sagentia innovation

WHITEPAPER

Technologies for product personalisation: transforming consumer experience

As digital and physical technologies evolve and mature, new opportunities are emerging for deeper and more meaningful personalisation of consumer products and services. In this whitepaper, our scientists, engineers, and technologists consider the interplay between genomic, microbiome and biomarker data. They look at current and future technologies to harness and interpret this data, for the creation and delivery of transformative personalised experiences.

Transformative personalisation

Bringing personalisation to life with commercially viable consumer products and services is no mean feat. Success lies in the ability to offer a meaningful experience at the right price point to drive consumer loyalty. We've explored commercial models in previous whitepapers, and Figure 1 outlines a framework of potential options.

Commercial models for personalisation

Personalisation business models must ensure a healthy margin despite increased production costs and other issues associated with smaller batch volumes.

As Figure 1 indicates, it's important to consider **where** personalisation will happen and **how often** the personalisation formula will change. Innovation teams should determine this early as it drives critical decisions surrounding technologies required.

Transformative personalisation doesn't necessarily mean products need to be ultra-personalised. Companies innovating in this space can reduce commercial risk by striking a pragmatic balance between how much personalisation is desirable and what is feasible.

We look at commercial models in more detail here:

Nutrition: A personalised future
https://www.sagentiainnovation.com/insights/nutrition-a-personalised-future/

Unlocking personalised nutrition
https://www.sagentiainnovation.com/insights/unlocking-personalised-nutrition/

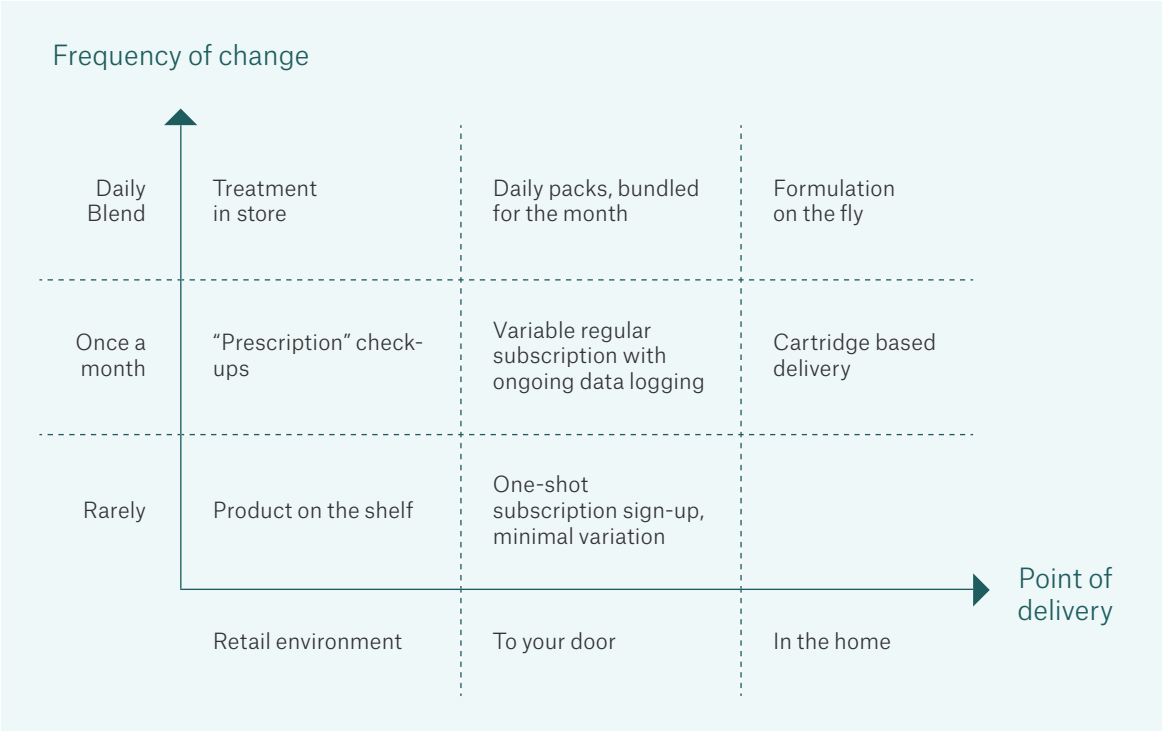


Figure 1: New product development needs to consider where the product will be personalised, and how often the personalised formula will change. This will influence technology selection for the product, the personalisation process and packaging.

This whitepaper moves beyond commercialisation to explore another key challenge: creating personalised products that genuinely enhance the consumer experience. We discuss five technology areas that will be pivotal in the delivery of transformative personalisation across skincare, oral care, haircare, consumer health and home care.

Three of these technology areas – related to genomics, biomarker sensing in general and the microbiome in particular – harness individual data to provide a framework for personalisation. Each represents an interconnected part of a complex puzzle. Figure 2 shows various data sources, from genetic and biomarker to environmental and behavioural, that fit together to create a more complete picture.

Companies which find meaningful ways to connect genomic and microbiome data with more dynamic information about the individual will be best placed to deliver transformative personalisation. This is where the final two technology areas come to the fore: advanced data analytics and technologies which 'close the loop' to drive actionable outcomes and enable fulfilment.

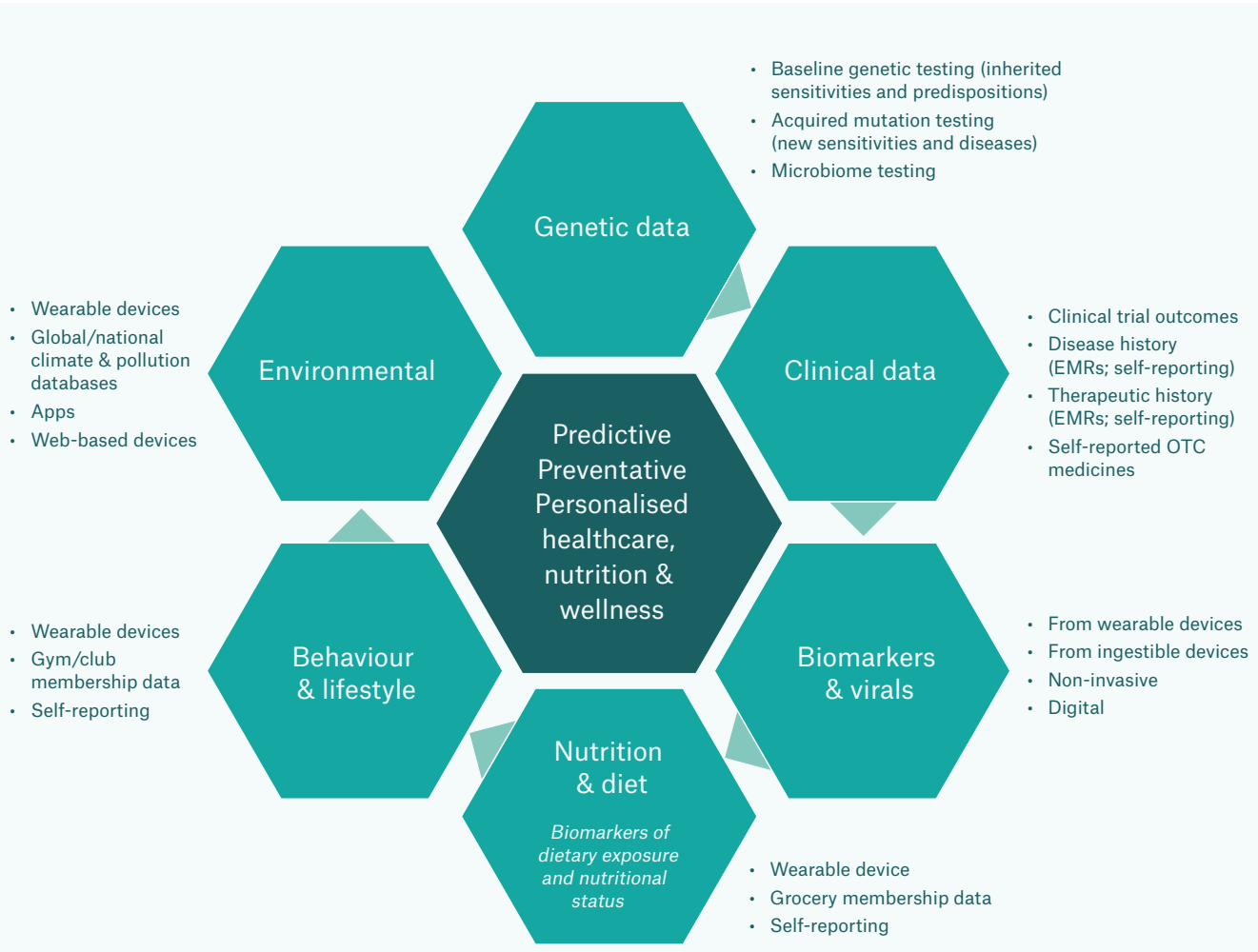


Figure 2: by combining data sources, brands can trade off depth and success of personalisation versus cost and complexity

Technologies to harness personalisation data

Data sources for personalised consumer products range from the static (e.g. genomics) to the 'stable but changeable' (e.g. the microbiome) to the highly dynamic (e.g. vital signs). Transformative personalisation draws on data from across this spectrum. Innovation teams need to find the sweet spot where they are capturing enough data to create sufficient impactful personalisation. Here, we consider the extent of what's possible, but in day-to-day client work we determine how far to go on a case-by-case basis.

Genomics

Genetic technologies will unlock new possibilities for personalised consumer health, beauty, and personal care over the next decade. There are still issues surrounding data and regulatory matters to be worked through. But the global direct-to-consumer (D2C) genetic testing market is now valued at $1Bn[1] and growing at pace. Much of this currently relates to ancestry and relationship testing, but the uptake shows consumers' willingness to share genetic data to achieve a desired goal.

Right now, hyper-personalised nutrition and wellness advice based on genetic predisposition testing is the fastest growing D2C segment[1]. Start-ups are driving novel innovation here, but market activity indicates that consumer products and services rooted in genomic technology are moving from niche to mainstream. Strategic partnerships, acquisitions, and initiatives from multinationals like GSK and Nestle show larger players are keen to occupy this territory.

Current opportunities

Globally, the US occupies 43% of the global D2C genetic testing market. However, rapid growth is also apparent in Europe, Canada and China. The Chinese government is encouraging genetic testing as part of its current five-year plan, which is likely to drive a surge of market activity across Asia[1].

As genotyping and sequencing costs decrease, these techniques become more relevant for consumer product applications. With increased adoption of genomic-led consumer products and services, pockets of evidence are emerging which demonstrate efficacy. For instance, the six-month Food4Me personalised nutrition study in Europe (which included personalisation based on genotyping) resulted in "larger and more appropriate changes in dietary behaviour" than conventional approaches[2].

The next five years

D2C genetic testing unlocks valuable data that was previously inaccessible to consumer product companies, and medical developments will continue to filter through to the sector. For example we expect the extensive use of lateral flow tests during the COVID-19 pandemic to drive a new era of at-home genetic and molecular testing. Combining this with personalised products and services will empower consumers to take more control of their health while reducing the burden on healthcare systems. So, an over-the-counter (OTC) molecular test for a condition like pre-diabetes could be coupled with personalised products to promote a healthier lifestyle.

Progress will be facilitated by innovative new devices like the miniaturized, portable DNA and RNA sequencer MinION[3]. Technologies like this continue to improve the speed, ease and cost-efficiency of analysis. Better access to genetic sequencing coupled with consumer acceptance will enable consumer product companies to take personalisation to greater depths.

Microbiome

The human microbiome is often dubbed 'the second genome', and there are close links between microbiome and genome testing. Together, data from these entities will enable science-led personalisation for consumer health, wellness, and beauty applications.

So how can data about the diverse microbes on and in our bodies help drive enhanced customer experiences?

Much has been written about the gut microbiome and the increasing evidence of causal links between diet, gut microbiome health, and wider health and wellbeing. The microbiome's integral role in the human body affects everything from digestive health and immune response to the development of obesity and diabetes. It's also believed to have a bearing on sleep, memory and cognitive ability as well as cardiovascular disease and urinary tract infections.

Current opportunities

As understanding of the factors that are influenced by the microbiome continues to grow, it reveals attractive and achievable opportunities for personalisation in the consumer space.

With its diverse array of microorganisms, the skin microbiome is becoming a cornerstone of personalisation in categories such as personalised nutrition, consumer health, personal care, and beauty. The same is true of oral health, where a microbial community of more than 1,000 different species and phylotypes must be maintained across distinct habitats, from the hard surfaces of the teeth to the soft tissues of the cheeks and tongue.

The microbiome is still an emerging discipline, but it is widely held as an important frontier between traditional healthcare and consumer health and wellbeing. Many companies already offer microbiome test kits and personalised recommendations. According to market research firm Fact.MR, the average annual sales growth for personalised probiotics is around 14%[4].

The next five years

One interesting technology which points towards likely future trends is the swallowable bioluminescent imaging capsule developed by researchers at the University of Missouri[5]. By determining levels of enzymes responsible for probiotic health benefits it may be able to assess the efficacy of pre and probiotic products.

Another area to watch is precision engineering of the microbiome, currently led by companies such as Eligo Biosciences with its solution that "allows modulation of the microbiome's composition and function to address human disease"[6]. While this technology is only relevant to pharmaceuticals at present, it could play a lead role in personalised consumer health and wellbeing in the coming years.

For more information, see our whitepaper Microbiome: an emerging integral part of precision medicine and personalised lifestyle changes

https://www.sagentiainnovation.com/insights/microbiome-an-emerging-integral-part-of-precision-medicine-and-personalised-lifestyle-changes/

Biomarker sensing

Genetic and microbiome data enable personalisation to reach greater depths; combining this with individuals' biomarker data takes it to greater heights. Collecting and analysing these quantifiable, dynamic health indicators has become easier with the rise of digital technology and there is further potential on the horizon.

Figure 3 outlines biomarker types, from vital signs, neurological and chemical to auditory, visual and physical. Widespread consumer uptake of activity trackers and smartwatches has normalized continuous monitoring of vital signs such as heartrate, blood pressure, respiration, blood oxygen saturation, and skin temperature. This has resulted in consumer applications for the diagnosis and monitoring of health conditions as well as exercise and factors such as sleep quality. Parallel to this, phone cameras offer easy image capture for the analysis of visual biomarkers for skincare and haircare applications.

Transformative personalisation requires data from multiple biomarker types as well as more sophisticated data analysis to generate actionable outcomes.

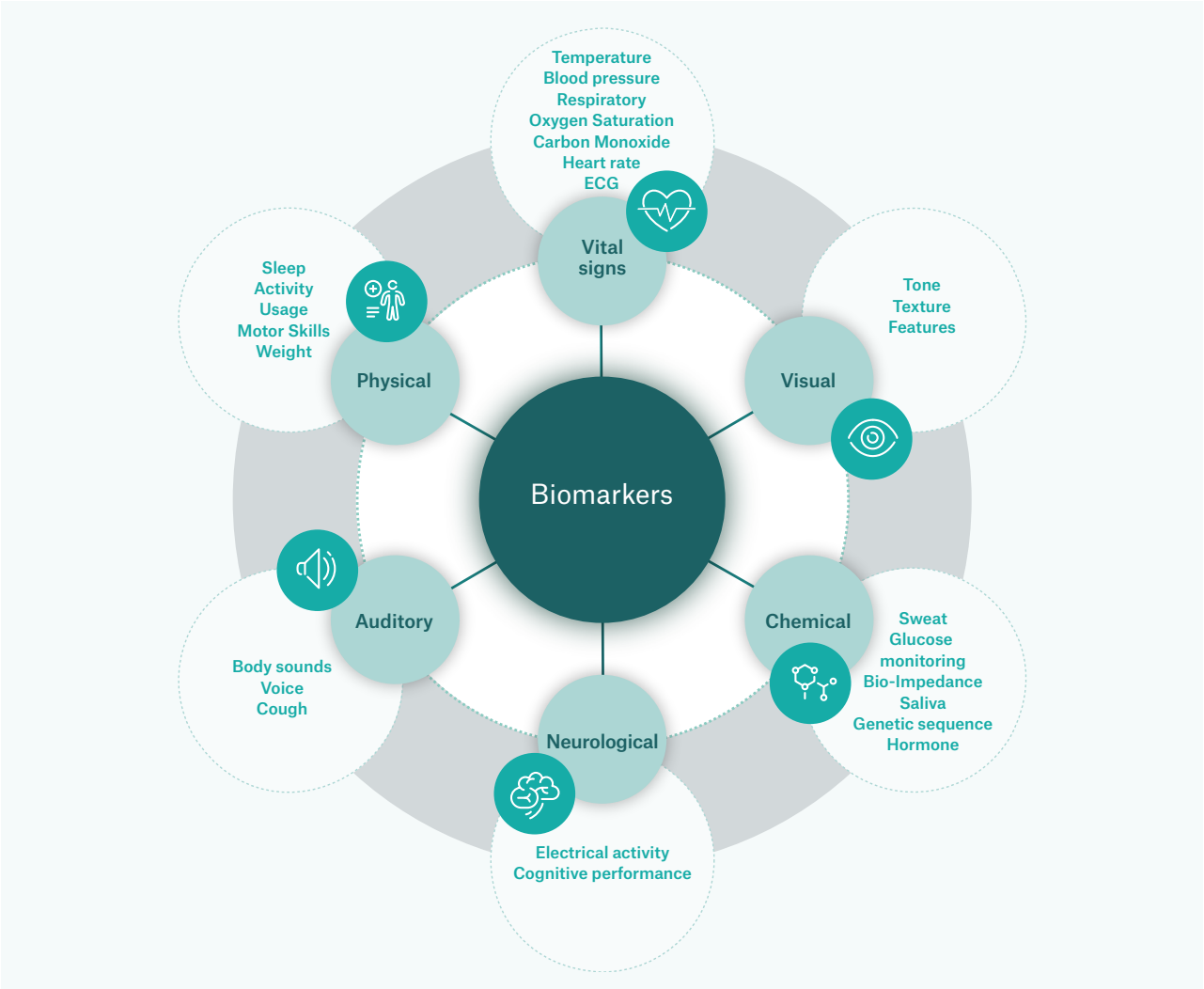


Figure 3: biomarkers can be classified according to six categories, each of which has the potential to offer valuable data for transformative personalisation

Current opportunities

Chemical biomarkers are an underutilized data source at present – hence they present great opportunities for novel, transformative personalisation in the near to mid-term.

At present, most consumer-focused chemical biomarker activity relates to the monitoring or diagnosis of health or physiological conditions. Well-known examples are the blood glucose monitors used by people with diabetes and lateral flow tests for the detection of antigens (e.g. SARS-CoV-2) or hormones (e.g. in pregnancy tests).

Moving from intermittent tests to continuous tracking of chemical biomarkers would open exciting new avenues for transformative personalisation. However, there are currently limitations in the continuous collection of biofluids such as urine and saliva. These range from hygiene concerns to the invasive nature of devices, which may require mouth or urinary tract implantation.

The next five years

In the coming years, chemical biomarker sensing solutions, for example based on sweat, will be a critical enabler. Sweat is a biofluid of great interest. As well as containing chemical biomarkers such as metabolites, electrolytes, proteins, and hormones, it offers physical insights related to the quantity and rate of loss as well as pressure and temperature. Companies such as Xsensio are already developing products and Innovation in wearable sensors could enable continuous, cost-effective, non-invasive collection and analysis.

The depth and breadth of insights that can be derived from sweat make it attractive for numerous personalised consumer health and wellness applications such as monitoring ion concentrations for info on hydration status, and cortisol levels for stress management. Work is needed to overcome challenges, such as variability in sweat composition, sensor sensitivity for detection of some trace analytes, sweat collection methods, and calibration accuracy. Nevertheless, we anticipate that sweat-based chemical biomarker sensing will be a pivotal technology for transformative consumer personalisation.

Technologies to drive actionable outcomes

Transformative personalisation requires macro-level technologies for handling big data as well as micro-level solutions for product fulfilment.

Advanced data analytics

How do you join the dots between vast and diverse data sets for genetic predisposition, microbiome condition and biomarkers in a meaningful way? Companies that make ambitious and effective use of powerful computer systems and technologies like artificial intelligence (AI) and machine learning are set to lead progress here.

It's important to acknowledge that any analytics work must heed relevant local and global data protection and privacy rules. This discussion is out of scope for this paper. However, it's encouraging to note that a PWC report on customer experience indicates that 63% of US consumers are willing to share more personal information with a company that offers a great experience[7].

To illustrate the role of data analytics and highlight key considerations we've focused on one specific area: image analysis for skincare personalisation.

Current opportunities

Computer-assisted analysis is increasingly adopted by cosmetic companies to characterise skin for the recommendation or creation of personalised products. Image processing can be used to evaluate skin condition in terms of texture, microstructure, wrinkles, melanin distribution, and pores to determine factors like elasticity and hydration levels.

The quality of images taken on smartphone cameras has led to a democratization of high-end beauty services. AI, deep learning, and software algorithms can use images and videos obtained via smartphones to analyse the skin and track changes.

Outcomes are getting closer to those from expensive imaging tools in clinical laboratories, such as hyperspectral systems which determine levels of hemoglobin and melanin chromophores. This makes highly-personalised skincare an affordable option for the mainstream consumer, enriching the experience while encouraging brand loyalty and advocacy.

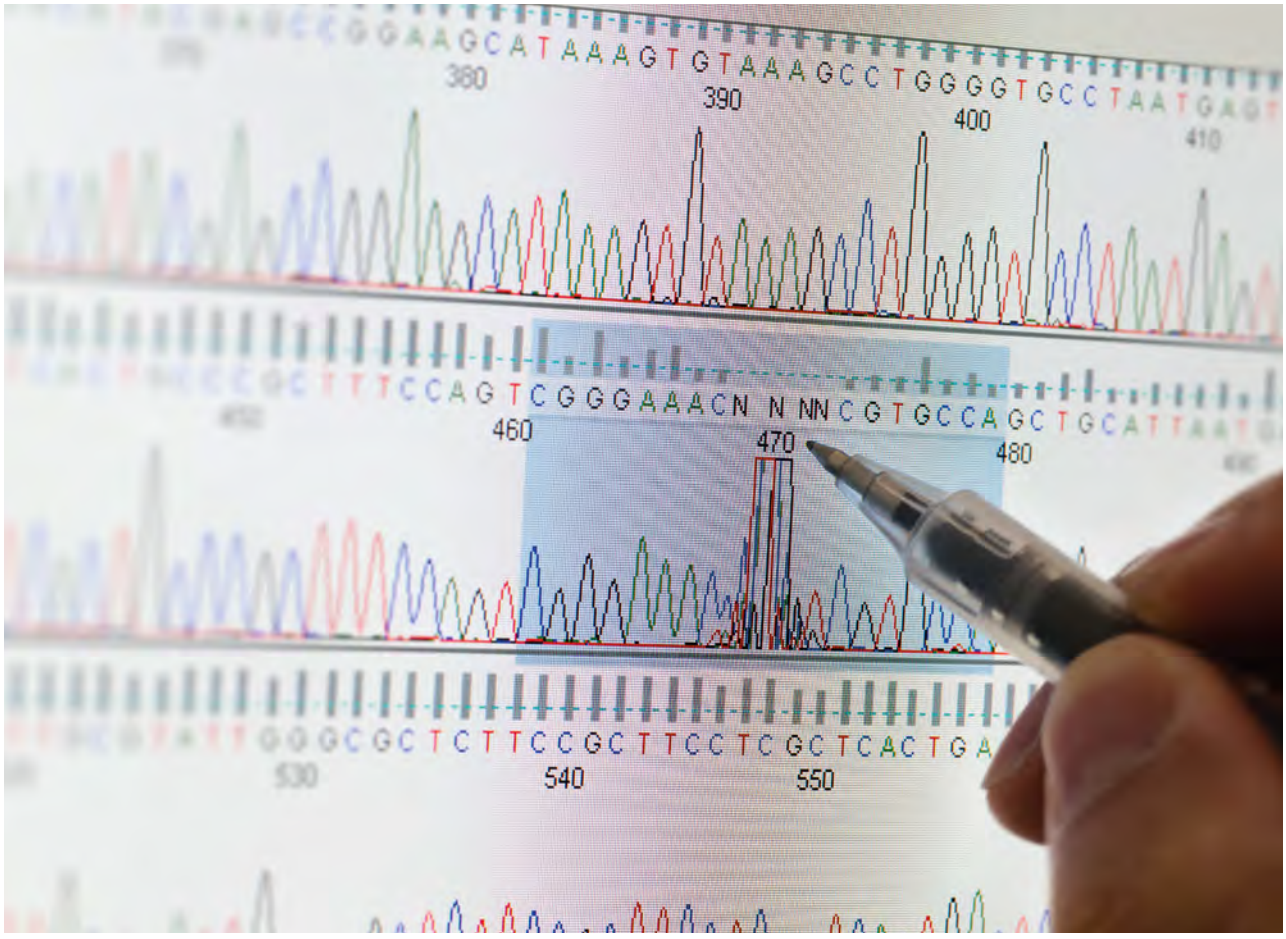
The next five years

Visual analysis combined with data analytics represents a big step forward for personalised skincare. However, the skin is also affected by hormones, the microbiome, physical health, and internal organs. Condition can also change over time, due to seasons, or use of cosmetic products. A convergence of genomic and microbiome data, as well as data from a greater range of biomarkers, will bring added value in the future. It is also important to ensure models are trained on inclusive and unbiased datasets of sufficient size to guarantee they work on all people (independent of type or colour of hair, skin, face, etc.).

Harnessing feedback is an important consideration to improve the accuracy of AI models for personalisation. For instance, if a consumer uses ten different products and gives each a rating (e.g. on a scale of one-to-ten), it's possible to derive which product characteristics are most important or effective more precisely than by using a questionnaire.

Advanced analytics (using neural network models, for instance) will be a critical enabler as datasets become ever richer and more complex – indeed, models are only as good as the dataset underlying them (this includes data type, quality, and collection frequency). So, a skincare application might rely on static data (e.g. genetics, the microbiome and consumer questionnaires) for 20% of its personalisation algorithm. The remaining 80% would be based on dynamic data from imaging (e.g. selfies), sensing devices (e.g. wearables), or consumer feedback (e.g. via an app).

This proposed versatility in personalisation data will come at a cost since databases which allow for preparation of data lakes from different sources (e.g. noSQL) require higher processing power. Breakthroughs in edge processing will aid faster processing and bring new capabilities for the management of sophisticated analytics and larger datasets together with potentially helping address potential privacy concerns by keeping sensitive data local and not in the cloud.



Closing the loop

Earlier, we noted the commercial challenges of small batch volumes and emphasised the importance of considering where and how products will be personalised (Figure 1). Traditional manufacturing environments set up for mass production generally have limited capacity for transformative personalisation. However, technologies implemented in retail environments or domestic settings can facilitate highly personalised variants of base products that have been manufactured at scale.

Many factors influence decisions about the mechanics of product personalisation. At-home options allow for greater convenience, flexibility, and frequency of updating the personalisation formula, which will appeal to many consumers. On the other hand, retail-based personalisation may be more appropriate for products that only need to be replenished or updated intermittently. It's also more cost-effective to deploy sophisticated technologies for sensing, analysis, mixing and dispensing in the retail environment.

Several technologies currently used in skincare and haircare applications offer a template for future personalisation models across multiple categories.

Current opportunities

Breakthrough personalised skincare solutions include Amorepacific's IOPE 3D Mask[8]. Currently available at IOPE Lab in Seoul, the made-to-measure hydrogel mask is 3D printed to fit the individual's face, then used in conjunction with bespoke serums for different facial zones. There is significant potential for further treatments to be personalised using this type of technology.

L'Oréal's Perso[9] is an impressive at-home device powered by AI to create personalised skincare and cosmetic formulas on-the-spot. Launched at CES 2020, it analyses data regarding skin type, environmental factors, social media trends and product preferences, then its patented three-cartridge system mixes and compresses ingredients. It has since been adapted into YSL's Rouge Sure Measure lipstick system.

Several existing solutions for 'on or around the body' use interesting approaches which could be adapted for wider personalisation applications. These include the Tineco MODA ONE Smart Iconic Hair Dryer[10] which senses hair moisture levels and air temperature more than 20 times per second to adjust heat and airflow. In the oral care category, Colgate's smart electric toothbrush, hum[11], tracks users' brushing habits and makes personalised recommendations to improve oral hygiene routines.

The next five years

Existing skincare and cosmetic personalisation technologies will underpin more intelligent consumer health offerings. For instance, UK-based retailer Boots offers a skin scanning service conducted by pharmacists and reviewed by dermatologists. This model could be further enhanced with AI-powered image analysis to diagnose skin conditions then trigger the dispense of OTC skin treatments formulated to meet individuals' specific needs. Technology that drives a differentiated in-store experience and therefore footfall could be very significant to retail recovery post COVID.

In home, genomic and other static data sources could be combined with other biomarker data, environmental and consumer input, to enable personalisation in dispense on the day of use, together with data collected over time such as sleep patterns. Wearables that respond to the environment and changes in the wearer – changing thermal or physical characteristics – will also contribute to personalised experiences.

We also anticipate future developments in the homecare category. This might involve the formulation of cleaning products that take account of variables such as water hardness, pet ownership and floor type. Similarly, personalised washing machines, dishwashers or floor-cleaning robots will dispense detergent or determine cycle length according to real-time data from inbuilt sensors.

A vision for sustainable personalisation

Many aspects of consumer personalisation raise questions surrounding waste and the sustainability of materials used. Conversely, personalised products are likely to be more satisfying and be kept longer by the consumer, reducing waste. A responsible innovation strategy finds ways to align personalisation and environmental goals. We explore this in detail in a forthcoming whitepaper.

Conclusion

Rapid technical evolution is enabling more consumer categories to explore transformative personalisation. Harnessing and combining static and dynamic data, then leveraging insights with advanced analytics, unlocks a new world of possibility. This is brought to life via bespoke formulations in the factory, in the retail environment, or in the home.

Any personalisation strategy needs to ensure it does enough to genuinely enrich the consumer experience at an acceptable price point while maintaining product margins. New technologies are pushing the boundaries of what can be achieved in a commercially viable way. Investing in the right digital and physical platforms allows consumer product companies to take focused steps towards a more personalised future. As the enabling technologies continue to mature, offerings will become increasingly valuable and individualised, driving competitive advantage.

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