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A TAXONOMY OF CUSTOMERS' CHARACTERISTICS INFLUENCING PRODUCT PERSONALISATION

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Abstract. Over the last two decades, the concept of product personalisation has received increased attention from both academia and industry. Recent developments in IT systems and digital fabrication technologies have made product personalisation not only technically doable but also economically profitable. Over the years, several studies have explored how customers' characteristics can affect product personalisation. These efforts have led to a multitude of variables being proposed and studied. This paper aims to reconcile these contributions by collating the customers' characteristics that affect product personalisation into a unified taxonomy. This taxonomy is grounded on the analysis of 56 papers. 21 costumers' characteristics have been identified and organised under 5 factors. The taxonomy clarifies which customers characteristics have been studied so far and which have been proved to influence the design of personalisable products and experiences. The taxonomy also provides the groundwork for the development of design methodologies and tools that can support designers in delivering successful personalisation experiences.

Key words: Product personalisation, customisation, theoretical framework, product design, service design.

1. INTRODUCTION

Personalised products have always existed. Since prehistory, humans have crafted items fitted to their individual needs and requirements [1]. However, during the industrial revolution, the idea of personalisation was, for the first time, abandoned in favour of reaching cost-efficiency by serialising production and delivering products with limited or no variety [2, 3].

By the mid-2000s, the efforts to conceive a theoretical model of personalisation became widespread. In 2002, Broekhuizen and Alsem [4] presented a conceptual model for successful mass customisation. The model considered external factors such as the characteristics of the customer, product, market and industry; and internal factors such as the capabilities of the company. The authors defined a successful product customisation as the one which delivers superior value to the customer by increasing perceived benefits and by minimising perceived costs. The model provided fertile insights on to the internal and external variables that influence a successful PP. Likewise, Blom and Monk [5, 6] proposed an entire theory of personalisation. This theory considered different aspects such as the system, the context of personalisation, the dispositions to personalise of the user; and the cognitive, social and emotional effects of personalisation on the customer. This theory was a significant advancement in uncovering and organising consumer characteristics. In design studies, Mugge, Jan P.L. Schoormans and Schifferstein [7] identified seven dimensions that characterise PP. The study provided a fresh perspective on the topic although it was limited at explicating dimensions rather than providing an overall framework. In 2012, Fogliatto, da Silveira and Borenstein [8] made a considerable contribution to the topic by summarising the last ten years of inquiry. Their literature review was a first attempt to provide a cohesive overview and delineate future research directions. More recently, Ferguson, Olewnik and Cormier [9] attempted to structure the knowledge on mass customisation using as a framework a generic

design process model. The authors provided a design process that practitioners can follow to deliver personalisable products. In their conclusions, the authors also outlined the current limitations and future developments for advancing PP in practice. Despite these contributions, as Ferguson et al. pointed out, there is still a lack of methods and tools for the design of personalisation processes and products.

In recent years, developments in computer science, information technologies, and digital manufacturing have challenged the dominance of serialisation [3, 10]. Technologies such as Additive Manufacturing (i.e. 3D Printing) [11], 3D scanning [12–14] and Computer-Aided Design [15] have enabled the design and production of affordable and personalised items [16–18].

In healthcare, PP is already an established practice. In this field, cost considerations are less prominent and personalised components provide incomparable advantages. Some examples are dental implants [19–21], wrist splints [22, 23], personalised hearing aids [24–26], surgical guides [27–30], and prosthesis [31, 32].

In consumer products, only recently there have been some serious attempts to implement personalisation. Some examples are ergonomic stools [33]; automotive components [34] glasses frames [35–38]; and custom-fit earphones [39, 40].

From an academic perspective, the concept of PP has attracted a significant speculative interest [8, 9]. Although the assessment of customers' needs and preferences has been widely studied, methodologies that transform these preferences into successful personalisable products are still missing [9]. Moreover, the intrinsic complexity of personalisation [9] has made it difficult for practitioners and researchers to acquire an overall understanding of this topic. Previous studies have explored the factors that should be considered when designing personalisable products; but, the interdisciplinary of the topic has led to many different theoretical models that are partially incomplete and sometimes contradictory. This has added additional confusion to an already complicated matter.

Ferguson, Olewnik and Cormier [9] proposed five future research directions and in particular the development of:

- methodologies that assist designers in converting coarse market assessment (customer requirements) into appropriate technical requirements and customisation ranges;
- methodologies for concept generation and selection that are focused on a customisable product.

To advance this field, we propose a taxonomy that collects and organises the major theoretical contributions on costumers' characteristics. The framework promotes the understanding of how to design and assess successful personalisation products and services from a customer perspective. It identifies relevant variables and provides the theoretical groundwork for the development of design methodologies and tools.

The paper is structured as follows. Section 2 describes the research methodology used for collecting, collating and representing the framework. Section 3 presents the variables connected to personalisation. Section 4, proposes the profile of an ideal personalisation customer. Finally, Section 5 discusses the implications of the model, the current limitations and the future research directions.

2. RESEARCH METHODOLOGY

To develop a taxonomy, we adopted a research methodology based on three steps: data collection, data analysis and data representation. Fig. 1 provides a representation of the methodology.

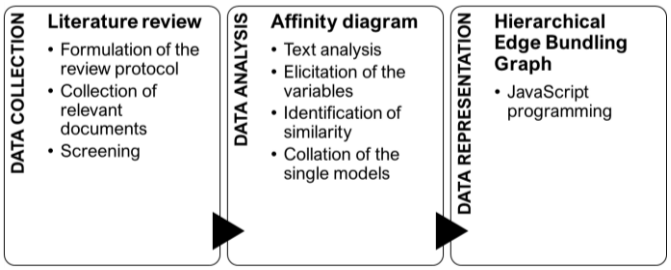

Fig. 1 – The methodology adopted in the study.

For the data collection, we adopted a literature review approach adapted from Kitchenham and Charters [41]. This method was chosen because it allowed an original critical analysis of the state-of-the-art to advance and integrate existing conceptual frameworks [42] while contributing to theory development by reorganising the available knowledge and suggesting new unexplored areas of research. Seuring and Müller [43] provided examples of how this approach can be used to develop a conceptual framework.

The literature review was carried out into three distinct activities. The formulation of the review protocol explicitly identified the basis of the search, in terms of keywords or phrases. This included the identification of inclusion/exclusion criteria, the search strategy, methods for data organisation and the approach to be used for analysis/synthesis. A key inclusion criterion was the definition of PP and its relation to Customisation as defined in the previous section. A broad range of criteria was used and articles that were eliminated included those that were:

- specific to manufacturing engineering;
- specific to supply chain or organisation studies;
- related to chemical and pharmaceuticals;
- related to food;
- related to service design;
- not related to PP;

The authors selected only the studies focused on:

- Customer applications (no B2B).

Since there is no clear agreement among academics regarding the definitions of personalisation and customisation, both terms were included in the search.

The collection of relevant documents covered research articles (from journals and published conference proceedings) that were written in English and published after January 1995. A range of databases was searched, with specificity (where available) regarding the use of the phrase in either title, abstract or keywords.

The use of alternative databases resulted in a considerable number of duplicates, which also helped ensure that the search was comprehensive. Mendeley Desktop, a bibliography management tool, was used to eliminate the duplicates.

Thereafter, the papers were screened first by looking at title and abstract and subsequently with a full-text review. During this process, an analysis of citations identified whether any important studies had been missed in the initial search. This 'snowballing' approach [44] generated additional articles that were further included in the full-text review.

The data analysis was carried out using an Affinity Diagram [45]. The models and variables described in the collected studies were isolated and organised in conceptual maps [46]. This method allowed the creation of a hierarchical structure that places the most general concepts at the top and the more specific under.

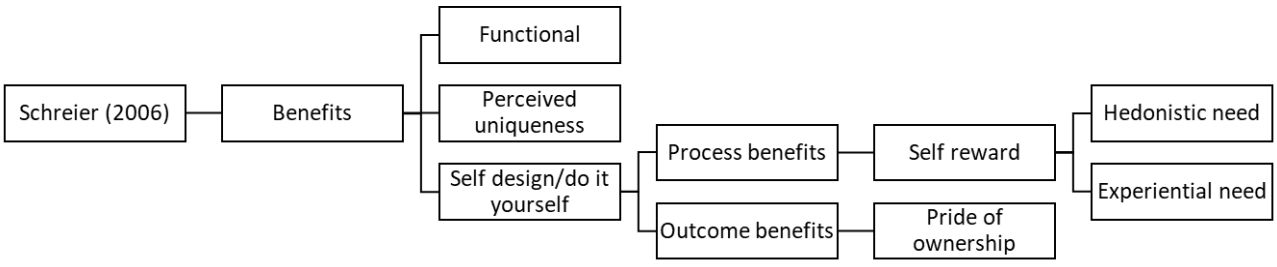

Fig. 2 – Example of conceptual mapping for one article.

When a conceptual map for each article was created (e.g. Fig. 2), the authors combined the content of each map following the same process.

3. A HIERARCHY OF PRODUCT PERSONALISATION CUSTOMERS' CHARACTERISTICS

The taxonomy is presented in *Table 1*. The number of references indicates the studies that have considered a specific variable. Although our study is based on 56 studies, this provides an approximate indication of which variables have been considered by more than one author. The variables have been organised according to 5 customers' factors. These factors are Behavioural, Cognitive, Social, Cultural, and Demographic (see *Table 1*).

Table 1

Taxonomy of customers' characteristics influencing product personalisation.

Factor(s)	Variables	References	N' of references
Behavioural factors	Individualist or ego-involved	Oulasvirta and Blom, 2007; Fogliatto, da Silveira and Borenstein, 2012	2
	Extroversion/introversion	Oulasvirta and Blom, 2007; Franke, Keinz and Steger, 2009)	2
	Self-determination	Simonson, 2005; Oulasvirta and Blom, 2007	2
	Desire for control	Oulasvirta and Blom, 2007; Marathe and Sundar, 2011	2
	Self-expression	Niinimäki and Koskinen, 2011; Va den Berge et al., 2020	2
	Idiosyncrasy	Simonson, 2005	1
	Variety-seeking	Simonson, 2005,	1
	Sensation-seeking	Oulasvirta and Blom, 2007	1
	Risk attitude	Simonson, 2005	1
	Mindset	Miceli et al. 2007	1
	Necessity bias	Simonson, 2005	1
	Product involvement	Broekhuizen and Alsem, 2002; Franke, Keinz and Steger, 2009; Franke, Schreier and Kaiser, 2009; Oulasvirta and Blom, 2007; Sung, Grinter and Christensen, 2009; Tunn et al. 2019	6
Cognitive factors	Expertise	Huffman and Kahn, 1998; Dellaert and Stremersch, 2005; Miceli, Ricotta and Costabile, 2007; Totz and Riemer, 2001; (Blom and Monk, 2003; (Monk and Blom, 2007; Chang, Changchien and Huang, 2006	7
	Personal preferences	Franke, Keinz, & Steger 2009 and Simonson 2005; Huffman and Kahn, 1998; Kwon, Cho and Park, 2010; Arora et al., 2008; Syam, Krishnamurthy and Hess, 2008; Aheleroff et al. 2019	7
Social factors	Social requirements	Sung, Grinter and Christensen, 2009; Franke, Schreier and Kaiser, 2010; Kudus et al., 2016; Monk and Blom, 2007; Ariadi et al., 2012; Jung Choo et al., 2012;	6
	Seasonal, media and peer influences	Blom and Monk, 2003; Monk and Blom, 2007	2
	Increase in social capital	Fischer, 2002	1
	Relation with the marketer	Simonson, 2005	1
Cultural factors	Individualistic/collectivistic	Totz and Riemer, 2001; Kramer, 2007	1
Demographical factors	Gender	Tossell et al., 2012	1

3.1. Behavioural customer factors

Behavioural characteristics can be defined as the inherent ways in which each customer acts or conducts oneself, especially towards the personalisation process or the personalisable product (adapted from [47]). For instance, the significance of personality traits is convincingly emphasised in the literature on personalisation. Traits that have been shown to have a positive correlation with personalisation involve **individualism or ego-involved** [8, 48], **extroversion** [48, 49], **idiosyncrasy** i.e. atypical behaviour [50], **self-determination** i.e. the ability or power to take independently decisions [48], **variety-seeking** [50], **self-expression** [51, 52], **sensation-seeking** [48] and **necessity bias** i.e. preference for necessity items over luxury [50].

The **risk attitude** [50] or the perceived risk represents the uncertainty about whether the engagement in the design process will result in a positive net value [53]. This risk can take the form of a user's self-doubt about spoiling the product because they are not skilled enough [54] or the feeling of uncertainty about whether the product has been personalised correctly [55]. Vesanen [56] and Broekhuizen & Alsem [4] also considered that customers may feel a privacy risk; in other words, the risk of disclosing intimate information which may be required for achieving the personalised outcome.

For Miceli, Ricotta and Costabile [57], also customers' **mindset** may influence the reasons why customers personalise. Goal-oriented customers, who are task-oriented, rational and utilitarian, may adopt personalisation for increasing user-friendliness, usability and convenience. In contrast, experiential customers, who are more hedonistic and playful, may personalise products to attain gratifying stimuli independently from utilitarian aims. The **desire for control** plays also a significant role in motivating personalisation [48, 58]. Customers may be motivated by interacting with the environment in a way that produces desired outcomes while reducing undesired ones.

Product involvement i.e. the relevance of a specific product as perceived by a customer based on his/her individual needs, preferences, and interest [4, 49, 59] or personal relevance i.e. a change in the way the product looks or behaves that bears significantly on the persona of the user [48] have a motivational effect on the user because they touch his/her personal interests, passions and preferences [60, 61]. For instance, a user that has a personal passion for furniture might be more motivated to engage in personalising this type of product. Conversely, an initial lack of involvement seems to negatively affect customers' willingness to personalise. Customers seem to be less likely to personalise if they do not think of the candidate product for personalisation as being their own [48].

3.2. Cognitive customer factors

Alongside the behavioural aspects, the literature provides indications of the importance of cognitive characteristics. These cognitive characteristics can be defined as the customer's mental action or process of acquiring knowledge and understanding through thought, experience, and the senses (adapted from [47]).

Huffman and Kahn and Dellaert and Stremersch [62, 63] highlighted the relevance of **expertise** in the personalisation process. Miceli, Ricotta and Costabile [57] stated that experts and novices have different information requirements during personalisation. For instance, experts can process more options and are less subject to information overload. Correspondingly, Totz and Riemer [64] proposed that inexperienced customers need well-guided processes and detailed information on every configuration step or attribute alternative. Blom and Monk [5, 6] suggested that two types of expertise can be at play when personalising products, the customers' knowledge of the product and the customers' knowledge of the personalisation process. Additionally, Chang, Changchien and Huang [65] distinguished three forms of product-specific knowledge: subjective, objective and experience-based knowledge.

Simonson and Franke, Keinz and Steger [49, 50] highlighted the importance of **personal preferences**. Several factors regarding personal preferences seem to be involved in personalising products. Some of which are: having well-defined and stable preferences, being self-aware of one's preferences, being able to express and articulate one's preference or being able to evaluate if a product fits one's preferences. All these factors positively correlate to personalisation [49, 50, 66]. According to Huffman and Kahn [62], discovering our preferences within product attributes can also be a motivation for personalisation.

Additionally, there are situations in which customers may have a **preference for standardised products**. Kwon, Cho and Park [67] argued that one-to-one personalisation of the content does not improve customer value more significantly than one-to-N customisation. According to them, market segmentation provides a

suitable alternative if one-to-one personalisation requires too much time, cost or effort. For instance, customers may realise after designing their "ideal" product that their actual preferences correspond more closely to a standardised one [68], [69]. Finally, because customers' preferences can be volatile, users may be as satisfied with products that seem to be customised even if the differences from standardised products are minimal [50].

3.3. Social customer factors

Social factors account for those dimensions that are related to society or its organisation (adapted from [47]). For instance, the socio-emotional context of use may play a role in motivating personalisation [6], [70–72]. Personalisation can be used to accommodate **social requirements** by eliciting an emotional response or expressing identity [73]. Also, **seasonal, media and peer influences** can prompt users to personalise [5, 6].

For Fischer [74], an **increase in social capital** can act as a motivating factor. This may be explained by the social contribution that personalisation can foster. By working on and learning about designing their product, users can act as resources for other users thus increasing their social capital.

Remarkably, also the **relationship with the marketer** can be a motive for personalising products. Simonson [50] suggested that the perceived costs and benefits of maintaining a relationship with the company that provides personalisation and the trust in the marketer can both positively affect customers' willingness to personalise. In other words, if the customer has a strong and trustworthy relationship with the company, this will positively affect his/her disposition to personalise.

3.4. Cultural customer factors

Cultural characteristics relate to the ideas, customs, and social behaviour of the customer's society (adapted from [47]). Totz and Riemer [64] pointed out the significance of the **cultural background**. Customers from a collectivist culture may react more positively to products that meet group preferences rather than to those that meet individual ones [75].

3.5. Demographic customer factors

Some authors have also found that demographical characteristics i.e. those characteristics related to the structure of populations, may play a role in motivating personalisation (adapted from [47]). For instance, Tossell et al. [76] proposed that **genders** may have different approaches toward personalisation. Males seem to be more motivated by enhancing their competence and perhaps autonomy. Instead, women seem to personalise more for appearance and social reasons.

4. DEFINING THE PROFILE OF AN IDEAL PERSONALISATION CUSTOMER

Based on the studies analysed, it is also possible to define a profile/persona of an ideal personalisation customer.

In terms of behavioural factors, this ideal customer is individualistic, extrovert and possibly eccentric. He/she is seeking for variety and sensation while having a desire to control the environment. He/she has a risk-seeking attitude and is willing to take a risk in personalising a product. The personal involvement with the product category that he/she is looking to personalise is high. He/she likes, is interested or engaged with the product category.

The ideal personalisation customer has also knowledge of the product and the personalisation process. He/she is confident in the personalisation process while possibly knowing how the product is made, how personalisation works and which outcomes can be expected.

The ideal customer has well-defined and stable preferences, he/she is self-aware of these preferences and can express and articulate them to others, to him/herself or a personalisation tool. The ideal customer is also able or confident to evaluate if a product fits with his/her preferences.

In term of social factors, a social context in which emotional response or the expression of identity are valued may push the ideal costumer to personalise items. This is also true for seasonal, media and peer influences. Fashion or technology trends that give a positive value to personalisation may influence the customer.

An ideal customer has also a good and trustworthy relationship with the marketer. This reduces the risk involved in the personalisation process with better aligning expectations with actual outcomes.

Finally, the ideal customer comes from an individualistic culture where the value of the individual is more important than social conformity.

5. CONCLUSIONS

This study aims to collect and organise the costumers' characteristics that affect product personalisation. 21 characteristics have been retrieved from the literature and categorised into 5 factors. By organizing these characteristics, the model provides a starting point for the development of methodologies that can assist designers in creating successful personalisation experiences.

The study shows that Customers' characteristics are important for successful product personalisation. Depending on how these characteristics are accounted for, customers' willingness to personalise and satisfaction can both be stimulated or inhibited. Designers need to acknowledge these characteristics and that only certain customers might be willing to embark into the personalisation process while others might not. This highlights the importance of understanding the target market and defining if there are customers with the appropriate characteristics. For a design perspective, this can also suggest that designers can facilitate personalisation by designing processes and experiences that acknowledge customers characteristics.

Additionally, the taxonomy exposes areas for future studies. For instance, the studies analysed so far do not consider the role of customers' behavioural, physical and cognitive impairments. Elderly customers may be less likely to personalise due to reduced cognitive and/or physical capabilities. This is also true for the social, cultural and demographic characteristics of customers. These domains have been studied only marginally but they could be significant for personalisation. For instance, customers' belonging to a specific subculture may be more willing to personalise, in order to fit more closely with their social context. Moreover, the more the subculture is a niche' the more personalisation might be relevant since it is more difficult to find an adequate offer on the market. Likewise, the same considerations can be applied to customers' demographics such as age, social class and education level. These could all be areas for future consolidation of PP inquiry.

Given the breadth of production personalisation, the study presented does not pretend to be a comprehensive review of all contributions on personalisation and mass customisation. Missing studies on single aspects of PP could provide additional variables or more insights on those already listed. Future research should aim at expanding the taxonomy and incorporating any neglected variable or those generated by future studies.

A major limitation of the model is a lack of the relative power and validity of the variables. While some factors appear to have been mentioned by more than one author; this provides a weak indication of their validity and power. The relative influence of the variables may be important considering a large number of factors at play. Further work is required to test the viability and relative power of each variable. Finally, further research should be undertaken to develop methodologies and tools that support the design of personalisation processes and products.

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