CATHY: Designing Adaptive Handles for Creative Art for Adult Artists with Disabilities

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Abstract

The scarcity of commercially available adult-sized art handles presents a problem for adult artists with disabilities at Community Living And Support Services (CLASS), a facility in Pittsburgh that provides creative art sessions. Commercially available products are often designed for pediatrics, and adult artists with disabilities who cannot use their hands fully are currently using homemade adaptive handles. These handles are not easily customized, limit their art tool options, are not easily cleaned and are not durable, resulting in inadequate temporary solutions.

We asked two questions inspired by user research: a) How does a handle improve adult artists with disabilities' art experience? b) What are adults with disabilities' preferred features for an adapted handle for art tools?

We designed three solutions that help users expand their ability to change tools, change paint colors, and have a wider range of tools to use in their artwork. Based on user preference for grips, the solutions were 1) T-Bar handle 2) Ball handle 3) Long Pole handle. Design criteria included simplicity, cleanability, and durability.

Our designs satisfy three types of grip preference, and reduce the artists' and teachers' time spent on setting up tools, allowing more time spent on creating art. Our handles work with a greater range of brushes and markers than the previous handle allowed, granting adult artists with disabilities the freedom to create the art that they desire.

Background

Art is an expression of the creativity and imagination of an individual. Visual art allows a person to express and communicate in different forms, like painting, sculpture, and drawing. A person with disability's interest and willingness to express themselves through art is by no means different. Adult artists with disabilities who cannot use their hands fully may face difficulties by not having absolute control of their shoulders, arms, wrists, hands or fingers. However, their creativity is unlimited.

Community Living And Support Services (CLASS) is an organization located in Pittsburgh, Pennsylvania whose mission is "to support people with disabilities as they explore options, participate in the community, and strive toward equality. We are "WORKING TOWARD A COMMUNITY WHERE EACH BELONGS."" Here, adult artists with disabilities use non-digital art tools like brushes, markers, and sponges. They use these with homemade art handles that break apart often, do not last long, and cannot be cleaned. There is a lack of adaptive art tools for adult artists with disabilities as most current assistive technology focuses on supporting independent living and employment-related activities (Perera, Eales, & Blashki, 2009).

Based on benchmarking, commercially available adaptive art handles are made for children's sized hands. These products do not facilitate easy switching between tools. The universal handles currently on the market do not provide appropriate orientation of art tools. As a result, they

would not work for any of our target users.

Problem Statement

Adult artists with disabilities who cannot use their hands fully use homemade adaptive handles for art tools during creative art sessions at CLASS. Current solutions do not work with a wide range of art tools, are not easily customized, are not easily cleaned and are not durable.

Research Questions

Based on primary user research, we asked the following questions: a) How does a handle improve adult artists with disabilities art experience? b) What are adults with disabilities' preferred features for an adapted handle for art tools?

Methods/Approach/Solutions Considered

Between September and December of 2017, the authors visited CLASS weekly for primary user research that included observations, contextual inquiry, expert interviews with an art instructor, and interviews with three adult artists with disabilities with aims to understand the challenges when working on their projects. Field notes were created in writing, video and audio recording that were later processed and saved in a secured location. Informed consents were obtained before recording. Expert interview and secondary market research suggested a paucity of adult-sized adaptive art tools.

Based on the characteristics of our clients (Table 1) and primary user research, we identified the following user's needs:

- The product is easy to set up
- The product works with different tools
- The product is durable
- The product is easily cleaned
- The product securely holds tools
- The product fits different grip constraints
- The product grants independence

Table 1. User Characteristics for Our Clients

Characteristics	Brooklyn	Phoenix	Aspen
Current Handle	Wooden Long pole with velcro at the bottom for stamp usage only	Tennis/Anti-stress Ball with hole	Cardboard T-bar with taped brush
Hand Grip Characteristics	Can grab tools on her own when close to the body	Requires assistance to grab and release art tools	Requires assistance to grab and release art tools
	Strong grip, gross hand movements	Light grip, fine hand movements	No grip, fine arm movements
Assistance to Set-Up & Change Tools	Yes	Yes	Yes

After initial brainstorming with sketches, mock-ups and looks-like prototypes, we aimed to create a system comprised of a handle, a connector and a tool holder based on promise to fulfill user needs. During the design iteration the connector became part of the handle as a single component. The tool holder was ruled out of the final approach and design based on user preference, user needs, and technical feasibility. The modeling of each handle was done in SolidWorks and 3D printed using Polylactic Acid (PLA) filament in a Makerbot printer.

<u>Final Approach and Design</u>

Based on user needs and other considerations such as hand grip, we designed three handle types: T-Bar, Ball, and Long Pole with cam lever.

1. *Long pole with cam lever for Brooklyn:* This solution provides the opportunity to use an increased range of art tools. The art tools are inserted into the pole made of a PVC tube and secured using a cam lever. The art tools can be easily changed and secured. The pole has a 1/2" diameter and is 12” long. This size was determined according to the user’s preference as it provided good grip. See Figure 1.

Figure 1. Long Pole

2. *Ball for Phoenix:* The ball handle includes three designs.

a. Ball Rotating (Figure 2): Consists of a 3D printed rotating disk of holes 5/16”, 7/16”, 9/16” and 13/16” diameter to fit brushes and markers of the corresponding diameters. The rotating disk is placed between half-sphered foams to provide better grip conformity while keeping the sensation of a soft ball.

b. Ball Several Holes (Figure 3): A 3D printed sphere with holes aligned in the same plane. Holes in diameters of 5/16”, 7/16”, 9/16”and 15/16” to fit brushes and markers, allowing the art tools to go through the sphere.

Figure 2. Ball several holes

c. Ball Foam Pipe (Figure 4): This solution consists of two components, foam pipe and sphere with a single hole. The foam pipe is available on the market with three different internal holes (1/4”, 3/8”, 13/16” diameter) which allow the user to insert the foam in the hole of the sphere (1 1/4" diameter) and use

different art tools. Because the foam pipe is flexible it can stretch and fit more brushes.

Figure 3. Ball several holes

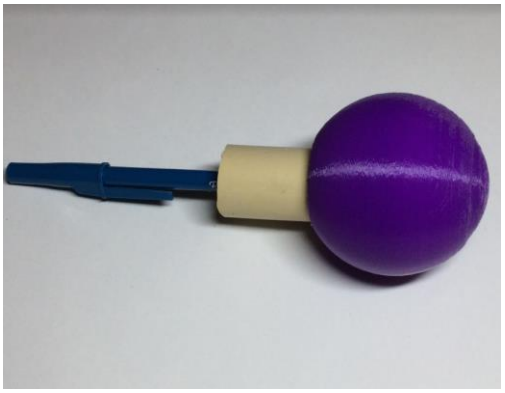


Figure 4. Ball Foam Pipe

3. *T-Bar for Aspen:* Aspen needs to have the art tool aligned with his arm in order to have control of the tool. Aspen requires more assistance than the other two clients, therefore the following solutions were considered:

a. T-bar ring (Figure 5): The design consists of the handle and the strap. In this case, the T-bar ring consists of a handle of 1/2" diameter and 3 1/2" long and a hole to insert foam pipe. The foam pipe is available on the market with three different internal holes (1/4", 3/8", 13/16" inner diameter) which allow the user to insert the foam in the hole for an easy exchange of tools.

b. T-bar cam-lever (Figure 6): The design consists of the handle and the strap. This solution involves a 2 1/2" long cam lever mechanism in which Aspen can push up and pull down the cam lever to unlock and lock the tool. The mechanism allows brushes and markers from 3/16" to 3/4" to fit in and be secured and is 2 1/2" long. The handle dimensions are 1/2" diameter and 3 1/2" long.

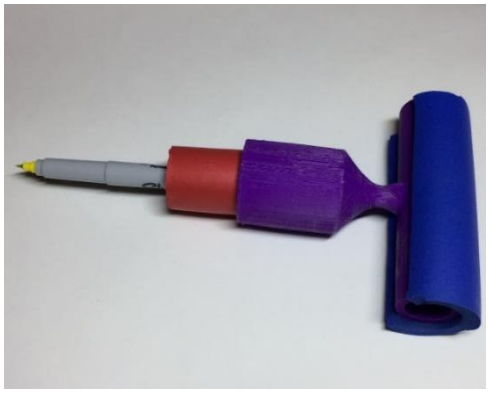


Figure 5. T-bar ring

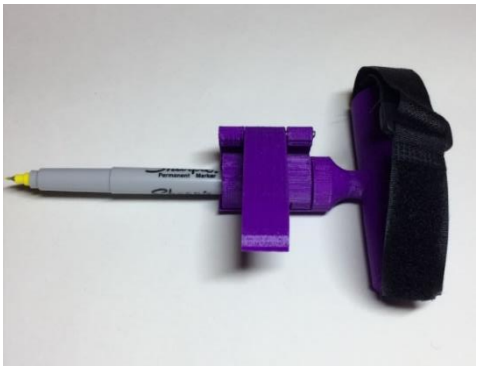


Figure 6. T-bar cam-lever

Our final designs require assistance from another person while setting up and exchanging tools. However, conversations with the users suggest this was not a problem as the assistant could secure the tool in the handle and make sure the handle is comfortable for the user. In fact, having the option of using different tools and colors is one of the main solutions that work for the users as they still have the power to decide what tool and color they want to use.

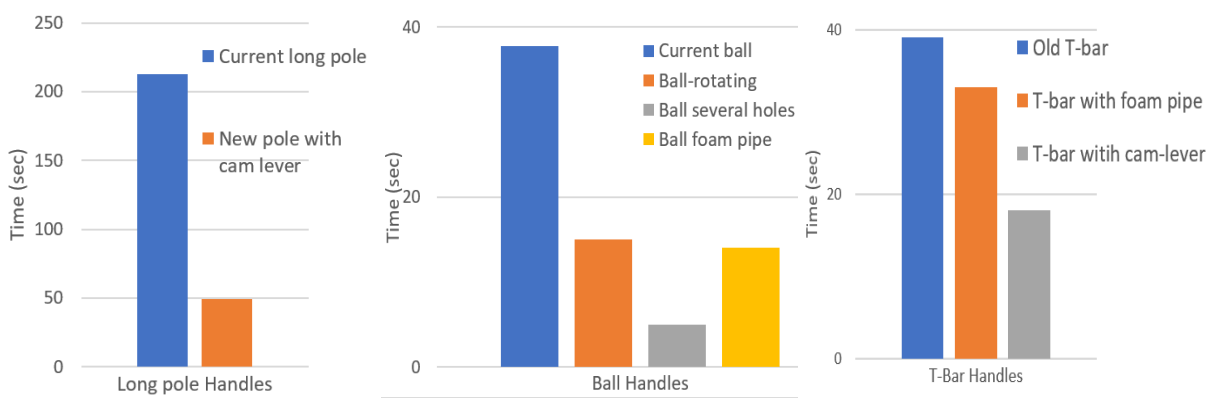
Outcome (Testing and User Feedback)

All prototypes followed the same testing procedures based on the product specifications and user needs (Table 2).

Table 2. Testing procedures

User Need	Product Specifications	Testing procedure
Grants independence	Decrease the number of times instructor spends to change/setup	-Report number of components -Report number of steps to set up.
Simple to use	Does not take much time or steps to set up	-Time measurement to set-up handle and change brushes.
Easy to clean	Can be hand washed or wiped down	-Wipe down
Tools held securely	Won't unintentionally fall off	-Shake brush for 15 seconds to see when brush falls off
Different hand grips	Different Grips: Ball, Handle with strap, Long pole	-Test handle with users with different grips
Flexibility of art tools	Different art tools: Brushes, Markers, sponge	-Test handle fit with 3 different tools (1 brush, 1 marker and 1 sponge)
Easy to use	Tools can be loaded without much effort	-Ask users to rate ease of use 1-5 (1 is very easy, 5 is very difficult)
Durable	Tool shall withstand routine drops in art room	-Drop handle from table height (30") 52 times, simulating 1 drop a week on average with a lifespan of 1 year

We collected measurements from end users. We performed the independence, simplicity, ability to change tools, different hand grips, and ease of use tests with our users following the testing procedures mentioned above. The durability and security of tools were tested independently without the users involved.



a) b) c)

Figure 7. Time to Set-Up in Three Handles

All the handles reduced the time necessary to set-up, exchange colors and exchange tools considerably. The decrease in time to set-up the tools for the long pole (Figure 7a), ball (Figure 7b) and T-bar (Figure 7c), in a successful single attempt, allows artists to have more time to create art. All of the prototypes securely held 3 different art tools, giving artists with disabilities a greater flexibility of art tools. All the users reported their preference to use the new handles when using the grip that fits better for them, and that the new handles were easier to use compared to their original handles when working on their art projects.

Durability testing suggested our current handles (2 weeks to 6 months) do not meet the desired lifespan of 1 year. For future direction, we plan to improve durability and strength by printing using Acrylonitrile butadiene styrene (ABS) instead of PLA.

Cost (Cost to produce and expected pricing)

The prototypes were created by 3D modeling except for the Long pole with cam lever. The cost of 3D printing is calculated by the amount of PLA filament based on MakerBot Print. The cost of labor and equipment was excluded. As a result, the cost of all the components of our prototypes ranged from $2.50 to $12.50. Production of prototypes using 3D printing provided the effect of lowering production costs. Therefore, even if mass production is carried out, the cost will not change significantly. Based on the cost of the prototypes, we can calculate the retail prices ranging from $7.30 to $36.60 which are similar to the price of art tools in the market. Additionally, our art tools provide the flexibility of using a variety of brushes, pens, and markers. Therefore, because of the benefits, our products will be competitive in the market.

Significance

Adult artists with disabilities currently do not have readily-available adaptive art tools. The current tools take a lot of time to set up and are not durable. This results in the teacher spending a significant portion of the class assisting students taking on and off these handles instead of focusing on teaching the actual art class. Additionally, tools frequently have to be remade after breaking, resulting in a loss of productivity.

By decreasing the amount of time it takes to set-up the brush handle, our solution reduces the time teachers spend on tools. This allows the teacher to have more time to help other students to work on their art projects. Our handles work with a greater range of brushes and markers than the previously tool allowed. This grants students the freedom to create their choice of art and supplies. By having a variety of different grips, our handle works with a large range of different students. Additionally, our handles' improved durability will allow more time and energy to be spent on making actual art instead of re-making brush handles.

Our solution also alleviates some caregiver burden. Many of the tools currently used at CLASS were made by family members of a student. Having tools readily available removes this burden. They no longer have to be concerned that their loved one might not be able to fully participate in art class.

The most important aspect of our handles is the impact on the end user. With our handle, artists are granted more freedom and independence. This may result in higher self-efficacy and quality of life.

Acknowledgements

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