

**PERSONALIZATION RESEARCH IN E-COMMERCE  
– A STATE OF THE ART REVIEW (2000-2008)**

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**ABSTRACT**

E-commerce product personalization and website personalization have been a topic of interest to a lot of researchers during the last years. As such, academic research in the area of personalization in e-commerce should rely on a rigorous literature review first in order to identify existing research and acknowledge the state of the art in research. This article provides a vast overview on personalization literature with a special focus on e-commerce (e.g. recommender systems). This literature, respectively our approach, can be used by fellow researchers to identify the basic literature for their own work. It serves as a rigorous way of retrieving literature for other fields in their scientific research.

A complete reference list is presented as well as additional figures and tables analyzing the personalization literature in general and according to an emerging classification. The three major categories of personalization research in e-commerce are: “implementation”, “theoretical foundations”, and “user centric aspects” under which there are several subcategories into which the papers can be classified. The reviewed articles (42 in total out of 15,116) were taken from all the relevant, high ranked (A to C) journals according to the journal ranking list: JOURQUAL2.

Keywords: personalization, e-commerce, state of the art, classification, literature review

**1. Introduction**

Personalization plays an important role for service providers in modern e-commerce strategies; it is important to build up a tight customer relationship in order to address customers personally. Speaking about personalization in e-commerce brings up the problems of identifying a customer, gathering information around the customer, and processing data to make a service seem personally adopted for a certain customer (e.g. recommender systems or comparison-shopping systems). One needs to look at two different business software systems when analyzing customer self-service applications in e-commerce (enabling the customer to use services on their own through personalization): (1) ERP systems as back-office systems and (2) Web applications (mainly e-shops) as front-office applications. Personalization is a means of facilitating this ease of use by presenting the customer with a pre-defined service for personal needs [Risch 2007]. It is an interdisciplinary topic with which research papers in the field of marketing and computer science have increasingly been concerned.

In order to give researchers a deeper insight into the facets of personalization in e-commerce and to offer a starting-point for this research, the outcome of a rigorous literature investigation on personalization from the field of IS research is presented. The following sections will give an overview on the current literature in the area of e-commerce personalization. The research methodology used for this research is based on a reasonable way for retrieving relevant articles. With the above-mentioned literature in mind, we started our research with an initial set of keywords for our title-based search (section 3). In section 4, we discuss the emerging classification of the collected articles to summarize the results in section 5. Afterwards, we discuss our contribution to the research on personalization (section 6) and point out the limitations (section 7) and future directions of our research (section 8). Founding our research on existing literature makes it a form of secondary research with an explorative and

descriptive focus. This article's structure is derived and inspired from several literature review articles published in the International Journal Production Economics [Ngai et al. 2007], International Journal Management and Enterprise Development [Moon 2007], Communications of the Association for Information Systems [Lee et al. 2003], and the Proceedings of the European Conference on Information Systems [vom Brocke et al. 2009].

## 2. Theoretical framing and related work

Personalization is targeted at fulfilling a special customer or user requirement [Risch 2007]. E-commerce, the technical assistance of transactional activities [Turban 2000] (selling and buying products and services), is a common field of application for personalization methods and techniques. Thereby e-commerce does not only cover webshops but also the actions of recommendation engines and comparison agents.

According to other definitions, personalization can be aimed at people (customers or employees) as well as at organizational roles in companies, such as a purchasing agent: Deitel et al. [2001] define personalization as using "information from tracking, mining and data analysis to customize a person's interaction with a company's products, services, web site and employees." Mulvenna et al. [2000b] understand personalization as "the provision to the individual of tailored products, service, information or information relating to products or services. This broad area also covers recommender systems, customization, and adaptive web sites." Adomavicius and Tuzhilin [2005a] summarize that "personalization tailors certain offerings (such as content, services, product recommendations, communications, and e-commerce interactions, which is in fact a facet of comparison-shopping agents) by providers (such as e-commerce web sites) to consumers (such as customers and visitors) based on knowledge about them, with certain goal(s) in mind."

These definitions imply a close relationship between personalization and the recommendation of items. Even if recommender systems are undoubtedly an interesting part of personalization, there are many other personalization functionalities that are geared to improving customer loyalty. Examples of such functions are personal shopping lists, customer-specific assortments, or extensive checkout support. In the terms of Herlocker et al. [2004] these functions relate to the satisfaction of the customer's goals ("user tasks"). Therefore, the broader definition of personalization provided by Riecken [2000] seemed most appropriate for this study: "personalization is about building customer loyalty by building meaningful one-to-one relationships; by understanding the needs of each individual and helping satisfy a goal that efficiently and knowledgeably addresses each individual's need in a given context." The possibilities of personalizing the user interface are pointed out by Peppers and Rogers [1997] as well as by Allen et al. [2001]. In connection to recommender systems comparison-shopping agents (as special instances of personalization systems) recommend commodities or services to a customer that fit the personal needs at a high rate.

Personalization starts after the identification of a user, e.g. through login. The personalization process is context sensitive (regarding the output for a certain user) and requires learning (by the system) since personalization uses information about customers. The general term used for stored customer information is the "user profile" or in the context of electronic shopping the "customer profile". There are various ways how e-shop operators can cultivate customer profiles: "historically" by storing (1) interaction with the website (click stream), or (2) by purchase transactions, or "explicitly" by asking (3) for preferences, or (4) for ratings, or (5) by recording contextual information (e.g. time, date, place). What formerly seemed to be possible only for the corner shop whose storekeeper knew all the customers personally, reaches new potential in the online medium where every customer leaves traces and thus "teaches" the system how to treat him in a different way than other customers. This form of personalization becomes feasible with the use of predefined rules that can be built into e-commerce environments. These automatic personalized websites do not achieve the high quality of corner shops but they help to establish a personal dialogue with the customers and, thus, to tie them closer to the electronic option. Additionally, the time spent by the customer to "teach" the system is assumed to lead to an increase in switching costs.

Over the past years, in the broad field of personalization, there has been a lot of research focusing on recommender systems [Sarwar et al. 2000; Adomavicius & Tuzhilin 2005b; Herlocker et al. 2004], comparison-shopping agents [Clark 2000; Wan et al. 2003; Yuan 2003; Maes et al. 1999; Guttman and Maes 1998; Doorenbos et al. 1997], privacy concerns [Ackermann et al. 1999; Preibusch 2005; Risch & Schubert 2005], human-computer interfaces (HCI) [Spiekermann & Paraschiv 2000; Baresi et al. 2002; Esswein et al. 2003] and personalization as a marketing approach [Peppers & Rogers 1997; Pal & Rangaswamy 2003; Schubert & Koch 2002]. The ability to deliver personalization depends upon (1) the acquisition of a "virtual image" of the user, (2) the availability of product meta-information, and (3) the availability of methods to combine the datasets in order to derive recommendations for the customer.

However, the collection and use of customer information also has a downside – collecting customer specific data may be considered to invade the customers privacy [Gentsch 2002; Nah and Davis 2002]. Other effects of careless data collection activities are intentional false statements which lead to bad data quality and, therefore,

useless customer profiles [Treiblmaier and Dickinger 2005]. The importance of privacy and security aspects in the field of CRM was pointed out in a survey by Salomann et al [2005]. There is an ongoing discussion about privacy that is closely related to personalization. Cranor [2003] discussed privacy risks associated with personalization in e-commerce applications and provided an overview of principles and guidelines to reduce these risks. He identifies the following privacy concerns: (1) unsolicited marketing, (2) system predictions are wrong (incorrect conclusions about users), (3) system predictions are too accurate (the system knows things nobody else knows about the users), (4) price discrimination, (5) unwanted revelation of personal information to other people, (6) profiles could be used in a criminal case, and (7) government surveillance.

This research focuses on the methodology of retrieving relevant literature in personalization in e-commerce. Besides two specific literature review articles from Veasanen [2005; 2007] that cover personalization in general, there are several articles dealing with essentials and basic literature around some focus topics in the area of personalization. For example, Schafer et al. [2001] provide a vast overview on e-commerce recommendation applications with their corresponding literature. Manouselis and Costopoulou [2007] classify multi-criteria recommender systems in their work. They take into consideration existing taxonomies for recommender systems or similar areas of research such as the work of Hanani et al. [2001] (information filtering systems), another survey that mainly deals with recommender systems of the e-commerce domain by Wei et al. [2002], the survey on recommender agents by Montaner et al. [2003], a state of the art analysis of recommender systems by Adomavicius and Tuzhilin [2005b] and a case study based analysis of online personalisation systems by Yang and Padmanabhan [2005]. Our work does not focus on concrete systems as the other surveys mentioned above but on a vast area of research including e.g. systems, methods, studies, and interdisciplinary sciences. This is why we decided to start researching from a neutral perspective not to have a bias towards a special characteristic of the research area and proceeded in a rigorous manner as stated in the next section.

### 3. Research methodology

Due to the large amount of literature on e-commerce and business studies, we decided to narrow our object of investigation to a reasonable amount of literature. In accordance with vom Brocke et al. [2009], we identified journal ranking lists as a valuable starting point for a literature research. Since journal rankings are an approved way to ensure the quality of a given publication source, we believe this as a reasonable starting point for a literature search. When striving for a relevant ranking, we decided on the VHB JOURQUAL2 ranking mainly for two reasons. First, unlike many journal rankings, JOURQUAL2 is fully and officially accepted by the national IS research community and goes along with international ranking lists. Second, since large parts of the German IS community have a design science background, JOURQUAL2 also takes into account journals that have a stronger design science perspective. The ranking was developed by the VHB, a German consortium of university professors participating in business science research. The ranking was established in 2003 (JOURQUAL) and evolved in 2008 (JOURQUAL2).

Altogether there are several ranking sublists within JOURQUAL2 for special topics in Business Studies (e.g. a partial ranking for finance, a partial ranking for production, a partial ranking for IS Research, and a partial ranking for Electronic Commerce). JOURQUAL2 establishes a classification in range from A+ (best) to E (worst). Journals omitted in the JOURQUAL2 ranking do not get enough points in the ranking process in which the research community awards points to the most relevant journals according to their experience with the journals (the complete ranking procedure is described by Hennig-Thurau et al. [2004]).

In this study, we focus both on the JOURQUAL2 lists on Electronic Commerce and on IS Research. We considered all articles from journals ranked from A+ to C which were published between 2000 and 2008. In total, we analyzed 38 journals, mostly written in English (very few of the investigated journals were published in the German language, namely *Wirtschaftsinformatik*, *Wirtschaftsinformatik* conference and partly *Lecture Notes in Informatics*). Altogether, we came to an amount of 15,116 international articles across all journals. In order to mechanically narrow down our search we applied the following keywords on the title of each article: “personali\*”, “customer” (separated into solely “customer” and the additive term “customer relation”), “customizing”, and “customization”. As a result, we received 317 articles (some of the articles were accounted twice or more within the automatic keyword search).

In the second step, we analyzed the resulting articles manually concerning their topic. We excluded every article that had nothing in common with Electronic Commerce or personalization by identifying exclude keywords. Hence, the following keywords were used to exclude articles: “public sector“, “mobile”, “smart phones”, “learning environment”, “learning platform”, “support learning”, “collaboration”, “online recruitment”, “television”, “music”, “CRM” or “customer” (with no “web”, “e-commerce” and “personalization” in title), “transaction cost”, “gaming”, “banking”, “auction”, and (personalized web-)“search” or “scanning”. We classified all selected articles

independently from each other after carefully reading the papers to check whether or not they fit into the subject of “personalization in e-commerce”.

As a result, our findings are based on journals within a ranking system that ensures the overall quality of the journals and the presumed scientific proceeding. Hence, any researcher following our methodology and proceeding can reproduce our findings. Note that we do not consider the quality measurements of individual articles (e.g. via impact factors). In total, we were able to identify 42 articles in the context of personalization in e-commerce (cf. table 1). Although the search was not exhaustive (compare section 7) it serves as a comprehensive basis for gaining an understanding of personalization research in e-commerce.

Table 1: Journals of the JOURQUAL2 list with number of identified personalization articles

Journal	No. of articles	Journal	No. of articles
Communications of the ACM	11	Communications of the AIS	0
Decision Support Systems	7	Computer Supported Cooperative Work	0
International Journal of Electronic Commerce	4	Computers & Operations Research	0
Electronic Markets	4	Data and Knowledge Engineering	0
Information and Management	3	DATA BASE for Advances in Information Systems	0
Journal of the Association of Information Systems	2	Human Computer Interaction	0
IEEE Transactions on Engineering Management	2	I&O Information and Organization	0
Information Systems Frontiers	2	IEEE Pervasive Computing	0
Information Systems Research	2	IEEE Software	0
International Journal of Information Management	2	Information Systems	0
Wirtschaftsinformatik / BISE	1	Information Systems and eBusiness Management	0
European Journal of Information Systems	1	Information Systems Journal	0
INFORMS Journal on Computing	1	International Journal of Media Management	0
ACM Computing Surveys	0	Journal of Computational Finance	0
ACM Transactions on Computer Human Interaction	0	Journal of Information Technology	0
ACM Transactions on Database Systems	0	Journal of the ACM	0
ACM on Information Systems	0	MIS Quarterly	0
Artificial Intelligence	0	MIS Quarterly Executive	0
		SIAM Journal on Computing	0
		The Journal of Strategic Information Systems	0

#### 4. Literature categorization in the field of personalization

In this article, we provide a content driven categorization of literature concerning the field of personalization in e-commerce. Three major categories emerged out of the collected articles which are in detail: “user centric aspects”, “implementation”, and “theoretical foundations”. A summary of all the major categories and their subclasses are collected in table 2. Detailed information on each topic is presented in the following paragraphs.

Table 2: Classification of the reviewed literature

Classification	References
<b>User centric aspects</b>	
User experience	Ho (2006), Kramer et al. (2000)
Loyalty	Gefen (2002), Kassim and Abdullah (2008), Otim and Grover (2006), Wang and Head (2007), Enzmann and Schneider (2005)
User acceptance	Ho (2006)
Privacy	Eugene (2000), Enzmann and Schneider (2005), Suh and Han (2003)
Customer orientation	Fang and Lightner (2003)
Customer risk	Nicolas and Castillo (2008)
Customer trust	McKnight et al. (2001), Hwang and Kim (2007), Gefen (2002), Suh and Han (2003)
Customer communication	Tam and Ho (2005)
Customer satisfaction	Negash et al. (2003), McKinney et al. (2002), Lu (2003), Shim et al. (2002), Koivumäki (2001), Kassim and Abdullah (2008), Gefen (2002), Wang and Head (2007)
Customer support	Negash et al. (2003)
Customer expectation	Schubert (2002)
Customer service	Lightner (2004)
Supplier customer differentiation	Yuan (2003)
<b>Implementation</b>	
Recommender systems	Mulvenna et al. (2000a+b), Cheung et al. (2003), Holland and Kießling (2004), Schubert and Silvestri (2007), Liang et al. (2008)
Mass customization	Blecker and Friedrich (2007), Cavusoglu et al. (2007), Mobasher et al. (2000)

Data collection and processing	Mobasher et al. (2000), Schubert and Ginsberg (2000), Shahabi and Banaei-Kashani (2003), Eugene (2000), Suh and Han (2003), Cingil et al. (2000), Frias-Martinez et al. (2006)
Practical guides	Fink et al. (2002)
Systems	Hwang and Kim (2007), Yuan (2003), Cheung et al. (2003), Negash et al. (2003), Enzmann and Schneider (2005)
Algorithms	Lee and Lee (2005), Cheung et al. (2003)
Design/Interface	Fang and Lightner (2003), Lightner (2004), Kumar et al. (2004)
<b>Theoretical foundations</b>	
Methods	Ardissono et al. (2002), McKinney et al. (2002)
Studies	Ho (2006), Kumar et al. (2004), Romano and Fjermestad (2001), Nysveen and Pedersen (2004), Hwang and Kim (2007), Liang et al. (2008), Koivumäki (2001), Kassim and Abdullah (2008), Otim and Grover (2006), Negash et al. (2003), Wang and Head (2007), Schubert (2002), Suh and Han (2003)
Guidance	Frias-Martinez et al. (2006)
Processes	Adomavicius and Tuzhilin (2005a)
Models	Aron et al. (2006), Frias-Martinez et al. (2006)

4.1. User centric aspects

Personalization in e-commerce is based on user interactions; hence, it is necessary to cover at least the most important aspects of this human machine form of communication. These aspects are, for example, using customer experiences for designing personalization systems; analyzing impact factors to customer loyalty, acceptance, or privacy; and several aspects concerning generic customer needs such as trust, support, or expectations (cf. figure 1).

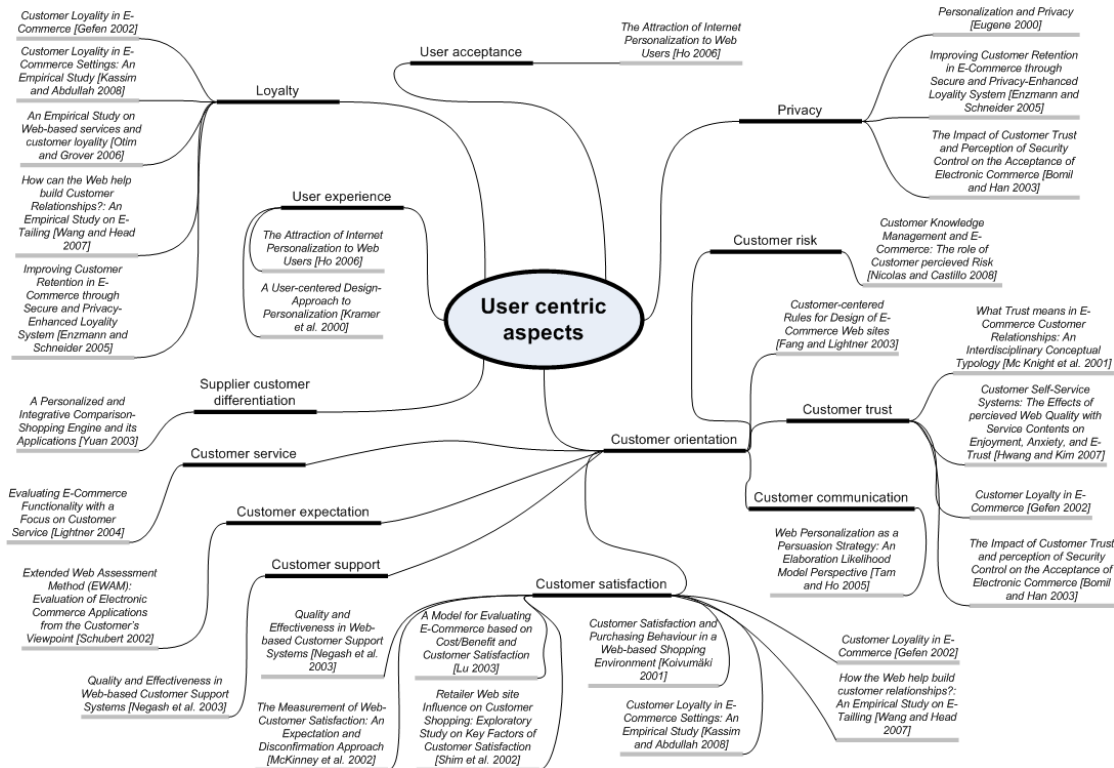


Figure 1: User centered literature on personalization

4.1.1. User experience, loyalty, and user acceptance

There are several articles arguing for learning from user experiences (e.g the influence of users' experiences with personalization on their attitudes towards personalized websites [Ho 2006]) and focusing on loyalty building mechanisms for increasing further personalization methods in the future: In order to gain knowledge about the aspects and factors concerning loyalty it is important to differentiate between attitudinal and behavioral components [Jacoby and Chestnut 1978] and to analyze the impacts on loyalty such as the quality of products, promotion, and pricing mechanisms [Danaher & Rust 1996]. According to Cigliano et al. [2000] there are several types of loyalty

programs such as virtual communities or rewarding systems. Kramer et al. [2000] developed a framework to use personalization techniques to benefit user experiences and user acceptance [Ho 2006] within e-commerce systems.

4.1.2. Privacy

Loyalty and privacy are coupled together tightly, as Suh and Han [2003] describe in their work on customer trust and its effects on the service acceptance. Privacy stands for all aspects that are concerning the prevention of misusing personal data and the juridical implications and challenges for using personal data within software systems [Eugene 2000].

4.1.3. Customer orientation (risk, trust, communication, satisfaction, support, expectation, service and differentiation)

In relation to personalization, a user is either the provider of a service (supplier) or the consumer of a service (customer). Therefore, it is essential to divide between the personalization issues of suppliers and those of customers. The most covered area of study on personalization or e-commerce is the user and his behavior and perception, with all the diversifications of this context: e.g. risk, trust, communication, satisfaction, support, or expectations. These aspects are covered by the following references: [Nicolas & Castillo 2008; McKnight et al. 2001; Hwang & Kim 2007; Gefen 2002; Suh & Han 2003; Tam & Ho 2005; Negash et al. 2003; McKinney et al. 2002; Lu 2003; Shim et al. 2002; Koivumäki 2001; Kassim & Abdullah 2008; Wang & Head 2007; Schubert 2002]. During the usage of an e-commerce service the customer is often forced to give away personal data not necessary for conducting the actual service (e.g. specifying a telephone number while paying of items in a virtual shopping cart with electronic payment). One goal for a provider of services is to gain the most possible from the collected data with a minimal level of risk for the customer while maintaining customer satisfaction and trust. Lightner [2004] developed a checklist to create effective e-commerce sites implementing the goals stated above.

4.2. Implementation issues in the field of personalization

Besides creating user-friendly systems for service providers and customers, it is important to consider implementation specific issues such as providing algorithms, design principles, and patterns for actions within a personalization system [Fang & Lightner 2003; Fink et al. 2002]. In literature, much has been written about recommender systems, mass customization, data collection, data processing, and generic guides for implementations (cf. figure 2).

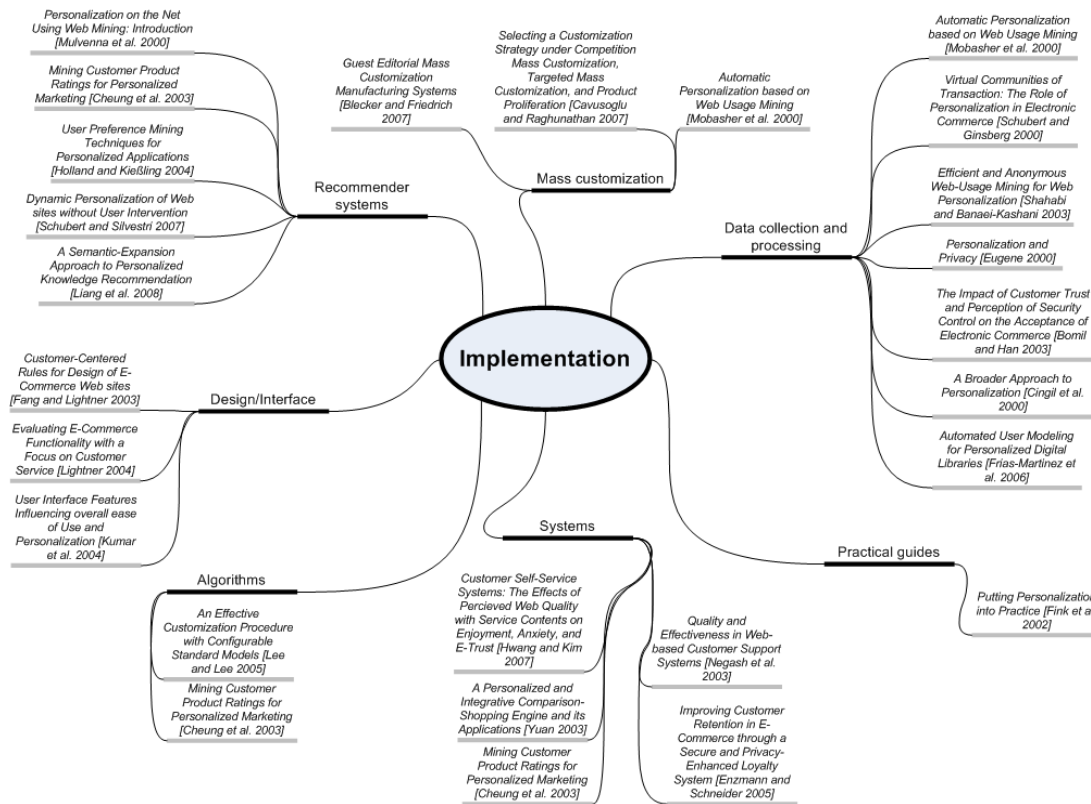


Figure 2: Implementation literature on personalization

#### 4.2.1. Recommender systems

Recommender systems combine two fields of research: artificial intelligence and information retrieval. The software can support customers within their buying process by calculating and presenting recommendations that fit the customers' personal profile as they search for products [Ricci & Werthner 2006]. In general, several input factors can be considered in order to generate a model of the users' needs and preferences. The considered input factors can implicitly be derived out of previous actions and transactions. Furthermore, in terms of ratings, preferences, user configurations, etc. they can be explicitly given to the systems that are responsible for generating the recommendations [Risch & Schubert 2005].

#### 4.2.2. Mass customization

Mass customization is an oxymoron combining two opposing terms: "mass production" and "customization" [Davis 1987]. In terms of production, it is the combination of two approaches uniting the benefits of each: producing cost efficiency through mass production and customizing products to fit the customer's needs to a maximum. "Mass customization" stands for the "personalization of a production process" and can be generalized as "individualization" as a hypernym to "general personalization" and "mass customization" [Risch 2007]. Blecker and Friedrich [2007] point out four critical factors to influence the performance of mass customization systems: product design, product configuration, production processes, and supply chain operations. According to Cavusoglu et al. [2007] the customization strategy should be tightly connected to given competitive situation (sometimes it can be more profitable not to customize a product).

#### 4.2.3. Data collection and processing

The collection and processing steps in terms of personalization stand for identifying relevant data to build so called "profile models" [Schubert & Leimstoll 2002]. In addition to building models, the input data has to be processed and unified into a homogenous data store which can then be used in calculations to build a personalization relevant output (output profile). Within the unification, analyzing, and other calculating processes, several techniques can be applied: e.g. rule based filtering (preset) or methods in the field of artificial intelligence used by decision management systems based on neural networks [Im & Park 2007; Frias-Martinez et al. 2006].

#### 4.2.4. Practical guides

In general, it is difficult to apply theoretical foundations to real world examples. Within personalization this means analyzing the customers' and providers' needs and matching these needs with available state of the art techniques and systems. Practical guides try to reach a tradeoff between the following aspects: customers, service providers acting according to market opportunities, and enabling technologies [Fink et al. 2002].

#### 4.2.5. Systems

Before implementing personalization functions or whole systems it is important to be aware of available frameworks and libraries for programming. There are many approaches for system designs in personalization systems such as comparison-shopping systems ([Hwang & Kim 2007; Yuan 2003; Cheung et al. 2003; Negash et al. 2003; Enzmann & Schneider (2005)]).

#### 4.2.6. Algorithms

To build output profiles in the overall personalization process, various algorithms can be used to combine the collected amount of data. In data management theories, there are learning and filtering algorithms ([Sahami et al. 1998; Lee & Lee 2005]), algorithms for collaborative recommendations (memory based or model based), and algorithms for content based recommendations with support vector machines [Cheung et al. 2003].

#### 4.2.7. Design/ Interface

Design and interface suggestions mainly exist to match the requirements of customers with the marketing strategies of the service providers. These suggestions are guidelines for presenting pieces of information in an appropriate manner: e.g. categorize products in a meaningful way, only ask necessary information in the registration process, or present enough details to let the customer easily decide which product or service fits most of his or her interests [Fang & Lightner 2003].

### 4.3. Theoretical foundations in the field of personalization

The articles, in this category are mainly divided into "studies", theoretical "guidances", evaluated "processes", and "models" (cf. figure 3). These references provide general knowledge in the area of personalization and are conducting surveys and model development.



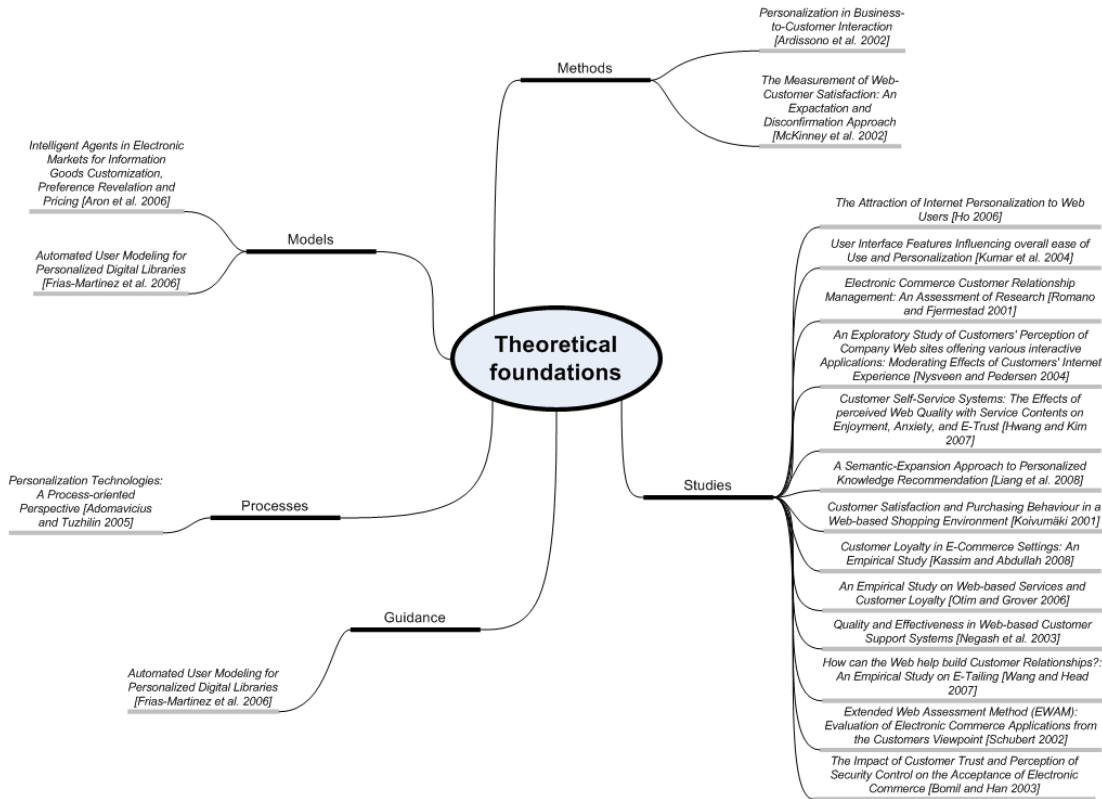


Figure 3: Theoretical foundations in the field of personalization

#### 4.3.1. Methods and Guidance

There are several methods that have been invented that try to assist system operators to solve important questions in the field of personalization. For example, McKinney et al. [2002], Delone and McLean [2003, 2004] and Barnes and Vidgen [2002] analyzed the customer perceived satisfaction and correlated the outcome to information quality (e.g. accurate data, relevant data, data that is easy to understand) and system quality (e.g. easy to use, design, responsiveness). As a result they suggested concrete methods to measure the satisfaction of customers and give some implications on how to act on the results of these methods. The model they developed can be adopted to increase acceptance and satisfaction of a customer using a recommender system. Ardissono et al. [2002] address the question of how to build up an electronic product catalog (focussing on telecommunication products) and how to personalize the catalog data to fit the needs of a customer. Frias-Martinez et al. [2006] precisely describe this proceeding in their work on machine learning techniques to construct user models (including models of interests, history, goals and system experiences) out of adaptive digital libraries.

#### 4.3.2. Studies

The field of studies within personalization covers case studies dealing with concrete companies and aspects mainly focusing on customers and their perceived attitude on personalization and e-commerce. Examples of examined research areas are: “ease of use within user interfaces”, “attraction factors of personalization to web users”, “measur[ing] the quality and effectiveness of web services”, and “the impact of trust on the acceptance of e-commerce” (cf. figure 3, e.g. [Romano & Fjermestad 2001]).

#### 4.3.3. Processes

Articles dealing with processes focus on transactions and fluctuations within a system. The authors of these articles describe the perceived environment as using states and transitions between states. The buying process as an example can be analyzed according to the available personalization technology supporting the customers’ decisions [Adomavicius & Tuzhilin 2005a] or according to the influence of advertisements in each purchase step.

#### 4.3.4. Models

Models can describe the behavior of a system (technical, social, or both) as a representation of the real world so that machines are able to fetch and receive structured and processible pieces of information. In this case, the model acts as an abstraction layer for real world observations. On the other hand, a model can be personalization specific particularly by automatically fetching customers’ details and preferences out of various computer systems (even



adding new attributes to an existing model of a customer). On the other hand a model can be a functional description of a whole system [Aron et al. 2006; Frias-Martinez et al. 2006].

## 5. Results

In total, we classified 42 unique articles (with a total of 75 matching hits in our classification table) according to our procedure described in section 3. The articles have been published in 14 different journals within the last 8 years. The complete list of articles including the classification is shown in section 4 (cf. table 2).

### 5.1. Distribution of articles by year of publication

As shown in figure 4, between 2000-2008, an almost even amount of articles per year have been published in the field of personalization. The set of collected articles is not large enough to significantly assume a constant interest in the area of personalization. However as an observance, the classification scheme and the articles being categorized suggest that the articles classified as implementation or customer concentration articles were mainly published between 2003 and 2004. However articles describing theoretical aspects of personalization were mainly published between 2004 and 2005.

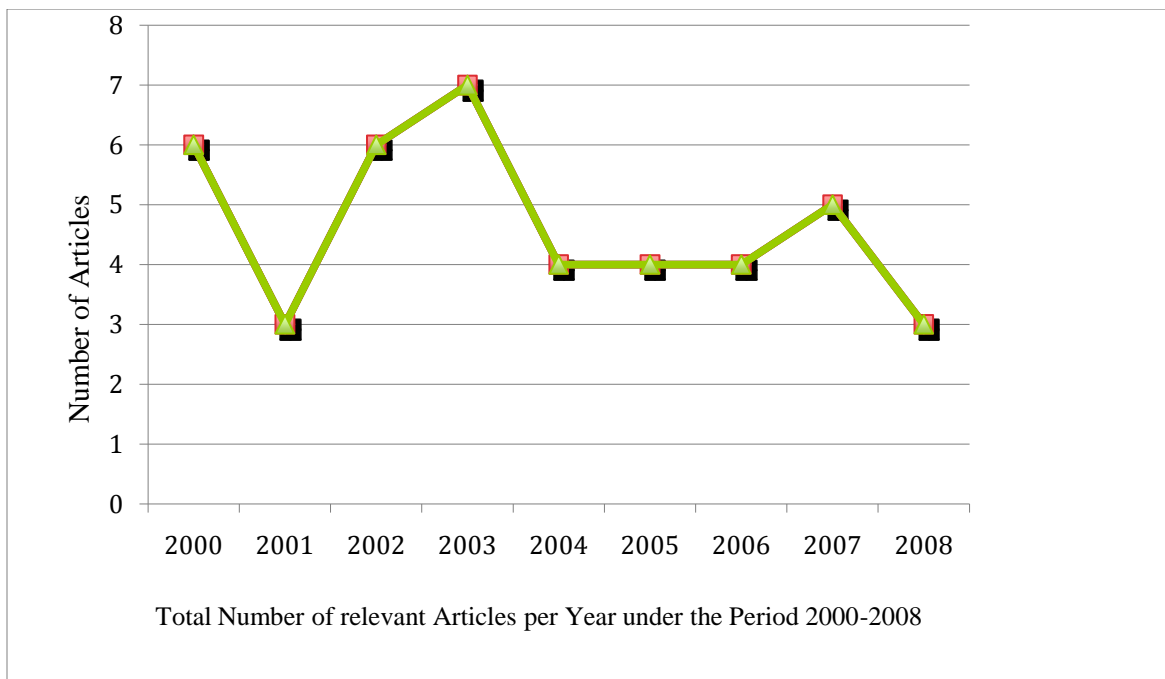


Figure 4: Total number of relevant articles per year (2000-2008)

### 5.2. Distribution of articles by journal

Our research shows that from a total of 40 different journals 5 journals have had more than 3 personalization articles published during the 2000 and 2008 period. Only 13 out of all of the 40 analyzed journals provided at least one article dealing with personalization in e-commerce according to our research approach. The distribution of articles among the most important journals is shown in table 1. Most of the articles we found in our survey are published by the Association for Computing Machinery (ACM) and the journal Decision Support Systems (DSS) which indicates these general interest journals as a good starting point for literature research in the field of e-commerce personalization next to all specific e-commerce journals that have not been in the main focus of this paper.

### 5.3. Distribution of articles by topic

The findings of figure 5, below, show the distribution of user centric articles among the subtopics motivated in section 3. The total numbers of matches in each category are printed on the left side, whereas the right columns indicate the net articles (without duplicates) being published in each category. Most of the reviewed articles focus on user centric aspects (30 out of 75 total matches, or 22 out of 42 articles: each article can be matched to multiple categories) by mainly addressing customer satisfaction (36.3 %) and loyalty (22.7 %). The category with the fewest articles being published on was “theoretical foundations” (18 out of 42 articles).

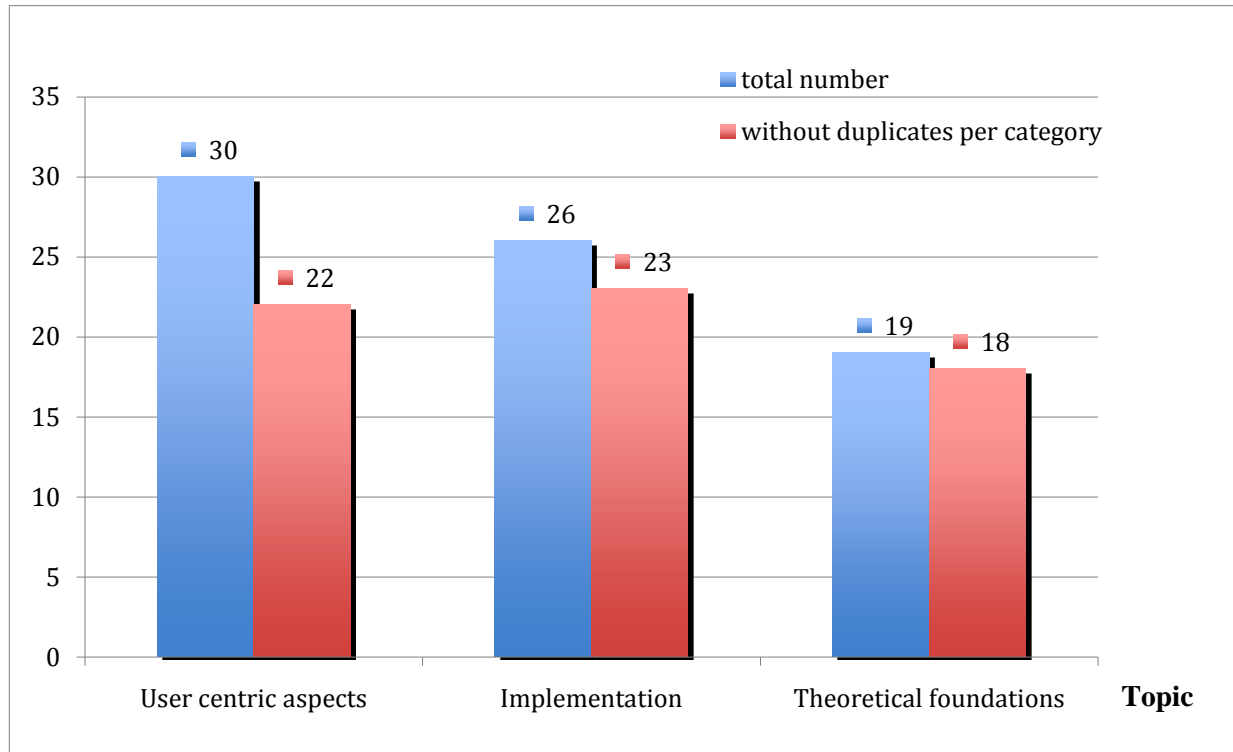


Figure 5: Total number of relevant articles per topic

Below, table 3 illustrates that there are a lot of varying articles in the main category of “user centric aspects” (spanning 13 different subcategories). In articles dealing with customer satisfaction and loyalty, it is important to identify the key factors for increasing satisfaction and therefore loyalty of the customer (e.g. [Shim et al. 2002]).

An important amount of articles is concerned with the privacy of a customer using personalized functions of e-commerce applications [Eugene 2000; Enzmann & Schneider 2005; Suh & Han 2003] and for building trust by relating the perceived behavior of a system with security features like using qualified digital signatures [McKnight et al. 2001; Hwang & Kim 2007; Gefen 2002; Suh & Han 2003].

Table 3: Number of user centric articles

User centric aspects	Number of articles	Percentage by subject	Percentage by all subjects
User experience	2	9.1	4.8
Loyalty	5	22.7	11.9
User acceptance	1	4.5	2.4
Privacy	3	13.6	7.1
Customer orientation	1	4.5	2.4
Customer risk	1	4.5	2.4
Customer trust	4	18.1	9.5
Customer communication	1	4.5	2.4
Customer satisfaction	8	36.3	23.8
Customer support	1	4.5	2.4
Customer expectation	1	4.5	2.4
Customer service	1	4.5	2.4
Supplier customer differentiation	1	4.5	2.4
Total	30 (22 different)		

As almost all concepts fall into the category of “implementations”, several personalization techniques have been implemented, like preference mining [Aron et al. 2006; Holland & Kießling 2004], customer support systems [Negash et al. 2003], and automated user modeling [Frias-Martinez et al. 2006]. More than one quarter of the

articles (30.4 %) in this category deal with implementation specific aspects of data collection and processing [Mobasher et al. 2000; Schubert & Ginsberg 2000; Shahabi & Banaei-Kashani 2003; Eugene 2000; Suh & Han 2003; Cingil et al. 2000]. Two more categories are of great importance to the implementation category: general personalization systems and e-commerce systems (21.7 %: e.g. loyalty building systems, customer self service systems, and shopping engines) and recommender systems (21.7 %) with, for example, knowledge building systems (cf. table 4).

Table 4: Number of implementation articles

Implementation	Number of articles	Percentage by subject	Percentage by all subjects
Recommender systems	5	21.7	11.9
Mass customization	3	13	7.1
Data collection and processing	7	30.4	16.7
Practical guides	1	4.3	2.4
Systems	5	21.7	11.9
Algorithms	2	8.7	4.8
Design/Interface	3	13	7.1
Total	26 (23 different)		

Table 5 shows the articles that deal with theories in the field of personalization and e-commerce. The absolute majority (72.2 %) of these articles are studies, analyzing input factors for personalization issues like quality of user interfaces, support, trust, risk, and experiences [Ho 2006; Kumar et al. 2004; Romano & Fjermestad 2001; Nysveen & Pedersen 2004; Hwang & Kim 2007; Liang et al. 2008; Koivumäki 2001; Kassim & Abdullah 2008; Otim & Grover 2006; Negash et al. 2003; Wang & Head 2007; Schubert 2002; Suh & Han 2003]. Other articles are about model building (11.1 %: e.g. automatic derivation of user models) or are about the analysis of concrete methods (11.1 %: e.g. measurement of customers' satisfaction [Ardissono et al. 2002; McKinney et al. 2002]).

Table 5: Number of theoretical foundations articles

Theoretical foundations	Number of articles	Percentage by subject	Percentage by all subjects
Methods	2	11.1	4.8
Studies	13	72.2	31
Guidance	1	5.6	2.4
Processes	1	5.6	2.4
Models	2	11.1	4.8
Total	19 (18 different)		

Table 2 (section 4) gives a summary of all the collected articles in our classification scheme. This table gives researchers in the area of personalization the opportunity to adopt this basic literature for their own work in this field of research.

## 6. Conclusion and Discussion

In order to address new knowledge in an existing research area, it is very important to first gain an overview of the existing literature (known as a "knowledge base" [Hevner et al. 2004]) and to identify research gaps. Hence, a structured and rigorous study of the literature in this context promises to be a good starting point for one's own research. Besides two studies that focus on literature retrieval in the area of personalization [Vesanen 2005; Vesanen 2007], this analysis of the related work in personalization and e-commerce extends the knowledge within the personalization field, especially in relation to e-commerce. The process of selecting appropriate articles can be verified by any researcher following our methodology. The outcome of this analysis is a collection of relevant academic literature that should help researchers. It serves as a starting point to enter the field of personalization. Hence, by stating and classifying literature from 2000 to 2008 we provide a picture of the past and current aspects of personalization in e-commerce.

We lay the foundation for an extended literature review including additional keyword searches to increase the amount of basic literature we already have collected from our research. With our actual keyword search we identified an amount of 42 articles (with a total of 75 matches in all categories) that deal with personalization in e-commerce and suggest the following implications:

- Our research shows that the customers using the systems should have trust in the underlying systems. This turns out to be a prerequisite for personalization systems. The relationship between trust and the

- acceptance of personalization has been addressed in several publications [McKnight et al. 2001; Hwang & Kim 2007; Gefen 2002; Suh & Han 2003; Kassim & Abdullah 2008].
- It is important to define standards for personalization systems in order to reduce risk and to increase customers' trust in personalization applications [Lee & Lee 2005; Nicolas & Molina Castillo 2008; Fang & Lightner 2003].
  - The loyalty of a customer is dependent on individual satisfaction and the service and support provided to each user; personalization is the adoption of a service to the needs of a single customer [Gefen 2002; Kassim & Abdullah 2008; Otim & Grover 2006; Wang & Head 2007; Enzmann & Schneider 2005].
  - Among personalization systems, recommender systems are the most popular implementations of algorithms within e-commerce sites [Mulvenna et al. 2000a+b; Cheung et al. 2003; Holland & Kießling 2004; Schubert & Silvestri 2007; Liang et al. 2008].
  - To achieve an optimal level of personalization, the system needs specially prepared input data from the environment. The process of collecting this data is the most important issue regarding the technical realization of personalization systems as indicated by 7 out of 23 different publications within implementation: 30.4 % [Mobasher et al. 2000; Schubert & Ginsberg 2000; Shahabi & Banaei-Kashani 2003; Eugene 2000; Suh & Han 2003; Cingil et al. 2000; Frias-Martinez et al. 2006].
  - Our research shows that most of the theoretical foundations are based on studies on customers of e-commerce sites that help the content providers to better adapt to the very personal and individual needs of each customer and customer's group [Ho 2006; Kumar et al. 2004; Romano & Fjermestad 2001; Nysveen & Pedersen 2004; Hwang & Kim 2007; Liang et al. 2008; Koivumäki 2001; Kassim & Abdullah 2008; Otim & Grover 2006; Negash et al. 2003; Wang & Head 2007; Schubert 2002; Suh & Han 2003].

## 7. Limitations

The methodology that we used to perform our literature survey has some limitations. First, we only analyzed the time frame from 2000 to 2008. We had chosen this time frame due to the preliminary work of Vesanen [2005; 2007] who published his literature review on personalization that focuses mainly on the early 2000s and before.

A second limitation of our work is that we used no conference proceedings, doctoral theses, master theses, text books, and news articles in our analysis. This procedure is motivated in section 3. Additionally, we only have taken one ranking system (JOURQUAL2) into consideration for this analysis. We focused mainly on personalization articles so we used not a pure e-commerce ranking list. To widen up our findings with different perspectives on personalization in e-commerce (e.g. the e-commerce centric view [Bharati & Tarasewich 2002]) additional ranking systems should be taken into consideration. At last, there was no backward search used to append the initially found literature, for example, by searching literature of all authors that have already been identified. (e.g. if we identify one author who has published an article with a topic that fits our search criteria, this author may have conducted other relevant work in this research field that cannot be identified with our keywords or is out of our research scope.) This article is based on the keyword search explained in section 3 – during further research these keywords can be altered, expanded or as we suggest in the next chapter newly created to cover and focus on special areas within personalization in e-commerce (e.g. recommendation engines).

## 8. Future directions within personalization in e-commerce

The main goal of personalization research is to identify and manage influencing factors for better customer relations in order to finally increase the loyalty to a certain system. Our research shows that almost 22 out of 42 articles (which produce 30 out of 75 hits in the “user centric” category) deal with users and their perception of certain forms of personalization. We discovered that about 50 % of all implementation articles deal with recommender systems (few with comparison-shopping as a shaping of recommender systems) or the proceeding phase of data collection and processing. On the contrary, theoretical foundations are not as prominent as implementation related articles or user related articles. This area of research seems to be under-investigated although 42 articles cannot give a significant prove of this thesis. Hence, following our assumptions there could be more work done in inventing new models of personalization use and in building processes describing the behavior of input factors to a system or the behavior of whole systems.

Beside this topic, there should be more analysis work conducted in related research directions in order to refine our rigorous literature research process shown in this article. As we think personalization and personalization systems gain more influence in our daily life, so we need a clearly structured foundation (basic literature) for other researchers in our area to append our work and to share our knowledge. As a result, we propose a paper providing basic literature with a rigorous process of information retrieval. In future work based on our literature survey, there

should be more factors taken into consideration to determine a set of suitable keywords and more techniques to find additional articles with rigorous search mechanisms (such author backward search, as presented in section 7). As a further step our methodology can be adapted to cover more specific topics like recommender systems, comparison-shopping agents or personalization algorithms in specialized surveys.

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