

INTRODUCTION

Livestreaming has become a global form of entertainment and employment, including for individuals with disabilities. In e-commerce livestreaming, Deaf and Hard-of-Hearing (DHH) livestreamers face unique challenges due to their reliance on sign language (SL), limiting access for hearing audiences and reducing earning potential. Inspired by the rise of virtual livestreamers and virtual human technology, we designed a virtual co-presenter system designed for SL livestreaming teams with DHH members. This system supports real-time speech and visual animation output to help bridge communication gaps between SL livestreaming team with DHH members and hearing audiences.

UNDERSTANDING CHALLENGES

We conducted semi-structured interviews with 4 SL livestreaming team members and 15 hearing audiences.

Lack Of Intention To Continue Watching

Hearing audience typically enter SL livestreams conducted by DHH livestreamers out of curiosity or compassion, but these motivations are insufficient to sustain long-term engagement.

Presenting & Receiving Product Information

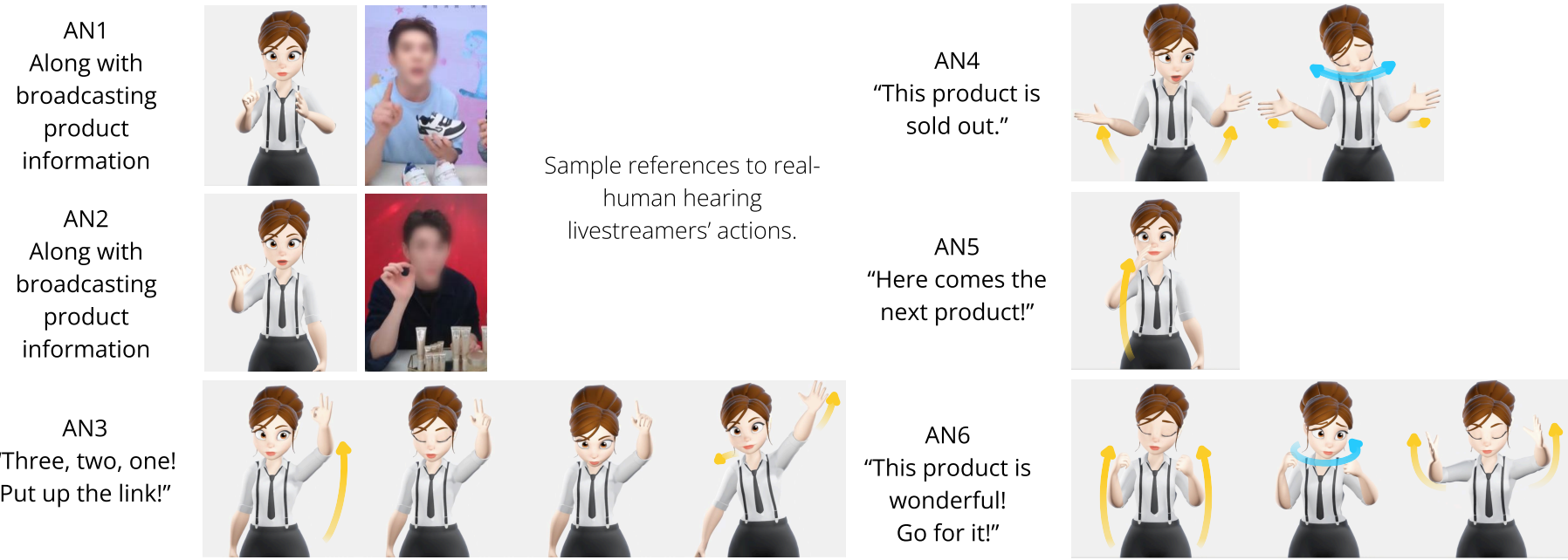
Both DHH livestreamers and hearing audiences identified **SL as a major communication barrier**. DHH livestreamers dropped plans to reach hearing audiences due to costly, limited SL interpreters. DHH livestreamers used text to convey information, but **excessive or unclear text information overwhelms** hearing audiences. Beyond visual overload, **unintentional background noises and unrelated audio** in SL livestreams also distracted hearing viewers, which DHH livestreamers often overlooked or intentionally adding it to avoid platform bans.

Emotional Expression & Resonance

Hearing livestreamers convey emotions through tone, volume, facial expressions, and gestures to enhance engagement and purchasing intent. The **auditory cues are absent** in SL livestreaming, making emotional connection more difficult to hearing audiences. DHH livestreamers rely on facial expressions and signing, which hearing audiences may **misinterpret the emotions**. Even when emotions were understood, hearing audiences **struggled to resonate** due to lack of context information. DHH livestreamers also acknowledged challenges in emotional expression, often due to **lack of confidence and the pressure to stay positive**.

VIRTUAL CO-PRESERENTER

The virtual co-presenter was designed through a workshop with 6 designers to support SL e-commerce livestreaming. It delivers scripted speech and expressive facial animations to convey product details and emotions. The design fully utilizes the structured workflow from script preparation to live product introductions, which is typical for SL livestreaming. Collaborating with the DHH team, the co-presenter enhances accessibility for hearing audiences while preserving the central role of DHH livestreamers.

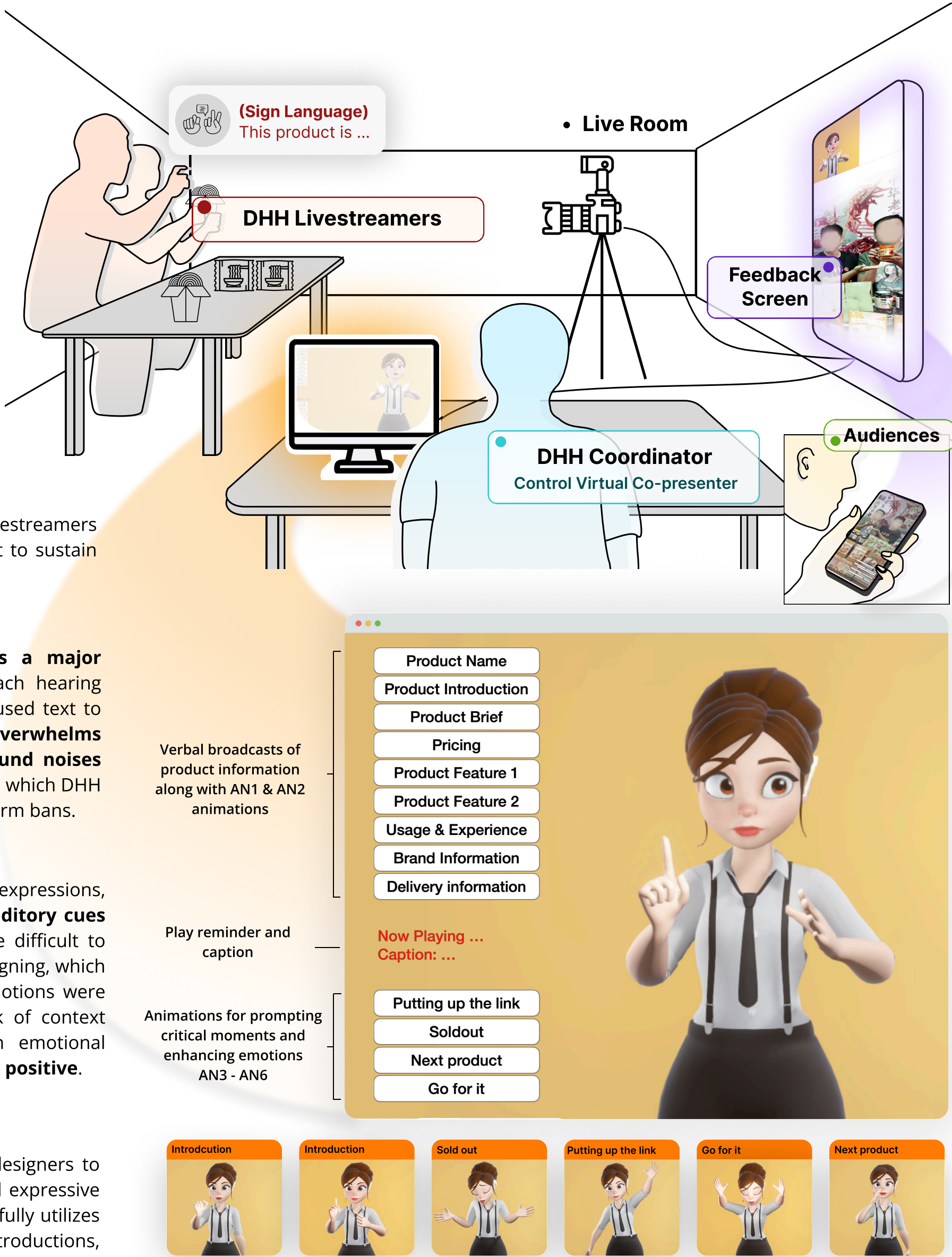


DESIGN SUGGESTIONS

The preliminary virtual co-presenter demo received mostly positive feedback. Participants appreciated its potential to make livestreams more distinctive and assist those with language barriers.

Appearance: Hearing viewers focused more on the co-presenter's appearance than SL livestreamers, preferring a simple, human-like cartoon style that feels approachable and natural. Both groups also suggested incorporating DHH-related elements (e.g., hearing aids) to represent identity.

Functions: The co-presenter should interpret sign language naturally, offer real-time prompts, express emotions to boost engagement, and remain easy to control and minimally intrusive for DHH livestreamers.



Animation Design

To help hearing audience better understand DHH livestreamers' emotions, the designers created 6 gesture animations (AN1-AN6) shown in the left, imitating gestures from real hearing livestreamers. The selection of gestures was informed by over 30 hours of observed e-commerce livestreaming by hearing livestreamers. AN1 and AN2 were designed to appear randomly or be repeated during the virtual co-presenter verbal broadcasts of product information to improve the anthropomorphism and naturalness of the virtual co-presenter. AN3 to AN6, paired with specific verbal broadcasts, were designed to highlight critical moments and amplify positive emotions.

User Interface Design

The designers developed the virtual co-presenter tool's user interface (upper figure) for SL livestreaming teams with DHH members. The left panel included buttons triggering verbal broadcasts paired with animations. The upper-left buttons corresponded to nine product information segments provided by DLs, while the lower-left buttons activated AN3-AN6. To enhance accessibility for SL livestreaming teams with DHH members, the designers incorporated a play reminder and red-colored captions to improve visibility and usability.

CONCLUSION & ONGOING WORK

This research explores communication challenges between DHH livestreamers and hearing audiences in sign language e-commerce livestreaming, focusing on information delivery and emotional engagement. We developed a virtual co-presenter through design workshops to support more expressive and interactive content. Initial feedback from both communities offered key design insights, guiding us to refine the system for team collaboration. Leveraging advances in text-to-3D animation, future versions will enable flexible content creation based on livestream scripts. We plan real-world testing and iterative optimization to enhance real-time interaction, aiming to build a design space that bridges DHH livestreamers and hearing audiences in e-commerce livestreaming.

Virtual Co-Presenter:

A Tool to Enhance Accessibility and Engagement of Sign Language E-commerce Livestreaming

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Livestreaming has become a global form of employment, including for people with disabilities. E-commerce livestreaming, having well-prepared scripts and relatively fixed structures, has recently become a dominant sales channel in China. However, Deaf and Hard-of-Hearing (DHH) livestreamers face challenges due to their reliance on sign language (SL), which limits hearing audiences' access and further reduces earning potential.

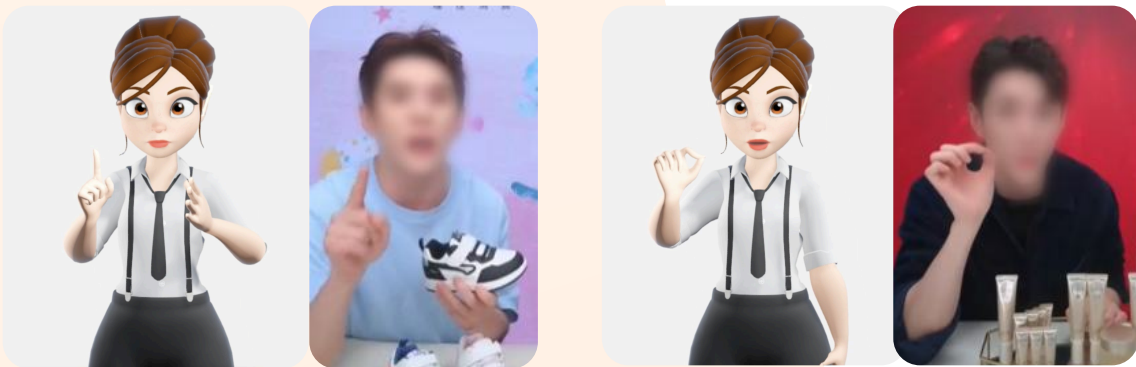
VIRTUAL CO-PRESENTER DESIGN

Inspired by the rise of virtual livestreamers and virtual human technology, we designed a virtual co-presenter system designed for SL livestreaming teams with DHH members. This system supports **real-time speech** and **visual animation output** to help bridge communication gaps between SL livestreaming team with DHH members and hearing audiences. We developed the virtual co-presenter through an iterative design process. We started by a design workshop with six designers, followed by a preliminary evaluation with SL livestreamers and hearing audience[1], and ended up with the design finalization.

DESIGN WORKSHOP

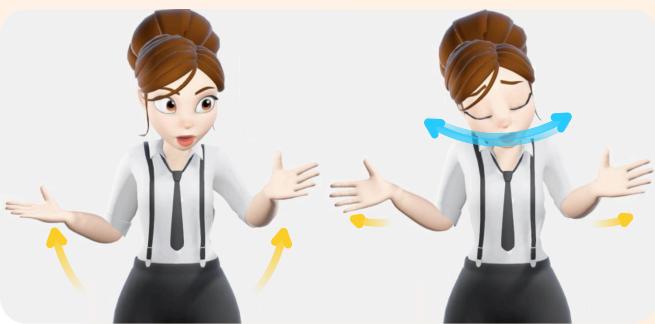
For the design, designers carefully selected audio content and gestures that are familiar to hearing audience and can also be aligned with SL livestreaming. So the animation design referenced to real-human hearing livestreamer's selected actions:

AN1 & AN2:
Along with
broadcasting
product
information

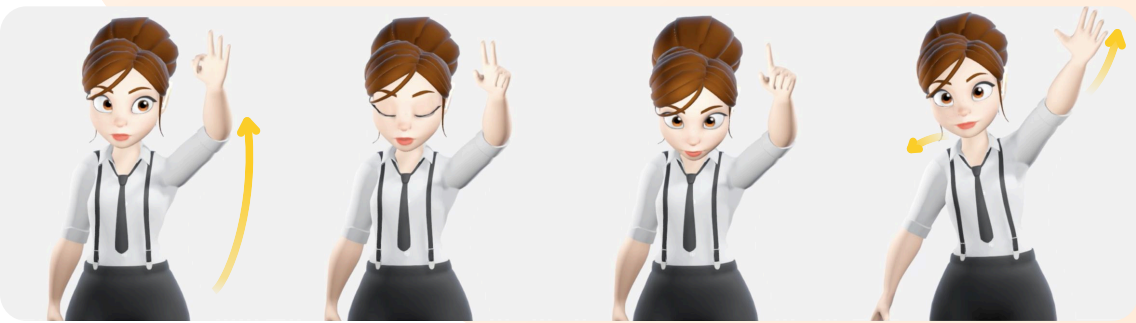


To prompt critical moment:

AN3:
"This product
is sold out."



AN4:
"Three, two,
one! Put up the
link!"



AN6:
"Here comes
the next
product!"



UNDERSTANDING CHALLENGES

Our prior work identified communication gaps in SL e-commerce livestreaming between SL livestreaming teams with DHH members and hearing audience [1].

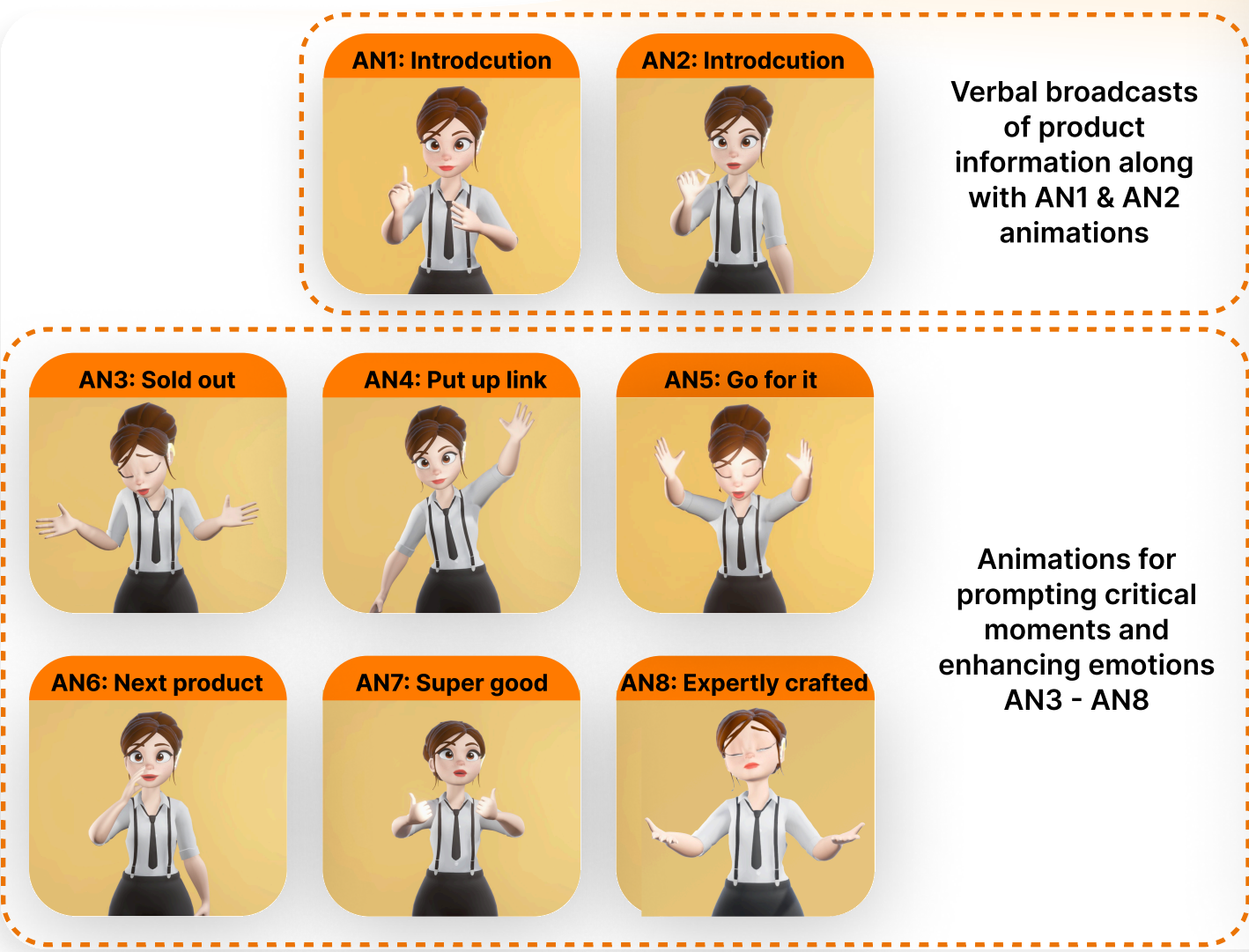
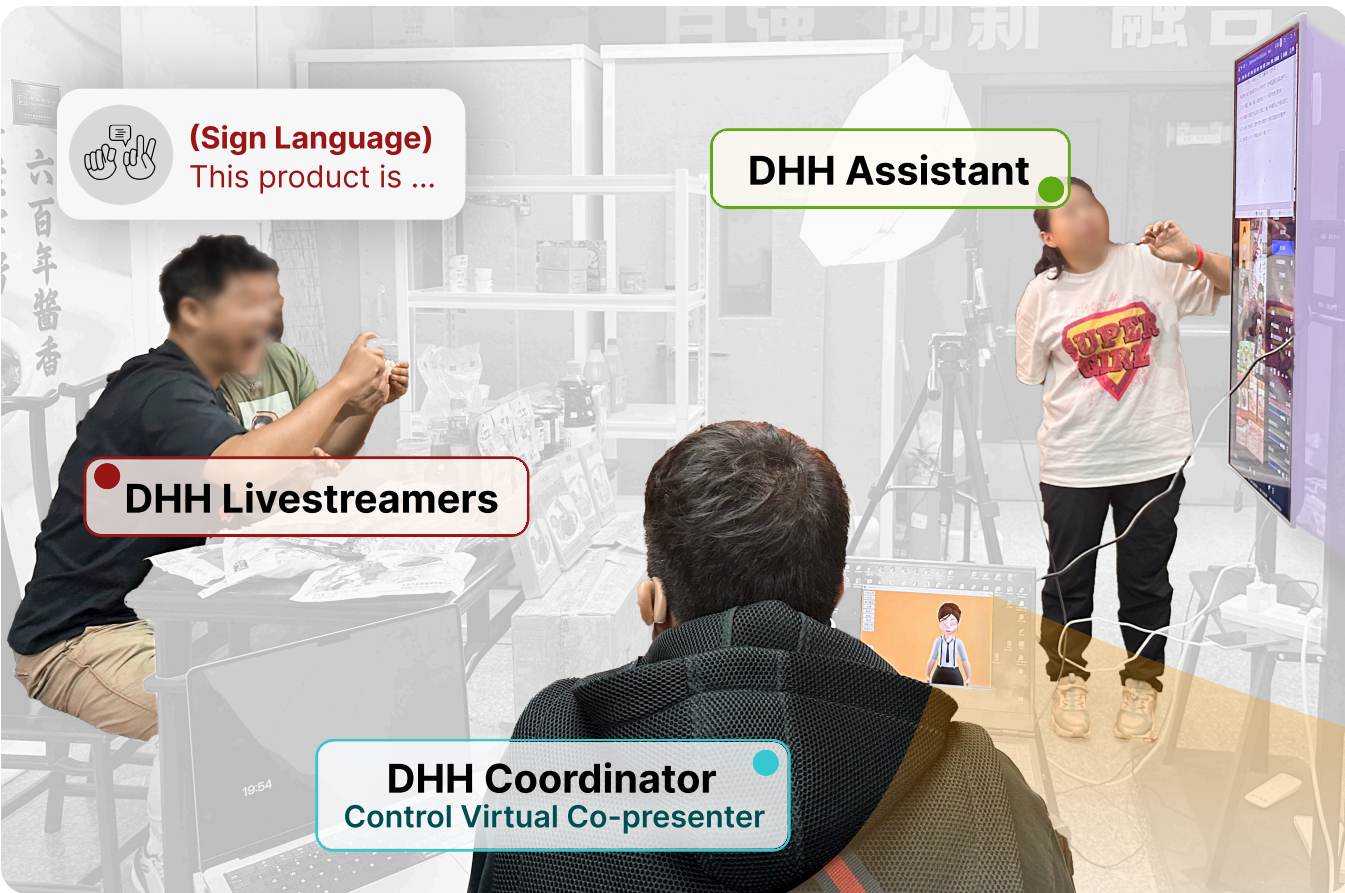
Lacks of Intention to Continue Watching

Information Conveyance

Sign language, overwhelmed text/visual information, etc.

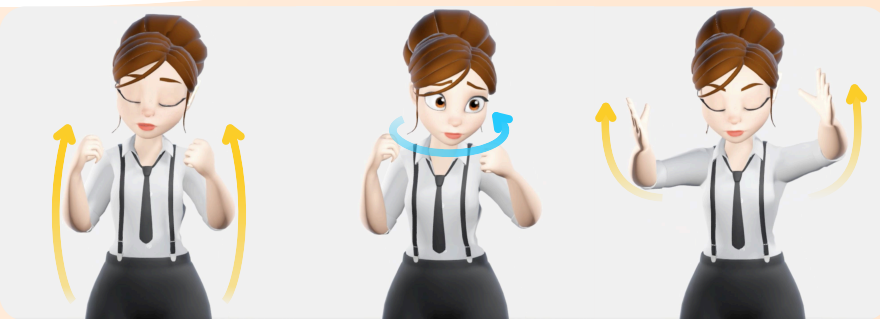
Emotional Resonance

Misinterpretation of the emotions, etc.



Paired animation with AN4 using iconic promotional phrases to enhance emotions:

AN5:
"This product is
wonderful! Go for
it!"



PRELIMINARY EVALUATION

While DHH livestreamers and hearing audience both appreciated the potential to overcome the challenges, they also provided some design suggestions:

Appearance

Incorporate DHH-related elements (e.g., hearing aids) to represent identity, etc.

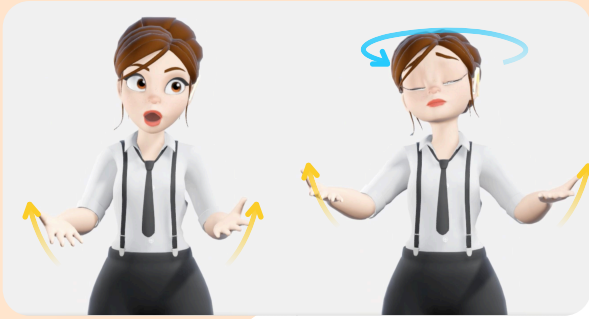
Functions

Express emotions to boost purchase, a visual cue to guide attention allocation etc.

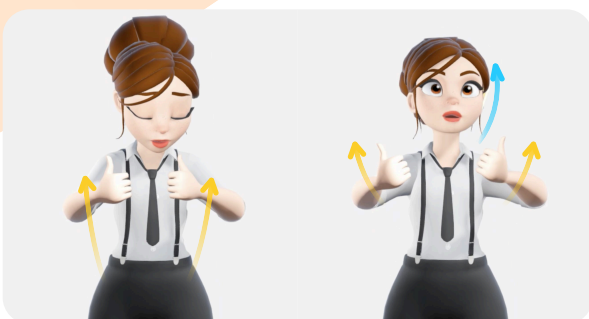
DESIGN FINALIZATION

Added more animation to enhance emotions:

AN7
"This is really super
delicious!"



AN8
"This product is made
with great care and is
very delicious."



Added AN9 as a cue to help hearing audiences navigate multiple visual centers while keeping DHH livestreamers in a dominant position.

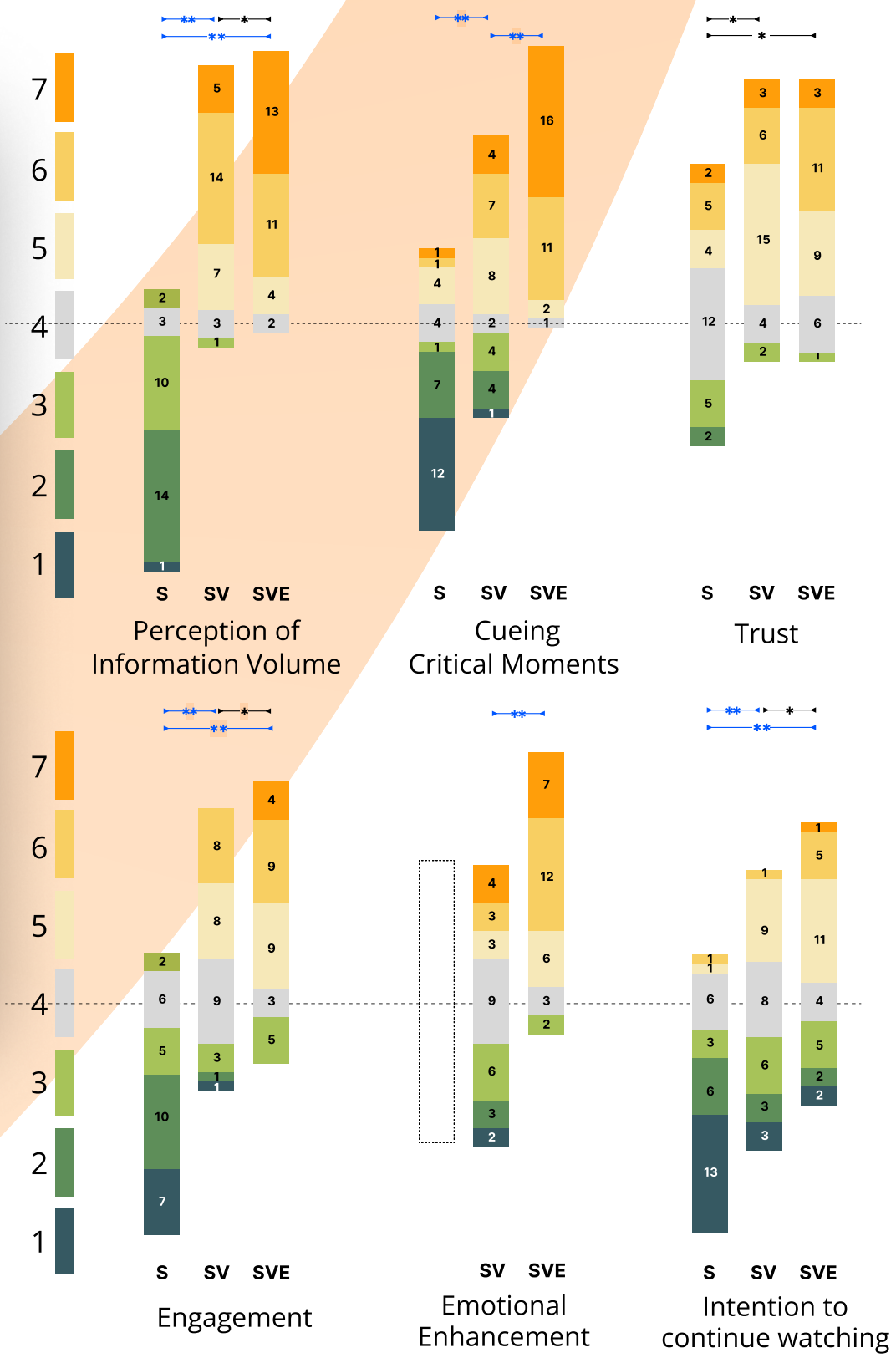
EVALUATION

One SL team (DL1-DL4), consisting of 2 DHH livestreamers and 2 DHH staff, tried the virtual co-presenter tool in real-world livestreaming. They provided very positive feedback during the interview:

"This is incredibly valuable to me.
I aim to expand my audience base.
The more, the better!" -DL1

By comparing three versions, virtual co-presenter improves hearing audiences' comprehension and engagement.

Version	Sign Language	Product Info	AN3 - AN8
S	✓		
SV	✓	✓	
SVE	✓	✓	✓



ON-GOING WORK

Continue evaluating virtual co-presenter with other SL livestreaming teams in real-world livestreaming; Investigate hearing audiences perceived performance across different teams.

We are enhancing the tool's robustness to make it open-source and exploring the integration of text-to-video generation to further improve the tool's flexibility in its future version.