder Participants

In total, 10 stakeholders participated in these demo sessions and discussion groups. Each participant had prior or current experience as a science communication trainer or facilitator of scientists getting such training. Some participants had prior familiarity with OTSF (e.g., the initial advisor meeting), while others were introduced to OTSF for the first time.

RESULTS

Encountering the OTSF Approach

Summary: Overall Response

After encountering OTSF, nearly all scientists identified at least one valuable aspect inherent to this approach. Interestingly, most scientists *also* identified specific concerns or limitations they saw in some aspect of the model – for themselves or the broader outreach community.

All but one scientist interviewed (98%) described something about the OTSF approach that they found useful or valuable to their practice as science communicators.

Interestingly, 92% of scientists (n=54) also described perceived limitations of the model itself. These comments were sometimes overt critiques of viability, while others were more framed around difficulties of doing this work successfully – either for themselves or the broader community of scientists.

More than two-thirds (71%) of scientists expressed another, broader insight sparked by their experience with learning the OTSF approach. These insights were not explicitly about the benefits of the OTSF approach, but spoke to ways scientists connected their experiences with OTSF to larger framing of science communication and public outreach.

The remainder of this section delves into greater detail and examples of these three types of response to OTSF.

1 Valuable Aspects of OTSF Approach

- The OTSF approach is valued for finding out more about the audience through immediate feedback.
- OTSF tactics are useful to keep audiences engaged.
- OTSF encourages purposeful planning for flexibility, supporting adjustment based on feedback.

2 Perceived Limitations of OTSF

- OTSF tactics can be perceived as limited in applicability – to certain venues, audiences, or fields.
- The act of modifying or adjusting outreach based on feedback is challenging.
- The OTSF approach takes a lot of practice and can feel challenging to implement successfully.

3 Other Insights & Takeaways

- The OTSF approach was seen to build on or give a name to outreach practices already in-use.
- OTSF tactics felt simple to understand and applicable to science communication.
- Learning OTSF made scientists more learner-centered, becoming aware of audience perspectives.

Valuable Aspects of the OTSF Approach

The value of being able to get feedback from audiences was the most valuable benefit that the OTSF approach provided, mentioned by almost 70% of scientists.

In addition to scientists clearly seeing the core benefit of OTSF, the other major theme was feeling that the **tactics were useful to engage audiences**. This was distinct from the benefit of OTSF for feedback, focusing more on the interactivity element. There was some overlap; 24% of interviewees saw the dual-benefit of feedback and engagement. But 20% of the scientists focused *only* on the value of OTSF for interactivity and keeping an audience engaged.

Other scientists liked that OTSF helped them **plan paths to respond to feedback** – a kind of pre-planned flexibility. A smaller segment, in contrast, described the benefit as **supporting flexibility** and adaptability (rather than planning) – this was more about feeling able to field unexpected reactions, questions, or interests in real time.

A few scientists felt that OTSF was especially useful for virtual events, and a handful of scientists appreciated the scope of tactics, which gave many options to include feedback in outreach events.

Perceived Value and Benefits of the On-the-Spot Feedback Model

Coded open-ended responses from scientist interviews (n=59).

	Description of Value or Benefit
69%	**Getting Feedback** OTSF tactics are useful to find out more about or get feedback from an audience, including helping scientists learn more about audiences or making visible what audiences are thinking or feeling during outreach events
44%	**Audience Engagement** OTSF tactics are useful to keep the audience engaged and/or to add greater interactivity to outreach events
36%	**Planning to Respond to Feedback** The OTSF Model encourages purposeful planning ahead for multiple pathways based on feedback or audience, and preparation for audience reactions
14%	**Adaptability & Flexibility** OTSF Model helped them to become more adaptable or to better improvise based on interactions with the audience, including fielding unexpected questions from the audience and what do when things don't go as planned
14%	**Supports Virtual Events** OTSF tactics were viewed as particularly useful for virtual outreach events.
10%	**Range of Tactics for Feedback** OTSF Model provides multiple avenues to get feedback and/or engage audiences
7%	**Other Useful Aspects of the OTSF Model** Other isolated comments that reflected some value of the overall Model or approach

Their Words: Valuing of Feedback & Engagement

Scientists valued the On-the-Spot Feedback approach to glean feedback from their audiences and/or as a way to increase audience engagement in their outreach events. Sometimes these ideas were linked and sometimes they were in isolation.

Getting Feedback: Scientists felt that getting feedback from their audiences during their events was a useful and valuable aspect of the OTSF Model.

"I think **it makes sense to be getting feedback from your audience to make your presentation better**. If no one is following along, then it's not a very good presentation. You're not teaching very well. So, I think that having specific ways to try to get that information is really helpful because sometimes that can be hard. ... So, I think that the particular tactics, the different kinds of questioning and activities and drawing, all those are good ways, very specific, concrete ways to try to get that information."

"I definitely think it's useful because when you're doing engagement with someone, you want them to get something out of it. And I think it's hard because people go in with, I think about my own if I'm giving a presentation to someone. You have a predetermined checklist of things that you think you need to get through, **but if you can't get past the first one, [if] nobody understands that. … You do sort of need to pivot**."

Engaging Audiences: Scientists saw the OTSF tactics as a way to provide more engaging and entertaining events for their audiences.

"Well, I think that [OTSF] is engaging for the listener and actually **aids in just maintaining attention during the presentation**. And so, I think that's quite appealing."

"I think it just draws people in more. And honestly, I think with a lot of science communication, people get really obsessed with their research and really want people to know exactly about it. And then this [OTSF] draws you back and helps you realize that **the bigger thing is engaging people first** and whether they get the takeaway of the very small scientific detail that you want them to, I think is less important than the enthusiasm."

"In general, I think [the tactics] are useful in that **they create a more interactive experience**. ... And it's just, if you're not super interested in the subject, then just listening is not enough to really keep your attention. And so, a lot of these tactics work in ways that are more engaging for an audience."

Limitations of the OTSF Approach

The most pervasive view of limitations of the OTSF approach were scientists who felt OTSF tactics were limited in where, how, or with whom they could be used effectively.

Although this was most common, there was no consistency in specific limitations mentioned. We explore this in detail on the next page.

The strongest skepticism came from 10 of the scientists interviewed (17%), who expressed **clear doubt about the value of getting feedback** at all. They tended to note that they already know their audiences or that information from OTSF isn't valid enough to guide change. This was a small percentage, but the strongest skeptical view.

Around a quarter of scientists expressed doubts or **hesitance about the ability to make real-time changes** based on feedback; this often focused on diverse audience perspectives, which meant changing would only suit a subset of the audience. Other limitations included critiques of a specific tactic (but no consensus on which one); that OTSF was difficult to grasp or put into practice (including that it was harder in the real world than in training); or that it was not prescriptive enough.

Perceived Limitations of the On-the-Spot Feedback Model

Coded open-ended responses from scientist interviews (n=59).

Description of Limitation or Challenge	
47%	**Tactics are Limited** Many OTSF tactics only work in certain situations or modes of engagement. Tactics were described by scientists as being limited by venue, event type, virtual vs. in-person, audience demographics, and/or field of study.
24%	**Hard to Modify** Expressions of doubt about whether it's really possible to modify an event based on feedback, or whether other scientists would be able to modify on the fly.
19%	**Skepticism about a Specific Tactic** Criticism or skepticism about the value or utility of a specific feedback tactic.
19%	**Hard to Learn or Implement** The OTSF Model is challenging to learn or implement; harder to use in real-world engagement events than expected.
17%	**Doubt the Value of Feedback** Doubt, objections, or caveats that getting audience feedback is fully necessary, valuable, or usable to make changes.
8%	**Too Open-Ended** There's no clear guidance of what tactics to use in what conditions and for what types of feedback; OTSF Model needs to be more prescriptive to be useful.
10%	**Other Limitations of the OTSF Model** Other isolated comments that reflected some skepticism, doubts, or limitations of the Model, including hesitance to hand over control to the audience

Viewing OTSF Tactics as Limited in Applicability

While nearly half of scientists interviewed described the tactics as limited in where, how, or with whom they would work, there was no consensus about those limitations

Descriptions scientists gave of how they saw limited applicability of OTSF tactics for certain situations or scenarios tended to describe how the approach wouldn't work in a certain venue or format, with a certain audience, or for a particular topic. But there was no consensus in these details. For example, some felt OTSF would only work virtually; others felt it needed in-person events. Some felt it was for small groups; others felt it was for large lectures. Some felt it was not for adults; others felt it was hard for children.

Instead of a clear pattern in the limitations described, the pattern tended to be that **scientists describing that OTSF was better suited for whatever outreach context they were *not* using**. In other words, these scientists were expressing, "It's useful for scientists who do a different kind of outreach than I'm doing; but for me, because of my setting, I can't use it or use it in that way."

In this way, these comments reflect that many participants saw the theoretical value of the OTSF approach, but still experienced underlying hesitance, difficulty, or anxiety when it came time to apply this approach to their outreach settings.

Perceived Limitations of Event Type, Venue, and Size: Scientists disagreed on which type of event was most suitable for OTSF

"I feel like this is a very… It's very social, right? **It requires a one-on-one or something approximating one-on-one interaction**. And so, for very large groups, that must be very difficult. Big lecture halls, I would have a hard time implementing a lot of these things."

"I feel like **it's aimed at sort of larger groups, longer time periods**. And I think having something [additional] that [would] help to make it more flexible for a shorter presentation or also one for very young learners, or people who are coming and going."

Perceived Limitations of Audience Demographics: Scientists found tactics to be limited across audience demographics

"**I had a group of young kids and I was like, we're going to do a drawing** thing because that's really fun. And it kind of turned into a little bit of craziness. It started off fine and they were drawing, [but] then the dinosaurs come out and the monsters come out and they start poking their pencil through their paper. And I was like, okay, **we're just not going to do this anymore**."

"I felt like it was very much if you're having like a kids' day at a museum, or if you're going in to give like a lecture to a group of people who are interested in the topic, who've shown up at a community event, or something like that. And I think that's great, but I also feel like as scientist do have a lot of other more specific types of audiences that you engage with. And **I don't, I'm not sure if it would be useful for me to have the farmers that I'm talking to pull out a sheet paper and draw something**."

Their Words: Other Limitations of the OTSF Approach

Scientists described challenges in making real-time changes based on feedback, and questioned whether getting audience feedback was always of value in their outreach events.

Hard to Modify: Scientists felt that making real-time changes based on feedback was challenging or impractical for either for themselves or other scientists.

Doubting the Value of Feedback: Scientists questioned the value and utility of getting feedback from their audiences, or felt other scientists wouldn't see the value.

"I'm going to be able to rephrase things, but I'm probably not going to have any visual aids or any additional material prepared. **I might be able to do a little intervention but definitely not completely change or restructure my presentation,** because my presentation is ready. It's been ready for a while."

"I mean, I think it's always hard in a presentation to cater to everybody in your audience. And so, **if you're shifting for some audience members, you might not quite be reaching other audience members**. ... Just, limitations with how much time you as a presenter actually have and how much On-the-Spot Feedback you can actually take and adjust to."

"You do sort of need to pivot. And I think that that is harder, it's obvious in some sense, but **it's harder to put into practice**."

"Like **if nobody's understanding what you're talking about, how can you adjust what you're going to talk about?** You better have a lot of backup slides or, yeah, I don't know what. If you missed it big time, then you're going to have to start doing an impromptu talk."

"So, if you know your audience [in advance] and you really know your audience and you deliver a talk that they can consume, then all's fine. But if you weren't so successful in knowing your audience, you might have a rude shock. **It's kind of like [getting On-the-Spot feedback is] what to do when you screwed up knowing your audience**."

Other Takeaways about On-the-Spot Feedback

Outside of direct value and limitations, the experience led to other related takeaways, including OTSF giving a name to current engagement practices and becoming more learner-centered.

Interestingly, about one-quarter of the interviewed scientists indicated that **OTSF didn't feel novel to them**; they felt it was similar to practices they already used, perhaps giving it a formal name and structure. This may indicate the conflation of engagement and feedback uses of the tactics.

Another interesting theme was that more than 20% described becoming generally **more attuned to thinking about the audience's perspectives, knowledge, and feelings** through this process. Other takeaways included learning foundational communication and teaching principles and insights about planning outreach events around goals, learning outcomes, or experiential outcomes (rather than around a topic).

A handful of scientists named takeaways of diversity, equity, access, and inclusion. These insights most often hinged on appreciation of how diverse backgrounds of people in audiences could influence perception of topic or language choices.

Other Big Takeaways related to Learning about On-the-Spot Feedback

Coded open-ended responses from scientist interviews (n=59).

Description of Big Takeaways		
	24%	**Building on or Naming a Prior Practice** OTSF added structure or a name to something they were already doing or it built on previous knowledge of engagement or feedback strategies
	24%	**Concrete & Applicable** OTSF tactics are concrete, simple to understand or use, and/or applicable to the outreach work scientists do
	22%	**Becoming More Learner-Centered** Learning and/or using OTSF helped scientists become more aware of being audience centered and think more about the audience's perspective, knowledge, and feelings
	15%	**Science Communication & Teaching Principles** A range of takeaways or lessons that refer to fundamental science communication or teaching principles to convey information effectively, such as clarity of slides, using metaphors, language, and fielding questions
	14%	**Goal Setting** OTSF provided new perspectives on planning events using goals and outcomes, rather than topics as a focal point
	12%	**DEAI Content & Practices** References to content or insights about DEIA issues explicitly, particularly thinking differently about how specific/different people may come to topics

Their Words: Other Takeaways

Scientists described a range of other takeaways they had as a result of learning about and/or using On-the-Spot Feedback tactics in their public engagement events.

Building on Prior Practice: Scientists often saw OTSF as an extension of their current outreach work.

"I think it was just helpful to have kind of **the recipe or framework for things that I was kind of already doing**, but not knowing, and then being like, "Okay, so these are the strategies." It helps you kind of elaborate on that. ... I think it was nice to put names to things that were already kind of happening by accident."

Highly Applicable: Scientists felt OTSF was well-defined and could easily be applied to their work.

"**I think [OTSF is] inherently practical.** I think that I have been to a lot of seminar talks where I really wish the person would've considered these things. I guess what I'm saying is **I don't think that this is just something for science communicators, I think this is something for everybody**, because I think I always tell people that, your science is only as good as what you can explain to your mom or your dad."

Becoming More Learner-Centered: Scientists described greater awareness of their audiences.

"So, it's great in that it makes the communication aspect easier for me, because I know where I've not been clear. And I hope also that it makes it more satisfying for the person I'm conversing with because they can then follow along as I'm talking and not be completely lost. So, I think that those things really feed off of each other, **just the idea of making it a conversation and not a lecture was kind of just a paradigm shift in how I talk to people**."

Goal Setting: Scientists reframed the way they approached the planning process.

"I think **it makes you really think about what you want people to get out of it**. Because yeah, I might just want to throw together a demo of how, I don't know, plants do photosynthesis, but what do I actually want them to learn from it? And [then] keeping all those goals in mind…"

Differences by Training

Virtual 2-Day

Participants from this format, which was used with just one institution, expressed **stronger skepticism of the OTSF approach**. This group had higher proportions of scientists describing OTSF tactics as limited – good for other people, but not appropriate to their venue, format, or audience. It also had higher relative proportions of those who felt it would be too difficult to modify on-the-spot or doubting the value or validity of on-the-spot feedback altogether. However, this group was most able to **see the value of OTSF for both engagement *and* feedback.**

Month-Long Virtual

Participants from this format, which was used most often, were essentially the only people who **viewed OTSF as valuable for *virtual* engagement** specifically. The format and examples set in the repeated sessions likely drove this sense of value. This group was also more likely to value their experience for having **gained fundamental communication or teaching principles**. This may reflect that recruitment for these sessions more often served less experienced communicators and incorporated non-OTSF lessons.

In-Person

Participants from the three in-person sessions, which was one full-day or two half-day trainings, had many similarities to those in the virtual formats. A distinctive response about the value of OTSF was that this group more often **reported that the model felt generally applicable, but that it also felt somewhat hard to learn** or hard to implement. This response may represent a sense of OTSF being an approach that is at the balance of being a relevant idea but challenging process to deploy.

RESULTS

Training Outcomes

Overall Experience Rating

Scientists reported high rates of satisfaction, with 3 out of 4 feeling the training was Excellent or Superior, the two highest possible ratings.

Scientists who rated the OTSF workshop highly tended to describe how useful or relevant the content was to their work as science communicators. Scientists also regularly described the workshop as well-run, organized, and taught in an engaging way.

Scientists who rated the workshop lower (good or fair) tended to describe a perceived lack of applicability, or a previous familiarity with the tactics.

High-Rating Quote:
"I loved how well the workshop was organized. Everything was well structured including the zoom sessions, assignment, and group presentations. I especially found the comprehensive OTSF guide really useful. I plan to refer to it every time I plan any public engagement."

Lower-Rating Quotes:
"I think a lot of the examples were focused on a particular kind of lecture or audience - somewhat social science centric. I was unsure of how a lot of the discussed ideas could easily be translated to my talk and lectures."

"Much of this workshop felt like repetition, and I did not feel as if I learned any new techniques or strategies that I did not already know. Perhaps this workshop was better for new science communicators."

Overall Experience Rating Across All OTSF Workshops

Scientists were asked to rate their overall experience in the workshop on a 5-point scale, with 'Poor' being the lowest rating, and 'Superior' being the highest. No one chose to rate the workshop as 'Poor.' (n=133)

Fair 8%	Good 18%	Excellent 55%	Superior 20%

Immediate Takeaways from Training

After the training, scientists most often described having new tools at their disposal, and the value of <u>both</u> engaging and getting feedback from audiences.

When asked about their biggest takeaways after the On-the-Spot training, scientists regularly expressed enthusiasm about discovering new tactics for feedback, as well as the **specific new tools they could use to elicit that feedback**, such as annotation and Jamboards.

Scientists also felt the training provided them with more ways to engage audiences and keep them engaged. Slightly fewer scientists described intent to use the tactics to get feedback or that the concept of feedback and subsequent changes was a big takeaway from the training.

Other themes that occurred less frequently included takeaways around more purposeful planning to incorporate tactics; staying flexible or adaptable during presentations; new insights about presenting to diverse audiences; learning from others in the workshop; and opportunities to practice and prepare to try the OTSF tactics in their public engagement events.

Biggest Takeaways Among Scientists Immediately Following Training

Coded open-ended responses to the survey question, "What was your most meaningful takeaway from this training?"

n=133	Description of Code
28%	**New Tactics and Tools** Encountering new tools such as annotation, or specific tactics such as polling
26%	**Audience Engagement** Describing the tactics as a way to better engage audiences
21%	**Getting Feedback** Tactics are useful to find out more about or get feedback from an audience
14%	**Value of Planning** Encourages purposeful planning ahead for flexibility and feedback from audience
8%	**Adaptability** Training helped them to become more adaptable or to better improvise
8%	**DEAI Practices** Insights about DEAI content, specifically how different audiences may react to the language choices and perspective of a presenter
7%	**Peer Learning** New learning and insights gleaned from other workshop participants
5%	**Opportunity for Practice** Allowed time to build familiarity and confidence with using tactics
	Other Takeaways Other miscellaneous comments including general praise, engaging or getting feedback during virtual events, and the value of setting goals.

Effectiveness of Training at Core Outcomes

While the workshop proved highly effective in helping scientists understand the purpose of OTSF in outreach, it was less successful in teaching how to adjust based on feedback – arguably the most difficult part of the OTSF cycle.

More than half of scientists reported that the training was very effective at helping them understand the purpose of using On-the-Spot Feedback in science engagement. This seemed to be the strongest outcome of the workshop.

However, around half of scientists felt the training was very effective at showing how the OTSF tactics can be used and how to develop their personalized plan to use OTSF during their own engagements. These were also strong outcomes.

It was the last phase of the cycle, responding to feedback, where only 23% of participants felt the workshop was very effective at teaching how to respond to feedback and make changes; although 50% felt it was moderately effective, so the workshops were not unsuccessful in this area. These differences may represent the degree of difficulty of this element and the availability of time in the workshops.

Ratings of Effectiveness in Key Workshop Outcomes

Scientists were asked to rate the effectiveness of the workshop in four key outcomes on a 6-point scale, from Very Ineffective (1) to Very Effective (6).

Ineffective (any level)	Slightly Effective	Moderately Effective	Very Effective

Helping me understand the purpose of OTSF in science engagement (n=134)
10% | 22% | 66%

Teaching me how OTSF tactics are used during engagement (n=132)
7% | 36% | 52%

Supporting me to develop my own plan of how to use OTSF in an engagement opportunity (n=133)
11% | 38% | 47%

Teaching me how to respond to the feedback to adjust or make changes to my outreach (n=109)
9% | 18% | 50% | 23%

Understanding of Tactics

On average, scientists felt they understood each of the tactics very well by the end of the workshop, with all ratings falling between a 4 or 5 out of 5.

The data indicated that, in the aggregate, all of the tactics were equally well conveyed by the workshop. There was not one tactic that was far more confusing or unclear for workshops.

Polling was the tactic rated the highest, with nearly 60% of scientists feeling they understood it extremely well (5 out of 5). Questioning and Listening; Drawing; Accomplish a Task; and Kinesthetic Activities were all rated at the highest level of understanding (5) by over half of participants. Observing the Audience was rated slightly lower, but by only a small margin.

When scientists left comments explaining why they had a hard time understanding a tactic, they most often described difficulties applying it to their topic, venue, or audience, or they had trouble understanding how it would work in a virtual setting.

"Overall, I had a hard time understanding how to apply many of these, outside of questions and polling, to my research."

Average Rating of Understanding Each Tactic after the Workshop

Scientists were asked to rate their understanding of each tactic presented in their workshop on a scale of 1 to 5, with 1 being 'I don't understand at all' and 5 being 'I understand extremely well.'

Tactic	Rating
Polling (n=131)	4.52
Asking Questions and Listening (n=124)	4.47
Drawing (n=132)	4.46
Ask to Accomplish a Task (n=124)	4.45
Kinesthetic Activities (n=132)	4.37
Think-Pair-Share (n=132)	4.36
Construct or Use a Model (n=131)	4.31
Observing the Audience (n=105)	4.25

1   2   3   4   5

TRAINING OUTCOMES
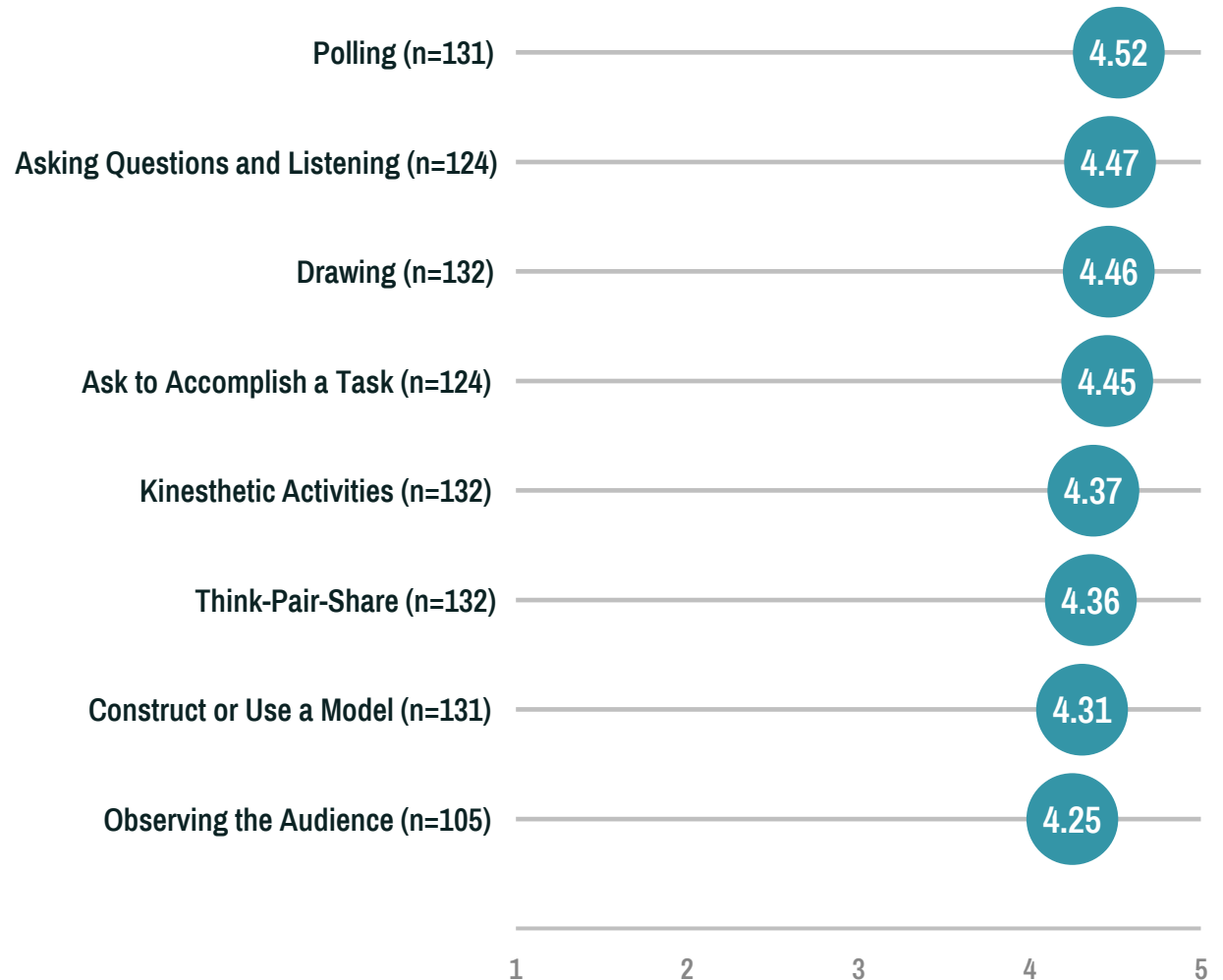
RESULTS

Training Process

Summary: Training Value

Nearly all scientists found a variety of aspects of the training experience especially valuable. Some also expressed barriers and challenges, which tended to center around contextualizing the tactics and logistical setbacks.

All but two scientists (97%) described at least one useful or valuable aspect of the OTSF workshop they attended. These rewarding aspects tended to center around peer-to-peer learning, seeing instructors demonstrate the On-the-Spot Feedback tactics, and/or getting time to practice the tactics themselves.

About two-thirds (66%) of scientists interviewed named at least one barrier or challenge from their training experience. While some of these challenges revolved around workshop content, many of these comments were also about logistical concerns, such as the intensity of the workshop, lack of time to commit to the training, or virtual limitations.

There were few notable differences in strengths and challenges among the three workshop formats. Scientists from the 2-day virtual training described it as long and intense more often, while virtual formats seemed to offer more time to practice, compared to the in-person trainings.

These themes are explored in detail in the following pages.

1 **Valuable Aspects of OTSF Training**

- Learning with and from peers was a highly valuable aspect of the On-the-Spot Feedback workshops.

- Demonstrations of the tactics helped scientists to understand the audience experience and see OTSF strategies "in action."

- Time to practice the OTSF tactics helped scientists feel more familiar and confident in using new tools and tactics they were less familiar with, especially in virtual workshop formats.

2 **Challenges in OTSF Training**

- The On-the-Spot Feedback workshop felt long, intense, or like a lot of work, most commonly in the 2-day virtual format.

- Scientists sometimes perceived a lack of applicability to their own work based on how the tactics were presented or the examples used in the training.

- Scientists occasionally found that they needed more examples than the workshop provided to really understand a tactic.

Value and Strengths in the Training Phase

Rewarding Aspects of the On-the-Spot Feedback Training
Coded open-ended responses from scientist interviews (n=59).

	Description of Value or Strength
61%	**Peer Learning** Getting feedback from peers, hearing about others' plans for using tactics during outreach, and/or sharing their work
56%	**Tactics Demonstrations** Seeing real-time demonstrations of the tactics facilitated by the instructors or exemplars of the tactics provided through workshop materials
36%	**Time for Practice** Having time to practice and troubleshoot using the tactics themselves during the training
27%	**Community of Scientists** Networking, talking to other scientists, and/or feeling like a part of a community of practice
25%	**Opportunity for Planning** Workshop provided focused time to plan for an outreach event via the homework, group presentations, and/or other planning processes
5%	**Other Useful Aspects of the Training** Other isolated comments that reflected some value of the OTSF workshops

The process of peer learning and the expert demonstrations of the tactics were the two most rewarding elements of the training process.

Peer Learning was most frequently described as a valuable or strong part of the On-the-Spot workshops. This included both sharing work and/or hearing about others' plans for using OTSF tactics in outreach. A related, but distinct, idea was the opportunities provided to practice the tactics (which was often done with peers). This approach built their confidence and gave the opportunity to troubleshoot. This sentiment was most common among scientists that did a virtual training workshop.

The other strong value of the training phase was the demonstrations of OTSF tactics given by instructors. Scientists felt the examples helped them experience the tactics as an audience member and provided context for how the tactics could be used in their own public engagements.

Other major benefits were of being in a community of scientists doing outreach work (but not specifically about the learning or practice), while another 25% felt the opportunities to plan for an outreach event specifically were especially helpful.

Their Words: Value of Training Phase

Scientists valued the On-the-Spot Feedback workshops for opportunities to learn from and with peer scientists and demonstrations of the OTSF tactics in action.

Peer Learning: Scientists felt that sharing with others and hearing others' experiences and plans aided in their learning experience.

> "**I think I just gained [insight] seeing how other people were going to present what they study, and that was just helpful to see other examples.** None of them ended up being directly applicable to what my activity ended up being, but I've tried to keep some of those things in mind, like, "How could I apply that to my research?" And sometimes I can't, but either way it's interesting to see that. Or at least I haven't figured out to. But either way, it's interesting to see how they're representing their scientific work."

> "Just the difference of perspective because it's easy to think about the one or two ways you might implement something into your own project but then **hearing about how someone else might take the same approach but use it a little bit differently or to a different end, that was helpful to hear** or just recognizing that some of the approaches would not be relevant in my case but were going to be relevant in someone else's situation. It helped me think about, "Okay, well, I might not be able to use that now, but down the road in a different situation, I could use it the way someone else at my table is using it." That was helpful."

Tactic Demonstrations: Scientists valued seeing the tactics in action and experiencing them as an audience member.

> "And you experienced it a bit more and you learn from the experience a lot better than just from reading it. And in particular I liked the examples that were not familiar. ... So that experience was very useful for me as a learner in general. And so, then **I could really put myself in the perspective of somebody that I would be teaching astronomy to, of what they would feel like as a learner**. And I found that very useful."

> "I think it was valuable to see it from the side of trying to learn the new things. So, for example, one of the ones that they did was the difference between a crow and a raven. And I feel like **seeing actually how mechanically that worked from the audience side** of like, all right, how do you choose which one? How do you discuss this in your group and then change your mind about things? **I think that was the useful part, the getting to try it out as an audience member.**"

Challenges during the Training Phase

The time commitment and intensity of the workshop was the most common barrier, followed by a perceived lack of applicability of the material.

Challenges to the training were less prevalent overall than benefits. But the biggest issue was that it felt challenging due to their own lack of time or high workload. This sentiment was heard from nearly all scientists from the 2-day virtual workshop, which may indicate a mismatch in expectations about workload and dedicated focus for a "short" virtual learning experience.

Around a quarter of scientists interviewed felt that something in the training wasn't applicable to them. Perhaps a counterpart to the overall sense that OTSF "doesn't apply" everywhere, this was more specific about examples in the training not being relevant to their settings. Some scientists wanted more examples of the tactics or otherwise found a tactic not yet well-understood. Others felt they needed more time to practice the tactics.

A handful of scientists who took a virtual workshop felt the experience would have been stronger in-person; these comments often praised the virtual experience, even while expressing preference for in-person.

Challenges or Limitations in the On-the-Spot Feedback Training

Coded open-ended responses from scientist interviews (n-59).

		Description of Barrier or Challenge
🕐	**31%**	**Long, Intense, or a Lot of Work** The time commitment or amount of work the workshop entailed was a lot of work due to scientists' distractions, high workload, lack of time, etc.
🚧	**24%**	**Lack of Applicability** Something in the training "didn't apply" to the scientist interviewed, their audiences, their context, or their conditions.
❓	**10%**	**Need More Explanation of Tactics** Found the way one or more tactics were explained to be insufficient; needed more examples to really "get it."
🖥	**7%**	**Need More Time for Practice** Felt they didn't get in adequate practice time, or would have benefitted from more practice time during the workshop.
🖥	**7%**	**Virtual Limitations** Perceived the virtual workshop to be limited, compared to an imagined in-person workshop experience.
	10%	**Other Barriers or Challenges from the Training** Other isolated comments that reflected some challenge or limitations, most often isolated logistical issues that did not fit into the categories above.

Their Words: Barriers & Limitations to Training

Scientists described challenges in finding time and energy for the training and struggled to apply the examples from the training to their own work and area of study.

Long, Intense, a Lot of Work: Scientists often blamed themselves for not having adequate time, energy, or resources to devote to the workshop.

"**I just remember it was very long. It was a lot of time to sit there.** Obviously, this is only for me, but it was at the same days as another conference I was in, so I was on Zoom all morning and then on this thing all afternoon. It was just a long time, but that was a little bit annoying."

"**And then, we're going to send you home with an hour video. I was, kind of, like, oh boy.** Between the workshop itself. And I think most of the people that were in the workshop were working full-time. We're at work all day, then a three-hour workshop, giant book [OTSF Guide], hour video. Which it didn't seem too much, again, doing it, but I was just like, I felt a little intimidated."

Lack of Applicability: Scientists found it hard to apply the examples they were provided to their own work.

"I felt like **I was designing a really cool program, but it's not one that I necessarily will actually be able to present.** And I can, because I was able to design it, I can use that worksheet for something else once I've sort of gotten cleared to present on a space topic that I'm trying to do, but that particular one that I designed for, I think is unlikely to actually get presented in the way I planned it."

"Maybe just perhaps a little bit of non specificity. ... I don't know, because there were a lot of people from different science backgrounds there. ... Our discussion was moderated by two, **I want to say they were astrophysicists or astronomers, so a lot of their examples naturally were based on that**. ... [but] **having other moderators who have different experiences or backgrounds might be helpful.**"

RESULTS

Planning Process

Summary: Planning Process

More than two-thirds of scientists identified a rewarding aspect of the planning phase during their interview, while just over half expressed a barrier they encountered during planning.

Most scientists (68%) felt some aspect of planning to use On-the-Spot Feedback tactics in their engagement was especially rewarding. This included scientists who described OTSF as encouraging them to plan ahead more than they normally would for an outreach event, getting feedback that helped with planning during the workshop, and continued planning processes after finishing the workshop.

Just over half of scientists (51%) described encountering some barrier or sticking point during their planning process. These barriers varied, but often revolved around the time and effort needed to plan for audience feedback or selecting tactics that would work well for their particular event.

These reflections encompassed planning activities within the training and those that occurred afterward.

There were a few notable differences between workshop formats. Scientists from **longer virtual workshops tended to mention the value of having tools and a framework for planning** more often, and scientists from **the virtual 2-day workshop described OTSF as encouraging planning generally**.

1 Valuable Aspects of Planning for OTSF

- Planning to use OTSF tactics helped scientists to think through their outreach events more thoroughly than they typically would.

- Scientists valued the tools and framework that OTSF provided for planning to use tactics.

- The feedback scientists received from peers and instructors as part of the training was useful for their planning process.

2 Challenges in Planning for OTSF

- Scientists sometimes felt that OTSF required more planning than was practical or doable in their science outreach work.

- Selecting a tactic that would be suitable for their setting, audience, or topic during the planning process was sometimes a challenge.

- A handful of scientists had trouble planning for time management and how long tactics would take, while others felt they didn't know enough about their audiences to plan well.

Planning to Use OTSF Tactics after the Workshop

Ratings of perceptions and intentions to use OTSF tactics.

Scientists were asked to rate each statement on a 5-point scale, from Strongly Disagree (1) to Strongly Agree (5). No one rated any statement as 'Strongly Disagree.'

Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Strongly Agree

I intend to try using an OTSF tactic in my next public engagement (n=131) — 10% | 89%
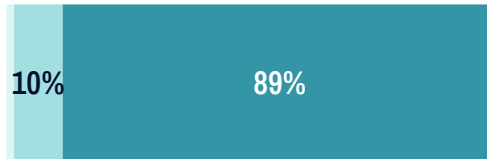
Using OTSF tactics will be extremely useful for engaging an audience during outreach (n=108) — 16% | 81%
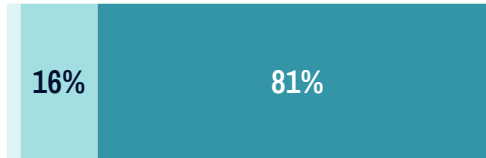
Feedback that results from OTSF tactics will be extremely useful for informing how I communicate better (n=107) — 25% | 72%

I feel prepared to try to use the OTSF tactics (n=132) — 36% | 61%

Immediately after the workshop, the vast majority of scientists strongly intended to try an OTSF tactic in their next outreach; at the same time, they were less confident in their preparedness.

A very encouraging finding was that nearly 9 out of 10 scientists that went through the training were quite certain they would try to use OTSF tactics in their public engagement. The follow-up interviews largely supported that these intentions bore out, as nearly everyone interviewed had tried using tactics at least once – and whether they reported into the research study or not.

Interestingly, while nearly all attendees agreed that they felt prepared to use the tactics, their confidence level in their preparedness was not as strong as their confidence that they would try. That suggests there was an acknowledgement of the difficulty of OTSF, but a willingness to try.

The vast majority of scientists felt very strongly that the tactics would be useful for engaging audiences. While most also felt strongly that the *feedback* from the tactics would be useful to inform or change how they communicate, the ratings to this statement were a significant decrease from the ratings about engagement.

Benefits and Value in the Planning Process

Scientists felt that OTSF encouraged a more comprehensive engagement planning process overall and found value in the tools and framework provided for planning their outreach.

Broadly speaking, conversations about the planning phase showed that the OTSF process intertwined planning for the *engagement* and planning for the *feedback*. It was difficult for them (or evaluators) to parse out the difference. In this vein, over one-third of scientists valued **being pushed to use a more comprehensive planning process** that they normally would. Scientists also cited **the tools and resources provided by OTSF** as useful in their planning process, most often naming the planning worksheet and the Guide.

Over a quarter of scientists felt that the feedback during training was a benefit of the planning phase, either by confirming that their plan would work or by giving them a chance to improve and iterate. About a quarter of scientists described ways in which they were continuing to plan and think about events beyond their time in the workshop. Finally, a handful of scientists described the benefit of finding out about their audience *before* a presentation, as part of their planning.

Rewarding Aspects of Planning to Use On-the-Spot Feedback

Coded open-ended responses from scientist interviews (n=59).

		Description of Value or Strength
	36%	**Encouraged Planning** Valued that the process forced them to invest more time, energy, or thought into planning for an engagement than they normally would.
	34%	**Provided Tools & Framework** Benefitted from having the tools, worksheets, framework, and the Guide to help them apply what they learned.
	27%	**Feedback from Training** Received useful and/or actionable feedback from peers and/or instructors during the workshop that informed their planning process or helped them iterate
	24%	**Continued Planning Beyond Workshop** Descriptions of additional planning scientists did on their own after the workshop, homework, and group presentations were complete.
	8%	**Learning About Audiences Before Engagement** Reaching out to venues or other stakeholders to find out more about their audience prior to an event as part of the planning process

Their Words: Value in Planning

Scientists described a range of valuable aspects in the process of planning to use OTSF tactics in their interactions with public audiences, most notably that the process was more purposeful than previous outreach planning they had done.

Encouraged Planning: Scientists felt OTSF made them plan their engagement more thoughtfully and purposefully.

"It's actually **being explicit in writing that down [in the planning document, which] was probably one of the most helpful exercises, because it really helped me home in on, am I even doing the right activity?** Maybe sometimes I think I'm doing the right activity and then I actually write down what I want them to learn. It's like, oh maybe there is something better I could be doing."

Provided Tools & Framework: OTSF provided resources that were useful in the planning process.

"I liked that [the planning document] was a guided questionnaire. ... Not specifically freeform everywhere. I like how **it helped you focus on what would be important when you're engaging with people, and then working through the process and thinking about what you want the outcome to be**."

Feedback from Training: Scientists got useable feedback that helped move their planning process forward.

"We all shared and had a nice session, where other people then shared what they thought I could do to improve or what they liked about it. And so, it was more tailored to your personal experience so, but **the feedback I received from the group gave me a lot of good food for thought and helped me planning the rest of the presentation**."

Continued Planning: The planning process often continued and evolved after the OTSF workshop was over.

"I think what I'm going to do now that I'm not under pressure, because I have a talk coming up in October to the same group of people, something a little lighter, a lighter topic. What I'm going to do now is actually follow the guidebook because I have to make a whole new topic I never talked about before. **So that's going to give me an opportunity now to do it better and plan a little better**, not just go to pre-made canned talk."

Challenges in the Planning Process

Challenges or Limitations in Planning for the On-the-Spot Feedback
Coded open-ended responses from scientist interviews (n=59).

		Description of Barrier or Challenge
🕐	**19%**	**Too Much Planning Required** Found it difficult that this approach requires more time commitment and/or effort in the planning phase
📄	**19%**	**Selecting and Planning Tactics** Experienced struggles or difficulty during planning to select tactics for their conditions or audience and/or to actually craft the prompts or questions for the tactics
📋	**7%**	**Too Rigid** Felt that the planning or tools provided were overly-structured, rigid, and/or not really useful to what the user wanted or needed for their outreach
⏱️	**7%**	**Time Management in Planning** Trouble envisioning how long each tactic would take, how many tactics to try and accomplish in a given event, and other time concerns in planning
❓	**7%**	**Lacking Knowledge of Audience** Challenges in planning tactics due to not knowing typical baseline knowledge or attitudes for a demographic or age group; not being sure who would show up to an event
	10%	**Other Barriers or Challenges from the Planning Phase** Other isolated comments that reflected some challenge or limitations; half of these comments relate to challenges integrating flexibility into their plan and/or anticipating the types of questions or feedback an audience might have

There were fewer challenges raised at the planning phase, but the time investment required and the process of selecting and designing tactics were the two biggest difficulties at this phase.

While many scientists described OTSF's emphasis on spending time on comprehensive planning as a benefit, about 1 in 5 felt the time needed to properly plan for using tactics and/or planning for feedback was a barrier in the OTSF cycle.

Along these lines, a similar number identified the process of selecting and planning the tactics to embed in the engagement as a challenge. Scientists experienced trouble with formulating appropriate questions and choosing tactics that would work in their outreach settings. This included some people who had to adapt to events changing formats unexpectedly, such as an in-person event becoming a virtual event.

Challenges mentioned by a few people included feelings that the planning process was too structured to be useful for them; lacking understanding about time needed for different tactics; and difficulty of planning tactics for unfamiliar or unexpected audiences.

Their Words: Barriers in Planning

Scientists described barriers in the time it took to plan for OTSF tactics and trouble selecting, planning, and developing tactics appropriate for their outreach events.

Too Much Planning: Scientists felt the extra time needed to plan for feedback tactics was a barrier to using OTSF.

> "I think that **it just takes a lot of effort at the beginning or before the presentation**, which for some people, maybe they don't do a lot of prep for presentations. And so, that could be a limiting factor."

> "Well, for people who have to do a lot of other work on top of the outreach, it would require more time commitment, but I think it is necessary if we want to fully engage the audience and really capture their imagination. ... I guess if you wanted to point out drawbacks, it's that **it would take more time, and yeah, more resources essentially, to put together good presentations** like that."

> "I didn't use as many of the techniques as I wanted to in my lecture in particular, the one that I gave, just because **I didn't have enough time to put it together properly**..."

Selecting and Planning Tactics: Scientists found it hard to select the right tactic for their outreach, and design that tactic to suit their goals and audience.

> "[It was difficult] **trying to adapt that worksheet of thinking through how are you going to get this feedback, and which questions are you going to ask, and what is the structure**? Thinking through that was really helpful, but it was really, it was hard to do it also in terms of trying to think about how to do that virtually because of COVID or in these sort of different spaces than what they had maybe designed it for."

> "I think [formulating a] question is very challenging for me, because what are the audience members' prior knowledge, opinions, interests, or understanding about what is being experienced or convey? ... **How [do you] design their questions, that will be a challenge**. Because if you [choose] a question, you need to think about, is this meaningful? Is this useful? Is this missing your intention? That's very important."

RESULTS

Applying OTSF

Summary: Using Tactics

86% of scientists interviewed had used OTSF in engagement settings, which led to a range of benefits and challenges. An overarching theme is that applying any approach in a complex, real world setting leads to unforeseen challenges.

Of the 14% of interviewees who had not yet used OTSF, the main challenges were in finding an event or applying OTSF to the types of events they had access to; a few had future events where they expected to use the tactics.

Getting feedback and engaging audiences were the two most rewarding benefits that resulted from using On-the-Spot Feedback techniques. Among those scientists who described getting feedback, many described how they were able to make real-time changes to their outreach based on that feedback.

At the same time, scientists frequently hit barriers in using the tactics. This was very pronounced when they did not have full control over the technology in virtual settings. Even when tactics went as planned, scientists described that making in-the-moment changes was harder than they expected based on their understanding from the workshop.

Scientists primarily used OTSF for the purpose of gauging incoming knowledge, interests, or attitudes, rather than as a mid-point or end-point check of understanding.

1 **Valuable Aspects of Using OTSF and Making Changes based on Feedback**

- Getting feedback was considered the most valuable aspect of using OTSF tactics, followed closely by audience engagement.

- Many scientists described instances of making in-the-moment changes to their outreach based on feedback from their audience, while others used feedback to reflect and make changes to future planned events.

2 **Challenges in Using OTSF and Making Changes based on Feedback**

- Scientists faced unexpected barriers during virtual engagements, which they often lacked control over.

- Scientists found it harder than they expected to make in-the-moment changes based on feedback.

- The way tactics were designed or the audiences they were used with sometimes limited usable feedback.

3 **Types of Feedback Elicited**

- Over half of scientists interviewed (59%) described using OTSF tactics to get a baseline understanding about their audiences at the beginning of an outreach event, such as knowledge, interests, or attitudes.

Types of Feedback Elicited

Types of Feedback Elicited Through OTSF Tactics

Coded open-ended responses from scientist interviews (N=59).

Feedback Type: Coded from scientists' description of goal		
	41%	**Incoming Knowledge** Tactics designed to understand something about the audience's prior knowledge to decide what material to cover or how to cover it
	24%	**Incoming Interests** Feedback to understand something about the interests of the audience to direct the focus of the outreach
	20%	**Mid-Point: Are They Getting It / Audience Thinking** Got feedback during outreach to try to gauge if the audience was following or fully grasping presented topics
	19%	**Summative: Achievement of Event Goals** Tactics designed to understand something about audiences' "end-state" response, reaction, or learning
	12%	**Incoming Attitudes** Seeking to understand something about incoming perceptions, attitudes, or feelings about the topic to inform how to talk about things
	10%	**Informed Work or Practice** Seeking to inform their research or work in some way, but not specifically their communication; often targeted when using OTSF with colleagues or other scientists

When using OTSF to get feedback, scientists primarily aimed to gauge the audience's baseline knowledge of a topic in order to decide what material to cover or how quickly to move through their presentation.

The next most common feedback aim was also a "front-end" question; instead of knowledge, these scientists aimed to discover incoming interests about a topic, to build relevance through directing the focus of the event to reflect those interests or using a "choose your own adventure" style. A few focused on incoming attitudes or perceptions.

Far fewer described using tactics for the purpose of assessing audiences' understanding or thinking along the way or at the end, to see if they'd achieved a goal. In this way, **scientists seemed more comfortable seeking information about an** *audience*, **versus assessing if** *their communication* **approach was making progress** toward their goal (mid-point or end).

1 in 10 scientists used OTSF quite differently, seeking information that they could use to inform their own research or work. This was often (although not exclusively) in communications with peers, rather than the public.

Benefits and Value in Using Tactics & Making Changes

Rewarding Aspects of Using OTSF and Making Changes Based on Feedback

Coded open-ended responses from scientist interviews (n=59).

	Description of Value or Strength
49%	**Got Feedback from Using Tactic** Felt that they got usable feedback from the audience through a tactic(s) they tried; these comments reflect scientist perception, not direct evidence of feedback or resulting changes
46%	**Engaged Audience by Using Tactic** Valued that the tactics helped keep the audience engaged; the audience participated effectively in the tactics
42%	**Made In-the-Moment Changes based on Feedback** Scientists that felt they were able to successfully about to make real-time changes to their outreach based on feedback from their audience
34%	**Intention to Try OTSF with a New Audience/Venue** Scientists that described wanting to try OTSF tactics across different venues, on different topics, and with new audiences
29%	**Future Changes based on Feedback** Scientists that felt they learned something specific from the feedback that they could apply to a later outreach event
19%	**Using Tactic Conveyed an Idea or Taught Something** Descriptions of using the OTSF tactics as tools to convey a message or teach content; sometimes in addition to getting feedback or engaging an audience

When they used OTSF, the benefits included getting usable feedback, keeping the audience engaged, and being able to adapt on-the-spot.

For those who were tried the tactics, the benefits aligned with the project expectations. Around half of interviewed scientists felt that they got feedback and/or kept the audience engaged. 11 of these interviewees described *both* feedback and engagement as valuable outcomes, which means that 16 scientists (over 25%) only described the benefit as keeping their audience engaged.

Nearly half of scientists described making in-the-moment changes based on feedback, some of which were subtle, such as shifts in wording or restating a main idea. More than a quarter reported feedback that would inform future changes, including changes to the tactics to be more useful for driving real-time changes. About a third of scientists, unprompted, described an intention to try the tactics again after learning from how their first event went, often with a different tactic(s), event, or audience.

A few scientists described how tactics *conveyed* a concept – the use was to inform the audience, rather than elicit feedback to inform the presenter.

Their Words: Value in Use & Making Changes

Scientists described value in using the tactics for both feedback and engagement, as well as making real-time changes based on that feedback.

Got Feedback: Scientists felt that they got usable feedback from the tactics they tried.

"We had these beans and pastas that we were using to represent bacteria. And so when I ended up asking them like, "Of our representation, which have the most similar genes?" they held up the pasta or the beans that looked most similar. And so **that was just good for me to know that they had understood what we were talking about**."

Engaged the Audience: OTSF tactics were participatory and helped the audience feel more engaged.

"It's probably half asking questions and half actually talking about other things. So, I use that one a lot, and I do think **it engages people. People are really excited to contribute things**, even when they don't really know what they're contributing. Just having something to say seems to really bring people in. So, I found that to work really well."

In-the-Moment Changes: Scientists felt they were able to make real-time changes based on feedback.

"I wasn't expecting to talk so much about fruits and vegetables at the beginning of the class but that's what the kids were... They had a lot of questions about them... I, again, backed it up, I didn't expect to say this, but I was like, "Does anyone know what a fruit is?" ... I didn't plan on doing that, but **the kids seemed to really get a lot out of it and were really interested in it and so, we went with it**."

Future Changes: Scientists got feedback they could use to make changes to future presentations and events.

"I made some notes and I have revised a little bit of what I am going to do for the next one. And so, **I've been able to get some feedback on how it went and will be able to change it up a bit for the second time around**. So, places where I had maybe not engaged or listened to feedback as well, figure out better ways to incorporate it."

Challenges in Using Tactics & Making Changes

The biggest barrier in the use of OTSF tactics was specific to virtual events, and the second biggest issue was simply struggling to find an outreach event.

Nearly a third of scientists described barriers experienced in using tactics as relating to unforeseen conditions in virtual engagement. These included not being made the host of the meeting, not being able to see or hear participants, and other barriers. This stresses the distinctive challenges of adapting OTSF to virtual settings.

The next biggest issue had nothing to do with OTSF, but simply reflected scientists struggling to find an outreach event, venue, or audience. As with virtual event challenges, this seemed to have some relationship to the reduction of in-person events due to the pandemic.

Other barriers were fewer, but included scientists who used tactics but struggled to make real-time changes in response to feedback, or those who used tactics, but found they didn't produce feedback, either due to the design of the tactic or low audience participation. A few scientists described needing multiple facilitators, especially when the larger group split up for an activity or discussion.

Challenges or Limitations in Using OTSF and Making Changes based on Feedback

Coded open-ended responses from scientist interviews (n=59).

		Description of Barrier or Challenge
	32%	**Unforeseen Virtual Barriers** Scientist intended or tried to use a tactic, but something about a virtual format prevented them from implementing it they way they planned to
	22%	**No Event, Audience, or Venue** Despite interest in trying out the OTSF tactics, scientist reported lacking an event, venue, or audience to do so
	17%	**Hard to Make In-the-Moment Changes** Found it was very challenging, or more challenging than expected, to changes or adjust in real-time based on feedback from the audience
	15%	**Tactic Didn't Produce Feedback** The tactic, or the way it was deployed, seemed not to get usable feedback; includes sentiments that using the tactics well was harder than it seemed during the training
	7%	**Need Multiple Facilitators** Tactics need more support or human power to manage effectively, including breakout rooms, activities, and working with large numbers of people
	19%	**Other Barriers or Challenges in Using Tactics or Making Changes** Other comments that reflected some challenge or limitations, including crowd control and audience expectations (3), time constraints for tactic use (2), and feeling no changes were warranted after receiving feedback (2), among other isolated comments.

Their Words: Challenges in Use & Making Changes

Scientists described challenges in using OTSF tactics due to unexpected virtual circumstances, lack of a venue, not getting usable feedback after using a tactic, and trouble making real-time changes based on feedback their received.

Unforeseen Virtual Barriers: Scientists were limited in their ability to use tactics in unexpected virtual conditions.

"I had no idea if it was just one person answering, if it was 10 people, if they were all on the same page or not, so unfortunately... I don't think this is the problem of the On-the-Spot Feedback. **It was just that this is the way it was set up technically. It was not a great way, but I also had no control over it**."

No Audience or Venue: Scientists had trouble finding an event in which to use OTSF tactics.

"**Some opportunities to do public engagement that I thought I'd have, I didn't end up having due to COVID**. And yeah, I appreciated that we worked through in the course thinking through a specific scenario, but it was more hypothetical in my case."

In-the-Moment Changes: Scientists found it hard to make real-time changes based on feedback.

"So, **I kind of got a little bit of feedback, but maybe I didn't know how to use it**. ...Maybe I wasn't able to recognize the feedback from that well enough. And I don't feel like I was able to change my plan based on that. And I don't know what I was expecting. ... For me, it wasn't as obvious. And maybe that's because I need to find a way to use the tactics a little bit better to get what I need, but that was kind of my experience."

Tactic Didn't Produce Feedback: Tactics as they were designed did not get usable audience feedback.

"If you make your question too simple and your audience already obviously understands that part of it, but doesn't understand the more complicated parts of it ... You have to make sure that you're at the right level, depending on your audience. And so, I think at some point during the workshop that I ended up doing, **I think one of the questions I asked was probably too low level for the girls because they all knew the answer to it right away**."

Differences by Training

PoP-Affiliated Groups

Workshops with participants recruited through Portal to the Public tended to report **using tactics to get midpoint feedback more often** than those from workshops not affiliated with PoP. These participants also more frequently **reported getting usable feedback as a result of using tactics**, compared to other workshop participants. This may reflect greater chance of success and confidence in using the OTSF approach for scientists with an established foundation of science communication knowledge and practice.

Virtual Workshops

Participants from virtual workshops **reported that the tactics they used didn't produce feedback** at higher rates than scientists from the in-person workshops. This was true of virtual workshops in both 2-day and 4-week formats. While it isn't clear what may have caused this difference, it's possible that some quality about **learning or seeing OTSF used in an in-person environment helped scientists to better design and implement tactics** in their own outreach events.

Spring & Fall 2021

Participants from these workshops reported **trouble finding a venue or audience to try using OTSF tactics** at nearly double the rate of other workshops. Due to the pandemic, **this time period appears to have been the most challenging to find a venue**, with many in-person events getting cancelled or making last-minute shifts to virtual formats due to surges of infection or local mandates limiting in-person gatherings. This placed a substantial additional stress on the earliest cohorts in the project.

RESULTS

Stakeholder Perspectives
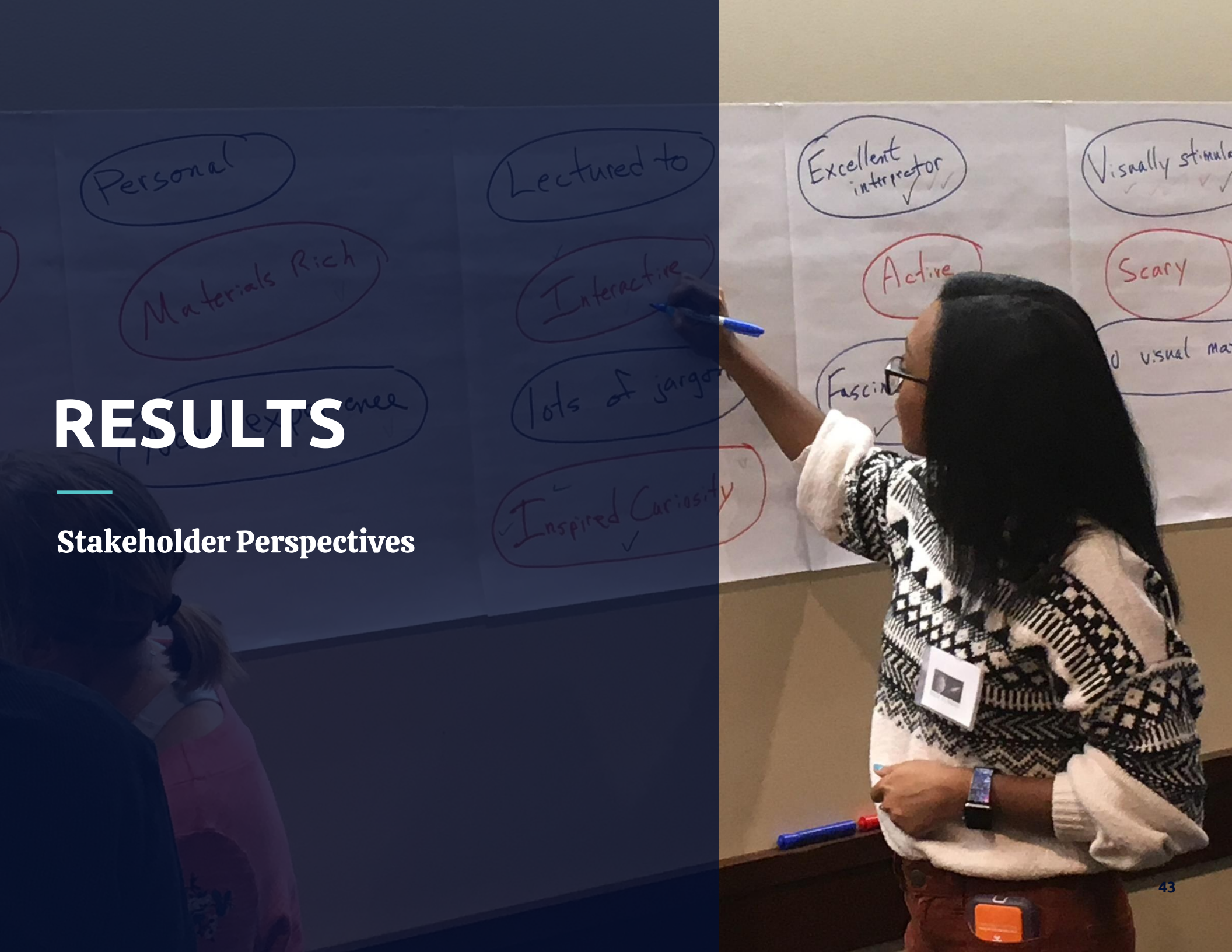
Value of OTSF Content & Approach

Example Quotes from Stakeholders

Coded open-ended responses from focus groups with science communication trainers and stakeholders.

Focusing on Getting Feedback: Stakeholders appreciated that the OTSF approach provides ways for scientists to consider audience feedback as part of their engagement.

> "What **we're trying to help people figure out how to be agile and nimble and responsive** to an audience in the moment. We try and tell them; we try and teach those skills. But **giving it a name, I think, helps us identify what it is** that we're after."

Emphasis on Strategy and Planning: Stakeholders valued the emphasis on encouraging planning and establishing goals or objectives for their engagement.

> "I think it's sort of revolutionary almost. In my work with most scientists, they have not really even sat down and thought about their goals carefully, and then figured out what the desired outcomes would actually look like and how they could possibly get some measure of them at all. And **it is pretty amazing to think of using feedback for the purpose of actually assessing your goals**."

201-Level Opportunity: OTSF training was seen as most appropriate for scientists who already had experience with public outreach

> "...this has potential, in my mind, to be **a very specialized skill, maybe a more advanced skill for people** who have already done some training and know the basics. ... You might not use it every time, but this is something to put in your toolbox that can take you to the next level."

Stakeholders identified three especially valuable aspects of the OTSF approach, all of which generally aligned with what scientists identified as valuable.

Science communication (sci-comm) trainers felt that getting feedback was a unique value of OTSF, and that **explicitly naming and defining the skillset needed to make changes based on audience feedback was an important strength**. Similarly, getting feedback was the most cited value of the OTSF model by scientists interviewed months after they completed an OTSF workshop.

Stakeholders were also attuned to the value of a **more robust planning process** than scientists typically use, and especially pushing them to set goals or outcomes prior to outreach events. This theme was also reflected as a source of value in scientist interviews.

Lastly, sci-comm trainers felt that OTSF tactics **might be best suited to a "201-level" audience**, scientists who had some prior experience with science communication. This sentiment was less common among scientist interviews; scientists relatively new to outreach work often felt that OTSF was a useful tool for them out of the gate.

Limitations of OTSF Content & Approach

The limitations stakeholders identified tended to be the flip-side of the valuable aspects they named, including concerns that the emphasis on general planning could detract from how to use OTSF tactics and the advanced nature of getting and using audience feedback.

Some of the sci-comm trainers felt that the OTSF training could essentially be split in two, separating the elements of broad planning, goal-setting, and audience research as the first part; while the second part would focus on using tactics to get feedback *about* goals. Some trainers felt concern that having both of these elements in the same training might be an overload for scientists.

While stakeholders found value in OTSF approaches as an advanced skill, they also had concerns that it could mean scientists new to outreach might struggle to fully grasp or put OTSF into practice. Novice science communicators may still be building their confidence and learning how to plan an engagement and its goals. Some stakeholders felt that trying to teach them to pivot and respond to feedback during the engagement is a much more advanced technique.

Example Quotes from Stakeholders

Coded open-ended responses from focus groups with science communication trainers and stakeholders.

Planning Emphasis May Dilute Core Message: Stakeholders cautioned that trying to include the planning process along with how to use tactics to get feedback may be too much to cover in a single workshop.

> "I think that **I would actually have done it in two tiers**... you would set your goals and set your outcome, and then think about how you are going to assess that outcome, and then think about, okay, how are you going to get feedback on the fly?"

Not Suited for Novices: Stakeholders felt that OTSF practices were beyond the capabilities of most beginner science communicators, especially responding to audience feedback in real time.

> "...**not only having a revision process, but also having an on-the-spot revision process, it seems pretty sophisticated**... I'd be very interested in seeing if they could take it all in and do it all at the same time, or whether of layering it would be a better approach."

Blending OTSF Content with Existing Programs

Example Quotes from Stakeholders

Coded open-ended responses from focus groups with science communication trainers and stakeholders.

Opportunities to Connect to Other Training Programs: Stakeholders noted a range of programs that dovetailed with OTSF concepts and practices.

> "I think it's something that **has the potential to fit into a lot of different programs**, then be plugged in and incorporated because it's necessary. You need to be able to respond to feedback on the spot. It's important… It has the potential."

> "I'm going to speak on behalf of [my organization] right now. This is a great potential collaboration with [one of our programs]. That would be a lovely combination."

Redundancy with Existing Programs: Stakeholders sometimes shared that their existing programs already included tactics or ways of getting audience feedback.

> "At UW-Madison, at the Wisconsin Institute for Discovery, **they have a program like this, and it looks identical to this**… it's highly successful and it works really well. And I don't see any fault or error with the things they're doing, right? It's just like, yes, we need more of this kind of thing."

Overall, stakeholders saw productive opportunities to connect OTSF training to other science communication training programs they are currently offering or that are available in the field.

All told, stakeholders viewed the OTSF approach as a positive contribution to the science communication training landscape. In these early conversations, many saw elements within the OTSF materials that they would eagerly pick up and apply to their training work with scientists.

However, a few stakeholders saw the OTSF approach as being redundant with other programs, feeling that they already incorporate approaches or tactics included within the OTSF model. Surprisingly, this included embedded feedback mechanisms within outreach events, although it was not always clear if the trainer was fully grasping the *feedback* concept (as opposed to using the same tactics to teach or engage). For example, in the comment to the left, a stakeholder stated that there is an "identical" program at UW-Madison, possibly referring to their Portal to the Public program. While the project team sees distinctions between PoP and OTSF, the differences may not be clear to all trainers.

Needs for Improving Usability of OTSF

Example Quotes from Stakeholders

Coded open-ended responses from focus groups with science communication trainers and stakeholders.

Scenario-First Structure for Selecting Tactics: Stakeholders highlighted a need for structure for filtering which OTSF tactics ere best-aligned with which engagement scenarios.

> "And **it would help me a lot if those were offered in the handbook and saying, here's some that are necessary and are really useful for this setting.** Here's some that are useful for this setting. Even if there was some duplication, I think **that would make it much more useful to trainers.** ... Because you only did a certain event type and you get the handbook, you might go, 'Wait, I don't do this. I don't do tabling [events], so this is not for me.'"

Filtering Tactics for Shorter Training Modules: Stakeholders felts that shorter, more-focused subsets of training would be useful and streamlined for adoption.

> "[For] people who are doing more of talk... some of these pieces are relevant to that as well. But **I don't think the entire piece would be necessary** in that case because it's a different goal that you have. ...I think that [preparing people to use OTSF in talks or lectures] would require a different kind of training."

Overall, trainers felt that for future roll-out, OTSF could be more focused, especially by providing a more directed tactic selection framework and creating more focused training modules with a subset of relevant tactics.

Many stakeholders felt that the training's approach to introduce all tactics equally, rather than providing a scenario-first structure to filter tactics, scientists have to do more work to understand all of the tactics and then match one to their setting or audience. This may create a barrier, wherein scientists view certain tactics or the overall approach as "not for them," because they cannot envision a given tactic being appropriate for their setting or audience. In fact, this sentiment was reflected within scientists' views of limits of the OTSF model (see page 12).

Dovetailing with interest in a greater scenario-first structure and guidance for selecting tactics, several stakeholders felt this would lend itself to creating shorter, more-focused subsets of OTSF training. For instance, if a group primarily communicates via lecture-style events, they could focus their workshop on the subset of tactics best-suited to the lecture hall environment.

Scientist Interviews: Needs for Support

Needs for Continuing Support Among OTSF Workshop Participants

Counts of coded responses from scientist interviews. Due to limited interview time, not all scientists were asked directly about needs for continuing support; the responses below are from 38 of the 59 interviewed scientists.

		Feedback Type
	14	**Follow-Up Coaching, Support, and Community** Looking for extra support or follow-up after the workshop to help with planning, using, or troubleshooting tactics; includes people interested in continuing the community of users
	14	**Illustrate the Tactics** Seeking more examples of the tactics; better ways to see the tactics in action in a variety of settings, how they work, what they do
	8	**Recruitment and Scientist Buy-In** Need to create greater awareness of the value of using an OTSF approach among scientists, training more scientists in OTSF, and getting more institutional buy-in
	6	**Reduce Density of Information** Written information about OTSF is too dense or obtuse; scientists requested shorter, bite-sized ways to refresh themselves on tactics and approaches after the workshop
	4	**Help Finding Outreach Venues** Requests for help in finding venues or audiences with which to use OTSF strategies
	10	**Other Types of Support** Includes providing more funding for training, more tactics tailored to specific areas of science, and targeting scientists that do not do science communication as a main part of their work

Among scientists that participated in an OTSF workshop, some were able to share feedback about needs for continuing support. Their ideas most often reflected need for follow-up support and illustration of the tactics.

Scientists who felt they would benefit from follow-up support often talked about one-on-one coaching to help with planning and implementing tactics, while others wanted to be a part of a community of users with which they could "compare notes."

Other scientists were more interested to see the tactics in action, having direct examples featuring a wide variety of event types and topics. This need may relate to the struggle some scientists faced in finding parallels with their settings or topics in the examples provided during the workshop.

A few others felt OTSF could have greater reach through broader recruitment and publicity to let scientists know these tools exist. Some scientists also felt that the current information available about OTSF (e.g., the Guide, in its draft versions) is too dense, and needs to be broken apart into shorter and/or more visual guides to using tactics and other OTSF practices.

CONCLUSIONS

Value of OTSF

Findings highlight that, in concept and in practice, the greatest values of the OTSF approach are generating usable feedback, keeping audiences engaged, and finding ways to adjust on-the-spot.

There were substantial parallels in the themes expressed by scientists when they were speaking broadly about the concept of OTSF, as a whole, and when they were very specifically describing what happened in their outreach events using OTSF. In both cases, the dominant themes were that this approach was valued for the dual and overlapping benefits of obtaining feedback and being engaging, interactive elements for an audience. And although adjusting or modifying on-the-spot was an advanced and challenging task, many felt they were able to do it, at least to some degree, and that it was beneficial.

In addition, science communication trainers more broadly emphasized similar themes of how this element of OTSF – ways to generate and obtain feedback from audiences – was a unique addition that would benefit the field.

Training Process

The OTSF training model was very well-received and achieved positive outcomes, including participants feeling they understood the tactics and were planning to use them beyond the training. The peer learning, expert demonstrations of tactics, and time for practice were critical elements of success.

Planning Process

The OTSF approach placed a very strong emphasis on planning for outreach, and that resulted in pushing scientists to put more time and thought into outreach planning than is typical. It also seemed that including the planning within the training helped ensure it happened and that scientists were supported.
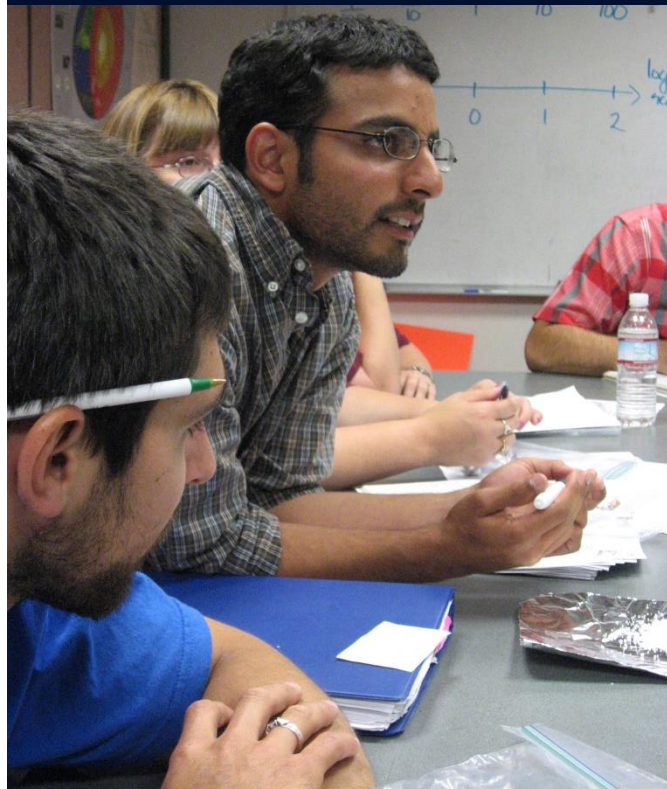
Threats or Limitations

While the response to OTSF was overwhelmingly positive – by scientists and stakeholders – one potential threat surfaced repeatedly among both groups: the potential view that OTSF is a great idea, but "not for me."

The biggest critique or viewed limitation of the OTSF approach that we heard from scientists who attended the training was a sense that, while it was a compelling and valuable model, it wasn't really applicable to their outreach. There was no consistency in these responses. The sentiment was, essentially: "OTSF seems really great for Outreach X, but I do Outreach Y, so it's not for me."

The OTSF approach posits that any tactic can be adapted for a wide variety of outreach formats, venues, and audiences; the training emphasizes this viewpoint of many possibilities and thinking creatively about applying tactics to your scenario. However, scientists and even the sci-comm trainer stakeholders can see this as overwhelmingly broad; they seem more primed to see a smaller subset of good fits between tactic and outreach scenario. The view from this perspective is that, by offering a more constrained, scenario-first approach to selecting tactics, more scientists will be able to quickly see their setting reflected in the OTSF approach, reducing the chance it is viewed as "not for me."

1 Clarifying the Unique Position of OTSF

A theme that emerged among scientists and sci-comm trainers was the sense that it was putting a label on something that was already commonly being done. While OTSF did grow out of embedded assessment in K-12 education, it is *not* commonplace in science communication. It seems likely that people newly introduced to OTSF see the tactics, which may be familiar as ways to engage an audience and prompt learning (e.g., use tasks so that audiences learn X); and they struggle to see the difference of using that same tactic for the purpose of getting information about a learner's knowledge, skills, or viewpoints.

2 An Advanced Skillset

There was clear evidence that, while the overall benefits and value of OTSF were many, the nuances of putting it to use – particularly creating good prompts within tactics and knowing how to pivot on-the-spot – were far more challenging. The fact that we saw scientists who came from PoP-affiliated sites (i.e., locations where some baseline sci-comm training exists) seemed to feel more successful at crafting prompts and getting useful feedback supports this finding. Sci-comm trainers also tended to feel this was a "201-level" training. However, the project found that there was less demand overall for an advanced training, but strong interest from trainees newer to the work of outreach. This may be an ongoing tension that OTSF will need to face in its next phase.

Other Insights

Virtual Challenges

The project itself had to make on-the-spot adjustments to adapt to COVID-19 in its very early days. It surmounted those challenges by creating a virtual and comprehensive training, as well as adapting OTSF tactics for virtual outreach and tools. These were very valuable; but as scientists navigated real outreach settings, we discovered a wide range of challenges to engagement (much less OTSF) in virtual outreach – from control of the meeting tools, to cameras-off culture, to last minute changes by organizers.

Types of Feedback

An interesting area of inquiry was around the information scientists decide to get through feedback. It was striking how strongly scientists gravitated toward assessing the audience at the outset (incoming knowledge, interests, attitudes), and that relatively few focused on evaluating the effectiveness of their communication (are they getting the concept I just taught, did I meet my goal). It may be that thinking about incoming audiences is an easier first foothold for grappling with OTSF, with other forms of feedback an area for future growth.

Planning and Flexibility

Another interesting relationship was a contrast in values of the model for adapting. Some appreciated that OTSF helped them plan for adapting on-the-spot; it helped them develop a clear path or script about how to be flexible, which aided those who are anxious about improvising. But for a few others, the takeaway expressed that they *had* built skills for nimbleness and adjusting to whatever happened. This contrast suggests OTSF can work for both types of communicators, rather than forcing just one way of responding on-the-spot.

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