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Advanced 3D Printing Techniques: Designing, Modifying, And Improving Your 3D Prints

Jon Turnquist MOL, OTR/L

Learning Outcomes

After this course, participants will be able to:

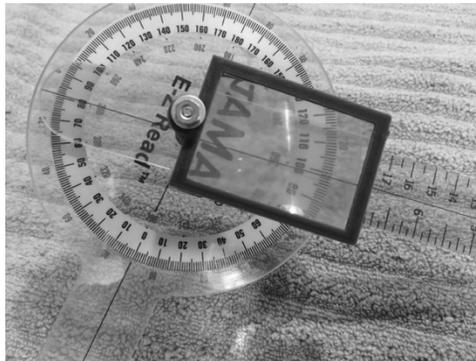
- 1) Modify a CAD 3D printed design using OpenSCAD
- 2) Describe 3 methods/techniques to improve 3D printing outcomes
- 3) Identify the strengths and weaknesses of designing with CAD programs such as TinkerCAD, OpeSCAD, and Fusion360

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A new dawn

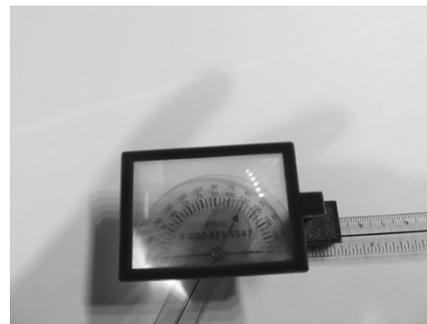
- AOTA Nashville
- 3D Scanning: TBA (we are not there yet!!)
- Supplying the design, not only the device
- Reducing the need for other tools and making equipment affordable (Tanaka, Lightdale-Miric, 2916)
- 3D printing inventions report improvements in satisfaction and medication adherence (Jaclyn 2018; Hofmann et al. 2019).
- Therapists should be (more) involved in the designing of 3D printed assistive technology intervention (Schwartz et al. 2019)
- Creation: Remaking & redesigning a device
 - Building on your work and others...

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Reuse a design

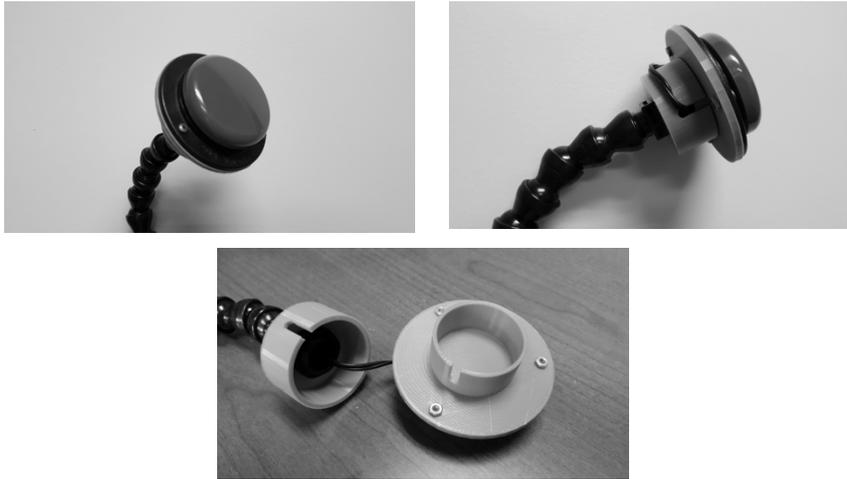
Don't reinvent



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Interface into commercial equipment



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Or go the inexpensive route



45mm Arcade Video Game Big Round Push Button LED Lighted Illuminated Lamp \$2.21



Or just for fun route

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Designing and Modifying with CAD

- Find a CAD program that fits your brain (and matches what you are designing)
- Tinkercad
 - Free and very simple to use
- Fusion360
 - **Very powerful** and free (steep learning curve)
- OpenSCAD
 - Free with lots of designs and support

CAD: Primitives vs. Organic

- Primitives shapes are added and subtracted to make objects: Tinkercad and OpenScad
- Organic: Macro commands to blend, form and change: Fusion360
 - (your design can be pulled/stretched with a mouse)

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CAD Examples

Use the best CAD tool for your design



Primitive shapes:

Cubes added and subtracted to make openings

Design Tool: OpenSCAD



Organic shapes and threads:

Threads are just a macro command, that figures everything out

Design Tool Fusion 360

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Finding files that can be modified

- Thingiverse, MyMiniFactory, GrabCAD
 - (many others)
- Yeggi is a 3D design search engine
- OpenSCAD: <https://www.openscad.org/>
 - Easy to modify as many files are parametric in nature (change it to meet your needs)
- STL File (a common universal 3D design format)
 - Can be modified but needs processing (Fusion 360 can do this but it's a steep learning curve)



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Other programs/equipment used

- **SIMPLIFY3D**: takes the STL files and turns them into G-code instructions that your printer can understand. (slicer)
 - Ultimaker Cura is a free program
- **MakerGear M2** printer
- **Hatchbox** filament (mostly PLA)

(I'm not endorsing anything)

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Example OpenSCAD File



<https://www.thingiverse.com/thing:2968392>
Or just Google: OTandAT

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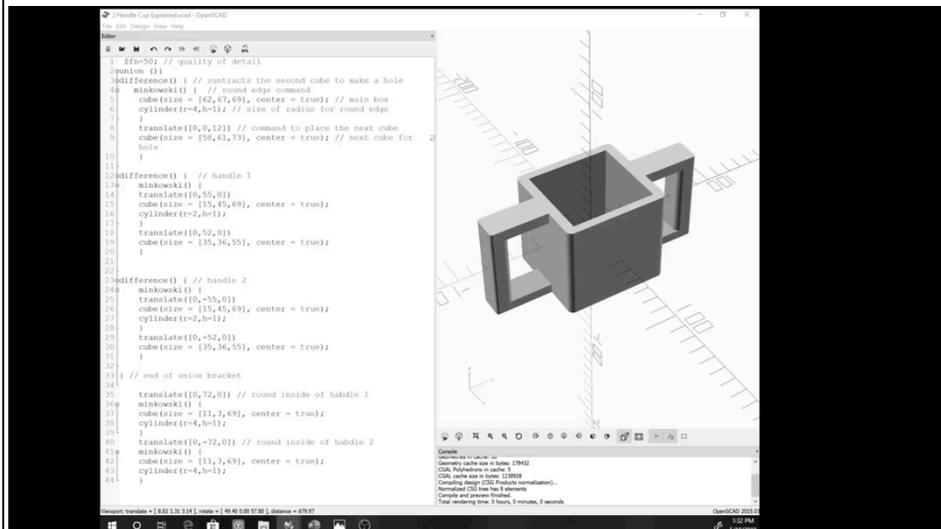
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Two Handled Milk Holder

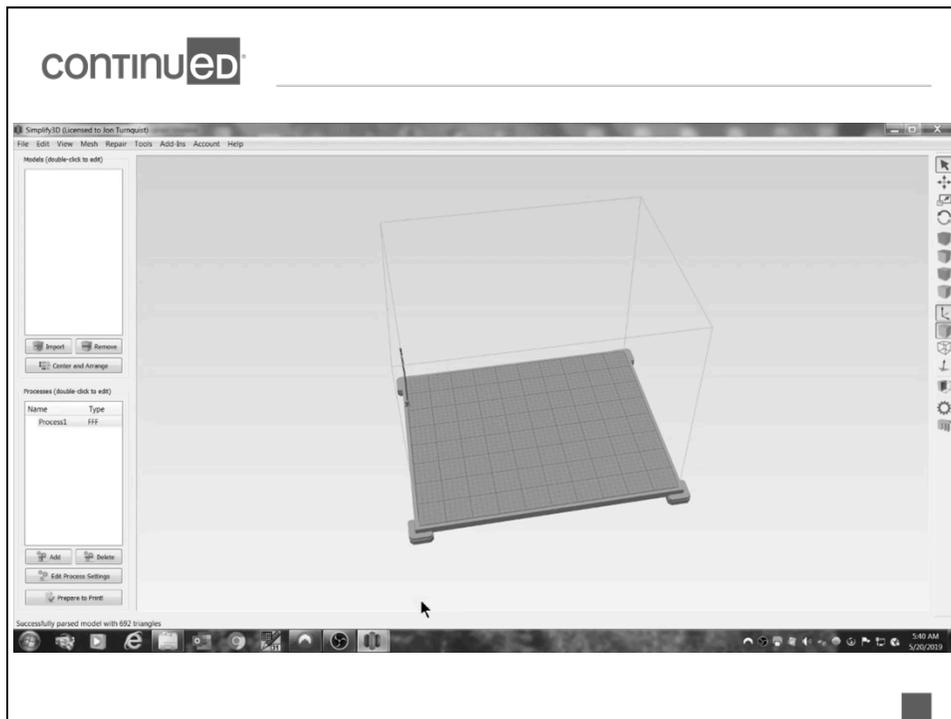
- A student AT project
- Device given, plus the design file provided
- Designed in openSCAD (scrip based but uses primitive shapes)
- Why openSCAD?



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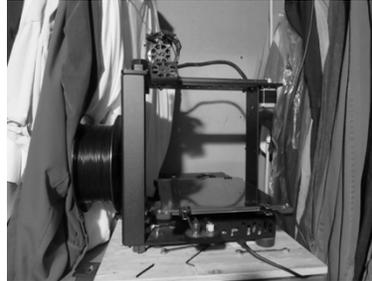
Printing process concerns

- Sticking too little to the build surface
 - Orient for a good base or use a raft
 - Spray for bonding
 - Heat and cooling
 - Level building surface
- Sticking too much to the build surface
 - Cooling
 - Knife
 - Water
 - Don't pry or knock it off the printer

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Printing process concerns

- Printer location, location, location...



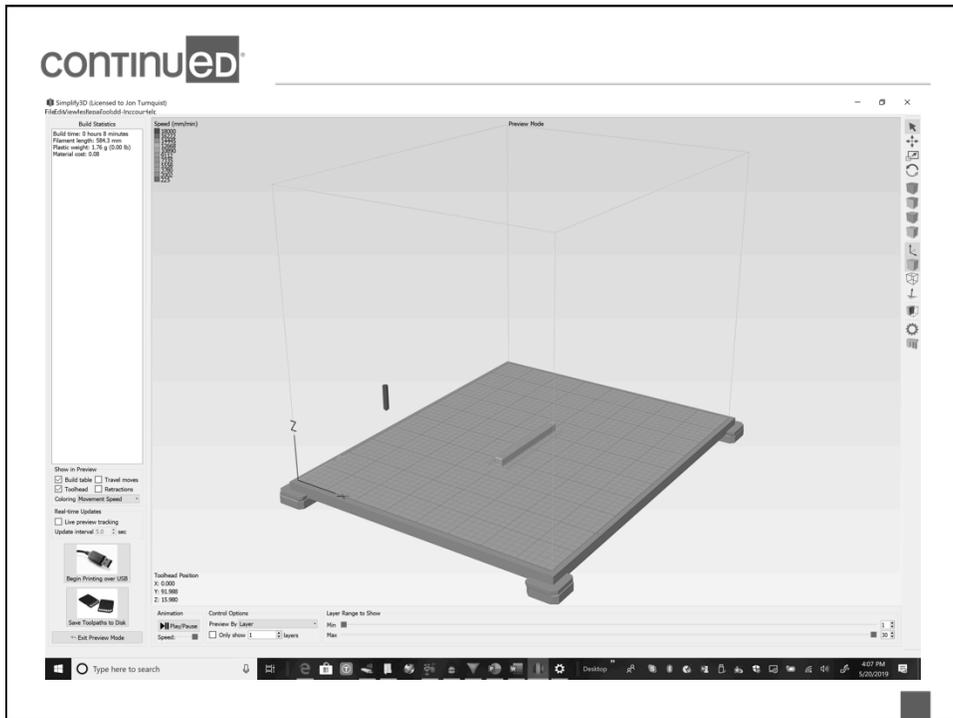
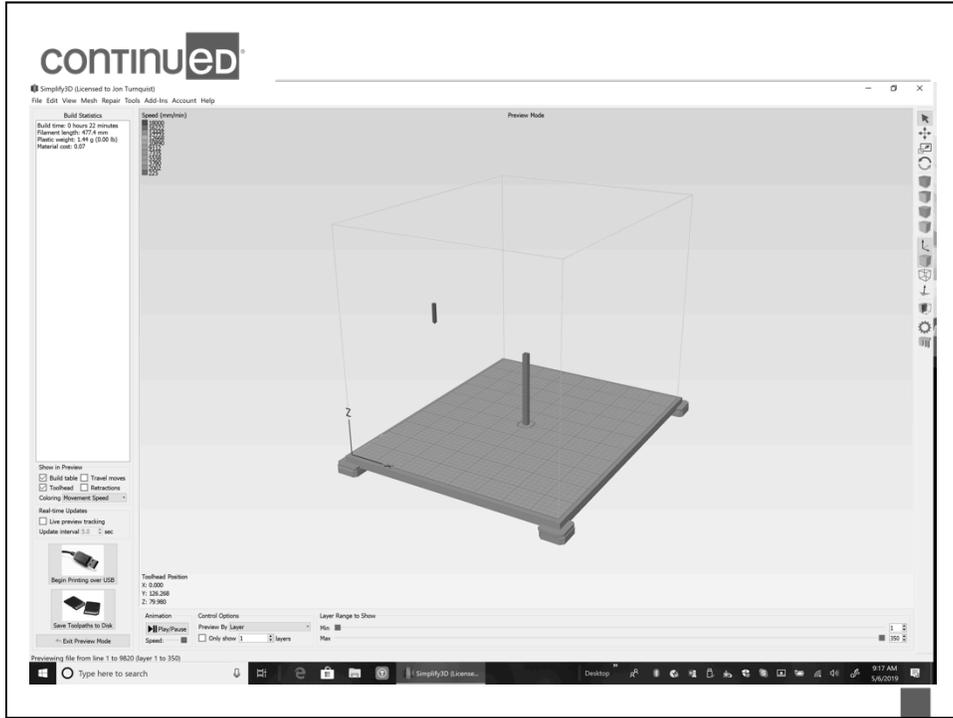
- Beware of...
 - Air or heater vent
 - **Changing temperatures**
 - Vibration

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Printing process concerns

- Build time vs. Quality of print
 - Changing orientation may mean different supports
 - Check orientation of axis for times
 - For example...

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Printing process concerns

- Repairing prints
 - Netfabb is a powerful tool to repair STL files
 - Free version
 - Windows 10 (3MF file is a windows proprietary file)
 - Meshmixer and Meshlab
- Most will take time to learn how to use the program
- Lots a help (good and bad on YouTube)

Printing process concerns

- Filament choice
- PLA vs. ABS vs. Nylon
- NinjaFlex, Thermoplastic Polyurethane (TPU)
- PLA is GRAS “Generally Recognized As Safe”
 - (R. Conn et.al.,1995)
 - Food grade PLA
 - However, the brass extruder may have traces of lead (inherent to brass) so switching to stainless steel may be an option.
 - But!...

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Sanitizing 3D prints and food

- The outer membrane (manifold) may pass all checks but that does not mean water tight.
- Any food that can spoil may penetrate into the print (think of a 3D printed spoon). This might make it difficult to sanitize. Soak in bleach/water?
- My recommendation is to use the 3D printer to made the device to “hold” an easy to clean spoon
- Loc-Line works well to epoxy a cut off spoon into a piece of loc-line and print an attachment to that.

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Ask for help...

- Many other disciplines have skills we can learn from.
- Cooperation is the key
 - We may not have all the skills we need as 3D printing is growing faster curriculums (Wagner et al, 2018).
 - Life long learning...

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Questions?

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