When Filters Escape the Smartphone: Exploring Acceptance and Concerns Regarding Augmented Expression of Social Identity for Everyday AR

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Figure 1: Examples of filters from our user study. From left-to-right: *1. sunflower badge and name badge,* an informative filter intending to make disabilities more visible to others; *2. Angels on the shoulder, question mark above head* - examples of extended reality augmentations on/around the body; *3. Mid-length coat* - an example of extended reality augmented fashion; *4. Sports logo on shirt* - an example of sponsored, branded augmentations; *5. Lipstick and skin smoothing, filled-in eyebrows and eyeliner* - examples of aesthetic modifications of appearance in-line with existing social norms around the use of make-up and minor cosmetics; *6. Cartoon-ified head and hair* - an example of a more extreme augmentation of appearance where human likeness is retained, but the portrayal becomes progressively more 'unreal'.

ABSTRACT

Mass adoption of Everyday Augmented Reality (AR) glasses will enable pervasive augmentation of our expression of social identity through AR filters, transforming our perception of self and others. However, despite filters' prominent and often problematic usage in social media, research has yet to reflect on the potential impact AR filters might have when brought into everyday life. Informed by our survey of 300 existing popular AR filters used on Snapchat, Instagram and Tiktok, we conducted an AR-in-VR user study where participants (N=24) were exposed to 18 filters across six categories. We evaluated the social acceptability of these augmentations around others and attitudes towards an individual's augmented self. Our findings highlight 1) how users broadly respected another individual's augmented self; 2) positive use cases, such as supporting the presentation of gender identity; and 3) tensions around applying AR filters to others (e.g. censorship, changing protected characteristics) and their impact on self-perception (e.g. perpetuating unrealistic beauty standards). We raise questions regarding the rights of individuals to augment and be augmented that provoke the need for further consideration of AR augmentations in society.

CCS CONCEPTS

• **Human-centered computing** → **Mixed / augmented reality**.

KEYWORDS

Augmented Reality, Mediated Perception, Identity, Social Identity, Augmented Identity, Self-Presentation, AR Filters

ACM Reference Format:
Jolie Bonner, Florian Mathis, Joseph O'Hagan, and Mark McGill. 2023. When Filters Escape the Smartphone: Exploring Acceptance and Concerns Regarding Augmented Expression of Social Identity for Everyday AR. In *29th ACM Symposium on Virtual Reality Software and Technology (VRST 2023), October 9–11, 2023, Christchurch, New Zealand*. ACM, New York, NY, USA, 14 pages. https://doi.org/10.1145/3611659.3615707

VRST 2023, October 9–11, 2023, Christchurch, New Zealand

1 INTRODUCTION

Augmented Reality (AR) will empower users, communities, businesses, governments, and others to selectively alter, augment, diminish or otherwise intervene with our perception of reality [55, 71]. Rapid advances in AR technologies will soon see consumer devices capable of enabling everyday/all-day AR in wearable, fashionable form factors (e.g. glasses [25]). Currently, AR filters which augment an individual's identity are restricted to the smartphone's lens [66]; soon, it will become feasible to see persistent augmentations of identity applied to ourselves and others through everyday AR devices. Such technology will enable individuals to curate their own public-facing digitally augmented facade, much as is currently evidenced in social VR and social media [35, 62, 68, 76], but transposed to perceived reality through everyday AR.

However, the widespread adoption of augmented social identities brings with it the risk of new forms of misuse and abuse emerging (e.g. virtual blackface [8, 41]). While current mobile platform guidelines aim to mitigate this [4, 6, 10], the breadth of everyday AR risks amplifying the harm or benefits experienced due to augmentations being applied onto oneself or others. Users could feel pressure to conform their appearance to perpetuated ideals [18], as is already noted in AR-driven "selfie" culture [69]. Moreover, it is easy to envision a convergence of AR sensing and cheap/deep fake technology [21] to sexualise [44, 61] or otherwise appropriate the identity of others for socially unacceptable reasons [47].

There is, however, the scope for good - from sustainable augmented fashion [54], to supporting individuals to present their better '*authentic* self' to others, and even alter how they perceive themselves. This could bring about virtual social transitioning around the presentation of gender identity, or disclose *hidden disabilities* (e.g. autism, chronic pain, learning difficulties, impairments, etc [48]). Yet despite such potential, little is understood regarding how everyday AR might be utilised to augment the expression of social identity, nor the concerns this provokes in mass deployment of everyday AR [56]. To this end, we first analysed 300 smartphone AR filters taken from three popular social media platforms (Instagram, Snapchat, and TikTok) to better understand the design space of existing AR filters. Informed by this, using an AR-in-VR user study (N=24), we investigated user attitudes and concerns towards 18 AR augmentations envisioned everyday AR environment, addressing:

RQ1 What role could identity-augmenting AR filters play in our perception of self, and external social identity in everyday life?

RQ2 What are the possible societal challenges posed when AR filters become ubiquitous in everyday life?

Our results show that our participants broadly respected other individuals augmentations and were connected to their own augmentations as an extension of self. However, tensions arose surrounding others' ability to augment them, feeling concerned they could have reduced control over how they visually express parts of their social identity, and exposing the potential for misuse and abuse (e.g. changing racial, gender and maternity characteristics). Our findings raise questions regarding the rights of individuals to augment and be augmented, perceive and be perceived and highlight the need for research to understand both the use/risk of this impending technology and to consider the greater permissibility and legality of such augmentations in an everyday AR future.

2 BACKGROUND

2.1 Impact of AR filters

Since AR filters were introduced onto Snapchat in 2015 [5], over 2 million have been created and published [11], with 200 million people using filters daily [38], and a multitude of applications incorporating similar filter-like capabilities, from TikTok to Instagram, becoming a significant influencing factor in how we perceive ourselves and others. AR filters typically allow for a range of augmentations of the user's outward presentation/appearance, from virtual makeup; to changes in age and gender; to virtual additions such as augmented fashion (with notable sustainability benefits in reducing the carbon footprint of designer-oriented fast fashion, constituting 10% of global pollution); to total replacements of visual features (e.g. virtual characters) [17]. Thus far, evidenced primary motivations for using AR filters includes presenting the ideal and transformed self-presentation, enjoyment and social interaction [40]. Some users chose filters with the goal of making themselves 'look better' [66]. However, when considering filters as enacted in an everyday AR context - where said filters could become an intrinsic part of our outward expression of social identity - the potential benefits of AR filters go beyond virtual apparel and augmented aesthetics alone. Augmented identity could benefit a breadth of other social interactions by allowing people to selectively convey information about themselves to others [67] and adapt their appearance to their social context, breaking down interpersonal barriers.

There are also potential negative effects regarding the use of AR filters. On smartphones, they have been used as a way of creating engaging and wearable advertisements attached to, or otherwise augmenting, the user [30], and in an everyday AR context business' capacity to exploit this capability could turn users into AR mobile billboards. Users are also exposed to potential harms regarding problematic augmented presentations of self. For example, some AR filter users have felt compelled to get cosmetic surgery to better look like their augmented selves, colloquially called '*Snapchat Dysmorphia*' [64]. And AR filters particularly targeting body image and beautification have been shown provoke a range of reactions "*from satisfaction and guilt to insecurity and body dysmorphia*" as users feel a pressure to conform to perpetuated ideals [18]. There are also known and speculated areas of concern regarding the explicit misuse and abuse of AR filters, e.g. portraying virtual blackface [8, 41], or sexualizing [44] or otherwise appropriate other's identities for socially unacceptable reasons. As Lemley *et al.* noted,"*what if people use this... to make [you] appear ridiculous... without your knowledge or consent? Or what if they want to make you appear naked...*" [47]. Whilst platforms have evolving guidelines to mitigate against misuse [4, 6, 10], everyday AR could bring about new problems, particularly as the effect of said filters is not broadcast on social media, but rather could be applied by anyone in your proximity, without their knowledge or consent - having the potential to invade both public and private spaces. This emphasizes the need for research to explore how *everyday* AR filters might be appropriated, and what tensions and concerns their use may expose.

2.2 Digital Expression of Social Identity

A person's social identity is informed by their own sense of self and how others perceive them in society [23, 62]. Defining important

facets of identity has been done through *protected characteristics*, which are demographic categories selected by the UK government in the 2010 Equality Act [14] as unlawful to discriminate against. A different set of characteristics are defined similarly by article 21 in the EU Charter of Fundamental Rights [31]. Such legislation demonstrates that there are elements of identity whose importance necessitate protection by law, raising questions regarding the consequences of everyday AR filters being able to augment or otherwise alter such characteristics.

Identity can be expressed and tied strongly to the image we outwardly present [22]. In an everyday AR world, our capability for altering our outward appearance/image, and consequently our expression of social identity, could be near-limitless, offering the potential for individuals to curate a public-facing digitally augmented facade [35, 62, 68] that is as much a part of their external social identity as physical clothing or accessories are today. We can observe motivations to having a digitally augmented self through pre-existing usage of avatars in gaming environments [33, 63]; these have become correlated to real-world movements through social VR avatars that users can feel more connected to [34]. Meta has recently developed hyperrealistic avatars [1] with the goal of improving real-life to avatar coupling. However, little is known regarding how AR users, bystanders, and society may react to this capability for digitally altering, augmenting or otherwise replacing our outward presentation of identity, around the potential benefits, concerns, and likelihood of adoption. Consequently, this paper examines the impact that everyday AR could have on social identity.

3 SURVEY: AR FILTERS ON SOCIAL MEDIA

Instagram [9], *TikTok* [16], *Snapchat* [15] are three popular social media platforms [7] that have allowed their users to create and publish millions their own filters [11] that augment the user's identity. If we are to understand the attitudes towards AR filters when applied to everyday AR, we must first map out how AR filters are currently used, how they occur and the extent to which appearances were augmented, altered, or otherwise manipulated. As such, we collected and analysed 300 filters from the above sites.

3.1 Methodology

We first screen-recorded the 100 most popular filters on each platform (i.e., flagged as trending on Instagram, Tiktok, and Snapchat in July 2022) by applying them to a researcher for up to ten seconds using their smartphone. The researcher wore no accessories or cosmetics whilst creating the videos. This process allowed us to explore any customisable filter settings, e.g. adding/removing elements such as fake eyelashes, colour overlays, scene objects, and demonstrated each filter sufficiently.

Three HCI researchers familiar with the study aims, with professional experience in XR and personal experience of AR filter platforms, then independently coded each filter across a series of metadata descriptors A full description of the codes and scales used can be found in Table 7. Each researcher's coding was then aggregated; in cases of categorical data the majority vote was taken; for ordinal data the mean was taken; and for *red flags*, we opted to **OR** coding results across the researchers as any individual perception of a filter being problematic should not be invalidated by others. A discussion session was then held between the researchers to agree instances where the researcher's codings differed significantly e.g. when both max and min values were coded by researchers. The coding was not designed to investigate the purpose/application of the augmentations, which in our view, was too subjective to code for through this process. The metadata descriptors coded for were:

Location of augmentation Examining where on or around the person augmentations were typically applied. Defined by how Lens Studio's [73] technical controls for creating filters.

Extent and intensity of augmentation The aesthetic extent to which a person was modified, *identifyability*, and how *achievable* this would be in reality.

Impact on Human Likeness, and "fullness" of augmentation Where a filter sat on the Reality-Virtuality continuum [53], further to that, considering whether filters *replaced or augmented* the target; How the filter subsequently altered or obfuscated *human likeness*.

Technical characteristics and Interactivity in terms of *use of animation* and *configureability* of filter aesthetic, and whether the filter additionally extended reality additional virtual objects. Defined by how Lens Studio's [73] interaction controls for creating filters, and object creation tool.

Red flag covering perceived issues where filters could be considered problematic [72]. through augmentations emphasising adult content, violence, or sexualization of the target user.

3.2 Results

We present findings split by AR platform (Snapchat, Instagram, TikTok), however, we caution that we do not conduct any Null Hypothesis Statistical Testing (NHST) to see if the differences *between* these platforms are significant. Our findings are intended to be illustrative of general trends across platforms based on currently popular filters and inform potential differences between platforms for further investigation. However the size of our dataset precludes making anything more than tentative observations about the differences between platforms, and we believe that reporting significant differences here could be misused (e.g. to claim that one platform is more or less problematic than another) when there is insufficient evidence at this point that this is the case.

3.2.1 Location of Augmentations. Unsurprisingly given the reliance on front-facing cameras, smartphone filter augmentations were predominantly applied to the target user's face, eyes, lips, and nose (see Table 1). However, a significant portion of filters also augmented the environment around the user (55%). Only a small proportion of filters were applied to the rest of the user's body. Skin tone and colour were often (25%) altered on TikTok and Snapchat (see Table 1), but not on Instagram.

3.2.2 Extent and Intensity of Augmentations. We observed the extent of aesthetic modification experienced (see Figure 2), ranging from light modification equivalent to make-up to significant alterations of structure, proportions and facial features that could be considered dysmorphia if the user presented themselves this way (Insta M:1.39 SD:0.54, Snap M:2.05 SD:0.81, TikTok M:1.53 SD:0.70). Instagram was predominantly focused on subtle aesthetic modifications of appearance, in keeping with the idea of presenting the "best" version of yourself based on photography. TikTok, and Snapchat

	Location on Body												Feature						Red Flags		
Platform	Eyes	Face	Hands	Lips	Nose	Ears	Limbs	Full Body	Around Person	Environment	Hair	Skin	Animated	Configurable	Additions	Augments User	Replaces User	Sexualisation	Adult Content	Violence
Snapchat	54	78	0	51	36	8	0	10	3	35	3	66	8	3	48	66	34	14	1	0
Instagram	30	88	0	33	17	2	0	1	2	79	0	95	27	21	35	97	3	2	1	0
TikTok	39	75	1	29	21	0	1	3	7	53	2	75	34	41	54	92	8	1	4	1
Total	124 (41%)	241 (80%)	1 (0.3%)	113 (38%)	74 (25%)	10 (3%)	1 (0.3%)	14 (5%)	12 (4%)	167 (56%)	5 (2%)	236 (79%)	69 (23%)	65 (22%)	137 (46%)	255 (85%)	45 (15%)	17 (57%)	6 (2%)	1 (0.3%)

Table 1: Counts of 1) location of augmentations across body; 2) the technical features of augmentations, covering whether filters were *Animated*, *Configurable*, Extended Reality through *Additions*, and whether they *Replaced* or *Augmented the User*; 3) occurrence of 'Red Flag' problematic augmentations, broken down by AR filter platform. Coloured highlighting ranges from 0 (white) to max (purple) across all cells.

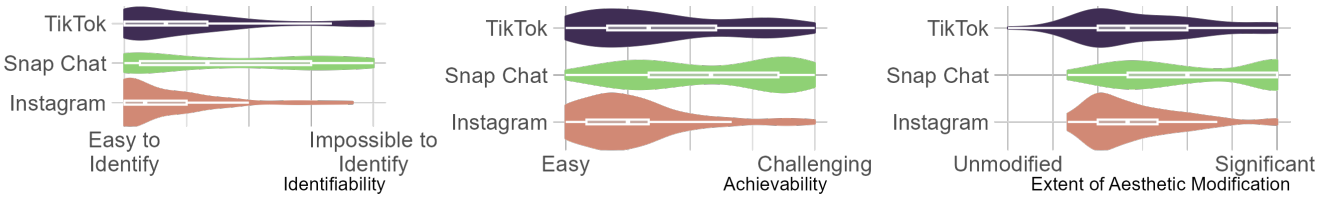

Figure 2: Results for Identifiability, Achievability, and Extent of Aesthetic Modification of filters, broken down by AR filter platform. Violin plots show the density/distribution of the data, with overlayed boxplots.

in particular, featured a greater degree of significant-to-extreme aesthetic modifications - warping facial and body proportions.

Regarding the achievability of the augmentation in reality (e.g. through make-up, plastic surgery etc., see Figure 2) Instagram tended to focus on light, achievable augmentations, whereas Snapchat in particular portrayed augmentations that went beyond what was commonly possible in reality without significant plastic surgery (Insta M:2.05 SD:0.88, Snap M:3.28 SD:1.24, TikTok M:2.56 SD:1.19).

Considering identifiability, platforms largely applied filters that retained the identifiability of the augmented individual, with the exception being Snap Chat, which featured a number of filters that encompassed partial or full identity replacement, such as appearing as an animal or abstract object (Insta M:1.59 SD:0.78, Snap M:2.63 SD:1.47, TikTok M:1.96 SD:1.08).

3.2.3 Impact on Human Likeness, and "full-ness" of augmentation. The vast majority of filters focussed on augmenting the target user, rather than replacing them (see Table 1). However, Snapchat as a platform did show a significant proportion of filters entirely replaced the target user, with replacements predominantly placing a static mask over the user without any user features in view - these masks varied from cartoon characters to animals and baby faces, and could be anchored to the user's head movements but no others.

Considering the Reality-Virtuality Continuum, platforms largely applied augmentations whilst retaining an underlying view of reality (Insta M:1.16 SD:0.43, Snap M:1.95 SD:0.83, TikTok M:1.45 SD:0.63). This was particularly the case for Instagram in our sample (a platform commonly focused on real-world photography), whereas Snapchat featured more filters that replaced reality in favour of virtuality. And Human likeness was largely retained across platforms (Insta M:4.63 SD:0.48, Snap M:4.37 SD:0.93, TikTok M:4.39 SD:0.85), TikTok, in particular, had a handful of augmentations that tended toward e.g. animal-like presentations.

3.2.4 Technical Characteristics and Interactivity. Augmentations were largely static in nature and non-configurable (see Table 1). Filters were relatively split between whether they extended reality through additions or not (see Table 1), with additions typically constituting informational elements, such as textual captions and displaying of dates as well as visual effects such as shimmering and transparent TV static.

3.2.5 Red Flag. N=24 were tagged as 'red flags' (i.e. in some way problematic) by at least one coder. Interestingly, the only Red Flag to commonly appear was *sexualisation*, with approximately 20% of the surveyed Snapchat filters exhibiting augmentations that could be considered (de-)sexualisation of the subject i.e. endowing or enhancing sexual characteristics, making the user appear younger. TikTok featured a small proportion of adult-oriented content, and violent content was largely not encountered, see Table 1

3.3 Discussion

Our survey highlighted some key commonalities in how current smartphone-driven AR filters are utilized. Augmentation of the head, and in particular augmentations intended to enhance the aesthetic were commonplace and applied across platforms. Whilst this finding is unsurprising, it confirms the ubiquity of presenting an 'enhanced' self through these platforms. Moreover, extended reality

additions were commonplace, particularly used for overlaying or conveying additional information about the person, their mood, their location, or other captions.

However, smartphone AR filters also exhibit significant limitations when considering the scope for everyday AR augmentations. Full body and around body augmentations were rare in our dataset - whilst these filters exist, they are not yet widespread, we expect, due to the limitations of applying these augmentations through the front-facing camera lens and its associated narrow field of view.

We note also the subtle inter-platform differences witnessed - with Instagram users appearing more focussed on lighter-weight augmentations that largely preserve identity and human likeness, with Snapchat and TikTok pushing the boundaries in achievability and human likeness. This suggests but does not confirm, that users seek out different styles of augmented self-presentation based on the community they portray themselves in.

Our survey highlighted the varying capacity of AR to facilitate both modest and extreme augmentations of self and the near-ubiquity of applying *some* form of aesthetic improvement to the user's expression of social identity on these platforms. The heterogeneity illustrated in this sample also emphasizes the breadth of ways by which AR filters could impact our self-presentation given everyday AR in the future, informing our next study.

4 STUDY: AR SOCIAL IDENTITY

Informed by our categorisation, we designed a follow-up study to examine user attitudes and concerns given the prospect of these filters in-time escaping the smartphone lens and being enacted in an *everyday AR* context. As the technology for persistent all-day AR filters is not yet available in an everyday AR form, we used a common approach to simulate AR experiences using virtual reality; 'AR-in-VR' [49–51, 70, 75]). We chose to investigate the influence of the following factors on attitudes towards AR filters:

Category: The type of filter being applied, covering common augmentation locations (Full Body, Head, Around Body) and use cases (Beautification, Sponsored Content, Informative Content). See Table 2 for an overview of the investigated filters in the study.

Role: Who applies the filter and to whom (summarised by Table 3), using 2 factors (control, application) we defined 4 perspectives: You have control; you do not have control; augmentations happening to another; augmentations happening to you.

Relationship: The relationship (Friend / Stranger) to the subject being augmented.

Category was treated as the independent variable throughout the presented clips in the study. *Role* and *Relationship* were examined through questionnaires/interviews but were not varied in the conditions experienced in the study.

4.1 Selection of Filter Categories

To explore the influence of *Category* on attitudes towards AR filters, we selected six categories of filters to implement based on a review of existing works. These categories were informed by, but not restricted to our survey findings. We first examined popular AR filter creation tools and found a distinction between world filters (e.g. augmenting the world surrounding an individual), full body filters (e.g. augmenting an individual's entire appearance), and facial/selfie filters (e.g. augmenting only an individual's face) [20, 28]. As such, we included *Around Body*, *Full Body*, and *Head* categories to capture each of these, respectively.

We then considered the application of existing filters on predominant AR platforms. As much prior attention has focused on their use for beautification [40, 69], emphasized by our survey findings around aesthetic modification, we included *Beautification* as a category. Furthermore, noting the increasing prevalence of filters for advertisement purposes [29], and the potential risks of such content to users [45], we included a *Sponsored Content* category.

Finally, it is commonplace to see filters with a functional basis [39] (e.g. for captioning), evidenced in our survey by the prevalence of extended reality additions, and so we included an *Informative* category, based around previous works on displaying personal information in AR [67], and initiatives such as the sunflower lanyard which seek to give people with hidden disabilities a signifier of their disability. See Table 2 for an overview of each of the categories

4.2 Measures

4.2.1 Demographics. Demographic data was captured regarding gender, age, previous usage of filters and XR (Multiple times a day, Daily, Weekly, Monthly, Less/Never.

4.2.2 Social Acceptability of Augmentations by Category, Role, Relationship. After experiencing each category participants were asked to complete a questionnaire rating how acceptable they felt it was

Category	Description	**Level 1** (lowest degree of augmentation)	**Level 2**	**Level 3** (highest degree of augmentation)
Informative	Augmentations designed to convey information to the wearer.	Name badge on shirt	Level 1 + sunflower lanyard	Level 2 with descriptive text saying "Hello I have a hidden disability"
Around Body	Augmentations tethered to the space around the person being augmented, not directly covering the body itself.	Question mark above head	Level 1 + characters on shoulders	Whole body outline
Full Body	Augmentations that surround the body from below the neck with varying degrees of coverage.	Vine wrapped around body	Mid-length purple coat	Full suit of armour
Sponsored Content	Augmentations that display logos and other iconography of a company.	Sports company logo on shirt	Level 1 + logo on face	Level 2 + logo signs next to head
Beautification	Augmentations that mimic real-world cosmetic enhancement products and procedures of varying severity.	Lipstick and skin smooth	Level 1 + filled-in eyebrows and eyeliner	Level 2 + smaller nose and chin
Head	Augmentations that take place on a combination of face, eyes, nose and mouth.	Sparkly freckles on cheeks	Enlarged eyes and shrunken mouth	Cartoonified head and hair

Table 2: The six augmentation categories and the three levels of these that participants experienced in the AR-in-VR study.

to apply the given augmentation *Category* based on their *Role* in applying the augmentations, and their *Relationship* to the subject on a 5-point scale ("Extremely unacceptable" to "Extremely acceptable"). For *Role*, participants were given a copy of Table 3 to assist them in considering the different perspectives. Each question was worded slightly differently to fit the role, see Appendix B.

4.2.3 Interviews. Participants took part in a semi-structured interview to explore their willingness to respect the proposed augmentations of others, and their perception of the potential impact AR filters could have on presented protected characteristics;

IQ1 If a person had free reign to augment themselves in any way they chose, would you respect their choices? i.e. would you seek to remove or alter the augmentation, or generally disapprove of this choice?

IQ2 These filters have the ability to augment you in such a way that would affect the appearance of certain protected characteristics [14, 27] (see Appendix C), can you try to explain ways this could be beneficial?

IQ3 These filters have the ability to augment you in such a way that would affect the appearance of certain protected characteristics can you try to explain if you think this is harmful?

IQ4 Does the role in which the augmentation takes place have an effect on your views of altering the appearance of protected characteristics?

4.2.4 Closing Questionnaire. Finally, we asked the participants to reflect upon AR filters having now experienced them:

CQ1 If you could apply any filters of your choosing daily, how would you perceive your augmentation on the following scale? 0-My true self, 50-An extension of self, 100-Digital self.

CQ2 Assume again that you apply any filters of your choosing on a day-to-day basis, how attached do you feel to your augmented self? 1-extremely unattached, 5-extremely attached.

CQ3 Assume again that you apply any filters of your choosing daily, where would the extent of your augmentation fit on the following scale? 0-unchanged, 50-Alterations to self, 100-Total avatar.

CQ4 Lastly, are you worried that applying the filters could result in the following? Select all that apply.

For **CQ4**, we pre-populated a range of potential concerns, covering privacy, social acceptability [46], self-consciousness [77], deception, risk of body dysmorphia and perpetuating unrealistic body and beauty standards [2], potential for abuse and loss of dignity and control [32, 47], dependence [69], and other concerns.

4.3 Implementation

For each category defined in Table 2 we created 3 filters (see Appendix D). Across the 3 filters, we varied the extremity to show the range in each category. For sponsored content, around body, full body and head we did this by increasing the area covered by the filter. Informative was varied in the amount of information shown. Beautification was made using the make-up helper environment [13] in which controls, such as level of skin smoothening, lip pigmentation and nose/chin shaping were increased.

To create the VR environment we recorded a 360 video of a person in an outside environment using a GoPro Max. A crop of this video was created and entered into Lens Studio [12] where the filter was applied and re-recorded. The location and time of the filtered crop and the original video were synced. A final video was created by editing together the videos of each filter, with pause and play instructions. We then loaded this onto used a Meta Quest 2 with an 1832 x 1920 resolution [52] to conduct the experiment.

	Applied to others	**Applied to you**
Control of augmentation	[*Role 1*] You apply a filter, similar to those you experienced, to 'person A'	[*Role 3*] You apply a filter, similar to those you experienced, to yourself, 'person A observes'
No control of augmentation	[*Role 2*] You observe a filter, similar to those you experienced, that 'person A' has applied to themself	[*Role 4*] 'Person A' applies a filter, similar to those you experienced, onto you

Table 3: The four roles of interaction possibilities in how AR filters are applied to the subject.

4.4 Study Procedure

We recruited N=24 participants, through social media and mailing lists for our lab study. Each session took approx 1 hr to complete, consisting of a 5-minute explanation of; MR (including differences between each VR, AR, and XR), everyday AR assisted via images of AR glasses with visuals displayed on the lenses and AR filters shown through images of viral filters; the study and demographics questionnaire; a 30-minute session where participants viewed filters of each category and filled out a questionnaire after each; a semi-structured audio-recorded interview; and finally a closing questionnaire. To compensate them for their time, participants were given a £10 shopping voucher. The study was approved by our University ethics board. We placed participants in the virtual environment. Each filter was viewed for 15 seconds, and after the 3 for each category were viewed (total exposure 45 seconds) the user was prompted to remove their headset. The participant was then given a phone with Snapchat where they were encouraged to subsequently apply the filter to themselves, to give participants an understanding from both the perspective of applying the augmentation to themselves, and seeing the augmentation applied to others, and then asked to fill out the main questionnaire (see subsubsection 4.2.2). This process was repeated for all 6 categories, the order of which was determined using a Latin square, after which was a semi-structured interview and closing questionnaire.

4.5 Limitations

We selected six categories from our coding, three relating to content and three pertaining to spatial locations. We aimed to select spatial categories that made sense for the content while showing breadth, i.e. (head or beautification, around body for informative, and head/around body for sponsored content. These choices ground the filters in connection with real-life presentation choices such as make-up, branding and name badges. However, with this overlap between our spatial and content categories, we acknowledge they are not independent factors. We also acknowledge that our participants were all living in the UK, meaning discussions would be impacted by predominantly western cultural and societal norms. Moreover with a limited sample size, a high variability across age, and a skew towards male participation, the generalisability of our findings should be taken carefully.

5 RESULTS

The study was completed by 24 participants (16 male - 67%, 8 female - 33%), aged between 21 and 56 years of age (M=27.5, SD=10.4). Participants were asked how often they used filters in their everyday life: 2 (8%) said daily, 1 (4%) multiple times per week, 2 (8%) once a week, 9 (38%) monthly, and 10 (42%) less/never. Participants were asked how often they used XR headsets: 3 (13%) said daily, 2 (8%) multiple times per week, 1 (4%) once a week, 1 (4%) monthly, and 17 (71%) less/never.

5.1 Social Acceptability Questionnaire

A three-way repeated-measures ANOVA was performed using an Aligned-Rank Transform (ART) [26] with the *ARTool* R package [42]. Effect sizes are reported as η_p^2, see [24] for interpretation. This revealed significant strong main effects on **Role** ($F(3)$=126.8, p<0.001, $\eta_p^2 = 0.26$) and **Relationship** ($F(1)$=364.7, p<0.001, $\eta_p^2 = 0.25$), and a significant medium effect on **Category** ($F(5)$=32.8, p<0.001, $\eta_p^2 = 0.13$), see Figure 3. There were also significant interactions between **Role*Relationship** ($F(3)$=30.0, p<0.001, $\eta_p^2 = 0.08$, medium effect) and **Relationship*Category** ($F(5)$=3.5, p<0.003, $\eta_p^2 = 0.02$, small effect). Other interactions were not significant. For pairwise contrasts [43] see Appendix A.

We also found that the role and relationship together were impactful on acceptability, as well as category and relationship. Meaning that for friends and strangers, there will be different acceptability for Categories and Roles. However, the factors defining the Roles (control and application) were not found to be the determining factors in acceptability. Rather, ensuring the person being augmented, be it themselves or others, is in control of their own augmentation was key. Having authority over what they saw of others was not as important as having others choose their own presentation. This enables a new way of defining the scenario, as *self-defined* vs *peer-defined* augmentations.

5.2 Interviews

The responses to each question were coded by one researcher, which was then discussed with a second researcher. The individual codes and more details for each question are reported below.

IQ1 Respecting augmentation choices - These answers were single-coded into three separate categories: *unconditional respect* for responses that did not indicate any Role where they wouldn't disrespect it, *conditional respect* where the state of respect was dependent on some factor(s), and *unconditional disrespect* where the participants indicated no situations of respect. We found *(N=8) participants would unconditionally respect* the proposed augmentations of others; *(N=13) would conditionally respect* the proposed augmentations of others; and *(N=3) would unconditionally disrespect* said augmentations. We then coded the conditional section into what factors the respect was conditional upon. This was done using multiple coding. (N=4) Participants indicated they would be respectful if the augmentations stuck within already existing social norms, like no nudity. (N=2) indicated that the location was impactful and that private spaces are more acceptable, but what's in public may not be. (N=4) specified they would respect it if it caused no harm without specifying that harm.

IQ2 Positive impacts of altering protected characteristics These responses were coded into the protected characteristics discussed. *Age was discussed positively (N=6)* across areas of protecting young people in dangerous situations making them look older, allowing people to make themselves look younger for beautification, and altering the appearance of age for jobs that have a bias towards certain stages of life. *Disability* (N=7) discussion focussed on consented display of disability indicators and information, P17 "*it could be used to like to empower them and make them feel more included and especially in things like disability*". Gender reassignment was mentioned positively the most times (N=11).

The *benefits of being able to present gender identity* in ways that avoid challenging cosmetic changes were discussed specifically with respect to opportunities for those who are gender fluid to express themselves easier, and the confidence and security this could entail, e.g. N=6 "*I feel like this is a really, a really good thing if even if it's cheaper than getting a gender reassignment surgery, it's also an easy way to explore*". Altering maternity was mentioned positively to mitigate bias from employers who would discriminate against pregnant women.

IQ3 Negative impacts of altering protected characteristics These responses were coded into the protected characteristics discussed. For *age (N=9)*, topics included young people trying to get into adult-only areas, gaining access to alcohol etc, and the predatory implications of augmenting adults into children. Making yourself look younger, and the perpetuation of unrealistic beauty standards also appeared. (N=4) suggested that the altering of any/all protected characteristics made them uncomfortable.

Disability (N=4) responses were concerned with faking disability. Gender reassignment and sex were discussed similarly (N=6), noting the impact of someone else being able to change your preferred gender identity if they disagree with your true identity, P12 "*if you had a transsexual person and they physically change their appearance to appear more of the gender that they align with, then having applied a filter onto them having the inverse is super discriminatory and just extremely offensive*". Regarding *Maternity (N=1)* issues around faking or altering the appearance of pregnancy were discussed.

The *altering of race was discussed negatively* with examples of digital blackface and mockery (N=5), e.g. P2 "*somebody could do something awful and change their race and act out in stereotype, and that could be extremely harmful to people of that race*".

Concerns were raised around the removal or addition of *religious signifiers and garments (N=3)* not being accurate to the person's belief, P20 "s*ome could want everyone around them to look like they're sharing the same faith. So they put some kind of augmentation of like religious garments on everyone*".

IQ4 Influence of Role in applying augmentation - (N=14) participants indicated that augmentations of self were acceptable (Role 2,3) but that augmentations of others were not (Role 1,4). (N=6) indicated that Role did not have an effect on their opinions, stating either another factor or that they were uncomfortable in all situations. (N=1) suggested they were comfortable when in control (Role 1,2), (N=1) suggested they were only comfortable with Role 3, and (N=2) suggested that they were uncomfortable with anyone augmenting them (Role 4).

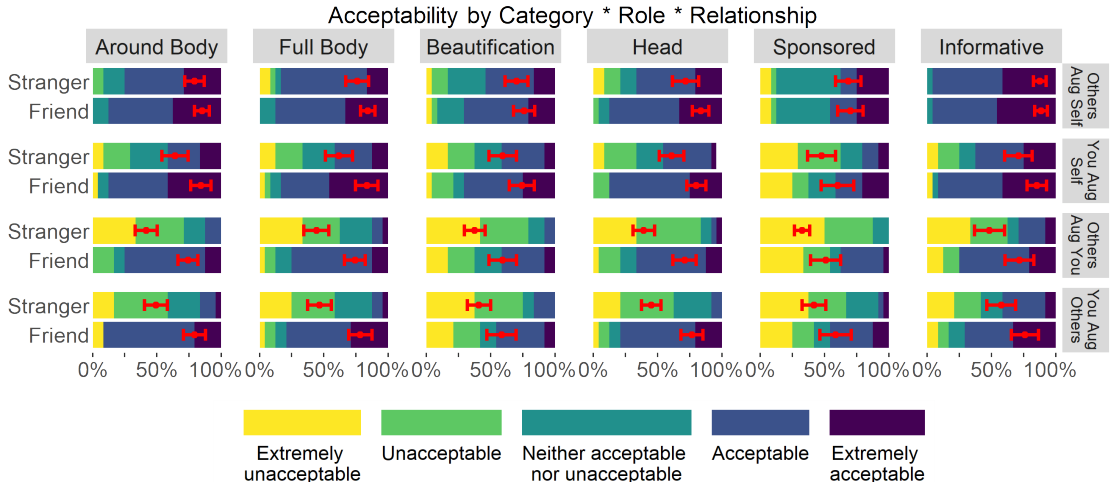

Figure 3: Responses to Likert-type questions surveying acceptability of AR filters. 95% confidence intervals are visualized with red bars, based on the conversion of dependent interval/ordinal variables to numeric ranks.

5.3 Closing Questionnaire

CQ1 True self or digital self - Regarding whether participants viewed augmentations as representing their true self in reality, or a digital extension of self, the mean indicated that the average participant sees their augmentation as an extension of self (M = 50.96, SD = 36.02, 0-100 scale). However, there were participants who chose the extremes: (N=2) chose 0 (complete true self), and (N=4) chose 100 (complete digital self).

CQ2 Attachment to augmented self - Participants reported 'neither attached nor detached' to their augmented self (M=3.13 SD=1.05, 1-5 Likert-type scale), suggesting flexibility in whether augmentations would form an integral part of the person's identity.

CQ3 Extent of augmented self - When asked how much they would augment themselves on a day-to-day basis on a scale from 0-unchanged, 100-total avatar, on average participants showed a desire for a small effect of alterations (M=16.46, SD=21.29). However there is again a portion of people choosing extremes, N=6 participants choose 0, where N=1 participants chose 100.

CQ4 Concerns regarding filters - Table 4 shows a summary of possible concerns regarding AR filters. The 'other' category was chosen three times: (N=2) Body dysmorphia; and (N=1) detachment from reality.

Factor	Count (out of 24)
Censorship	11 (46%)
Loss of privacy	13 (54%)
Technological dependence	14 (58%)
Inappropriate sexualisation	15 (63%)
Obsession with aesthetic flaws	15 (63%)
Deception	15 (63%)
Loss of control over a situation	15 (63%)
Potential mocking/bullying	16 (67%)
Self-consciousness	16 (67%)
Unrealistic beauty standards	17 (71%)
Discrimination	19 (79%)
Loss of dignity	19 (79%)
Other	3 (13%)

Table 4: Responses regarding "Are you worried that applying the filters could result in any of the following".

6 DISCUSSION

6.1 RQ1 - Everyday AR filters on Oneself

6.1.1 AR filters as extensions of self. Our results show most people would consider adopting augmentations as "extensions of self" rather than presenting an entirely "digital self" (Section 5.3). This emphasises that as filters move from smartphones to everyday AR they would be used to meaningfully alter our social presentation.

A minority of people would consider their augmented self part of their true selves, meaning that they believed that everyday AR filters could become a useful and delicate part of their life, noting the potential to make invisible disabilities visible, or to reduce gender dysphoria, with the prospect of such use cases further evidenced by recent related work in VR [65]. Our findings show that where filters are applied in everyday AR, they have the potential to become part of a person's self-expression. However, this is tensioned against those that perceived augmentations as irrelevant to their real-world existence. Whilst such findings are tentative, it is clear that current perceptions are split - between those that hold that augmentations would be delicate and personal, against others that may not yet perceive them as an important part of social identity (**CQ2**).

6.1.2 Extent of Filter Application. It was also shown that the degree to which users would choose to augment themselves isn't unanimous. Most participants erred towards modest augmentations in our study. Problematically, even modest use could still bring about the harms seen in smartphone AR, such as users feeling inferior to the augmented self [64], and cause worries of unrealistic beauty standards, discrimination and loss of dignity **CQ4** as people feel connected to their digitally augmented selves **CQ2**. However some instead chose more extensive augmentations or even the presentation of a total replacement avatar. This range of capability (from partial to full augmentation) motivates the need to investigate augmentation behaviours in more detail (e.g. use of and contextual changes in augmentation levels [58, 60]) alongside the purpose/content of users' augmentation choices. Role 3 specifically discussed the ability of others to augment oneself. Our participants

found the possibility of personal appearance being controlled by others, particularly strangers, uncomfortable and daunting. While some discomfort with strangers is expected [59], others in everyday AR having agency over how we are perceived/presented raises significant questions regarding the right of individuals to see the world as they choose, augmented to their own preferences, or whether individuals should retain the ability to present their true augmented selves, keeping autonomy over their social identity.

We show that there exist positive use cases and motivations for filters in an everyday AR context. Their uptake is not guaranteed and technological advancements may restrict or slow any usage, but we understand that everyday AR filters have the potential to be impactful. As such, we believe it important to investigate further the vulnerabilities and concerns posed *before* mass adoption.

6.2 RQ2 - Everyday AR Filters in Society

6.2.1 How do users respond to the different augmentations of others? When asked if the choices of others' augmented expression were to be respected, some stipulated extreme augmentations as exceptions, e.g. P1 "There are boundaries, don't walk down the street naked. It's a self-expression as long as it's not harming others, they can wear a superhero outfit, if they want". However, the majority felt they should respect others' choice of self-presentation, often irrespective of their attitudes towards augmenting themselves. This is an indication that users would generally not seek to prevent their everyday AR device from presenting these augmentations of others, and further emphasizes that for many participants, the proposed augmentations could constitute an integral part of the filtered user's identity, and that this would be respected - to a degree.

We also found that people would *not* respect the right to augment if they took that augmentation to "extremes", seemingly based on the deviation of these augmentations from what is achievable in reality. This begs the question: should AR filters be regulated in line with existing legal restrictions and/or cultural norms around appearance? For example, public nudity is typically illegal - should the same rules apply to the AR space? Moreover, violations here can be enacted unilaterally on anyone - raising potential concerns around, e.g. effectively invisible sexual assault being perpetrated.

Participants also discussed specific augmentations that would make them uncomfortable, suggesting that there is more than just the *Roles* and *Categories* defined above and extrapolated from that are definitive wrongs that are unacceptable to users - potentially based on their existing worldviews and bias. Even if we take our most acceptable scenario (informative augmentations to self by a friend), there is still an uncomfortable situation discussed in the interviews of someone labelling themselves with false disability information, suggesting an underlying concern throughout regarding misuse/abuse. These findings illustrate the complex nature of augmenting our social expression of identity - *what* the augmentation consists of, the *intent* behind the augmentation, *how it is applied*, and *who it is applied to* can all impact perceptions of acceptability.

6.2.2 Societal issues and the Augmentation of Protected Characteristics. Over half of our participants raised significant concerns around the application of filters - from fears around deception to perpetuating unrealistic beauty standards, to enabling abusive augmentations of others such as obfuscating someone's religious garments - and most significantly, concerns around the use of this technology for discrimination, and the potential for loss of dignity [32, 47]. In interviews, participants reflected on discrimination based on race (e.g. digital blackface) and maternity (faking or hiding pregnancy), with external others empowered to alter or ignore protected characteristics. Whilst such augmentations might be varyingly feasible in everyday AR (depending on the fidelity of the headset and its capability to occlude/replace reality), this capability could have implications for a range of other protected characteristics and social expressions that make up part of our social identity. Consequently, future research should consider the permissibility and legality of such filters. For example, filters to change gender identity were specifically mentioned as a potential positive use case. We can hypothesise filters that would affirm a person's gender presentations, potentially easing dysmorphic feelings. Should others have the capability to ignore or reject this personal augmentation choice? On the face of it, this would seem to violate the rights of the augmented individual. But there may also be warranted cases where an argument could be made for the perceiver to have control over what they perceive. Should we be subjected to scary, upsetting, or (personally) offensive augmentations because an individual chooses to represent themselves in this way?

6.2.3 Towards AR Perceptual Rights? These tensions illustrate that *if and when* everyday AR becomes a reality, it poses not just notable benefits, but also *societal challenges* around how we perceive social expression of identity - requiring pressing multi-disciplinary consideration from technical, legal and social domains as well as affected stakeholders, to determine what rights, regulations, or restrictions may be required. Our work contributes to a growing body of research [3, 19, 36, 37, 57, 74] evidencing the need for *perceptual human rights*, in the vein of proposed neurorights [78], governing AR/XR perceptual mediation, considering *perceptual autonomy* (who can mediate your perception of reality), *perceptual agency* (what elements of reality are permissible to be augmented), *perceptual integrity* (how reality is permitted to be altered).

7 CONCLUSION

In this paper, we reflected on the prospective adoption, usage, and concerns around everyday AR-driven augmented expression of social identity. We surveyed and coded 300 existing AR filters to map out how social identity is currently augmented. Informed by this, we designed a study to explore the perceptions of, and attitudes towards, *everyday* AR filters. The perceived acceptability of everyday AR filters is affected by many factors including the *role* in applying/perceiving the filter, the *relationship* to the person applying the augmentations or being augmented, and the *category* of AR filter, with informational needs in particular being widely accepted, and sponsored content significantly less so. The problematic nature of AR filters was strongly noted (e.g. around discrimination, loss of dignity, potential for misuse) but preventing such usage could be challenging without causing more harm by limiting individuals' ability to express their true self through this medium. Our findings raise important questions around the rights of individuals to augment and be augmented, perceive and be perceived, which provoke the need for further multi-disciplinary consideration of the permissibility of augmentations of appearance and identity.

ACKNOWLEDGMENTS

Thanks to the Research Impact & Knowledge Exchange (RIKE) committee in the School of Computing Science, University of Glasgow, for funding this research. This research was also partially supported by an International Postdoctoral Fellowship (IPF), University of St. Gallen. We also thank our participants for taking part in our study.

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A PAIRWISE CONTRASTS FOR REPEATED MEASURES ANOVAS

Pairwise contrasts for the repeated measures ANOVAs are reported below, using ART contrasts [43]. See Table 5 and Table 6 (overleaf).

	contrast	estimate	SE	df	t.ratio	p.value	sig
1	Others Aug Self - You Aug Self	134.89	20.73	1080.00	6.51	0.00	*
2	Others Aug Self - Others Aug You	368.76	20.71	1080.00	17.81	0.00	*
3	Others Aug Self - You Aug Others	294.06	20.71	1080.00	14.20	0.00	*
4	You Aug Self - Others Aug You	233.87	20.73	1080.00	11.28	0.00	*
5	You Aug Self - You Aug Others	159.17	20.73	1080.00	7.68	0.00	*
6	Others Aug You - You Aug Others	-74.69	20.71	1080.00	-3.61	0.00	*

Table 5: Contrasts for Role.

	contrast	estimate	SE	df	t.ratio	p.value	sig
1	Around Body - Full Body	21.50	26.68	1080.00	0.81	0.97	
2	Around Body - Beautification	175.53	26.68	1080.00	6.58	0.00	*
3	Around Body - Head	44.41	26.80	1080.59	1.66	0.56	
4	Around Body - Sponsored	227.33	26.68	1080.00	8.52	0.00	*
5	Around Body - Informative	-50.49	26.68	1080.00	-1.89	0.41	
6	Full Body - Beautification	154.03	26.68	1080.00	5.77	0.00	*
7	Full Body - Head	22.92	26.80	1080.59	0.86	0.96	
8	Full Body - Sponsored	205.84	26.68	1080.00	7.71	0.00	*
9	Full Body - Informative	-71.99	26.68	1080.00	-2.70	0.08	
10	Beautification - Head	-131.11	26.80	1080.59	-4.89	0.00	*
11	Beautification - Sponsored	51.80	26.68	1080.00	1.94	0.38	
12	Beautification - Informative	-226.02	26.68	1080.00	-8.47	0.00	*
13	Head - Sponsored	182.92	26.80	1080.59	6.82	0.00	*
14	Head - Informative	-94.90	26.80	1080.59	-3.54	0.01	*
15	Sponsored - Informative	-277.82	26.68	1080.00	-10.41	0.00	*

Table 6: Contrasts for Category.

B MAIN QUESTIONAIRE

All questions were asked from the following (friends, strangers):

Role 1 How acceptable do you think it is to apply these filters to the following people?
Role 2 How acceptable do you think it is for the following people to apply these filters to themselves?
Role 3 How acceptable do you think it is to apply these filters to yourself around the following people?
Role 4 How acceptable do you think it is for the following people to apply the filters to you?

C PROTECTED CHARACTERISTICS

Taken from the UK Equality Act 2010 [14]

- Age
- Disability
- Gender – reassignment
- Race
- Religion and belief
- Sex
- Pregnancy and maternity
- Marriage and civil partnerships
- Sexual orientation

D FILTERS

See Figure 4 for a breakdown of the filter categories and levels used.

E FILTER CODEBOOK

Meta Data	Description	Scale
Location	Where any effects were positioned; eyes, face (not feature areas such as temple, forehead, cheek, chin and jaw), hands, lips, nose, ears, hair, limbs, full body, around body, environment.	Yes/No (for each)
Identifiability	How easy was it to identify the user with the filter applied?	1 (Easy to identify) - 5 (Impossible to identify)
Dynamic	Does the way the filter looks to change with movement?	Yes/No
Animated	Is the filter fixed to the person or does it move independently?	Animated/Static
Human Likeness	How much did the user resemble a human?	1 (No human features) - 5 (All human features)
Achievability	An indication of how hard it would be to get this appearance in the real world	1 (Easy) - 5 (Challenging)
Aesthetic modification	How much the filter changed appearance from unmodified to make-up & skin tone, equivalent to typical plastic surgery, and equivalent to extreme plastic surgery and beyond - significant alterations of structure, proportions, and facial features that in reality would be considered dysmorphia if the user perceived themselves that way	0 (unmodified) - 3 (significant modification)
Configurable	Is there a way to edit the filter as it's applied?	Yes/No
Milgram's Continuum	Where does it fit on Milgram's Continuum [53],	1 (Real Environment (more reality)), 2 (Mixed), 3 (Virtual Reality (more Virtuality))
Red Flag	Are there perceived issues by the researcher, including adult content, violence or sexualisation?	Yes (text response)/No
Replacing	Is the filter covering, or manipulating the image of the user?	Replacing/Augmenting
Skin	Does it alter the appearance skin?	Yes/No
Additions	Does it extend reality objects attached to/ around the user	Yes (text response)/No

Table 7: Meta data collected for AR filter survey.

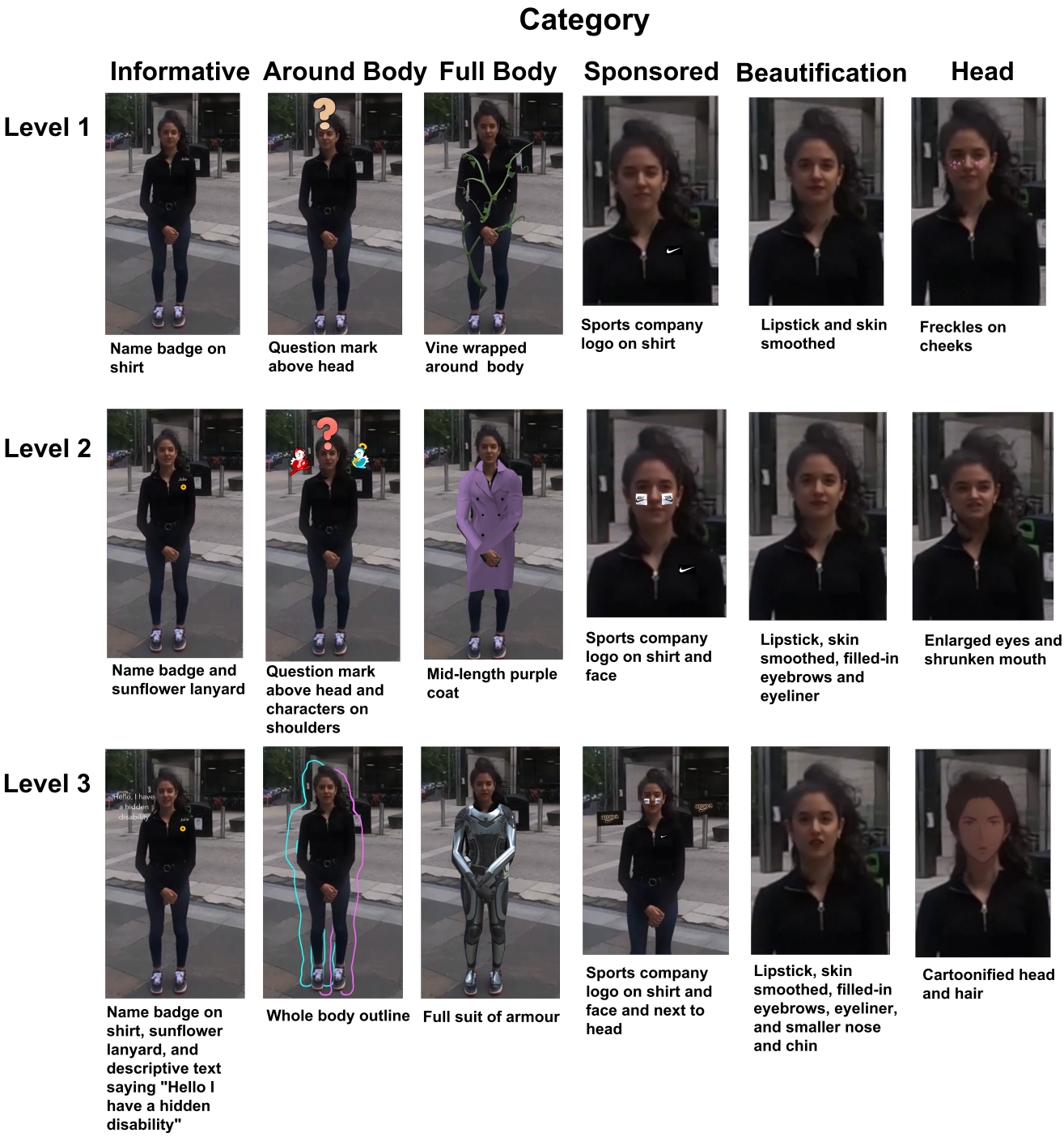

Figure 4: Examples of the six categories of AR filter that participants experienced in VR applied to a 360 degree video, and the three levels illustrating light, moderate, and significant application of these filters.