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IS THE FUTURE OF BEAUTY PERSONALIZED?

CASE STUDY FOR MICROBIOME SKINCARE BRAND SKINOME

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IS THE FUTURE OF BEAUTY PERSONALIZED? – CASE STUDY FOR MICROBIOME SKINCARE BRAND SKINOME

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Abbreviations:

AI – Artificial Intelligence

RS – Recommender systems

TEP - Technology-enabled personalization

IoT - Internet of Things

ABSTRACT

The researcher takes a user-centric empirical approach to estimate different consumer group participant views on the personalization technology adoption within the skincare industry. In addition, the study aims to highlight the main identified opportunities and concerns that users associate with the personalized technology solutions within the industry, such as skincare and product quizzes, in-depth questionnaires, smart skin analysis tools, and others. The empirical study sample consists of 17 subjects who represent three different generation groups (Generations X, Y, and Z). For data analysis purposes, the author has performed content and discourse analysis, sentiment assessment, and word cloud visualizations using the Python word cloud library. The conducted sentiment analysis shows that the Gen X group's users overall have a negative attitude towards personalization technology adoption for the skincare (average sentiment: 0.294) in comparison to Gen Y and Gen Z consumers whose sentiment analysis results showed neutral and positive tendencies. The content analysis showed that Gen Y and Gen Z consumers are more concerned about the data governance and its associated risks than Gen X consumers for whom the results and skin health-related improvements were indicated as having higher importance. According to the gathered data, the majority of Gen Y and Gen Z consumer group participants see personalization technology as the future of the skincare industry; nevertheless, Gen X consumers believe that personalization within the skincare will not be attached to one brand and will be more focussed on addressing specific skin conditions and concerns as well as will be more evidence-based.

Keywords: personalization, beauty tech, Artificial Intelligence, Recommender systems, AI ethics, data security

SAMMANFATTNING

Forskaren använder sig av en användarcentrerad empirisk metod för att uppskatta olika konsumentgruppers åsikter om hur tekniken för att ge personliga hudvårdsråd används inom hudvårdsbranschen. Dessutom syftar studien till att belysa de viktigaste identifierade möjligheterna och farhågorna som användarna förknippar med dessa tekniska lösningar inom branschen, såsom hudvårds- och produkttester, djupgående frågeformulär, smarta hudanalysverktyg och andra. Den empiriska studiens urval består av 17 personer som representerar tre olika generationsgrupper (generationerna X, Y och Z). Författaren har för analysen av datan genomfört en innehålls- och diskursanalys, en känsloutvärdering samt en ordmolnsanalys med hjälp av Pythons ordmolnsbibliotek. Den genomförda känslighetsanalysen visar att användare i gruppen Gen X överlag har en negativ inställning till att införa teknik för att erhålla personliga hudvårdsråd (genomsnittlig känsla: 0,294) i jämförelse med konsumenter i generationerna Y och Z, vars känslighetsanalysresultat visade neutrala och positiva tendenser. Innehållsanalysen visade att Gen Y- och Gen Z-konsumenterna är mer oroade över datastyrningen och de därmed förknippade riskerna än Gen X-konsumenterna, för vilka resultaten och förbättringarna av hudhälsan angavs ha större betydelse. Resultaten av studien visar att en majoritet av Gen Y- och Gen Z-konsumentgruppens deltagare ser att utvecklandet och användandet av teknik för att ge personliga hudvårdsråd är framtiden för hudvårdsbranschen. Gen X-konsumenterna tror dock att tekniken för personliga hudvårdsråd inte kommer att vara knuten till ett märke och att den kommer att vara mer inriktad på att hantera specifika hudtillstånd och problem samt vara mer evidensbaserad.

Nyckelord: teknik för personliga hudvårdsråd, skönhetsteknik, Artificiell Intelligens, Rekommendationssystem, AI-etik, datasäkerhet

1 INTRODUCTION

Personalization within the skincare industry has become a recognized trend that is no longer only an "embellishment" element for the organizations' operations, but a high-potential component that enables companies to meet rapidly changing consumer demands and supports companies in remaining competitive in the saturated skincare and beauty industry. While there is no commonly accepted personalization definition, it is mostly referring to targeted or individual marketing strategy, which is illustrated by an organization's operations in ensuring a high product or service relevance to the users' needs [6]. Today, personalization within the skincare industry is enabled mainly through three different approaches – in-person recommendations (recommended product suggestions), and online recommendations and technology-enabled personalization. In comparison with traditional in-person recommendations, online personalization technology enables consumers to make efficient purchasing decisions without interacting with sales representatives, to illustrate, diagnostic online quizzes support customers in making skincare product selection that is the most suitable for their individual skincare needs and health status. Such solutions provide users also with make-up and skincare product customization opportunities. Technology-enabled personalization, on the other hand, is more related to the offline environment, such as retail, where physical and digital integrations provide users with relevant, context-specific information that reflects combinations of historic and real-time data needs [15].

Within the research scope the author discusses Artificial Intelligence and Recommender systems, which are widely applied for online as well as technology-enabled personalization. These systems need significant consumer data input to provide highly relevant solutions and recommendations; however, the data processing and storing entail certain risks that might negatively impact consumers' trust and present data security-related risks for the organizations. The research author is taking a user-centric empirical approach to estimate different generational consumer group preferences and main concerns about the personalization technology application within the skincare and beauty industry. Lastly, the case study reviews if the personalization technology is viewed as the future technology within the beauty industry by the different age group users.

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2 BACKGROUND

2.1. Personalization technology offered benefits to users' and providers

Although the personalized technology application has been existing in the market for a couple of years already it must be noted that technology diffusion rate was significantly accelerated with the emergence of COVID-19, as consumers were limited in their opportunities to physically attend store locations and receive in-person recommendations from the skincare experts. An interesting pattern that can be observed from the industry market reports in terms of consumer behaviour and

personalization is that customers are no longer looking for more products, they are looking for the right products [12], which presents a significant shift in the market that industry professionals must acknowledge and act upon to stay competitive. Personalization can be a channel for brands to ensure excellent user experiences and can also be utilized to reach those customers who do not have strong knowledge about their skincare requirements, for instance, teenagers [17]. Among other benefits that have been noted by skincare industry participants on personalization are the ability to control the price (67% of respondents), development of products that are an exact match to consumer's microbiome or DNA" (65% of respondents), and ability to customize fragrances or scents [1]. Furthermore, it must not be overlooked that personalization technology supports brands in connecting with different consumer segments whose needs previously have not been fully addressed in the mass market, to illustrate, ensuring haircare needs for customers with Afro-Caribbean hair structure, personalised treatments for men and others [17].

2.2 Ensuring service availability to diverse customer groups

As mentioned previously, the personalization technology adoption rate was significantly accelerated by the emergence of Global pandemic, which additionally gave rise to the replacement phenomenon which characterizes customers' reliance on tools such as Artificial Intelligence and Augmented Reality to work and do shopping [10]. Considering this, it can be inferred that personalization technology is enabling industry participants to engage with their customers while fostering their business growth regardless of the challenges that have been imposed by social distancing [10]. While personalization technology presents a significant potential for inclusivity, pricing level is one of the main recognized challenges within the industry in ensuring personalized service and product accessibility to larger user segments. This correspondingly makes it challenging to ensure tailored service availability to diverse customer groups which overshadows technologies' intentions to meet individuals' unique needs and hence increases the risk of marginalization as well as racial bias [19]. One way how this could be potentially addressed is by developing personalization services that would be targeted at specific user groups and by encouraging the development of business concepts within the skincare and beauty sector that would provide personalization opportunities to all the market participants.

The market reports reveal that there is market demand from consumers for personalization technology when it comes to skincare. To illustrate, 82% of consumers would be interested in having a skincare regimen created specifically for them; 78% responded that they would be interested in a device that would let them formulate skincare in their own home; 76% responded being interested in an augmented reality or smart mirror (in-home or at a store); while 72% of interview participants expressed their interest to have an application or camera that would let them track the health of their skin [1]. In reference to the same research, the emerging opportunity for the industry is the development of personalized product offerings that are aimed to positively impact customers' skin microbiome health.

2.3 Artificial Intelligence application and Recommender system risks

It must be acknowledged that ensuring such tailored services and skincare products requires a sizable amount of consumer data processing since technology is based on AI technology and RS applications. The Artificial Intelligence business applications present considerable risks that organizations operating within the industry must acknowledge, such as security issues, consumer privacy risks, and moral hazard, which is aggravated due to the incomplete laws and regulations in the market, supervision imperfection and limitations for the AI technology itself [8]. Moreover, the previously conducted research suggests that policy regulation is also a common issue in mHealth applications, where one can see parallels also with the Recommender system functions and its provided services to the consumers. To illustrate, a survey developed with 27 key informants showed that most of the questionnaire participants are concerned about the regulation of mHealth tools and programs. Several research participants also voiced their concerns about the existing mHealth application efficiency and inability to meet the user needs [16]. This consequently raises the question of how consumers can be confident that such system-provided recommendations and solutions are the right ones for them?

As mentioned earlier, Recommender systems are commonly adopted within the skincare industry to ensure relevant user experiences and recommendations; however, RS are also subjected to potential data privacy issues. Sharing personal data

is necessary for such systems to ensure improved recommendation amenities; nevertheless, the author acknowledges that users are reluctant to share their data due to potential system cyber-attack concerns and potential consequences. The Recommender systems are subjected to the three types of violations: exposure (undesired data access), bias (manipulation of users' recommendations) and sabotage (intentionally reducing recommendation accuracy) [18].

While AI and RS technology enable brands to build strong relationships with the users and assist in ensuring seamless user experiences, both technology applications involve risks that must be acknowledged and prevented with the support of different risk mitigation strategies. For instance, a potential solution for addressing the AI technology threats from consumer data and IoT security perspective could be ethical standard establishment, development of registration publicity systems, or principle establishment for responsibility fixation among participating stakeholders and safety design strengthening [8]. Furthermore, the analysed literature suggests that a common legislative framework must be established which correspondingly would guide product and service developers in ensuring the data security for its users and developed systems. Another essential element that has been emphasized by literature is the necessity to educate industry professionals on moral consciousness and social responsibility through different educational courses [8]. Concerning Recommender system-imposed data privacy risks, utilizing different data approaches, developing a multidimensional trust model, or multiprobing locally sensitive techniques are suggested as a feasible risk mitigation strategies [18]. It is equally important for organizations that apply Recommender systems in their business models to estimate how much data the user must provide to ensure the maximum recommendation accuracy, which means that once a certain data input threshold is reached, additional information from the user might not add significant value from provided recommendation quality perspective [7].

2.4 The regulatory framework for Artificial Intelligence systems within the European Union

It is imperative to review the legislative frameworks that relate to AI technology application in the business operations within the European Union (EU). A positive observation is that AI technology legislation is already being actively discussed and addressed within the EU. To illustrate, in March 2018, the European Group in Ethics in Science and New Technologies published a statement on the Artificial Intelligence, Robotics and Autonomous Systems that reviewed the moral and regulatory challenges of AI from the ethical framework perspective. The published statement proposed several guiding principles for the technology framework. The proposed principles within the statement were human dignity, autonomy, responsibility, justice, equity, solidarity, democracy, rule of law, security, safety, bodily and mental integrity, data protection, privacy, and sustainability [5]. The statement was followed by the adoption of the Coordinated Plan on Artificial Intelligence (by the European Parliament) which aimed to set common goals and harmonized efforts regarding the AI practice implementation within the EU. In 2021, the European Parliament issued a proposal for AI regulation (the regulatory framework), which goal among others was to enhance the governance and effective enforcement of existing laws [13]. The issued document specifies prohibited AI practices and proposes frameworks for addressing certain applications of remote biometric identification systems. The proposal categorizes the AI technology into four different risk groups: unacceptable risk, high risk, limited and minimal risk systems. According to the regulation, particularly harmful practices are prohibited according with the EU values; whereas high-risk systems must comply with mandatory requirements of trustworthy AI and follow conformity assessment before the technology is introduced in the Union market [13]. According to the Annex of the regulation's proposal, examples of high-risk classified systems are biometric identification and categorization for natural persons, systems used for education and vocal training, AI systems applied for recruitment, termination, or promotion decisions, AI systems intended to be used to assess risks of security, irregular immigration, or a health [14]. According to the European Commission, the earliest term when the regulation could become applicable is the second half of 2024 [2].

METHODOLOGY

The research author performed semi-structured interviews for the empirical part of the study. This specific research method was chosen, as it allows the researcher to clarify questions during the interview and if necessary, to follow up on any themes or trends expressed by the interview participants [4]. Throughout the discussions with all three research

participant groups, author used a common interview template (please see Appendix); however, if any particular trends or attitudes were identified during the interviews, the researcher followed up on them by asking additional investigative questions. This specific interview method was chosen as the study has an explorative nature, and furthermore, the author saw this as an efficient approach to identify any outliers, for example, negative or positive attitudes. In addition, the specific interview method allowed the participants to elaborate on their provided answers and experiences, which is essential for the study results.

The research study sample consists of 17 consumers that represent three different generational groups: generation X (participants born between 1965 and 1979/80), generation Y (customers born between 1981 and 1994/6), and generation Z (subjects born between 1997 and 2012). The author has ensured within the research development that the study sample represents different gender groups, ethnicities, as well as varying levels of skincare knowledge. The primary goal for the performed interviews is an initial exploration which is investigating different generation customers' attitudes, identified opportunities (needs), and concerns regarding the personalization technology adoption within the skincare.

For data analysis purposes, the results review is divided into three sections: content and discourse analysis for questions 1-3 (exploring general consumer behaviour in terms of skincare, main challenges, and awareness about personalization technology adoption in the beauty and skincare industry). The sentiment analysis was performed by using Microsoft Azure Machine learning tool in Excel application for questions 4-5 to identify research participant attitudes towards personalization technology adoption and for sharing different levels of personal data to the organizations to obtain tailored services. The sentiment analysis method for these specific questions was selected because it would support the researcher in efficiently illustrating all three-user group overall emotional attitudes in terms of numerical values, and hence address the first research question (please see below). The author acknowledges that this specific data analysis method entails certain limitations, such as small data sample as well as natural language processing (NLP) shortcomings in analysing the context-related content, such as irony or sarcasm [3]. To ensure higher sentiment analysis accuracy, during the data analysis process, the author removed context-sensitive phrases, leaving only the key expressions that described the users' overall attitudes toward the discussed subjects.

In addition, the research author developed word cloud visualizations using the Python word cloud library [9] for question 6 to identify the main technology-related concerns. This visualization approach was chosen due to the tool's provided abilities to accurately illustrate groups' overall opinions on technology-related concerns in relation to the second research question.

The data analysis was concluded with the content and discourse analysis for questions 7– 9 to evaluate users' openness towards trying skin analysis tools (smart mirror), to identify the main expectations for companies that are providing personalized solutions and to estimate if users see personalization as the future of the skincare industry. The empirical study's interview question template is available in the Annex.

The case study explores two major research questions:

1. How do different generation (X, Y, and Z) group consumers see the personalization technology adoption within the skincare industry and for their skincare?
2. What in their opinion are the main opportunities and possible concerns regarding such system application (AI technology and Recommender systems) within the skincare?

Hypothesis. The author's hypothesis is that younger generation consumers (Y and Z) prefer more tailored or personalized skincare experiences and are less concerned about the threats associated with personal data sharing than customers who represent generational group X and older.

3 RESULTS

3.1 Generation X

Generation X group in this study represented subjects born between 1965 and 1979/80. The group consists of 5 people, of whom 3 are women, and 2 are men.

Question 1 – 3

The interview representatives from the Gen X consumer group category indicated that they primarily use skincare products for maintaining their skin health, and most of the participants have established consistent skincare routines (a tendency for skincare minimalism) and are loyal to the brands whose products they have been using. One participant indicated using skincare products to achieve specific skin care goals, such as improving pigmentation.

Among the major challenges, Gen X group participants indicated difficulties to find the right products and brands, for example, finding the right foundation shade, and the right skincare products. One participant during the interview reflected that it sees that finding the right products is already challenging; nevertheless, circumstances like pandemics, make the process even more difficult. During the interview, the respondent also expressed willingness for having a solution that would support users in finding the right products, such as foundation:

> I think that it would be great to have some technology where you could send a good picture of yourself and you would get a good recommendation or something that would address your skincare needs.

Another member of the group indicated experiencing difficulties in finding the right products, illustrating it more from the product testing perspective:

> Before you buy from the brand you, first need to have tested it before sticking with it, so it is difficult to buy a product which I have not tested yet.

When it comes to personalization within the skincare, only one of five respondents answered being familiar with it. The remaining participants admitted not being familiar with the technology, associating it with solutions that are based on customer or products that suit user better than an average product.

Table 1. Result summary on primary motivation, major challenges, and personalization knowledge for Gen X group

Topic	Result summary
Primary motivation for the skincare	Skin status maintenance and addressing skin conditions (pigmentation); make up products; using skincare products consisting of natural ingredients.
Major challenges experienced when using or the purchasing skincare	Finding the right foundation (1), product use (inefficiency in product packaging design) (1), finding the right brand and product testing (1), overwhelming amount of skincare product offering (1), not experiencing any challenges (1).
Knowledge about the personalization	Good understanding of the personalization (1), not familiar with the solution but associates it with product tailoring to individual's skin condition/type (2), someone advising what and how one should do things (1), products offered by segmenting offering to different consumer groups and not personalizing (1).

Sentiment analysis for questions 4 and 5

Sentiment analysis was performed by using Azure Machine Learning data analysis solution in Excel application. The sentiment ratio is divided into three categories: negative (sentiment ratio lower or equal to 0.33); neutral (> 0.33 and < 0.67) and positive when values are larger or equal to 0.67). The sentiment analysis was conducted to review participant attitudes towards trying the personalization technology and sharing different depths of data to obtain personalized skincare services and products.

Sentiment towards trying the personalization technology solution within the group overall was negative. The main mentioned reasons for hesitation are lack of trust for the industry, recognizing that industry lacks products for specific skin conditions, such as melasma. One of the participants admitted having tried personalized skincare solution; however, now is continuing to look for other skincare products because was not satisfied with the product quality.

Table 2. Sentiment analysis results for Gen X group

Value	Sentiment analysis result (average)
Sentiment towards trying personalization technology	0.294 (negative)
Filling questionnaire with primary questions	0.429 (neutral)
Filling in-depth questionnaire	0.351 (neutral)
Sharing the skin image with the organization (apps)	0.356 (neutral)
Performing the skin scan	0.666 (neutral/positive)
Performing skin swab test (microbiome test)	0.433 (neutral)

The sentiment analysis showed that the group has a neutral attitude towards filling in a general questionnaire with skincare goal-oriented information, and similar results were obtained for filling in an in-depth questionnaire. In terms of the in-depth survey, customers maintained the importance of knowing how the data will be used by the company and mentioned that they would feel less comfortable sharing health-related information with the company. The overall sentiment towards sharing the skin image with the company was neutral; however, three of five group members expressed concerns regarding the service necessity, seeing it more like a marketing tool, and one member expressed feeling comfortable sharing the image if the customer would not be identifiable. The performed analysis showed that most of the interview participants have a neutral or positive attitude towards performing skin scans and see it as an efficient tool to learn more about their skin. Lastly, when it comes to sharing microbiome test results, the sentiment ratio was neutral, although some subjects expressed reservations towards solution efficiency, repeatedly questioned the necessity of it, and are expecting the organization's guarantees regarding the data protection.

Main concerns identified by the generation X group

The main concerns regarding personalization technology as expressed by Gen X group's participants are related to the solution's performance, in other words, concerns that the personalized technology solution, such as recommendations, tailored skincare products, will not be able to achieve efficient and visible results for the skin. Two participants of the group indicated that data processing and governance are one of the main concerning areas for them; however, one interviewee mentioned not being concerned about the data processing for companies that are operating within European Union but rather organizations outside of it, as different regulation scope applies. One respondent mentioned being concerned if the personalization service, for example, product recommendations is offered only by one skincare brand, motivating it by having concerns that in this specific scenario, recommendations might be more oriented towards recommending more products to users in order to generate more sales for the organization.

Figure 1. Word cloud, Gen X participant major concerns about the personalization technology within the skincare

Question 7 – 9

In the smart mirror scenario exercise, overall positive attitude was noticed within the group, but one participant expressed scepticism about the solution questioning if it would understand better users' skin needs than the participant itself. The participant also highlighted that skin's condition is linked with nutrition and activity levels which must be acknowledged. During the interviews, participants expressed their concerns about the consumption sustainability of such devices, asking questions about the products that will be needed for starting such services, product storage and freshness. During the interviews, participants also suggested alternative skincare service and product ideas, for example, holistic smart mirror (offering supplementation or dietary suggestions). One participant expressed desire to have ability to connect skin analysis solution to phone to make an independent skin analysis.

Table 3. Gen X result summary on smart mirror scenario, company expectations and the skincare industry future

Topic	Result summary
Scenario exercise, smart mirror	Overall positive attitude but concerns regarding sustainable product consumption; suggestion to adapt holistic approach in the skin analysis (1); viewed as an interesting solution, especially if connected to phone and would allow the customer to independently perform analysis (1); awareness that such solutions will become popular among users but questioning if such technology will have better knowledge of users' skin (1); enthusiastic towards the solution and views it as support for skin health (1); positive attitude (1).
Expectations from companies that ensure personalization	Important to trust the brand before using the solution, results (1), data processing and security (compensations are included) & ongoing communication and feedback (1); evidence that solution is working (1); trust towards companies operating in EU (1); relationship building and personal communication (1).
Is personalization the future of the skincare industry	Ideal personalization is not attached to one specific brand (more like independent service providing personalization) (1); not sure, hope to have more clean products in the market (1); it will be there but won't be the future (1); yes, and seems to be a natural development stage for the industry (2).

When it comes to consumer expectations of organizations offering personalization services or products, participants expressed that one significant factor in their decision-making would be having trust for the organization. Among other factors mentioned were transparency about the data processing and receiving visible results from the product use. As expressed by one of the interviewees:

> If you claim something with a product, then you as a customer need to feel that you get something from it. So, it is more that you see the evidence, that it is working.

Two subjects during interviews expressed that they would expect two-sided communication and relationship building on the brands' behalf, especially if they don't know the company. Regarding the question, of whether personalization technology is the future of the skincare industry, one participant recognized that the skincare market is already very saturated with a large number of market players and expressed hope that the industry will be more focused on the results, personalization, and addressing specific skin issues, such as pigmentation. Another significant matter discussed during interviews was preferences that personalization services, such as product recommendations, are being provided by an independent organization than a single brand that offers the products or services:

> I don't believe that one brand will be able to provide products for all the skincare needs, I don't believe that brands could have these products for all the skincare-related issues. It would be more effective to have beauty shopping centres, and then I would feel that they are neutral in their recommendations.

Two respondents expressed that personalization technology is the future of the skincare and described it as a natural evolution within the sector. One interview participant demonstrated reservations towards the personalization technology as a future of the skincare industry, questioning how personalized the technology is for the users:

> How many different types of personalization there could be? Should there be a recipe for every person, is it that personalized? I am not sure if that is. We are so many different people; I am trying to see how it would work. Is it custom-made just for me?

Furthermore, the interviewee expressed hope for a higher market share of clean products (as natural as possible) in the industry and evidence-based communication on the product results. During the interviews, one participant also raised an issue on the marketing communication and skincare information being mostly targeted to the female users, motivating it as one of the main reasons why men customers are not being actively engaged in skincare and industry.

3.2 Generation Y (millennials)

The Generation Y group in this study represented subjects born between 1981 and 1994/6. The group consists of 7 participants, of whom 5 are women and 2 are men.

Question 1 – 3

The data analysis illustrates that the primary reason for using skin care products within the group is maintaining skin health (to prevent skin aging, development of breakouts); whereas the main motivation for make-up product application is appearance enhancement. The major challenges experienced when using or purchasing cosmetic products for interviewed group are overwhelming product offering in the industry, difficulties in finding the right products or knowing if the product quality is good for the skin health. Other mentioned challenges included changing product formulations, marketing-oriented product offering and high product prices. Furthermore, several participants expressed that the overwhelming product amount in the industry is challenging factor in making their purchasing decisions:

> For example, when I am buying powder, it is overwhelming. I don't know what to buy and what is good for my skin.

During the interview, another subject shared experiencing difficulties with finding the right products, such as foundation, that would match the consumer's skin tone and would provide a natural look for the skin. During the interview, product selection was described as a complicated area and the interviewee motivated it from a sustainable consumption perspective as well as indicated frequent changes in skincare product formulations. Another participant described having felt that a lot of products in the industry are a little bit "gimmicky" and heavy on marketing activities, stressing that user needs to see product results before making any purchasing decisions.

In addition, the product price was mentioned as a challenge for products that are targeted at dark-skinned customers. One participant during the interview noted that:

> Cosmetic product brand A and I don't even know other brands, are very expensive if you compare them to common brands. And this is something which restraints me to buy.

The same respondent also mentioned experiencing difficulties in larger beauty retailer stores, as the interviewee feels that in-store advisors do not have the necessary knowledge to advise or suggest the most suitable products.

Interview results showed that Gen Y consumer group has overall a good understanding about the personalization technology within the skincare; however, two of the respondents expressed scepticism towards this technology linking it with company marketing efforts and increased product price without adding much value to consumers. One participant expressed not being sure on what personalization technology stand for within the skincare, and two respondents demonstrated a good knowledge of the technology; nevertheless, admitted not linking the solution to the skincare yet but rather retail or make-up.

Table 4. Result summary on primary motivation, major challenges, and personalization knowledge for Gen Y group

Topic	Result summary
Primary motivation for the skincare	Maintaining the skin health (more preventative motivation), using make up products with different motivations, for instance, covering certain features (dark circles), make-up as part of everyday routine.
Major challenges experienced when using or purchasing skincare	The overwhelming product offering (2); finding the right product (2); changes in product formulations (1); views product offering more focussed on the marketing efforts (1); product price (1).
Personalization knowledge	Good understanding, associates it with tailored solutions for skin needs (2); good level of knowledge but views it sceptically (2); Not sure (1); solutions that helps consumer to in making purchasing decisions (more retail or make-up oriented) (2).

Sentiment analysis for questions 4 and 5

The gathered results showed that within the Gen Y group there is a neutral attitude towards trying the personalization technology solutions within skincare or beauty. Majority of people expressed positive comments stating that such technology would support them in finding the right products; however, some expressed that they would not like to purchase solution without trying the products, another participant mentioned already having established routine which decreases motivation for trying such solution. One subject identified that solution could be used by identifying best matching routines based on user's microbiome status.

Table 5. Sentiment analysis results for Gen Y group

Value	Sentiment analysis result (average)
Sentiment towards trying personalization technology	0.542 (neutral)
Filling questionnaire with primary questions	0.569 (neutral)
Filling in-depth questionnaire	0.542 (neutral)
Sharing the skin image with the organization (apps)	0.433 (neutral)
Performing the skin scan	0.657 (neutral/positive)
Performing skin swab test (microbiome test)	0.473 (neutral)

The sentiment analysis illustrates that overall, the research group feels comfortable with sharing data when filling out general online questionnaire; nevertheless, several participants expressed concerns regarding personal data use in case of in-depth skincare survey. Sharing the skin image with the organisation was overall approached neutrally by the subjects as well. The main expressed concerns regarding this solution were the personal identification when sharing the image, and lack of trust for the applications. Most of the participants; however, did not see any challenges with sharing the skin images, justifying this by their active presence and image sharing across social networking platforms.

The sentiment analysis showed a neutral/positive ratio for skin scan conduction, as the majority of participants saw this as a beneficial tool for gaining information about customers' skin status, such as moisture content, and evaluated this approach as more efficient than performing analysis from the user images. Lastly, the skin swab test received a neutral ratio; however, expressed opinions differed among participants. Some subjects expressed concerns regarding the personal data use, comparing it with the blood sample and one participant argued that they would not see this as a necessary step for the skincare, in other words, the skin test was viewed as requiring too much effort. On the other hand, other participants expressed trusting such tool analysis more than other previously discussed methods, such as sharing answers online.

Main concerns identified by the Generation Y group

The main concerns voiced by the participants are data governance, transparency regarding the data usage, technological system safety, technology trustworthiness, and the ability to find products in an already saturated market.

Data governance and the trustworthiness of the technology were two of the most concerning topics for the participants. In terms of data governance, consumers are mindful that data collected that will be needed to receive personal products or routine suggestions will be sensitive since it will involve health data; furthermore, consumers also voiced being concerned about the technological system safety. Respondents also questioned the technological solution's trustworthiness from the skin health perspective, wondering:

> What happens if they are recommending something that is making my skin worse? More products to fix that? It is like a cycle.

Figure 2. Word cloud, Gen Y participant major concerns about the personalization technology within the skincare

Question 7 – 9

The received answers on the smart mirror technology scenario indicated that most of respondents have positive attitude when presented with the technological solution. For instance, one participant expressed finding the concept very exciting and discussing potential implications to tailor the product recommendations to users' natural cycles and suggesting that the fashion how products are suggested should be encouraging to the user and not blunt. One subject responded being interested in the solution but expressed reservations about the monitoring aspect of the technology.

Another subject while admitting solution's convenience, expressed concerns that skin routines and traditions will lose their emotional value:

> I would say it is convenient and I would take part in it. However, I am afraid that the whole hobby of skincare would go away. You will not be able to make presents of skincare anymore, if everyone has a personal routine, it will be missed.

Nevertheless, three respondents demonstrated not willing to have such technology implemented in their everyday skincare routine, seeing it as rather irrelevant or not focussed on the right aspects in terms of its primary purpose. For instance, one subject motivated that such solutions will have a high price point and will not offer information that the individual already does not know about the skin:

> Well, it sounds that it would be expensive and would not give me too much information which I do not already know. It might be relevant for someone who has skin problems that one would like to address, and they do not know what to do, but I know my skin very well and I know my habits very well.

Two respondents indicated that personalization technology application would be more useful when applied in other fields, such as health care or mental health.

Table 6. Gen Y result summary on the smart mirror scenario, company expectations and skincare industry future

Topic	Result summary
Scenario exercise, smart mirror	Positive, but concerned about technology being too intrusive (1); very positive, opportunities for syncing product with consumers' natural cycles (1); negative sees more benefits for health or psychological perspective / no relevant to the consumer (3); Positive

	but sees technology as having high price point (1); Positive but concerns about losing skincare as tradition (1).
Expectations from companies that ensure personalization	Data governance (3); transparency on how data will be used (1); good brand's reputation (1); prioritizing consumer's skincare needs (1); ongoing communication (1).
Is personalization the future of skincare industry	No, don't think so (1); Yes, but more as service and not personalized skincare or make-up (1); Yes (5).

According to the received responses, the main expectations from the industry players are data governance and transparency on how consumer data will be used, good reputation of the brand, prioritizing consumers' skincare needs in the core of business operations and ongoing communication, as well as relationship building activities. During the interview, one participant mentioned that full transparency on data use would be a determining element for trusting the company; furthermore, another subject reflected having high expectations on data governance due to historical examples where organisations were not able to provide data security for the consumers.

Two of the respondents indicated expecting the organizations that operate within the industry to prioritize consumers' skin health first and personal relationship development, to illustrate:

> I would expect ongoing consultations and services by the companies, as skin the changes (cycles, aging, etc.). That would include check-ups, experience, and consultation meetings.

When it comes to the question on the personalization as the skincare future, most of the consumers answered positively. The respondents explained their answers, motivating it with the increasing skin health demands and high diversity among represented skincare consumers. One subject responded seeing this technology as a future that is targeted for younger generation customers but sees challenges in preserving the skin care tradition emotional value and solution's affordability.

Lastly, one participant answered not seeing this technology implemented within the industry for mass consumers' market, reasoning that personalization technology is unproven concept at the moment. The same research subject reasons that the future of the skincare will be more democratized, and more research based.

3.3 Generation Z

Generation Z group's participants surveyed for this study are born between 1997 and 2012. The group consists of 5 people, of whom 3 are women and 2 are men.

Question 1 – 3

The primary motivation for using skincare among participants is to balance or address skin conditions (for example, acne), and preventative skincare. Most of the research group's participants have established skincare routines. Make-up products are used mainly for enhancing one's appearance. The major challenges listed when using or purchasing cosmetic products for the interview subjects are purchasing the right skincare products, unsupportive retail experiences when visiting shops in-person, purchasing products online and products with active ingredients.

Two subjects during the interview mentioned experiencing difficulties in purchasing the right skincare products, one participant reflected on negative product usage experience, after receiving recommendations from the skincare professional in the past:

> My doctor recommended me a product and after using it, the skin on my face turned red. I think for me it is because I have sensitive and oily skin, and it is important that I do not use something that does not suit my skin, because it can harm it.

Another participant voiced experiencing difficulties with purchasing make-up products online and reported frequently experiencing situations when bought make-up products do not match the skin tone. Purchasing skincare with active ingredients has also been mentioned as challenge by one participant, and the user argues not being confident about ingredient specific functions and noting that the price point makes difference for it.

During the interviews gathered data illustrate that majority of respondents do not have knowledge on personalization technology within the skincare but associate it with software or algorithm that suggests solutions to the customers. Two respondents showed very good understanding of the personalization technology and reflected on real life examples they have seen or experienced.

Table 7. Result summary on the primary motivation, major challenges, and personalization knowledge for Gen Z group

Topic	Result summary
Primary motivation for the skincare	To cure specific skin conditions (acne), preventative skincare and make-up for appearance.
Major challenges experienced when using or purchasing skincare	Confusion in purchasing the right products (1); not helpful in-person retail experiences (1); finding products that suit skin needs (1); purchasing make-up products online (1); purchasing products with active ingredients (1).
Personalization knowledge	Never heard before (3); Very good understanding (2).

Sentiment analysis for questions 4 and 5

The performed sentiment analysis when examining users' sentiment score towards trying the personalization technology showed a positive ratio, which means that majority of interview participants have a positive attitude towards trying such solutions for their skincare.

Table 8. Sentiment analysis results for Gen Z group

Value	Sentiment analysis result (average)
Sentiment towards trying personalization technology	0.730 (positive)
Filling questionnaire with primary questions	0.556 (neutral)
Filling in-depth questionnaire	0.304 (negative)
Sharing the skin image with the organization (apps)	0.496 (neutral)
Performing the skin scan	0.670 (positive)
Performing skin swab test (microbiome test)	0.405 (neutral)

In terms of filling in data for general questionnaire, majority of consumers responded feeling comfortable to share such data. One respondent from the group answered not feeling comfortable with it, arguing that such questionnaires are not useful for data collection. When it comes to filling in in-depth surveys, sentiment analysis indicated negative results. Quite large proportion of interviewed subjects indicated not being comfortable with sharing such data by questioning the technology's trustworthiness, not feeling comfortable about sharing too personal information about the life-style related data. One person argued that it's attitude towards sharing such data would depend on the brand reputation that would request such information.

The sentiment analysis showed that Gen Z group participants are neutral towards sharing skin images with the organization, arguing that many applications are asking users to share such data. Interview participants mentioned it as a trade-off for receiving personalized recommendations. The sentiment analysis showed positive results for sharing skin scan data with the company. Most participants responded feeling comfortable with sharing such data, describing it as an efficient

approach in choosing products and tailoring the skincare. Lastly, in comparison to the skin scan, the sentiment analysis showed decreased positivity towards microbiome test sharing. During the interviews, participants expressed slight confusion about why such data are needed for the companies, and some admitted that such data sharing would be scary because of its relation to the DNA.

Main concerns identified by the Generation Z group

The main concerns expressed by the participants on the personalization technology during the interviews are personal data, price, and technology's trustworthiness.

In terms of the data, one participant specifically expressed concerns about data being sold to third parties, admitting that consumers are aware that data are stored in applications and sold to advertising businesses, which the participant is not content with. The same participant stated not being found of targeted advertisements but admitted that targeted suggestions would be useful. Another subject expressed being concerned about sharing too personal information with the companies, such as lifestyle and diet, but if it is about the skin and texture, the user would feel more comfortable towards this kind of data.

Another respondent mentioned being concerned about the recommendation potential negative effect on the skin health. The interview participant questioned the following:

> What happens in case of a mistake? Because if it is built on an algorithm, I guess on AI, there is always a probability that something could go wrong. Let's be real that our skin and faces are what everybody sees, and it is an important source of how we feel about ourselves, and this should be very well researched I feel.

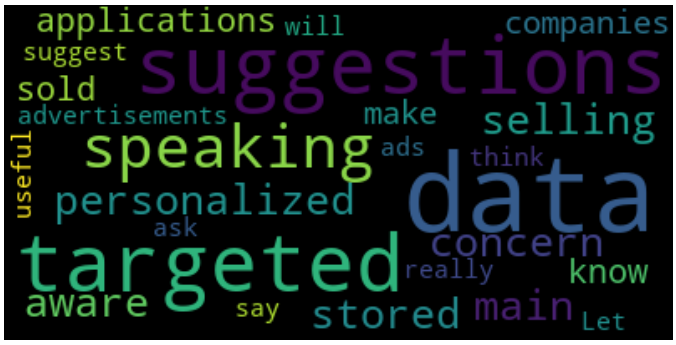

Figure 3. Word cloud, Gen Z group participant major concerns about the personalization technology within the skincare

Question 7 – 9

Most of the interviewed participants replied being interested when presented with smart mirror technology scenario; however, one user mentioned that although the concept sounds intriguing, it does not see how it could be used in specific participant's case, describing product as unnecessary. The remaining four participants expressed interest in trying such applications, nevertheless, they shared several concerns, such as device price point and product-related development sustainability. Other participants voiced concerns about the trustworthiness of the received recommendations and the fashion how the recommendations are ensured. To be more precise, in terms of application trustworthiness, consumers are troubled about the recommendation potential negative impact on skin health and are questioning the technology itself. Another interview subject expressed that in the case of such device application it would be interested to receive daily

suggestions; however, the participant communicated not being interested in receiving commercial information about how and where recommended skincare products can be purchased.

Table 9. Gen Z result summary on the smart mirror scenario, company expectations and the skincare industry future

Topic	Result summary
Scenario exercise, smart mirror	Interesting but won't use it (1); Interested but concerned about solution's price point, sustainability (2); Interested but worried about what happens when recommendations don't work (1); positive about receiving recommendations but not commercial information about products (1).
Expectations from companies that ensure personalization	Trust and open data (1); Company expert reliability & skincare knowledge (1); ability to purchase smaller fragments of service and not 100% online based (1); data encryption, and reliable and safe system (2).
Is personalization the future of skincare industry	Not really, rather functional skincare (1); Yes, but concerned about technology diffusion among customers and affordability (1); Most likely but must be communicated for masses (1); Yes, especially with technology development (2).

According to the received responses, the main expectations for organizations ensuring personalization are trust and open data, company expert credibility and skincare knowledge, the ability to purchase smaller service fragments and receive in-person recommendations, and data security.

In terms of data security, the group's participants would expect data security and system reliability, to be more specific:

> I would need massive reassurance that data is fully encrypted that they have good and reliable and not hackable technology.

One noticeable pattern that emerged during interviews is the importance for the users to trust brands and know who manages the organization. One interview participant mentioned expecting a brand that ensures personalization services in the skincare to be knowledgeable about the skincare. The ability to purchase smaller service fragments or product volumes was another area expressed by the participants; furthermore, the ability to physically visit specialists for consultations:

> For my skin type, treatments should be evaluated by a doctor or visiting someone or maybe microbiome test. But I would not go 100% online, I do not know how trustworthy the technology is at this point.

When it comes to the future of the skincare, most participants agree that personalization is the future of skincare. Two participants expressed being very positive about personalization within the skincare industry, noting that it will be a natural development for technology and services within the sector. Two respondents of the Gen Z group answered that they believe that personalization most probably will be the future of the skincare technology but have concerns about such technology diffusion in the consumer markets due to price, and solution customization and development for the mass market.

In terms of product availability, one participant also raised an issue that in many countries skincare for men is a social issue and the respondent believes that this specific issue is not about technology, but more about cultural stereotypes and hence

it needs to be made accessible in a way that seems acceptable. Similarly, as discussed above, one subject expressed not believing that such personalization technology will be relevant for all the consumers, explaining that it believes that this technology is more targeted at people who regularly use skincare.

According to other research subject, *"how males are introduced to society are not skincare friendly"*, which corresponds to the above-mentioned issue. The respondent also added that in their opinion, skincare routine adoption among men generally is very low and the participant does not see any need for such a solution's introduction in the industry yet. The same respondent believes that the future of skincare is going to be more functional, in other words, oriented towards addressing specific skin conditions rather than being something esthetical.

4 DISCUSSION

The discussion section of the study is divided into three main parts, the research question analysis, gathered results evaluation concerning the established hypothesis, and finally recommendations for the organizations that are operating within the industry.

Different generations (X, Y, Z) group consumer views on personalization technology adoption with the skincare and their personal care

The conducted sentiment analysis showed that the Gen X group's research participants overall have a negative sentiment towards trying the personalization technology solutions within the skincare (average sentiment: 0.294). The potential reasons mentioned for the hesitation towards trying the solution are lack of trust in the industry, recognizing that the industry lacks products for specific skin conditions, such as melasma. The sentiment analysis results showed that the Gen X participant group is neutral towards sharing varying degrees of data; however, a neutral/positive trend was seen when asked about performing the skin scan analysis test (average sentiment: 0.666). Throughout the interviews, the research group participants questioned the necessity for sharing specific types of data, for example, sharing the skin image with the company or microbiome test.

Concerning the Gen Y consumer group, the research results showed that participants overall have neutral attitude (average sentiment: 0.542) towards the personalization technology adoption within skincare, and the sentiment ratio was increased in comparison to Gen X group's results. Most of the subjects expressed positive comments on technology provided support in finding the right products; nevertheless, maintaining that they would not like to integrate the personalization solution prior to trying the products. Lastly, the performed sentiment analysis (average sentiment: 0.730) for Gen Z group's participants showed positive attitude towards trying the personalization technology for the skincare, which shows the most positive trend in comparison with the sentiment results for participants representing Gen X and Gen Y groups.

Main opportunities and concerns regarding personalization technology application in skincare decision making (Gen X, Gen Y, and Gen Z perspective)

A survey developed by Whittaker on mHealth applications showed that the major reservations indicated by the solution users are regulation of such applications within the market and the ability to meet the users' needs [16]. Similarly, the research study result analysis showed that the main concerns among Gen X group's participants are solution performance and the ability to achieve the promised results. Furthermore, users mentioned data protection as one area of concern maintaining the necessity for organizations to provide guarantees on the data protection; nevertheless, this theme was not the most dominating one as showed by the data analysis. Among other concerns mentioned were the solutions provider neutrality, in other words, subjects expressed reservations towards application adaption if they are provided by the companies whose products are recommended to the consumers. During the discussions users identified several opportunities for the industry in terms of personalization technology, for instance, providing recommendations with more holistic focus (nutrition, hydration, or activity levels) and ensuring that solution could be paired with other devices, such as phone, this way ensuring that user is able to perform skin analysis independently at any time of preference.

Providing personal data is essential to achieve improved recommendation solution amenities for Recommender systems' nevertheless, users are reluctant to share their data due to concerns relating to potential cyber-attacks and potential consequences in connection to it [18]. The data analysis revealed that millennial (Gen Y) group participants are mostly concerned about the data governance and transparency regarding the customer data processing, ability to find the right products in the saturated market and product recommendation impact on the skin health. In comparison with Gen X group, this specific group is more concerned about potential negative effects on the skin; while Gen X participants are concerned that solution will not be able to obtain the promised results, show visible improvements. Among expressed concerns within Gen Y user group was concern that personalization technology within the skincare will replace the skincare as a hobby or tradition. This; however, reveals opportunities within the industry to develop solutions that would respect individuals' skincare preferences and traditions, as well as incorporate learning opportunities and communication within the community. Other potential technology solution opportunities identified by the research group participants are providing tailored service offerings based on natural cycles as well as microbiome health status. The participants also proposed that recommendations by the applications should be presented in an encouraging fashion and by creating safe space for the users.

The main identified concerns by Gen Z research participants during the interviews are personal data protection, price, and technology's trustworthiness. In this specific group, users expressed being worried about their data being sold to the third parties and hence sharing too personal information with the companies. Similarly, as in Gen Y group case, Gen Z group respondents also reported being concerned about received skincare recommendation and product impact on one's skin health, emphasizing the necessity that the solution's concept is well researched and proved.

Personalization as a future of the skincare

The performed research study examined what are the research participants' views on the personalization as the skincare future and if this technology will become a mandatory solution to meet consumers' needs and to ensure seamless service experiences? Among the Gen X consumers, the diversity in the expressed opinions was noticed. According to the participants' point of view, the ideal personalization will not be attached to one brand, but rather will be an independent service which will provide products recommendations from various brands. During the discussions, one group participant noted that currently the communication within the industry is not well tailored for men consumer group, which emerges opportunities to tailor communication for different user groups. Some Gen X group's representatives expressed that personalization in the future will be more functional and more oriented towards addressing specific skin related issues, such as pigmentation or acne. Lastly, users' also expressed hope for cleaner products in market and evidence-based communication.

Most of the Gen Y group's surveyed consumers' see that personalization is the future of the skincare industry, motivating it with increasing skin health demands and high diversity among skincare consumers. Some Gen Y participants expressed that the future of the skincare will be more democratized information-wise and will provide more opportunities to access trustworthy data in an online environment through the social media and content sharing platforms. Likewise, most of Gen Z group's consumers agree that personalization is the future of sector. Two participants expressed being very positive about personalization within the industry, noting that it will be a natural development trajectory. Nevertheless, some participants identified some potential challenges when it comes to technology diffusion within consumer markets, such as affordability and solution's customization for the mass market. One participant of the group also noted that the future solutions within the sector will be more functional, similarly as expressed by participants from the Gen X group.

The Hypothesis

The research projects hypothesis was that younger generation consumers (Gen Y and Gen Z) prefer more tailored skincare experiences and are less concerned about the threats associated with the personal data sharing than customers who represent generational group X and older.

The performed sentiment analysis showed that consumers representing Gen Y and Gen Z generations from the research sample are more positive about trying the personalization technology for their skincare as compared to consumers from

the Gen X group. Nevertheless, the content analysis and generated data illustration (word cloud) showed that Gen Y and Gen Z users are more concerned about the data governance associated risks than Gen X consumers for who the results and improvements are more important. To sum up, the established hypothesis for the research project has been accurate in terms of younger generation consumer preferences in receiving tailored experiences; nevertheless, the gathered data reported that Gen Y and Gen Z users are more concerned about the data-related risks than Gen X represented research sample.

Recommendations for the organizations operating within the skincare and beauty industry:

Data governance

As mentioned in the results discussion above, one of the major areas of concern for participants representing Gen Y and Gen Z group is data governance, furthermore, the content analysis also showed it as one of the major expectations for the corresponding groups from organizations that ensure personalization services. During the interviews, subjects referred to previous occurrences when companies with consumer data were not able to prevent data leaks. One potential solution to address this risk would be estimating how much user data are needed to ensure high-quality recommendation accuracy, meaning that once a certain threshold is reached the gathered data does not provide significant value from a recommendation quality perspective, in other words, estimation of the optimal user data amount [7]. Other suggestions to mitigate potential data security-related threats could be ethical standard establishment, strengthening of the safety designs, development of registration publicity systems, and principle establishment for responsibility fixation among involved participants [8]. When it comes to legislative frameworks within the European Union, in 2021 the European Parliament issued a proposal for AI regulation that aims to enhance governance and provides guiding principles for organizations whose operational activities involve AI technology application [13]. According to the regulation, the AI technology systems are categorized into four risk groups, which must fulfil specific requirements before being introduced in the market [2].

Personalization solution reliability

The personalization solution reliability was mentioned as a concern from consumer data and provided a recommendation impact perspective on the skin health. To mitigate consumer data-related risks, it is recommended that organizations ensure necessary education for involved stakeholders on the moral consciousness as well as social responsibility [8]. When it comes specifically to the skincare technology, interviewed subjects expressed concerns that such systems are developed by professionals that do not have in-depth skin health knowledge, which correspondingly highlights the importance for skin professional active engagement in such solution development as well as emerges education-related requirements for stakeholders who are responsible for Recommender or AI system development within the industry.

Relationship development

The organizations that ensure personalization technology applications must think about the relationship development with their consumers, which could include two-sided communication, requesting feedback for provided product recommendations to the consumers, offering opportunities for users to ask questions, and enabling in-person consultations. To illustrate, during the interviews Gen X and Gen Y group representatives stated expecting ongoing relationship development efforts by the companies, such as ongoing consultations and services, that would include in-person check-ups, and experience meetings reaching beyond the email communication or digital calls.

Inclusivity

The analysed results showed that there are different emerging challenges that organizations must address from an inclusivity standpoint. The gathered data from the interviews showed that price point is viewed as a factor that has a high potential for hindering personalization technology adoption among different consumer groups, and hence might increase the risk of marginalization [19]. To address this, the innovation within the industry must be encouraged as well as new personalization solutions that would be available to the mass consumer market. One potential approach in addressing this could be different personalization solution development, for example, personalization system development within the

retail that would ensure better in-store experiences, independent organization development which would provide product recommendations by offering consultations to the customers in an online environment. It is also significant to emphasize that companies in their communication must provide information on the personalization service scope, definition, for instance, what personalization entails in case of specific brands' operations as well as transparently explain the value provided to the consumer. During the performed interviews, consumers from all generational groups maintained the need for evidence-based communication as well as a business concept. In addition, the performed content analysis showed that additional inclusivity efforts are needed for male customers who purchase skincare products. For example, a Gen X research group participant during the interview mentioned that although there are available products for men users, they experience difficulties with finding the right skincare products, as the communication and the skincare advice are more tailored to the female consumers. One participant mentioned that in certain countries men's skincare is rather a social issue and is linked with cultural stereotypes, and it should be made accessible and acceptable within the industry. Another subject from the research group noted that skincare routine adoption among men is generally very low and before introducing the personalization solution for men's skincare market, the general interest and knowledge about the skincare among male customers must be developed.

Additional services

During the interviews, consumers identified additional service or product opportunities that they would see as necessary within the industry concerning the personalization. For instance, several subjects from Gen X and Gen Y research groups expressed that they would like to have an opportunity to try personalized services and products before purchasing the products or becoming active users of the solution. A potential solution to this scenario could be offering "trial periods" with the availability to opt-out from the service and receive refunds or smaller product samples for testing, which correspondingly indicates new service opportunities for the technology. Furthermore, the performed sentiment analysis showed that all three user groups view the skin scan analysis positively, seeing it as an efficient and reliable skin analysis tool and an opportunity for receiving more information about an individual's skin health. Furthermore, during the interviews, several consumers expressed that they would not like to have a 100% online-based personalization experience, expressing interest in receiving in-person consultations and skin assessments justifying that the solution is a yet unproven concept from their point of view. Several consumers suggested that personalization provides the opportunity for developing holistic skincare solutions, for instance, skincare recommendations in relation to nutrition or vitamin intake. Some additional ideas expressed during the interviews were ensuring tailored product suggestions taking into consideration users' natural cycles or skin microbiome health status. One participant expressed a desire for having recommendation solution which could be connected with other devices, such as cell phones, and would enable the user to perform skin analysis independently. Lastly, interview subjects expressed that personalization solutions could have a high potential for skincare retail environments as such solutions would support users with purchasing decision-making based on the specific pre-requisites individual users have.

Sustainability

Finally, sustainability when it comes to consumption and product development must be considered when providing personalization solutions and products within the skincare and beauty industry, taking into consideration high product provider saturation within the sector. During the interviews, users questioned the solutions' sustainability inquiring about the product amount users would need to have in the beginning when starting subscription services (smart mirror device), actions how companies will ensure that recommended skincare products remain fresh. Another participant highlighted the potential challenges from the personalized solution device manufacturing perspective. Potential approaches in addressing the sustainability-related challenges could be offering opportunities for consumers to receive products in smaller packages, ensuring personalization service and device as well as product development circularity. Open innovation as well as coopetition could be other tools in tackling the sustainability related challenges within the industry.

5 FUTURE RESEARCH AND CONCLUSIONS

For the research results to be generalized, the future research development should include a larger scale sample size to evaluate the study's result implications and applicability to the larger consumer group. The larger sample size could

represent older customer groups than Gen X and hence would provide additional insights concerning the established research hypothesis about personalization technology adoption, personal data-related concerns and users' needs concerning the personalization technology within the skincare. Furthermore, during the empirical research study, male participants noted the inclusivity issues that technology could address such as lack of skincare education and interest within the users' group. This could also be an intriguing future research area that would yield applicable recommendations if performed on a larger sample size.

To conclude, this user centric research study offers insights about different age group user attitudes towards the personalization technology adoption within the skincare and beauty industry and illustrates the main opportunities and potential risks that must be acknowledged and mitigated by the companies providing such personalization solutions. Finally, the study reviews if personalization services are seen by the users as industry's future and provides recommendations for skincare companies about the data governance and application reliability as well as potential personalization service development areas. The author hopes that this research will provide insightful data for industry's stakeholders on potential opportunities and risks that personalized skincare technology entails. Furthermore, the author aspires that performed case study will inspire developers to create new innovative solutions and business concepts that will make personalization technology within the skincare even more accessible and inclusive for different customer groups and users.

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8 APPENDIX

During the performed interviews the following interview template was followed:

1. Which products are you actively purchasing (skincare/make-up)?
2. Are there any challenges that you see/experience when purchasing or using cosmetic products?
3. Do you know what personalization technology within skincare is? What are your associations when you hear this term?
4. Have you ever used any personalization services when purchasing skincare products/beauty? If yes, please elaborate on your experience and if no, would you be interested to use it one day and why yes or why not?
5. What personal data would you feel comfortable sharing with the skincare companies today to receive a personalized product or service experience? I will provide examples of services and I would like you to evaluate how comfortable do you feel from a privacy and ethical point of view and provide an explanation.
A Filling in online survey, illustrating your primary skincare goals and overall information about your skin type. (Comfortable/Neutral/Not comfortable + explanation why).
B Filling in in-depth online quiz which would examine lifestyle, diet, medical information (Comfortable/Neutral/Not comfortable + explanation why).
C Sharing skin image with the organisation, for example, a selfie (Comfortable/Neutral/Not comfortable + explanation why).
D Performing in-person skin-scans (Comfortable/Neutral/Not comfortable + explanation why).
E Performing a skin swab test and sharing it with the lab (Comfortable/Neutral/Not comfortable + explanation why).
6. What are your main concerns or reservations regarding the personalization technology based on the provided answers in question before? Do you see any grey/high risk areas?
7. Imagine a scenario. 10 years from now, beauty technology will be developed to the level that it can be or act as your personalized everyday guide for your skincare and beauty care. For example, you wake up in the morning, go to the bathroom and a smart mirror with skin scan technology determines your real-time skin condition and provides suggestions for skincare products or routine you should adopt during the day, might also provide supplement suggestions. How do you feel about this scenario? Would you like to have or use this beauty technology in your daily life? What do you see as the main benefits of this? Do you have any concerns or reservations about this?
8. Based on the discussion during the interview, what should be in place from the company's perspective that would make you feel safe use personalization technology in the beauty? What would be your expectations? Do you have any suggestions or additional ideas on experiences or needs you wish this technology would address?
9. What would you say is the future of skincare and beauty industry? Do you think that personalization technology is going to be a "must- have" technology for organizations that operate within skincare and beauty to ensure great customer and product experiences? Why yes or why not?

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