

Softball Safety: Mitigating Concussion Risks with Reinforced Fielders Masks



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INTRODUCTION

Background

- An estimated 200,000 concussions occur in Canada annually [1] and approximately 25% of those concussions are sports related [2].
- Preventative measures for softball defensive play related concussions are under-researched and underdeveloped [3].
- Defensive players make up 83.7% of head injuries occurring from contact with a softball [3].
- Softball batting helmets for offensive players often prevent concussions upon impact, but defensive fielder's masks are seldom required and do not offer the same level of protection [3].

Objective

- Modify pre-existing fielder's masks by increasing the surface area of the components using braided composites to absorb impact of a batted or thrown ball against the head.

PROCESS

Design

- The requirements of the design were to keep the structure lightweight and wearable while still adding surface area to protect the head.
- Initial designs included 2 side attachments that clip onto the pre-existing mask and 1 piece fitted around the back of the head (Figure 1).
- The design is intended to attach to and reinforce the pre-existing structure of a fielder's mask.

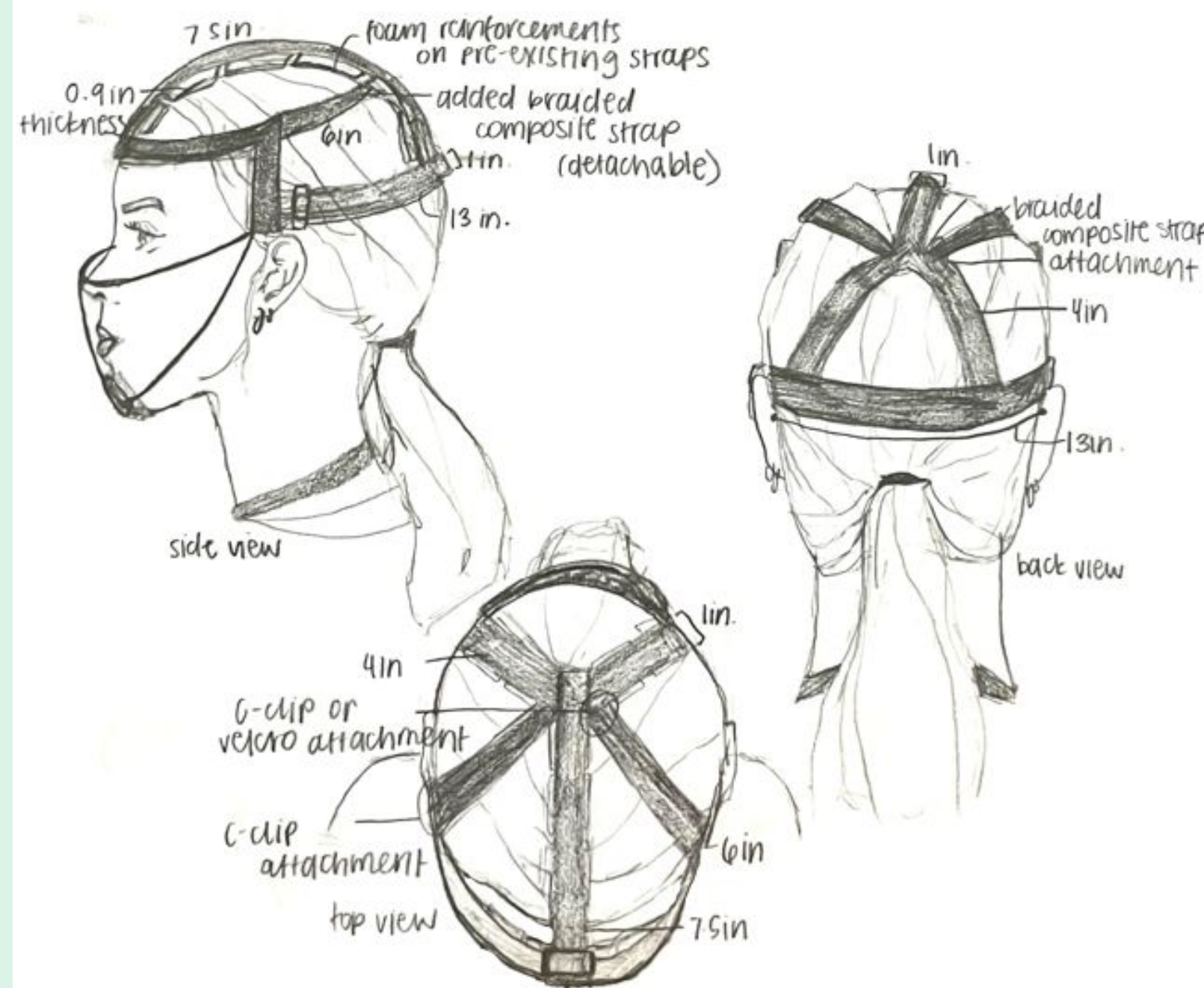


Figure 1: Initial sketches of the attachments and placement on the fielder's mask.

Core

- The cores of each attachment were designed in SOLIDWORKS®.
- An open-source head template was used to dimension the pieces for effective sizing (Figure 2).
- The components were 3D printed with a Prusa MK4 printer using PLA (polylactic acid) filament.

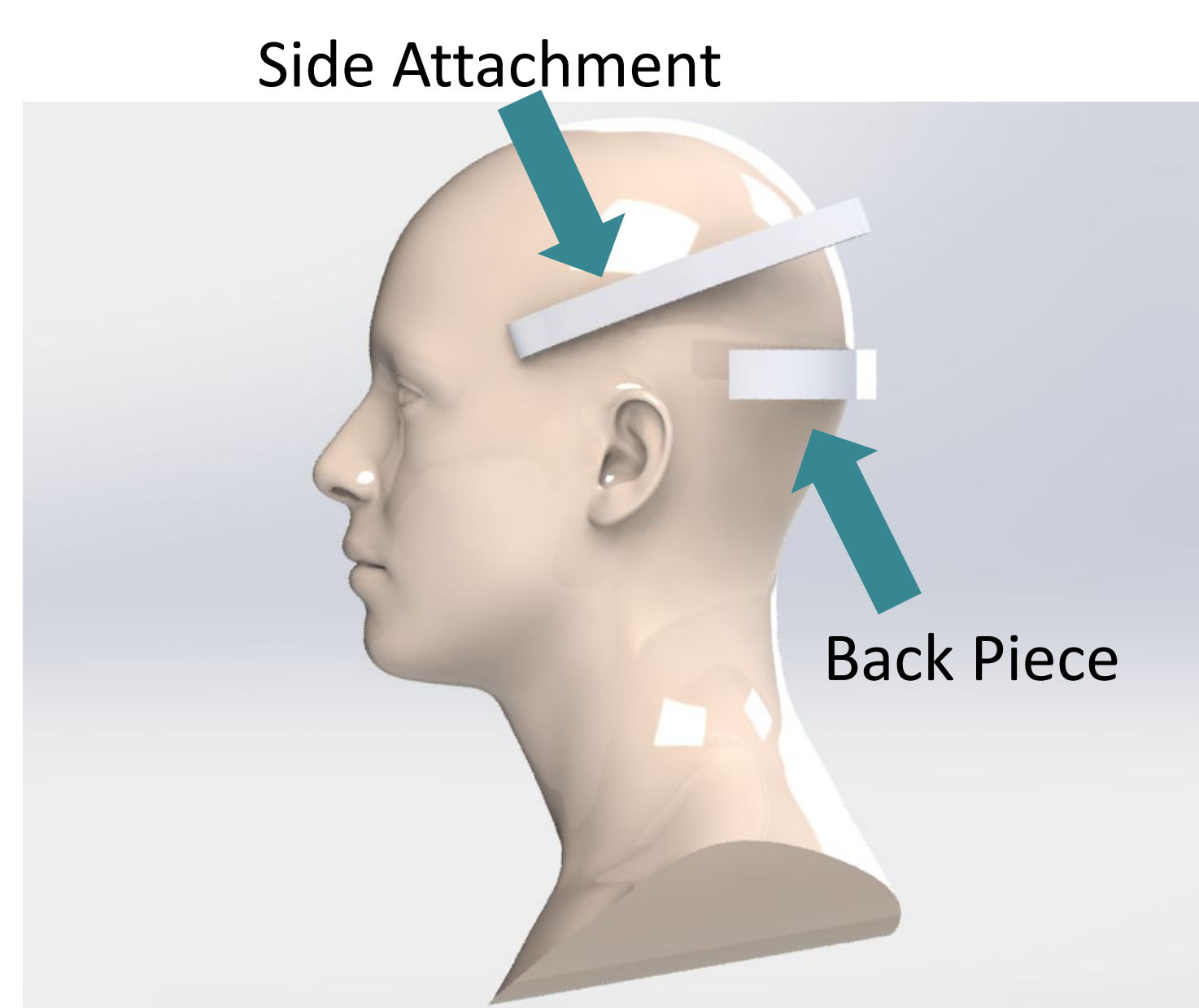


Figure 2: Design of pieces created in SOLIDWORKS®.

CONSTRUCTION

Material Selection

- A Kevlar based braided composite was chosen.
- Braided composites are lightweight and durable, while still performing well under impact [4].
- This material is ideal for the attachments as it is light while still able to absorb and withstand the impact of a softball.
- Cold-cure epoxy was selected so that the plastic cores would not melt (Figure 3).

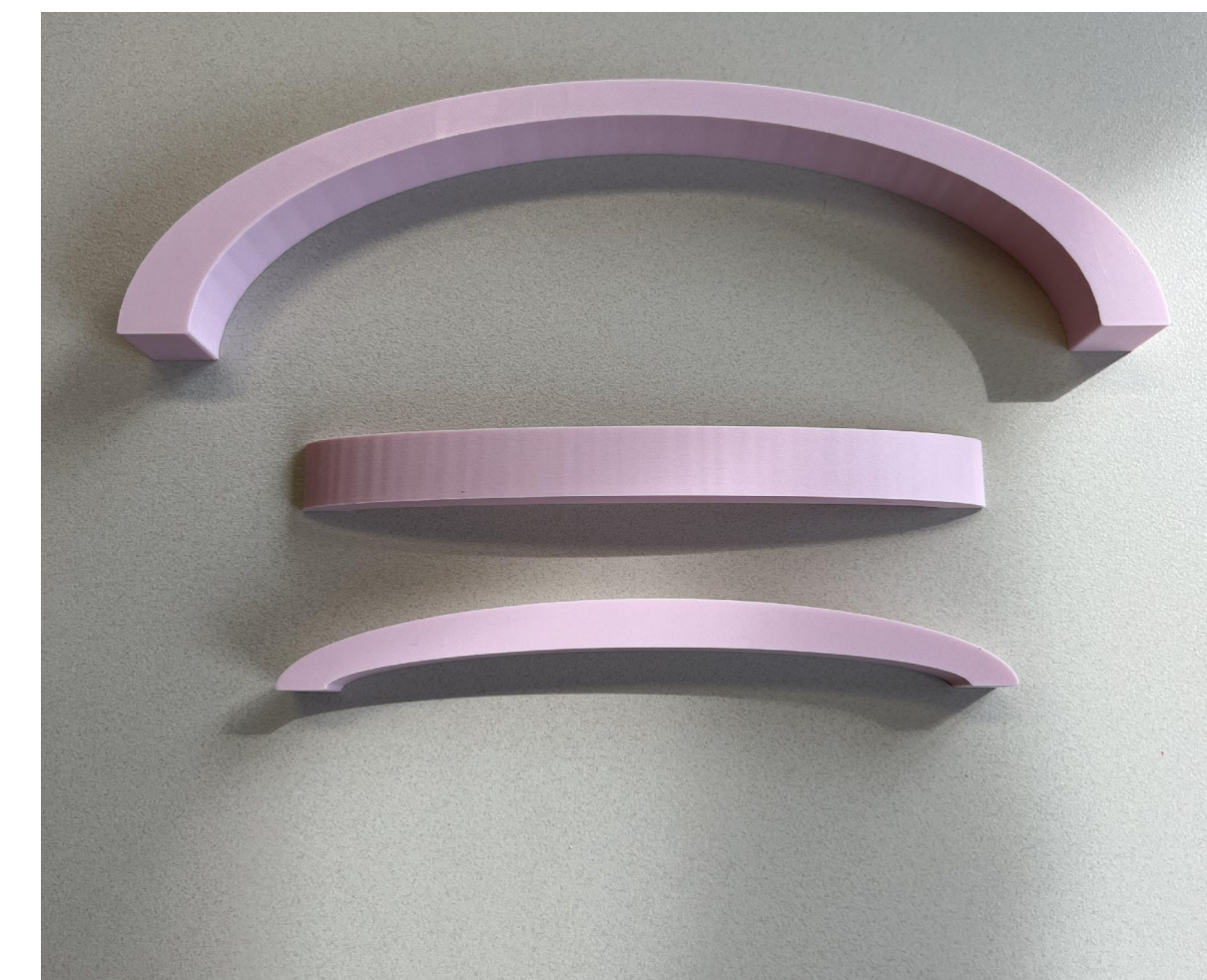


Figure 3: 3D printed components.

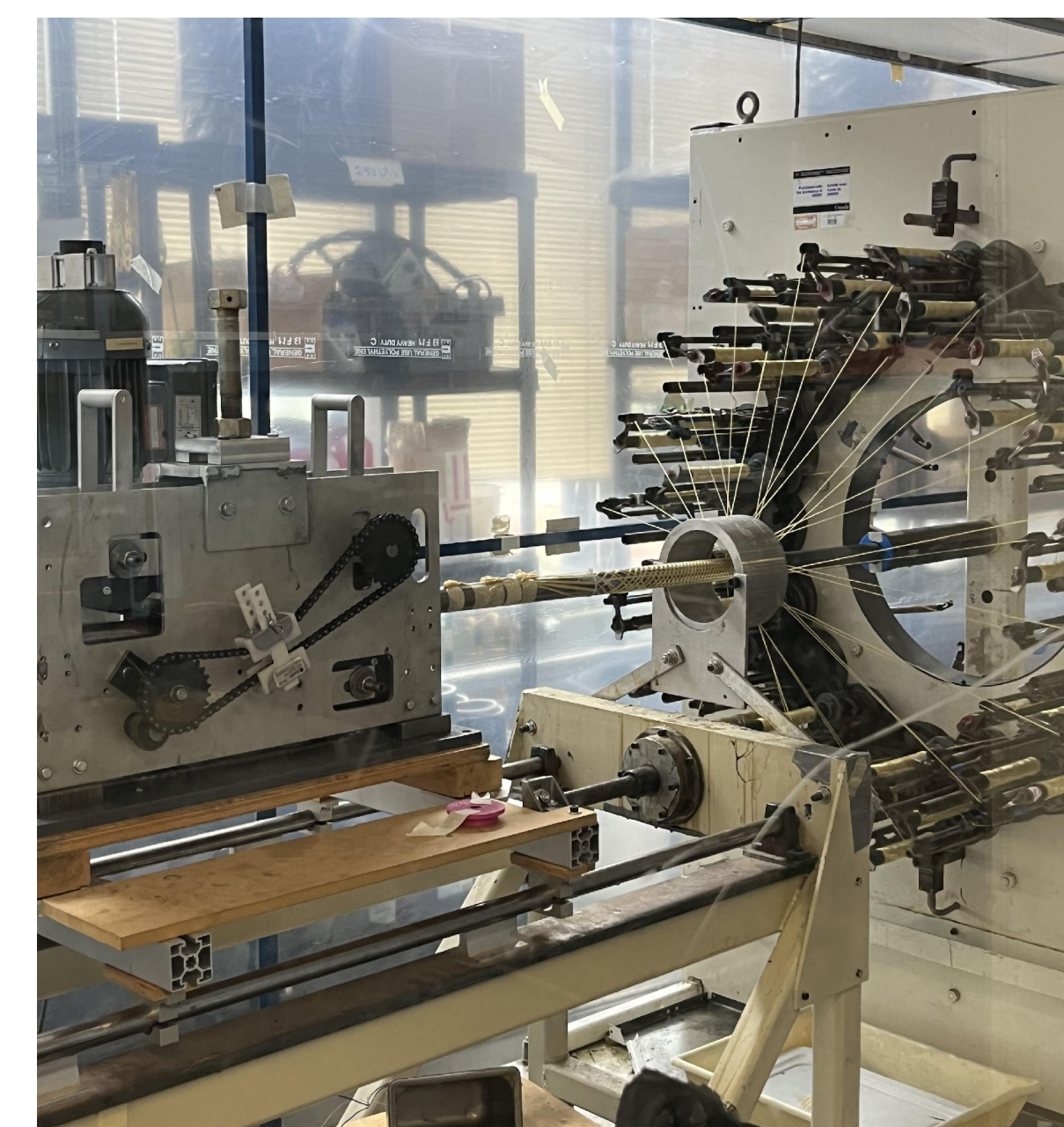


Figure 4: Braid being created using the maypole rotary braider.



Figure 5: Braids being cured in cold-cure epoxy.

Maypole Rotary Braider

- A braid angle of 55° was chosen on a 1" diameter mandril to create a braid for the larger backpiece attachment (Figure 4).
- A braid angle of 35° was chosen on a 7/16" diameter mandril to create braids for the smaller side attachments.
- Once the braids were complete, they were slid off the mandril onto the 3D printed cores.
- The pieces were coated with epoxy and left to cure (Figure 5).

Building the Mask

- Dimensions of a pre-existing fielder's mask were examined (Figure 6).
- Each braided composite attachment was attached to polyethylene foam, then finally connected to the mask with hook and loop fasteners.
- This ensured the attachments were removable.
- Straps that did not have braided attachments were reinforced with strips of polyethylene foam.



Figure 6: Rip-it® Defence Pro Softball Fielder's Face Mask.

CONCLUSION

Overview

- Pre-existing fielders' masks can be improved and modified so that they offer the same level of protection as other types of headgear, because defensive play related concussions happen frequently, but could be prevented.
- Having practical and readily available head protection for all aspects of game play in softball decreases the risk of concussion and allows players to feel safer.
- By creating a comfortable attachment to reinforce a pre-existing mask, concussion prevention is simple and functional.
- Inner components for three separate attachments were designed using SOLIDWORKS® and 3D printed. Kevlar braided fibers were wrapped around the 3D printed cores, then cured in epoxy.
- The attachments were reinforced with polyethylene foam and attached with hook and loop fasteners to the existing fielder's mask.

Future Considerations

- To be used in actual games, the mask should be tested under impact to see if it can withstand forces from contact.
- For braided composite materials like this to be practical in fielder's masks, they would need more flexibility when cured to increase comfort and functionality.

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