# Breakout Session Abstracts

## Breakout Session I

### Tactile Representation and Production Methods Part 1

This is part one of a two-part breakout session that will engage participants in a variety of hands-on activities focused on *Tactile Representation and Production Methods* of access learning media and art (materials generated for self-expression). The aim of this session is to give participants a direct experience interpreting and producing tactile materials, as well as to support participants in critically thinking about what creates effective tactile media. The breakout session will be facilitated by a team of tactile graphics designers, a tactile artist, and a design researcher who have come together based on their interest in: 1) developing and sharing new techniques that create legible, useful graphics, and inspiring tactile materials that can be acquired at an affordable price; and 2) cultivating a community of designers and educators passionate about tactile and multimodal design.

### Touching the Future: Graphiti

Access to graphical information is a significant challenge for people who are blind and visually impaired. With the increased dependency on technology in schools and the workplace, the lack of access to on-screen graphics can be an impediment to people with visual impairments. Graphiti™ is a dynamic, multilevel tactile display developed by Orbit Research in partnership with the American Printing House for the Blind. Graphiti allows students and adults to access on-screen graphics and image files in a wide variety of popular formats. Attendees will see a demonstration of the software and hardware features that include the ability to view graphics, as well as the touch interface that allows the user to draw and erase graphics, to edit graphics by touch, and to scroll and zoom images. In addition, the presenters will demonstrate some of the newest features that include working with a live camera or computer input using HDMI and onboard support for standard graphic files on the SD card. Presenters will demonstrate the use of the Graphiti with STEM tools including a still camera, a microscope, and the Orion TI-84 Talking Graphing Calculator™. This presentation will also discuss input and suggestions made during the expert review, the feedback from TVIs working with students, and the potential for use in online testing.  
  
Sensables: 3D Printed Models for Visually Impaired Students

Although 3D printing technology is making three-dimensional models available, these models’ instructional power is limited because they lack interactivity. While a student can feel the shapes and textures on a 3D model, a knowledgeable sighted person must explain what the shapes and textures represent. In tactile graphics, explanatory information is commonly represented in Braille, which is difficult to add to 3D models because of Braille’s large size and the model’s topology. What if models could explain themselves? Sensables are interactive 3D printed models that use artificial intelligence to help blind people learn about the models and enhance tactile literacy. Three-D models become interactive Sensables when used with the applications that we developed for computers and mobile devices (i.e., smartphones, tablets).   
In this talk, we will introduce the key components of Sensables, the design tools we developed, and the research insights we found during the development process. Audience will have the chance to play with different Sensables and experience these interactive models by themselves.

### Addressing Diverse Learner Needs through Multimodal Access

One size does not fit all when it comes to education. Fortunately, technology is making it increasingly easier, faster, and cheaper to produce materials that cater to various learning styles and student needs. Given the ever-growing number of alternative tools and files, there needs to be an easier way for educators and end-users to find and store a variety of learning materials such as: 2D tactile graphics, 3D-printed objects, and interactive simulations. One way that the Benetech DIAGRAM Center is addressing this challenge is by developing a central platform called Imageshare, which allows users to search for accessible files across multiple collections. The tool functions as a central repository and registry of accessible alternatives for core STEM (science, technology, engineering, mathematics) concepts frequently encountered in classrooms. Come hear about our recently updated Imageshare website and learn about how you can help contribute to this expanding collection of accessible STEM resources.

## Breakout Session II

### Tactile Representation and Production Methods Part 2

This is part two of a two-part breakout session that will engage participants in a variety of hands-on activities focused on *Tactile Representation and Production Methods* of access learning media and art (materials generated for self-expression). The aim of this session is to give participants a direct experience interpreting and producing tactile materials, as well as to support participants in critically thinking about what creates effective tactile media. The breakout session will be facilitated by a team of tactile graphics designers, a tactile artist, and a design researcher, who have come together based on their interest in: 1) developing and sharing new techniques that create legible, useful graphics, and inspiring tactile materials that can be acquired at an affordable price; and 2) cultivating a community of designers and educators passionate about tactile and multimodal design.

**Tactile Images for Concept Building and Spatial Awareness**

This presentation will feature five books with tactile images that were developed to help visually impaired students with concept building. Spatial awareness is important for communication in general and, more specifically, for mobility skills, mathematics, logical thinking, and even understanding art. The books can be used independently from age twelve and up. A description alone often leaves only a vague impression. The combination of a description with a tactile image, and sometimes 3D-prints or even a lively discussion, is much more likely to help build a correct mental representation. Five volumes were created to help visually impaired readers understand highly visual concepts and develop better spatial awareness. The books use a method that is based on orthogonal projection, or ‘technical drawing," to teach visually impaired students to both read and draw tactile images of three-dimensional objects. The first volume starts with simple geometric figures, like a ball, cylinder, block, pyramid, and other shapes. Each shape is drawn and explained in text that guides the hands reading the tactile images and with the help of 3D printed figures. The second volume introduces daily living objects that are present in most households. The third volume in this series explains shadow; and perspective is the subject of the fourth book. A fifth volume is currently under development to teach building with Legos. Here all skills are combined in both a playful and educational way.  
  
Bringing Digital Graphics to Life: The Promise of Multimodal Touchscreens—Progress and Future Work

Recent interest has explored multimodal touchscreens—touchscreens that provide visual, aural, and vibratory feedback—as an assistive technology for conveying 2D graphics to students with blindness or low vision. In this session, we will discuss both empirical investigations and translational efforts illustrating the challenges and opportunities of displaying graphics multimodally on touchscreens with the goal of realizing their potential impact in and out of the classroom. On the empirical front, we will summarize our NSF-funded work, as well as the work of others, which provides perceptually-rooted, fundamental findings to inform how digital, multimodal graphics should be created and when and where they are most appropriate. In addition, we have begun to establish standards for multimodal touchscreens, and we are excited to share our current progress. On the commercial front, we will highlight the work of Vital, an NSF-backed startup bringing multimodal, digital graphics into the hands of individuals everywhere, with a specific focus on serving those who are blind or have low vision. We will share our mission and vision and will provide a demo of our teacher/parent-facing web application and our student/child-facing mobile application so that users in the session can experience the graphics and the creation of these graphics first-hand. We will share lessons learned and “tricks from the trenches” that we garnered only by having end users iteratively test and contribute to this new paradigm in a variety of settings. We will close the session by sharing both challenges and opportunities for this new approach, as well as insight on the areas most in need of further research. We will open the floor for creative and constructive discussions on future directions and will provide avenues by which interested members of the session can become connected or more involved.

### Interactive Tactile Graphics in Pre-K–12 Education

The speakers will demonstrate a special printer that produces Braille-annotated interactive tactile graphics worksheets to support BLV students’ full engagement with learning materials that require drawing. We will present the technology (which includes a digitizing sketchpad), summarize results of its evaluation, and offer hands-on experiences with the printer and the content it produces. Topics covered will be: integrating interactive tactile graphics and exercises into course materials; tips, tricks, techniques, and tools for teaching young children how to draw; accessing the STEAM (STEM + arts) curriculum through interactive tactile graphics; and drawing as a life skill—why and how to learn to draw. The speakers will aim for the participants to be able to: (1) re-imagine standard and one-off assignments and performance evaluations that require freehand and tool-assisted tactile drawing by the student as accessible to BLV students; (2) recognize the feasibility and practicality for teachers of selecting and producing accessible interactive content; and (3) appreciate the potential for digitally-mediated creation, selection, printing, student completion and editing, and submission of Braille-annotated tactile graphics worksheets.

### State of the Art Technologies for Producing Tactile Materials: A Hands-On Experience

Producers of tactile materials have a variety of materials and technologies from which to choose from. This hands-on presentation will allow the participants the opportunity to learn about and tactually examine materials produced using 2D and 3D technologies. Well known technologies such as capsule paper, Tiger graphics, and Thermoform will briefly be covered. The bulk of the session will be dedicated to both additive and subtractive rapid prototyping technologies.

## Breakout Session III

### The Read Read—Literacy for All—Equality by Design

Developed at the Harvard Innovation Lab, and piloted at the Perkins School for the Blind, The Read Read is the first device that allows children to independently learn to read using best practice manipulatives. The Read Read is a physical device with fifty tiles that represent all of the English speech sounds—by placing one of these tiles on the device, and touching the Braille located beneath large, embossed, high-contrast letters, the device provides immediate audio feedback pertaining to the letter’s name, Braille dot configuration, or phonetic sound, depending on the mode. Students who have been classified as non-readers have learned to read using The Read Read. We will discuss the neuroscience, cognitive science, and best practice pedagogy that went into the design of the device, and we will give attendees the opportunity to use the device first-hand. We will also present tiles that teach numbers, shapes, animals, and even music notation!

### Innovation in Tactile Graphics Production: UV Printing Could Replace Vacuum Forming

Teachers have long relied on raised line and textured maps and diagrams to explain spatial concepts to visually impaired students. While there are many techniques available, the most efficient way to produce high quality tactile graphics has long been vacuum thermoforming. Now, new large format, flatbed UV (ultra violet) printers are available that may finally replace vacuum forming. These printers can produce precise, consistent, and durable raised lines, textures, and Braille directly on paper or plastic substrates, rigid boards, and flexible sheets. Most importantly, these printers make it possible to print over the tactile image with high resolution visuals that are perfectly aligned and registered with the raised lines, textures, and Braille. Since the new generation of UV printers can produce both tactile and visual images on the same machine, the difficult problem of lining up vacuum formed and ink-print images is solved. This means that we can now produce universally-accessible signs, floor plans, and tactile interpretations of visual art that can be used by everyone.

### Music Touch from Dancing Dots

Participants will witness a demonstration of the Music Touch system for teaching Braille music. There will be ample time for questions and discussion. Dancing Dots is offering a new and rich multi-media experience—the Music Touch system on the Talking Tactile Tablet (TTT) from Touch Graphics—for learning Braille music and the concepts of print music notation. Our first courseware offering for Music Touch on the TTT is a presentation of Lesson Exercises from Taesch’s Part I of his Introduction to Music for the Blind Student course. Ultimately, we plan to add courseware that incorporates tactile graphics of print music symbols to acquaint the blind musician with key concepts of print music notation. We also want to give teachers access to the Music Touch TTT authoring tool so that they can create their own material.

Tactile Outline Drawings: Examples, Theories, and the Limits of Our Understanding

“This breakout session will explore theories relating to our understanding of tactile outline drawings. A Psychology of Picture Perception” (1974) argued that outline depicted discontinuities in the perceptual field. This theory predicted that tactile line drawings would be successful. This was followed by a theory that outlines depicted relief borders. Since edges of surfaces are tangible, raised lines should be able to depict the shapes of edges of surfaces. Later, it was argued that outline used contour-extraction and median-extraction, since the line has two borders but often the line only depicts the edge of one surface. Recently it has been argued that lines trigger equations in the brain, and the equations reveal the shapes of surfaces. None of these theories are equal to the task of explaining why blind and sighted people use outline drawings as successfully as they do.

## Breakout Session IV

### 3D Printing for Blind and Low Vision Students: How to Do It

There are several open source (free!) software and internet applications that can be used to produce 3D models, maps, and diagrams that can be used by blind and low-vision students and their teachers to clarify concepts and help these students understand concepts that may otherwise be out of their reach. Participants will learn how it is done, and they will be provided links to the open-source applications and to information that will help teachers to get started in using this technology. A 3D printer will be available, so participants will see the production process from start to finish.

### Tactile Maps Automated Production

This session will present Tactile Maps Automated Production (TMAP), an automated tactile mapping app; we will discuss its importance and features and demonstrate its use and production. TMAP—a tool for on-demand creation of tactile street maps—is an accessible, web-based app that uses Google maps search information and OpenStreetMap data to generate tactile and visual representations of streets around a user-specified address or intersection. Using design parameters to ensure tactile legibility, TMAP produces usable, custom street maps quickly and affordably. TMAP supports tactile literacy, exploration, and independent travel. We will discuss the design decisions behind TMAP that reduce clutter and offer important information to map users without compromising clarity. We will walk participants through a TMAP of the NFB Jernigan Institute, exploring map features, methods for labeling, and introductory use. We will also demonstrate TMAP production, looking at map-creation settings, and printing options. After the presentation, we will print TMAPs for participants, discussing desired additions and changes, and dissemination models.

### Making Tactile Templates Talk: Let Me Count the Ways

Learn how audio-enriched tactile templates for STEAM (STEM + arts) subjects can be made to enhance learning opportunities for blind and low vision students. 3D printed, 3D laser cut and raised line graphic templates combined with conductive paint produce an audio-capable product.  Presentation will empower parents, teachers, and accessibility staff so they can make their own audio-enriched tactile templates.

### National Federation of the Blind Tactile Art and Tactile Graphics Symposia Report

The purpose of this session is to share the findings of the National Federation of the Blind Tactile Art and Graphics Symposia Report. This report provides an in depth review of the activities that occurred during the design and implementation of three Tactile Arts and Graphics Symposia (TAGS) that occurred in 2016-2017, as well as the topics, perspectives, and resources that arose during each symposium. The design and implementation of the symposia emerged through the vision of tactile artist Ann Cunningham and the National Federation of the Blind as a way to “improve the practices of how we educate blind people about art, how to use art, how to play with art, how to express themselves through art, and hopefully set a foundation that we can use to pursue new avenues of providing non-visual information”-NFB President Riccobono (2017)*.* Underlying this statement is a call to action to develop new understanding about the problems of practicesurrounding tactile literacy and graphicacy and translate such understanding into implementable action steps that ensure that people who are blind and low vision are prepared to fully participate in the lives they want to live.

## Breakout Session V

### A Review of Tactile Graphics Repositories

For purposes of this presentation, a tactile graphics repository is usually a website that contains files that can be downloaded and used to prepare either a two-dimensional or three-dimensional tactile graphic. Use of repositories saves time and can make it possible for those not skilled in computer aided design (CAD) software to produce tactile materials. Several repositories will be reviewed. Although not currently in existence, the possible operation of a depository of physical materials will be discussed.

### Tactile Graphics on a Shoestring . . ., and Possibly Using One

Many teachers of blind students, parents, and professionals in rehabilitation have the desire to assist blind children and adults to increase their tactile literacy, and their understanding of abstract or “untouchable” concepts throughout their daily lives; however, they do not have access to the more expensive and specialized tools for creating tactile graphics. In this session, participants will be guided through a basic overview of the philosophy of how and why to use tactile graphics. In addition, attendees will explore the unique tools, challenges, and opportunities of building one’s own tactile graphics. Topics in this session will include:

* Determining when a tactile graphic would add to the learning experience
* Choosing to create or obtain a tactile
* Determining what information that tactile needs to convey
* Making tactile models and art with everyday objects
* Building your Tactile Toolbox
  + Basic supplies you may want to have on hand
  + Options for labeling
  + Adding Audio on a budget

### Supporting Pre-Algebra Students with Visual Impairments to Increase Their Proficiency Obtaining Information from Graphics

Participants will learn about materials developed under a three-year Institute of Education Sciences project to support students at the sixth through seventh grade pre-algebra level to increase their efficiency in obtaining information from a variety of graphics. Materials discussed will include an accessible iPad app, book of graphics in the student’s literacy medium, and a curriculum for the teacher of students with visual impairments. During the session, the presenters will share the challenges they encountered in preparing graphics, both in print and Braille. Emphasis will be given to the skills these materials teach students so they can be effective consumers of a variety of graphics including: bar graphs, line graphs, circle graphs, Venn diagrams, coordinate planes, box and whisker plots, and scatterplots. Through demonstration of the accessible iPad app and a review of our teacher curriculum, audience members will develop an understanding of how the AnimalWatch Vi: Building Graphics Literacy project is supporting students to be successful in math and science classes at the middle school level.

### The Right Touch: The Importance of Good Design

This presentation is aimed at the novice and experienced tactile graphics designer, as well as users who read materials that contain tactile graphics. The main objective of this presentation is to emphasize the importance of good tactile design techniques and to convey some of the methods used to achieve a well-designed tactile graphic. The presentation reflects on tried-and-true design principles employed in the production of tactile graphics for textbooks and other reading materials for the visually impaired. The use of time-saving tools, such as macros, and templates for computer-generated tactile graphics will be demonstrated. This presentation will demonstrate how well-designed diagrams enhance the reading experience, and how poorly designed graphics may actually discourage readers from further exploring the subject matter. PowerPoint slides and sample handouts in microcapsule paper and Tiger-embossed paper will be provided to demonstrate how to improve the readability of a tactile graphic illustration and to compare graphics produced in different mediums.

### The Role of Tactile Feedback from a Programmable Tactile Display in Orientation and Mobility

This session will present research on the use of programmable tactile display for orientation and mobility. The presenter will discuss the results of a research study to test the effectiveness of the BlindPad programmable tactile display when used by blind and low vision study participants to perform an orientation and mobility task.

## Breakout Session VI

### Tactile Graphs for Teaching the Principles of Scientific Literacy in Introductory Psychology Courses

There are a number of modifications that can be made to course materials to make them more accessible to students with visual impairments. Although these modifications make course materials available to these students, they do not always require the same type of cognitive processing produced by the materials for sighted students. Text or verbal descriptions of graphical materials typically provide an interpretation of the data, rather than providing the opportunity for students to construct their own representation. This session will focus on a set of tactile graphs created to accompany a set of existing teaching modules in order to make the materials truly accessible to students with visual impairments. The set of eight teaching modules was originally designed to teach scientific reasoning skills to students in college introductory psychology courses. In this breakout session, we will discuss the collaborative effort to create, review, and revise the tactile graphs. Additionally, we will have physical copies of the tactile graphs available for use.

### Tactile Graphics the Easy Way

This presentation is intended for non-experts such as sighted parents wanting tactile graphics for their child, blind people wanting to make their own tactile graphics, as well as experts. The session will cover how both novice and expert can make tactile graphics using MS Word or Tiger Software Suite, and a ViewPlus embosser.  
  
Designing an Accessible Traveling Exhibit: A Case Study Using 3D Printed Replicas of Stone Tools from Archaeological Sites

Creating high-quality, 3D-printed replicas of artifacts balances the competing priorities of public outreach and preservation of the original artifacts in museum collections. While 3D replicas provide tactile information to people who are blind or have low vision, they can also be appreciated by sighted audiences. Thus, the exhibit design is intended to be inclusive of multiple audiences. This presentation describes the process of creating 3D replicas of stone projectile points (spear tips) that are found in the collections of the Maryland Archaeological and Conservation Laboratory. We describe the design considerations related to (1) scanning artifacts to acquire accurate data with which to produce high-quality replicas, and (2) ensuring that audience members are able to retrieve information about these artifacts, including electronic Braille and audio-text descriptions accessed through QR codes on a common web-enabled smartphone and connected Braille devices.  
  
Agenda for Inclusive Media Production

This session will present the conjecture that full inclusion of people who are blind and visually impaired in our contemporary information and media culture will not occur unless we take a sociotechnical approach to addressing passive and active exclusion in art and media production-focused activities. Consumption of media only constitutes half of what Deuze (2011) calls the media life—a state where media is seen as intrinsically part of life, not outside of it. Media production is a key component of a person's graphicacy and literacy development and an important part of a person’s media and information literacy. Media and information literacy is considered a critical set of competencies and skills required for participation in contemporary educational and civic environments, as well as in their work life. In fact, media and information literacy—the ability to access, analyze, evaluate, and create media and information—has become paramount to full participation in educational, professional, and social activities. The presenters will also share a set of teaching and learning materials to support three groups of stakeholders to make media production more inclusive: 1) people who are blind (end producers), 2) people who create contents for others (intermediary producers), and 3) people who make technologies to support creation (meta producers).

**Quantity, Variety, and Responsiveness, as well as Quality**

Perhaps the most intuitive principle of learning is that practice makes perfect. In addition, it is important that practice through repetition use as wide a variety of examples as possible for the learner to learn concepts that can be generalized to other instances. Responsiveness—in terms of teaching in the context of a learner’s understanding in the instant—is also important. Resources are needed for both in the classroom and incidental learning outside of the classroom to provide equivalent opportunities to learners who are sighted. This presentation focuses on technology produced by the Rehabilitation Technology and Haptics Laboratory at Virginia Commonwealth University that has been developed to address these issues for graphical information for individuals who are blind or visually impaired. The first topic will describe the development and preliminary assessment of a low-cost group of tactile crayons that deposit different distinct textures on regular paper; these crayons can be used for drawing and coloring by young children, as well as scribbling symbols and diagrams to aid in problem solving by older children. The second topic will describe work on the development of an automatic method to convert visual drawings, diagrams, and photographs into effective, simplified tactile diagrams in the manner of TVIs. We will also talk about an on-line workshop we have made available for TVIs to touch up or develop tactile diagrams of drawings, diagrams, and photographs using free/low-cost electronic drawing programs with a validated texture palette. Finally, we will highlight some ongoing work in facilitating the understanding of perspective, providing low-cost tactile interfaces for exploring virtual tactile diagrams on a computer and for STEM learning in computer science and engineering.