

Inclusive beauty: how buying and using cosmetics can be made more accessible for the visually impaired (VI) and blind consumer

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Abstract

Historically, assistive technologies for visually impaired and blind consumers evolved around aiding users in navigation, online content accessibility, learning, object and text recognition, and social interactions. There is no specific work done on technologies assisting these consumers with the use of cosmetics and engaging in self-grooming activities, whilst such tasks are common and expected in the context of social and professional environments.

This paper consists of two parts. The first one is a review of the assistive technologies relevant to shopping for cosmetics, as well as of the applications and systems which enable the choice of products, including some specifically developed for cosmetic purposes in line with the drive for personalised cosmetics. The second part reports the outcomes of a survey exploring the shopping and product usage of cosmetics by VI and blind individuals, including some qualitative data.

The literature review identified a growing field of research and development of assistive technologies supporting shopping tasks and accessing product information. For example, conversion of text and visuals into auditory cues (verbal or other sounds) has been commonly used by VI and blind consumers. A small number of organisations/apps were found which provide advice, tutorials or direct assistance with cosmetics use and makeup application in particular. However, there were no reports of products and services within the remit of the cosmetic industry designed to assist the VI and blind users other than one brand adding Braille to product packaging. A range of technologies aimed at providing personalised cosmetic product choice were identified, however only one app was focused on helping such consumers with lipstick application.

The survey showed that the VI and blind consumers used a variety of makeup products for reasons such as feeling good, looking professional, and simply because this is what sighted people do. Their choice of products was mostly driven by ease of use and brand familiarity, but sensory characteristics were also referred to. As lipstick was the most commonly used product, the colour was also an important choice factor. Shopping and finding the right product in store were considered easier than shopping online.

The combination of primary and secondary data suggests that the use of cosmetics amongst VI and blind consumers could be encouraged in many ways: by improving the accessibility of product information – in store and online; by the design of accessible systems and applications which facilitate reliable product choice (colour and other desirable performance attributes); by offering access to affordable personalised products.

Keywords: assistive technology, blindness, visually impaired, cosmetics; personalisation; makeup.

Introduction

Assistive technology is a field of technology that aids or assists individuals in a multitude of different ways: from the completion of daily chores to travel and education. Typically, assistive technology is designed for individuals with impairments or disabilities but if the technology is inclusive, it can be used by the wider population. The World Health Organization reports that, as of 2020, there were approximately 2.2 billion visually impaired (VI) or blind individuals globally (1). Visual impairments can range from colour blindness and presbyopia to glaucoma, and, in addition, vision deteriorates with age. Given the immense range of visual impairments, and that their degree of severity can vary from person to person, visual impairment and blindness is a very niche issue that requires a diverse range of options and personalization of assistive technologies.

There are two schools of thought in relation to disability management: the medical and the social models of disability. The medical model has focused primarily on the impairment and rehabilitation of the disabled individual, rather than the improvement of their environment and the elimination of social barriers. The social model, on the other hand, aims to empower the individual by giving them the independence, equal accessibility and social benefits to seamlessly integrate into society (2). Some experts in Disability Studies say that the social model of disability is yet to penetrate the employment and labour market, because a large focus is still on the individual's impairment (3). At the same time, disabled consumers are often overlooked by consumer brands and retailers alike. The Purple Pound refers to the spending power of disabled households in the UK. According to Vogue UK, 'the cosmetic industry has mostly overlooked this £249 billion consumer market [of disabled users]' (4). Although this term is not used in countries like the US, the disabled household disposable income there is still significant, amounting to \$490 billion (5).

Importance of Cosmetics

Cosmetics have historically played a role in 'women's consumer culture (as) a means of self-reinvention and transformation, and allow[ed] women to articulate different aspects of the self' (6). There is not much reporting on cosmetics for disabled individuals generally, and much less on VI and blind individuals. This could be because of the specific problems each disability group has and each individual's unique experience with cosmetics.

Studies show that facial attractiveness influences overall physical attractiveness more than body type or physique and that decorative cosmetics (makeup) assist individuals in temporarily altering their appearance and facial features to heighten facial attractiveness (7,8,9). But, for the VI and blind consumer, conducting a beauty or skincare regime is not as straightforward as it is for sighted individuals, not only because self-appearance is subjective and requires some degree of personal judgement, but also because facial makeup is heavily reliant on colour. Blind individuals were found to pay a lot of attention to their appearance because they know people around them can see them. However, an obvious and major problem for completely blind users is that there is no way for them to check or confirm their appearance, hence 'blind people rely on sighted or partially sighted people to act as their mirrors. And what's more, sighted people are not exactly "reliable" mirrors' (10).

Reducing the reliance of blind and VI consumers on sighted people, friends and family, could be helpful in achieving a more independent life. Combining cosmetic and assistive technologies can make beauty more inclusive by empowering disabled individuals and giving them equal opportunity in experiencing makeup and grooming independently.

Recently, some cosmetic brands have started to address the lack of inclusivity in the industry. For example, some companies have focused on giving the consumer better control during application (11, 12) whilst L'Occitane (13) have designed Braille packaging for their products, which is helpful for VI and blind consumers who can read Braille.

There are currently very few products or services combining assistive technology and cosmetics but the general trend towards personalization could be a driver of future developments. Hence, this paper explores two questions:

- What assistive technologies and cosmetic technologies are available to the VI or blind consumer?
- What design considerations for cosmetics purchase and usage can be potentially implemented to support the VI and blind consumers?

Methods

A combination of a semi systematic literature review and primary data collection via a small online survey were applied. The aim of the review was to answer the first research question, whilst the purpose of the survey was to answer the second research question.

Semi systematic review

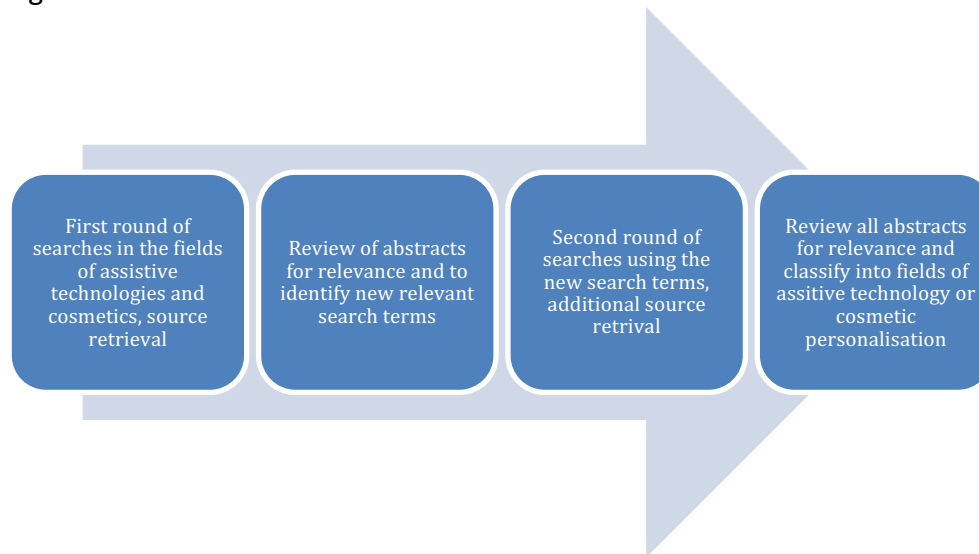
The following databases were searched: *ACM Digital Library, Cochrane Library, IEEE Xplore, Spie Digital Library, NCBI, Research Gate and Elsevier ScienceDirect, KOSMET*. A generic internet search was also conducted to find articles that provided information on cosmetics designed for VI or blind users or disabled-friendly brands. The key search terms combining both fields, assistive technologies and cosmetics, are presented in a word cloud (Figure 1).

The inclusion criteria were: peer reviewed papers, business articles, conference presentations and posters; all sources had to be published in English; the publications were to be dated from 2000 to current date. Studies based on sighted participants (unless related to cosmetics) and studies on population <18 were excluded. The process of searching, search term expansion and data retrieval followed two iterative phases and is illustrated in Figure 2.

Figure. 1 Word cloud visualisation of the search terms used for the data acquisition in the literature review. The larger the font size, the more frequently used the search term was.



Figure 2. Literature search flow chart.



Survey

Participants were recruited from previous University College London (UCL) studies, the Global Cooperation on Assistive Health Technology (GATE) community, and the World Blind Union—a sight loss organisation. The survey was approved by the UCL Research Ethics Committee (Ethics number: *UCLIC_1920_006*). The survey was designed and launched on Microsoft Forms (Microsoft Corporation, USA) in July 2020 and was left open for responses for two weeks post publishing. Descriptive data analysis was conducted via Microsoft Excel (Microsoft Corporation, USA) whilst the qualitative data from the survey was examined using the principles of thematic analysis.

Results

Semi systematic review

The two rounds of searching produced approximately 200 abstracts and other articles, and 12 webpages. These were reviewed against the inclusion and exclusion criteria, the final number of papers considered was 31. They were grouped into the six categories discussed below.

Navigation towards and within the cosmetic store

The first step in cosmetic use is buying the product, either in-store or online. Tasks that VI and blind individuals typically undertake around instore shopping were identified as: ‘shopping list preparation, getting to the supermarket [or store], finding products in-store, getting to cash registers, paying, getting to the exit, getting home’. These tasks required an assistive system incorporating ‘mobile product selection, store navigation, product search, product identification, utilization of existing devices, and minimal environment adjustment’ (14). A range of navigation systems were identified, all aiming at providing real time guidance at the

start of the shopping experience. Ranging from smart phone applications to navigation robots, the systems' common outputs were cues via sounds or verbal instructions (15, 16, 17, 18, 19).

In-store shopping is a different experience to online shopping and the type of content and website accessibility features are important for the VI or blind user's online shopping experience. Experience with online stores appeared under-researched, however; a study on blind people's interaction with visual content on social networks ascertained that they firstly relied on web accessibility features and then on people around them. This study highlighted that VI and blind users sought independence and self-reliance, but generally relied more on family and less on friends. Finally, the study highlighted that newly designed sites with fewer accessibility features forced blind users to invest a lot of time in understanding and familiarising themselves with the site via the use of screen readers (20).

Finding the product

Finding the right cosmetic product can depend on previous experience at the store, guidance by sales assistants, technology embedded in the store, or assistive devices in possession of the individual. The technologies which were identified were either based on text recognition or visual feature detection for the identification of products on the shelves (21,22,23,24).

Obtaining product information and label reading

This is the process of choosing the specific product that meets the need of the consumer, which could present challenges if a number of similar alternatives are available. The identified technologies were reliant on smart mobile applications, using text or barcode reading and converting the information to real-time audio or tactile feedback (24,25).

Finding and using products at home

It is assumed that a VI or blind person will be able to locate objects at home following personalised home environment principles. However, object detection systems to locate and identify products at home have been reported (24). In addition, AI enabled personal assistants such as the Apple HomePod or Amazon Alexa devices allow human interaction based on different sensory modalities via multi-modal dialogue processing. This means that VI or blind users can use input modes such as body movement or speech to interact with the personal assistant (26).

Cosmetics application by VI and blind users

Applying cosmetic products, and makeup in particular, requires precision and technique which, depending on the severity of vision loss, can differ significantly from person to person. Support organisations were identified which specialised in assisting blind and VI users of cosmetics. *VisionAware* (27), an organisation that encourages independent living after sight loss, emphasised the use of systematic routine and suggested numerous tried and tested makeup application techniques for individuals living with visual impairments or blindness. An example of a makeup application sequence was: 'cleanse, moisturise, (apply) foundation, powder, blush, eye makeup, lipstick'. However, various issues such as mismatched foundation or concealer colour, running of eye products or bleeding lipstick arise with makeup use. To overcome these

challenges, smart phone applications connecting VI and blind individuals with sighted volunteers were identified. Based on video calls, they enabled a sighted person to observe and provide feedback to the VI or blind person as to how ready (makeup or hair) he/she is. For example, a popular free app is BeMyEyes (28) whilst Aira (29) is an on-demand service including, amongst other options, a similar mobile application.

Whilst the above technologies and services reduce the reliance on friends and family, further automation is now possible due to advances in computer vision and Artificial Intelligence (AI). The conversion of visual information into auditory feedback is already used for wayfinding (see the relevant section above). The first ever assistive technology focused on makeup for the blind and VI consumers described a process of lip recognition from a face image and followed by auditory feedback on the lipstick colour and application (30). A more recent and innovative approach was sonification: the transformation of shape and colour into sound and specifically into musical format for the purpose of visual rehabilitation (31).

Finally, two excellent and still relevant general reviews into assistive technologies for blind people emphasised that the blind and VI people only used technologies that met directly their specific needs. Therefore, user centred design is very important (32). An exponential growth of research in several fields such mobility, multisensory research and sensory substitutions, accessible content and user interface are all expected to contribute to the recent rapid developments in this field (33).

Cosmetic personalisation technologies

The drive towards more personalised cosmetics is a key enabler for VI and blind consumers who face challenges with accessibility of information and advice related to the choice and successful application of cosmetics. Two main streams of cosmetic technology are most developed - skin and make up diagnostics via selfies or via a purpose-built device (sometimes wearable).

Both approaches aim to substitute or better, and to widen the access to the personalised advice traditionally offered by trained sales advisers. Such service was seen as quite exclusive and with variable quality, with the most advanced techniques in the past being the point-of-sale use of measurement devices, only available in certain locations. To increase the personalised service accessibility, platforms using selfie images as a base for foundation colour matching have been developed by a number of brands. This technology was reported back in 2010 (34) with one of the key considerations remaining the image quality and the need for a colour reference chart in the photo in order for the AI to process the image colours correctly. Methods for projections of full makeup applications on a face have been reported too. These range from the complete makeup generation using a human face avatar (35) and transferring image characteristics from a (desirable model) to the face (image) of the consumer (36) to entirely computer-generated makeup suggestions for human images (37). The core to these technologies was the use of ubiquitous mobile phone cameras, which is a key for the VI and blind consumers too, but the accessibility of such apps and websites needs to improve.

Another drive for product customisation in skin care is skin diagnostics for the choice of skin care (38, 39, 40, 41). These systems were focused on wrinkle, pigmentation and other skin characteristics, and could help the consumer in the choice of products and routine, as well as with providing the consumer with some feedback on the effect of the chosen skincare over time.

In summary, such applications could reduce the reliance on sales assistants or friends and family for the choice of off-the-shelf products, but they should be generally accessible.

In addition to the peer reviewed papers, relevant technologies were identified (on the market or presented at technology shows) which went a step further from providing customised product suggestion. They were reliant on a specialised diagnostic device or on taking an instruction from the user to manufacture a product which is a true match to the consumer's needs and/or preferences: Proctor & Gamble's Opté™ Wand (42), a device detecting various facial spots and applying a serum to conceal and repair the skin, 3D printing technology for makeup printing by a company called Mink (43), Lancome's custom made foundation Le Teint Particulier (44). Beyond skincare and make up, Wella's e-salon hair treatments (45) and Kérastase hair brush offered customization in haircare (46).

Lastly, whilst the above examples illustrated the expansion of Artificial Intelligence (AI) in cosmetic product customisation, the pace of progress appeared relatively slow. Two explanations for this are that beauty lies in the eye of the beholder and that the experience of a cosmetic product is multisensory and evolves over time, hence training algorithms to support or mimic human judgement is not an easy task.

Survey results

Twelve individuals with varying degrees of visual impairment or blindness completed the survey. Their age was between 18 and 65+, with five participants being in the age group 45-54 whilst the remaining individuals' ages were evenly distributed in the remaining decade groups. Table 1 reports the responses to questions related to the easiness of shopping for cosmetic products in store and online. The participants rated shopping in store for cosmetic products easier than shopping online (mean values: 3.33 vs 4.08), also % of responses considered positive e.g. meaning not difficult (based on ratings 1,2,3) further contrasted the in-store and online experiences (50% vs 16.7%).

Table 1. Results from the online survey questions on how easy it is to: Q1=shop online; Q2=shop in store; Q3=select the right products in store. 1=very easy; 5=very difficult

	Q1	Q2	Q3
Mean	4.08	3.33	3.75
Standard deviation	1.19	1.25	1.23
Median	4.50	3.50	4.00
% positive responses (1,2,3)	16.7%	50.0%	33.3%

The way product information was identified and used in store was rated as moderately difficult (3.75%) and 7 out of 12 people listed using shop assistants as the most common way to select the right product, whilst 4 relied on the advice of friends and family, and one on the product information provided on the packaging.

Open ended questions returned the following main themes which were related to the difficulties experienced by the VI consumers: accessibility of information, especially online; colour or product identification, packaging and familiarity; human intervention; personal preference (Table 2).

Table 2. Qualitative data analysis of the free text responses to open ended questions

Themes	Answers to “main difficulties you experience with shopping for grooming products”
Accessibility to Information	“Lack of easily accessible information”
Accessibility to Information	“Knowing the ingredients”
Accessibility to Information	“Web sites are dynamic and cluttered screen reader accessible/friendly”
Accessibility to Information	“Web sites are very visual with pictures and very little description”
Accessibility to Information	“Inaccessibility of specialty store websites and face to face shopping process”
Accessibility to Information	“Access information of what’s available to make informed choices”
Colour or Product Identification	“It is hard to identify colours of product and skin matching of products from the online descriptions”
Colour or Product Identification	“With my vision, I can usually find the general isle in store but then identifying the specific products apart from each other is difficult and also between brands due to reading difficulties. With online using magnification on devices makes it a slow process scrolling through the various products once you have done a search”

Colour or Product Identification	“Finding the correct colour for makeup and lip sticks is impossible for me”
Human intervention	“Some shop assistants are not familiar with cosmetics”
Packaging and Familiarity	“The ever-changing packaging”
Packaging and Familiarity	“It is often not possible to handle products as they are only from an online store only”
Personal Preferences	“I want to use products that are in environmentally friendly containers and they are often not available from places I go with my partner such as supermarkets”
Personal Preferences	“I probably am not good at finding new products; I use tried and true products”

The use of colour cosmetics was then explored in more detail. Three survey participants did not use make up. Those who used make up ranked the following most used makeup products (Table 3).

Table 3. The top three most used makeup products as ranked by the participants

	Frequency of responses placing products in the top three most commonly used (out of 24)	% of selected in top three choice (out of 24)	% of selected as a first choice (out of 8)
Lipstick	7	29.17%	75%
Foundation	7	29.17%	0%
Blusher/bronzer	4	16.67%	0%
Eyebrow gel/pencil	2	8.33%	0%
Eyeliner/eyeshadow	2	8.33%	25%

Foundation and lipstick were the most commonly used makeup products, with lipstick being the most commonly selected as a number one product. The range of products listed suggests that product format and application are not a defining factor in the decision to wear makeup. In an open- ended question asking for the choice of makeup, the following themes emerged: ease of use, familiarity, colour and other sensory performance. Environmentally friendly products were also mentioned (Table 4).

Table 4. Reasons for choosing makeup or grooming products provides as free text

Theme	Explanations provided for “most important reasons for choosing your makeup or grooming product”
Ease of use in terms of time spent	“I <u>don’t like taking ages</u> when applying makeup”
Ease of Use/allergies	“Because I am blind, <u>ease of use</u> and <u>scent</u> are important, a <u>good brand</u> for my allergies, the rest, a low price I guess is good for my budget, the rest doesn't apply.”
Ease of Use	“ <u>Ease of access</u> and <u>practical</u> ”
Ease of use/familiarity/colour	“If it is <u>hard to use</u> , I won't bother. I am definitely a <u>brand person</u> . There is no point in using something that is the <u>wrong colour</u> . I'd rather go without than get it wrong.”
Familiarity	“I don’t use makeup but if I did <u>familiarity</u> would be the reason as I do with skin care products.”
Ease of use/colour/long lasting	“Given I mainly use lipstick and blush, <u>colour</u> is the top reason. These products for me are <u>most easily</u> applied so also why I use them primarily and I like things that <u>last</u> .”
Texture/sent/long lasting/environmentally friendly	“I therefore go with products that I enjoy, and I enjoy products that have appealing <u>textures</u> and <u>scents</u> . I like quality products and if they are <u>long-lasting</u> , it is likely they will be high quality. Although not stated as a choice here, I also prefer to get environmentally friendly products.”

The motivation for using makeup was explored further and the following key themes emerged: *feeling more put together, more feminine, more professional; that’s what sighted people do, sighted people say it looks good; feel good, part of my daily grooming routine.*

The following reasons were given for the usage of the lipstick, the most commonly used product: *gives more definition to my face; gives me colour; wear (it) when going out; sighted people have said it looks good.*

The other popular choice, foundation was used mainly for special occasions and challenges relating to the choice of colour and blending were mentioned. Using fingers for application was preferred.

The average rating for ease of use of cosmetics (8 users) was 3.4 and 2/3 of the responses were between 1 (easy) and 3 (neutral or not difficult). Some of the challenges noted with the use of makeup products were: *uneven application (foundations and lipstick); likelihood of error in applying and removing, cannot see the result.*

Discussion

The review part of this research identified most progress in supporting VI and blind people in the shopping experience, with navigation assistance and product information readers being amongst the most common technologies. These technologies were not specific to cosmetic shopping but would enhance it too, and are important in the context of the survey data suggesting that instore experience is easier and consequently the more likely way of shopping. At the same time, the cosmetic brands should consider making product information in store more accessible, specifically in the context of constantly updated packaging and art work.

Technologies for face recognition as well as image analysis and manipulations were identified as enabling the sighted consumers to receive a more personalised product advice or prediction/feedback on the way the product would look/work from the AI. Whilst this is exactly what VI and blind consumers need in order to boost their independence in choosing and using cosmetics, the on-line shopping and using websites were specifically noted in the primary research as difficult. The accessibility requirements for website and app design should therefore become a prime consideration for cosmetic brands if they were to encourage the engagement of the VI and blind consumers and facilitate their product choices.

The survey data suggested that VI and blind consumers need products which are functional and easy to use. The easiness of use from a perspective of such consumer requires further investigation as it is a decisive factor and should include holistic design considerations of the product format, applicators and packaging.

According to the surveyed consumers, they use makeup at the right time and product performance such as colour, even application, long lasting effect, scent and texture were important alongside the key priorities of ease of use and familiarity. These expectations are universal and should be explored further from the perspective of easiness of application and techniques which are helpful to these consumers, for example foundation blending or softness of lipsticks.

Currently, the VI and blind users rely on their familiarity with a cosmetic brand, which would include the complex sensory profile and the perceived quality and reliability of the product as well as the actual handling. Combining product quality with accessibility of product information (in store and online) can increase further the brand loyalty. This creates a business case for a long-term commitment of the brands to personalisation technologies which are inclusive from the start.

Conclusion

Blind and VI consumer are a very niche group of consumers of cosmetics, however the literature review and the survey have confirmed that they are interested in using cosmetics and are making use of friends, family and apps to enable themselves to choose and apply products.

Enabling such consumers to engage and enjoy the purchase and use of cosmetics can be viewed as a two-stage process:

- Considering product characterises, packaging, labelling, as well as display instore and online from the perspective of a blind or VI use, putting accessibility in the core of a brand;
- Developing personalisation technologies and applications which are capable of providing a service to blind and VI users such as real time feedback on product use and advice.

The former is within the capacity of many brands but requires recognition of the needs of such consumers, whilst the latter is intertwined with move of the industry towards a more technologically advanced and inclusive beauty.

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APPENDIX 1

Table A

#	Question	Answer options
1	I confirm that I am at least 18 years old and consent to participating in this study:	Yes, I confirm; No, I do not confirm
2	I confirm that I have read and understood the above information about the study:	Yes, I confirm; No, I do not confirm
3	What age group do you belong to?	18-24 years old; 25-34 years old; 35-44 years old; 45-54 years old. 55-64 years old; 65 and above
4	How easy or difficult is it for you to locate your daily grooming products (shampoos and other hair products, skin creams and makeup) when shopping online?(1=very easy, 5=very difficult) If	(1-5 rating scale)

	you do not shop for grooming products online please leave this question blank and move to Q5.	
5	How easy or difficult is it for you to locate your daily grooming products in-store? Please rate this on a scale from 1-5 (1=very easy, 5=very difficult) If you do not shop for grooming products in-store please leave this question blank and move to Q6.	(1-5 rating scale)
6	How easy or difficult is it for you to identify specific information about your products during shopping: for example - key ingredients, the colour, suitability of the products for your skin or hair? (1=very easy, 5=very difficult)	(1-5 rating scale)
7	How do you select the right product?	Read online product feedback; Follow online blogs/vlogs; Friends or family helps in choosing; Shop assistants' recommendation; other
8	Please list the main difficulties you experience with shopping for grooming products:	[Open textbox]
9	Out of the following makeup products, which 3 products do you use the most in comparison to the others? Please move your choice up or down to rank in order of the most frequently used to less used. *Please note that we will only be saving your top 3 ranked products* if you do not use any of these makeup products you can leave this question unanswered.	Eyeliner; Eyeshadow; Foundation; Concealer; Blush/Bronzer/Highlighter; Lipstick/Lipliner; Mascara; Eyebrow gel/pencil; Colour sticks
10	Please explain briefly what motivates you to use makeup?	[Open textbox]
11	Which of the following do you use for application of makeup? Tick all that apply.	Brushes or sponge blenders; Hands; Automated makeup applicators
12	Do you use tech-enabled products? (Tech-enabled products would be battery-operated, handheld devices through which products are applied on the skin or hair. Examples would include electric toothbrushes, Foreo's facial cleansing brush)	I am using tech-enabled products; I am likely to use tech-enabled products; I do not use tech-enabled products; I am not likely to use tech-enabled products
13	Overall, how difficult or easy is it for you to apply your makeup? Please rate this on a scale from 1-5 (1=very easy, 5=very difficult)	(1-5 rating scale)

14	Select the 3 most important reasons for choosing your makeup or grooming product. Please move your choice up or down to rank in order of level of importance. *Please note that we will only be saving your top 3 ranked products*	Texture; Scent; Colour; Long-lasting; Low price; Familiarity with the brand; Ease-of-use
15	Please give the reasoning for your answer to the above question:	[Open textbox]
16	Lipsticks: do you use them?	At least 4 times a week; Between 1 and 3 days a week; Only on special occasions; I do not use them
17	Please expand on why you use this product with such frequency:	[Open textbox]
18	What challenges do you face while using lipsticks (for e.g. in application or removal of the product)? If you selected "I do not use them", please type "NA" in the box below:	[Open textbox]
19	Foundation: do you use it?	At least 4 times a week; Between 1 and 3 days a week; Only on special occasions; I do not use them
20	Please expand on why you use this product with such frequency:	[Open textbox]
21	What challenges do you face while using foundation (for e.g. in application or removal of the product)? If you selected "I do not use it", please type "NA" in the box below:	[Open textbox]
22	Eye products (e.g. eyeliners, eyeshadows, eyebrow gels): do you use them? Respond according to the product that you use more.	At least 4 times a week; Between 1 and 3 days a week; Only on special occasions; I do not use them
23	Please explain why you chose that option:	[Open textbox]
24	What challenges do you face while using eye products (for e.g. in application or removal of the product)? If you selected "I do not use them", please type "NA" in the box below:	[Open textbox]
25	What assistive technology applications do you use most commonly (at least once a week). Please list them:	[Open textbox]
26	Please briefly explain what motivates you to use assistive technology:	[Open textbox]

Table B

Database: keyword	Paper	Platform/Device
American Foundation for the blind: Smartphone	An Evaluation of the RAY G300, an Android-based Smartphone Designed for the Blind and Visually Impaired (Preece, 2013)	Smartphone
ACM: Visually Impaired	Current and future mobile and wearable device use by people with visual impairments (Ye et al., 2014)	Wearable
Research Gate: Assistive Technology; Blind individuals	Guiding Blind People with Haptic Feedback (Kammoun et al., 2012)	Wearable

Table C

Database: keyword	Paper	Platform/Device
ACM: Visually Impaired	EyeTAP (Eye Tracking Point and Select by Targeted Audio Pulse) (Parisay et al., 2020)	Assistive Technology
ACM: Visually Impaired	Automatic Alt-text: Computer-generated Image Descriptions for Blind Users on a Social Network Service (Wu et al., 2017)	Assistive Technology
IEEE Xplore: Assistive Technology; Blind individuals	Real Time Text Detection and Recognition on Handheld Objects to Assist Blind People. (Deshpande and Shriram, 2016)	Assistive Technology
Cosmetics & Toiletries; Technology	Givaudan Launches A.I. Tool for Cosmetic Products (Daily, 2018)	Assistive Technology Device
Assistive Technology; Blind Individuals	Vision-Based Mobile Indoor Assistive Navigation Aid for Blind People (Li et al., 2019)	Assistive Technology Device
Research Gate: Assistive Technology	Assistive technology (electronic aids) for children and young people with low vision (Senjam et al., 2019)	Assistive Technology Device
ACM: Text reading	A review and update on the current status of retinal prostheses (bionic eye) (Luo and da Cruz, 2014)	Assistive Technology Device

Table D

Database: keyword	Paper	Domain
KOSMET: Personalization	Personalized Packaging in Beauty (Stephenson, 2019)	Cosmetic Research
London College of Fashion Library: Cosmetic Science	Handbook of Cosmetic Science and Technology: Third Edition (Barel et al., 2009)	Cosmetic Research
KOSMET: Visually Impaired	Fragrance – Employment: A Superman Sense of Smell (Jacobius, 2019)	Cosmetic Research
Cosmetics & Toiletries; Technology	L'Oréal And Alibaba Bring Mobile Acne Analysis to China (Grabenhofer, 2020)	Smartphone
Cosmetics & Toiletries; Technology	La Roche Posay's My Skin Track UV (Schleehauf, 2018)	Wearable
Research Gate: Physical Appearance	The Unspoken Truth: A Phenomenological Study of Changes in Women's Sense of Self and The Intimate Relationship with Cosmetics Consumption (Liu et al., 2012)	Cosmetic Research
Cosmetics & Toiletries: Technology	Wearable PH Sensor (Behrens, 2020)	Wearable
25th IFSCC Conference "The Beauty Space Where Science Reigns"	Proposal for Personalized Consultation to Predict Future Skin Conditions Using Skin Transition Patterns: Exploring "My Very Own Skincare" (Kaneko et al., 2019)	Cosmetic Research
Cosmetics & Toiletries; technology	NaDES technology ("Opening new horizons for natural cosmetics with NaDES technology," 2020)	Cosmetic Research
Cosmetics & Toiletries; Technology	Kanebo To Debut Colour and Texture Adaptable Makeup (Grabenhofer, 2020)	Cosmetic Research
Research Gate: Cosmetic Technology	Beyond skin feel: innovative methods for developing complex	Cosmetic Research

	sensory profiles with silicones (Reeth, 2006)	
ScienceDirect: Cosmetics	The effects of cosmetic surgery on body image, self-esteem, and psychological problems (von Soest et al., 2009)	Cosmetic Research

APPENDIX 2 – Information Sheet and Consent

“The aim of this survey is to obtain information, feedback, and advice on the development of potential grooming and cosmetic products for visually impaired and blind users. This is also to find out more about what visually impaired and blind users need and want as part of their daily grooming routines.

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This study has been approved by UCLIC ethics committee: UCLIC_1920_006_Staff_Cho

What are the possible benefits of taking part?
 Whilst there are no immediate benefits for those people participating in the project, it is hoped that this work will shape future research and contribute to the development of advanced technologies (in cosmetics and grooming) for visually impaired and blind users.

Do I have to take part?
 It is up to you to decide whether or not to take part. If you do decide to take part, you will be asked to sign a consent question before proceeding with the questionnaire. You can withdraw anytime by closing your browser before clicking the final submission button.

The data collected will only be collected for the purpose of this study and will not be shared with a third party. The data will also be entirely anonymous.

All the information that we collect about you during the course of the research will be kept strictly confidential. You will not be able to be identified in any ensuing reports or publications unless you have given us written permission in the consent form.

The findings of our analysis of the data collected from the participants of the research project will be published in reports and articles and presented at public engagement and research talk venue. You will be able to access academic publications of these findings on the principal investigator’s research website: <https://uclic.ucl.ac.uk/people/youngjun-cho>. You will not be identifiable in these publications and presentations.

Local Data Protection Privacy Notice :

The controller for this project will be University College London (UCL). The UCL Data Protection Officer provides oversight of UCL activities involving the processing of personal data.
UCL Data Protection Officer: Alexandra Potts, data-protection@ucl.ac.uk.

Further information on how UCL uses participant information can be found in the UCL general privacy notice: <https://www.ucl.ac.uk/legal-services/privacy/ucl-general-research-participant-privacy-notice>

The categories of personal data used will be as follows: Age range

If you are concerned about how your data is being processed, or if you would like to contact us about your rights, please contact UCL in the first instance at data-protection@ucl.ac.uk.

Thank you for reading this information sheet and for considering taking part in this research study.”