M.A. Research Paper

A technoethical exploration of online dating algorithms: A systematic literature review

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Abstract

While algorithmic online dating has been increasingly used by singles worldwide to build romantic relationships, a growing number of studies focus on social impacts and ethical concerns of online dating algorithms. To comprehensively examine online dating algorithms from a social and ethical perspective, this researcher conducted a systematic literature review and a technoethical assessment of online dating algorithms' social influences and ethical innovations. This work identified seven major social and ethical issues around online dating algorithms, including personal development, culture, social equality, business, political concerns, ethics and morals, and privacy. The technoethical assessment also calls for 1) more public awareness of online dating algorithms' influential potential, and 2) online dating platforms' responsible design, use and regulation of online dating algorithms. This study fills the knowledge gap between technology and communication studies concerning algorithmic governance in online dating and contributes strategic information on ethical innovations in online dating algorithms' design.

Keywords: algorithms, online dating, technoethics, systematic literature review, social constructionism

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Chapter 1: Introduction

Background

Online dating has become increasingly popular for modern singles worldwide. In 2019, for instance, nearly 2.3 million Canadians and 297.8 million people worldwide used online dating sites and apps to seek dating partners and form romantic relationships (Statista, 2020). Especially during the COVID-19 pandemic, as in-person dating was largely restricted, many daters chose to chat with potential partners using dating apps (Sullivan, 2020). Match Group, which owns more than 45 dating app brands including Tinder, Match, and OkCupid, also reported a 15% increase in subscribers during the COVID-19 pandemic (Meisenzahl, 2020). Now, more than ever, online dating influences how people form, manage and maintain their intimate relationships.

Many online dating platforms achieve their matching functions using mathematical algorithms (Sprecher, 2011). According to Chandler and Munday (2016), an algorithm is "an automated set of rules for sorting data." In online dating, these algorithms support users' mate matching through profiling users, screening partners, locating, and even rating users (Rolle, 2019).

While online dating companies keep upgrading their algorithms to provide more efficient, scientific and superior matches, some users disclosed their frustrating experiences with online dating algorithms. For example, Eror (2016) shared his failure to get matched in Tinder. After being unmatched and rejected for six weeks, he finally received his first match, which, however, also ended up in his partners' ignorance of his greeting. This experience considerably lowered Eror's confidence when he wrote: "at this point I couldn't put the

fruitlessness of my Tinder experience down to outdated iPhones: I'm quite obviously not as attractive as I'd like to think I am" (Eror, 2016, para. 10). Shadel (2019) also found in his interview with queer online daters that mainstream dating apps failed to meet queer users' needs. Neither did dating apps design corresponding gender tags for queer users, nor algorithmic matching considered users' sexual orientations. These cases demonstrate that the online dating industry rarely pays attention to algorithms' social impacts in their designs.

Research also raised concerns about algorithms' negative impacts on individuals and society. As algorithms mediate online dating's social affordance, these technologies may directly exert power over users and cultures. For instance, algorithms' problematic classification criteria may limit users' self-presentation and cause identity crises (David & Cambre, 2016). Algorithm designers may also program their biased gender and culture perceptions in algorithms, causing negative impacts on online dating culture (Beever et al., 2019). Moreover, it is suspected that capitalists and politicians can exploit online dating algorithms to achieve economic and political goals, which reinforces the asymmetric power relationship between platforms, algorithms, third parties and users (Albury et al., 2017).

As an ever-increasing number of studies bring up online dating algorithms' social influences, it gains significance to systematically review previous discussions over this topic and provide a holistic picture of how online dating algorithms shape and are shaped by social context. Furthermore, it is necessary to examine online dating algorithms' designs and innovations from an ethical perspective. As an influential factor in social and cultural changes, technologies should be carefully designed to secure ethical outcomes and ultimately promote public welfares (Aizenberg & van den Hoven, 2020).

Based on this context, the present work used an interdisciplinary-triangulated-qualitative method to explore the outcomes of online dating algorithms' design and the mutual influences between algorithms, organizations, daters and cultures. The study consists of a systematic literature review of previous studies on online dating algorithms' social influences and a comprehensive examination of online dating algorithms' innovation through a technoethical lens. According to Luppicini (2010, p. 25), technoethics "is concerned with all social and ethical aspects of the design, development, utilization, management, and evaluation of science and technology in society." It provides interdisciplinary theories and methodologies to analyze technologies from social and ethical perspectives (Luppicini, 2008). The purpose of this research is to identify 1) major social and ethical issues concerning online dating algorithms, and 2) opportunities and challenges in online dating algorithms' design. The work will address two primary research questions:

1) What are the social impacts and ethical concerns identified in the previous literature concerning online dating algorithms?
2) How can we promote an ethical innovation in online dating algorithms' design?

Ultimately, this study will fill knowledge gaps in technology and communication studies regarding algorithmic governance and innovation in online dating.

Research structure

The present research consists of five sections: introduction, literature review, methodology, findings and discussion, and conclusion.

Chapter one (Introduction) presents an overall statement of research questions, motivations, methodologies and research purposes. It also gives a brief introduction of the

social context of online dating algorithms' design and application.

Chapter two (Literature review) consists of two parts: a conceptual framework and a literature review. First, the conceptual framework presents theories that examine the relationship between technologies, individuals and society, including Social Constructionism, Actor-Network Theory and Technology Mediation Theory. It also presents definitions of key terms in this research. The literature review locates online dating algorithms in previous literature discussions. It explores the prevalent use of online dating platforms, the application of algorithms in online dating, algorithmic governance in online dating platforms, and a technoethical lens of technology studies.

Chapter three (Methodology) presents the triangulated methodology used in this study. This includes a systematic review of the literature concerning online dating algorithms' social impacts and a technoethical assessment of online dating algorithms' social and ethical concerns. It justifies the reliability of two methodologies in answering research questions. This chapter also clarifies how data were collected and analyzed in this research.

Chapter four (Findings and discussion) reveals online dating algorithms' seven significant social impacts identified through the systematic literature review, including human development, culture, social equality, business, political issues, ethics and morals, and privacy. Based on this result, this chapter also thoroughly examines online dating algorithms' innovation from an ethical perspective and provides suggestions for future algorithm design.

Chapter five (Conclusion) summarizes research findings and implications of online dating algorithms' influential potential. It also discusses the limitations of this research and suggestions for future research concerning online dating and algorithm innovations.

Chapter 2: Literature review

Conceptual framework

- *Social constructionism*

Many scholars investigate the relationship between technologies, society and individuals from the social constructionist perspective. Social constructionism is a sociology and communication theory that examines the power of meaning and discourse (Cojocaru et al., 2012). Social constructionists uphold the assumption that the "reality" that people take for granted is socially constructed through the interaction and negotiation between social agents (Galbin, 2014). Language plays an essential role in constructing social reality (Burr, 2013). As Berger and Luckmann (1996) mentioned in *The Social Construction of Reality*, language is not merely a way of describing knowledge and connecting people but determines the process of knowledge production. Namely, knowledge is externalized by individuals through discourse and negotiated within society before it is eventually perceived as truth by future generations (Berger & Luckmann, 1996). Although social constructionism is criticized for denying the attainability of knowledge through empirical practices (Craib, 1997), it still indicates how people's perceptions of the world can be tremendously affected by social settings and individuals' communication processes.

From social constructionist perspectives, technologies have a close relationship with society as well as socially constructed reality. Contrary to the technological determinism which believes in technologies' determinant influence on social, political, cultural and economic structure, social constructionists emphasize the social influence on technology design and production (Djordjevic et al., 2016; Kline, 2001; Winner, 1980). As Bijker (1995,

p. 273) stated, “the technical is socially constructed and the social is technically constructed.” According to Klein and Kleinman (2002), technologies are socially constructed from four perspectives: interpretive flexibility (technologies’ design can have different outcomes depending on social contexts), relevant social group (different social groups may afford different meanings to same technologies), closure and stabilization (social groups’ conflicting images of technologies motivate constant innovation of technologies), and wider context (technologies’ innovation takes place in a complicated social and political context). In this scenario, individuals’ perceptions, which can be influenced by technological change, also shape the design, production and innovation of technologies.

- *Actor-Network Theory*

Derived from social constructionism, Actor-Network Theory examines the relationship between human actors and non-human actors (e.g., technologies, media, vehicles, etc.) through a networking perspective (Latour & Woolger, 1979). The basic assumption of Actor-Network Theory is that human actors and non-human actors exert mutual influence on each other through seamless interactions and all together construct the world we live in (Spöhrer, 2017). Non-human actors have the same influential capacities as human actors because they are associated with human actions. As Latour (2005, p. 78) explained,

> every artifact, such as for example a machine, can be understood only in terms of the meaning which its production and use have had or will have for human action; a meaning which may derive from a relation to exceedingly various purposes.

Despite its origin in social constructionism, Actor-Network Theory differs from social constructionism in their view of the relationship between society, nature and technologies

(Djordjevic et al., 2016). Namely, Actor-Network Theory abandons the disputation over which actor has a more powerful influence over others and whether it is the technology that causes social changes or the social context that determines technology innovation (Latour, 1991). Rather, it blurs boundaries between society, nature and technologies and examines their co-construction of reality through networking and interaction (Schulz-Schaeffer, 2000). As Callon (1986, pp. 200-201) indicated, "the observer must abandon all a priori distinctions between natural and social events. He must reject the hypothesis of a definite boundary which separates the two." This perspective can be both contributive and challenging. On the one hand, Actor-Network Theory alleviates the contradiction between social constructionism and technological determinism by acknowledging the mutual influence between human and non-human actors (Spöhrer, 2017). While on the other hand, Actor-Network Theory is criticized for lacking critical scopes as it deems all actors have the same influential potential, which makes powerful institutions less visible in critical studies (Teurlings, 2013). For instance, Teurlings (2013, p. 112) mentioned that actor-network theory "does not discard the economic as a force structuring relationships in the network, but it does so without making it into the sole focus of attention." In this way, Actor-Network Theory may not be suitable to identify the power relationship between actors.

In addition, Actor-Network Theory contributes to media studies by identifying the differences between intermediator and mediator. Latour (2005, p. 39) explained:

> An intermediary, in my vocabulary, is what transports meaning or force without transformation: defining its inputs is enough to define its outputs. … Mediators, on the other hand, … transform, translate, distort, and modify the meaning or the

elements they are supposed to carry.

Based on this definition, Schüttpelz (2013) identified media as mediators because media not only transmit messages but also reflect certain values and perceptions that influence individuals' interpretations of messages. In this scenario, media are active mediators that possess influential potential on individuals, culture and society, supporting Marshall McLuhan's (1964) argument that "the medium is the message."

- *Technology Mediation Theory*

Technology mediation theory is a young theory that focuses on the role that technologies play in society (Verbeek, 2015). Inspired by Latour's definition of intermediator and mediator, Verbeek (2015, p. 29) argued that all technologies are mediators as they "help shape how human beings can be present in the world and how the world can be present for human beings." For instance, social media not only present news and messages but also determine what and how to present. In this way, technologies mediate individuals' perceptions and experiences instead of neutrally extending or opposing humans (Verbeek, 2015).

Technology Mediation Theory also examines technologies' ethical design. It argues that instead of eliminating technology mediations, designers should facilitate "responsible forms of mediation" by anticipating technologies' potential influences and design positive and responsible mediations (Verbeek, 2011; Verbeek, 2015).

- *Definitions of key terms*

Existing definitions of "online dating" highlight the use of the internet to form romantic relationships. For instance, Shirley (2017, p. 1177) referred "online dating" as "an

Internet-based form of communication with the primary intent to establish in-person (i.e., face-to-face) friendships, or romantic or sexual relationships between consenting adults." Similarly, Finkel (2012, p. 7) defined "online dating" as "the practice of using dating sites to find a romantic partner." Therefore, in this work, I define online dating as the practice of using internet-based applications (including websites, software and mobile applications) to seek potential partners, gratify sexual needs, build romantic relationships and facilitate offline intimate interactions.

Although "online dating algorithm" was not sufficiently defined in previous literature, most studies emphasized the matching feature of online dating recommendation systems. Xia (2016, p. 31) mentioned that "a recommendation system for online dating aims to match people who are mutually interested in and likely to communicate with each other." Jia et al. (2018, p. 429) also indicated that online dating algorithms lie in "double opt-in design, which provides the users with appealing online dating experiences: … These dating apps only notify the users when both sides like each other (i.e., referred to as a match)." Based on these viewpoints, I define online dating algorithms as algorithms that facilitate the whole process of profiling, matching, screening, result presenting, browsing, and user interaction in online dating.

Online dating and algorithmic recommendation system

For thousands of years, people place great importance on finding appropriate partners as it is closely related to courtship and marriage (Ahuvia & Adelman, 1992). While traditionally people used newspapers, magazines, radios and televisions to advertise for potential partners, the rise of computers and the internet boosted online dating services by

providing open platforms and efficient matchmaking processes for global daters (Orr, 2004).

Although the first online dating company (kiss.com) appeared in 1994, it was Match.com that expanded the online dating business in 1995 (Brainz, n.d.). Based on search engine technologies, Match.com, together with PlentyOfFish, OkCupid and Zoosk that were developed later, provided internet users with platforms to post self-advertisement and browse others' profiles (Finkel et al., 2012). As Finkel et al. (2012, p. 6) mentioned, easy access differs online dating sites from traditional in-person dating: "because many sites have thousands, sometimes millions, of users, online dating offers access to a larger number of potential partners than anybody could have access to in the offline world."

However, these dating sites could not sufficiently satisfy users' increasing need in filtering partners according to their mate preferences. Accordingly, many online dating sites, including eHarmony, PlentyOfFish and OkCupid, launched or updated their websites with mate matching algorithms (Finkel et al., 2012). As online dating companies claimed, their algorithms were informed by social behavior theories, aiming to provide recommendations that were more scientific than human judgements and help users identify their "soulmates" (Schwartz & Velotta, 2018; Rudder, 2014). Users needed to fill in questionnaires and provide information of personal background, hobbies, mate preferences, religions, cultures, etc. After that, algorithms would analyze users' profiles and automatically make recommendations. At this stage, more online dating sites designed for minority groups such as Black People Meet entered the market and started to provide matchmaking services for diverse groups (Finkel et al., 2012; Flug, 2016).

In the 2010s, as mobile applications were well developed, online dating apps, for

example, Tinder, Grindr, Bumble, Coffee Meets Bagel, etc., rapidly dominated the online dating market (Flug, 2016). Their success was primarily due to the prevalence of smartphones as well as their simplified algorithmic profiling and recommendation system; users can create profiles with a few clicks and get matched by swiping on the screen instead of wasting a large amount of time on questionnaires (Jung et al., 2019; Schwartz & Velotta, 2018). This swipe logic, which is a mate-selection mechanism based on rapid algorithmic recommendations and users' swiping gestures indicating "yes" or "no," had a great impact on online dating culture (e.g., enforcing daters to get accustomed to the computer-mediated communication) (David & Canbre, 2016; Tong et al., 2016*b*).

Currently, online dating platforms can be classified into three kinds: 1) algorithm/questionnaire-based platforms (e.g., eHarmony), which rely on algorithmic analysis of users' survey data to make recommendations; 2) see-and-screen platforms (e.g., Tinder), which rely on the swipe logic to make recommendations; 3) blended platforms (e.g., OkCupid), which combine the survey and screening in the matching process (Tong et al., 2016*a*). Despite different matching mechanisms, it is undeniable that all online dating platforms use algorithms to manage the profiling, matching, screening and browsing processes (Parisi & Comunello, 2020).

Algorithms can support mate matching in various ways. Taking Tinder as an example, algorithms serve to 1) profile users according to the information uploaded to dating platforms and data retrieved from connected social media (e.g., Facebook and Instagram), 2) filter potential partners according to user-set criteria (e.g., gender, age and physical distance) and user ranking, 3) present mate recommendations, 4) match users who are both "swiped right,"

and 5) update user profiling according to their previous behaviors and interactions (David & Cambre, 2016; Hitsch et al., 2010; MacLeod & McArthur, 2019).

However, as Rolle (2019) suggested, in online dating, algorithms' jobs are more complicated and implicit. For example, Tinder's CEO Sean Rad confirmed that Tinder uses an "Elo score" to rank users according to their "desirability" (Carr, 2016). Although how Tinder's algorithms score users' desirability is unclear, it is undeniable that Tinder analyzes users' "attractiveness" according to their previous behaviors (e.g., frequency of swiping right and receiving right swipes, frequency of logging in, etc.) and only shows recommendations of those who are ranked at same levels (Rolle, 2019). This score also influences users' visibility in online dating, including the number of people that users' profiles can be shown to and the sequence of these profiles (SwipeHelper, 2019). In this way, algorithmic ranking raises privacy concerns as users' personal data can be exploited without users being aware of it and reinforces algorithmic control over users' dating process (Rolle, 2019). Namely, online dating algorithms are more potent as it directly determines whom the users can date with.

Algorithmic governance in online dating

Informed by Actor-Networking Theory and Technology Mediation Theory, as the fundamental technology that supports online dating's profiling and matching process, algorithm serves as a mediator between actors and the perceived world, shaping and being shaped by social, cultural, political and economic context (Gillespie, 2014; Kitchin, 2016).

On the one hand, actors and social contexts can influence how algorithms are anticipated, designed and used. Bucher (2017) investigated Facebook users' experience with algorithms as well as how users perceive Facebook algorithms' functions. She found that

users form an algorithmic imagination, which means "ways of thinking about what algorithms are, what they should be, how they function and what these imaginations in turn make possible," through their interaction with Facebook algorithms (Bucher, 2017, pp. 39-40). This imaginary not only reflects users' anticipations towards algorithms but also affects how users treat and utilize algorithms. For example, users may change their "information-sharing behaviors" (Bucher, 2017, p. 40) to exploit perceived algorithm functions to the full.

However, as Sharabi (2020) and Gillespie (2014) mentioned, this algorithmic imagination is a result of commercial promotion. As more social media platforms, including online dating platforms, promote their algorithms as scientific, objectives, and superior to human judgement, users blindly believe in this claim and perceive how algorithms work according to platforms' statements. Sharabi (2020) identified an algorithmic belief in online dating where users uncritically accept algorithmic recommendations. Gillespie (2014, p. 177) also pointed out that commercial aims can shape the algorithms' design and functions:

> [The landscape of algorithm] can no longer be described as two distinct territories, social and commercial; rather, it interweaves the results of algorithmic calculations (what status updates and other activities of friends should be listed in the feed, what links will be recommended to this user, which friends are actively on the site at the moment), structural elements (tools for contributing a status update, commenting on an information element, links to groups and pages), and elements placed there based on a sponsorship relationship (banner ads, apps from third-party sites).

Therefore, while at first glance algorithms are designed to meet users' need for online socializing, a closer look reveals the economic and political influences imposed by powerful

institutions on algorithms' design and use.

While actors can affect algorithms' designs and innovations, on the other hand, algorithms can re-organize social contexts through their interactions with actors, forming an algorithmic governance on individuals' perceptions, social norms and social structure (Bucher, 2018; Gillespie, 2014; Katzenbach & Ulbricht, 2019; Striphas, 2015). According to Katzenbach and Ulbricht (2019, para. 2), algorithmic governance is "a form of social ordering that relies on coordination between actors, is based on rules and incorporates particularly complex computer-based epistemic procedures." This governance is multilateral as algorithms mediate the power of different social actors including users, designers, corporations, governments, organizations, and other technologies (Katzenbach & Ulbricht, 2019).

Algorithms can mediate the power of algorithm designers and users through specific designs and functions, for example, categories. While a category enables users to present themselves and express their opinions efficiently, it also governs how users think about a question and nudges them to accept the classification prescribed by designers (Becker, 2009; Gillespie, 2014). As Gillespie (2014, p. 174) argued,

> we are invited to formalize ourselves into these knowable categories. When we encounter these providers, we are encouraged to choose from the menus they offer, so as to be correctly anticipated by the system and provided the right information, the right recommendations, the right people.

Algorithms also implicitly classify users according to their previous using behaviors, forming an algorithmically assigned identity in online platforms (Cheney-Lippold, 2011). As

algorithms predict users' intended purchases and preferences according to calculated identities, this process turns algorithms into soft biopolitical tools which govern how to construct and define identities and social groups on the internet.

From this perspective, the research identified problematic category designs in online dating and criticized their control of gender construction. MacLeod and McArthur (2019) and David and Cambre (2016) investigated the gender categories in Tinder and Bumble and found that these apps' gender options were limited to "male" and "female." Although Tinder provided opportunities for gender minorities to display their identities in profiles through descriptions and icons, these narratives were not taken into account in algorithmic profiling and recommendation (MacLeod & McArthur, 2019). Besides, while some dating apps (e.g., Tinder and Bumble) add more gender options in recent years, gender minorities cannot fully benefit from this upgrade. For example, Bumble still limits the "gender of recommended users" to binary options. While Tinder announced its introduction of more gender options to all markets in July 2020, it still excluded places with "state-sponsored sexual orientation laws" from the list (Tinder Blog, n.d., para. 1). In this scenario, dating apps' binary gender category may reinforce a cisgendered definition of gender, precluding gender minorities from the online dating market (Bivens & Hoque, 2018).

Algorithms may also magnify social power and shape individuals' perceptions of reality through filtering and screening. As a technology that selectively presents information, the algorithm governs what and how knowledge is externalized (Just & Latzer, 2017). Pariser (2011) observed a "filter bubble" phenomenon in searching engines (e.g., Google) and social media (e.g., Facebook). Since algorithms recommend information according to users'

preferences, this “personalized universe of information” may reinforce users’ pre-existing knowledge and perceptions and hinder active knowledge exchange. Parisia and Comunello (2020) also observed the filter bubble phenomenon in online dating. Although daters differed in their preference of similarity and diversity, they all ended up receiving recommendations of users with similar interest because of “both algorithmic dynamics (that tend to show us people with whom we share some characteristics), and relational dynamics, enabled by the ways in which platforms steer users’ self-presentation” (p. 85).

In addition, research also demonstrated the mutual influences between online dating algorithms, users’ emotional wellbeing and dating culture. To begin with, in an algorithmically constructed dating world, users may feel anxious and disappointed as all users recommended by algorithms are fine-looking with great personalities (Bonilla-Zorita et al., 2020). These negative experiences may lower users’ self-esteem and force users to unconsciously accept the dominant perceptions of beauty and success (Breslow et al., 2020). Furthermore, the senses of depression and disappointment motivate users to keep using online dating apps so as to demonstrate their attractiveness and deny their failures, resulting in an online dating addiction (Bonilla-Zorita et al., 2020). In turn, algorithmically transformed users contribute more data that reflects and supports dominant culture to online dating platforms, reinforcing an anxious and appearance-centered online dating culture (David & Cambre, 2016).

Algorithms’ operating logic, for example, Tinder’s swipe logic, also contributes to the current online dating culture. For instance, Tinder’s swipe logic restricts daters to express their intentions of potential partners in a binary way (David & Camber, 2016); by swiping

left, they completely reject the match, while by swiping right, they are ready for the date. This binary logic not only compromises the interaction between daters but also encourages them to make a quick decision of potential partners depending on external appearance. As Degen and Kleeberg-Niepage (para. 58) argued, the rapid review of algorithmic recommendations indicates an "acceleration of the pace of daily life and the acceleration also regards the dating itself, as the single date loses importance and value as the next one is just around the corner." This acceleration of dating culture, according to Breslow et al. (2020) and Haywood (2018), encourages users to treat other users as objects and commodities instead of existing human beings. In this way, algorithmic swipe logic intensifies an objectification culture in online dating in which users "focus on their appearance, [and] experience their body for how it looks rather than how it feels" (Breslow et al., 2020, p. 26).

Technoethics of algorithms

As previously mentioned, according to Luppicini (2010, p. 40), technoethics is "an interdisciplinary field concerned with all ethical aspects of technology within a society shaped by technology. It deals with human processes and practices connected to technology which are becoming embedded within social, political, and moral spheres of life." By examining the socio-technological context of technology innovation, technoethics provides a sustainable and human-centered insight into technology design (Fan & Ge, 2018). Technoethical inquiry is a useful method in technoethics studies that "provides powerful tools to help integrate interdisciplinary expertise (and experts) and deal with competing values and ethical issues connected to the actual and potential influences of technology in society" (Luppicini, 2010, p. 69). It requires researchers to evaluate technology through practical

experiences and identify social responsibilities of all actors (including technology itself) involved in technology innovation. Therefore, researchers should examine the roles that technologies play in society through multiple perspectives, including philosophy, history, culture, economy, politics and legality (Luppicini, 2010).

Although technoethical assessment of online dating algorithms was insufficiently conducted in previous literature, studies identified two major ethical concerns of social media algorithms, which are automation and transparency (Beever et al., 2019; Heller, 2012; Katzenbach & Ulbricht, 2019; White & Boatwright, 2020). Katzenbach and Ulbricht (2019, para. 20) emphasized the importance of automation and transparency: "they stand out with regard to their normative implications for accountability and democracy." They argued that an ethical algorithm should facilitate the human decision-making process and be self-explainable and accountable at the same time. In this way, we can turn "out-of-control" algorithms into "autonomy-friendly" algorithms, preventing negative influences of algorithmic governance (Katzenbach & Ulbricht, 2019, para. 23).

Beever et al. (2019, p. 84) also mentioned ethical responsibilities for algorithm programmers:

> Moral algorithms, in other words, must be produced through careful thought and intentional design, not only in regard to the specifications of a program but also in carefully considering that program's use (e.g., functionality and operation) and context (e.g., stakeholders, access, equity, etc.).

This requires algorithm designers to identify algorithms' potential influence on diverse stakeholders and avoid programming biased algorithms.

Chapter 3: Methodology

To fulfill research goals, this research used a triangulated qualitative research method to investigate online dating algorithms' social impacts and ethical concerns. According to Carter et al. (2014, p. 545), triangulation refers to "the use of multiple methods or data sources in qualitative research to develop a comprehensive understanding of phenomena." Triangulated research method allows researchers to examine one social issue through diverse perspectives and frameworks, increasing the validity and dynamics of research findings (Morse, 2009). In the present study, research methods consist of two steps: 1) a systematic review of the literature concerning online dating algorithms' social impacts, and 2) a technoethical assessment of online dating algorithms' design.

Systematic literature review

According to Petticrew and Roberts (2006, p. 10), a systematic literature review refers to

> a literature review that adheres closely to a set of scientific methods that explicitly aim to limit systematic error (bias), mainly by attempting to identify, appraise and synthesize all relevant studies (of whatever design) in order to answer a particular question (or set of questions).

This method requires researchers to conduct 1) a systematic search of the literature relevant to research questions, 2) a systematic screening of collected literature and data according to inclusion and exclusion criteria, 3) a systematic analysis of collected data, and 4) a systematic presentation of findings according to themes or characteristics (Siddaway et al., 2019; Xiao & Watson, 2019).

As researchers usually examine a large amount of literature in the systematic literature review, this method guarantees the comprehensiveness of the analysis. Therefore, as Petticrew and Roberts (2006, p. 21) suggested, the systematic review is suitable "when a general overall picture of the evidence in a topic area is needed to direct future research efforts." In addition, the systematic search and screening of literature require researchers to collect data according to pre-set criteria and process, which increases the reliability and validity of resources (Kitchenham et al., 2010). Although Rousseau et al. (2008) and Sandelowski et al. (2006) criticized systematic literature review for integrating conflicting data, methodologies and frameworks into analysis, research indicated this disadvantage could be overcome by identifying different research contexts underlying each study and group data accordingly (Xiao & Watson, 2019). Therefore, in this study, I conducted a systematic literature review to draw a holistic landscape of how algorithms exert social influences and generate ethical concerns in online dating.

Between December 2020 and February 2021, I systematically searched literature from four databases, including ABI/INFORM Collection, SCOPUS, SpringerLink and Web of Science. I chose these databases because of their comprehensive and multidisciplinary coverage of both academic and non-academic journals and books in communication, computer science and social science. To grasp a current research pattern, I restricted the literature's publication period to between 2016 and 2020. The literature collected in this study includes both academic articles such as peer-reviewed articles and scholarly books, and non-academic articles such as newspaper and magazine publications.

I searched the literature on four databases with the same term *("online dating" OR*

"dating app" OR "dating site") AND (algorithm OR "recommendation system")*, with subjects limited to *ethics* OR social**. After the preliminary literature search, I applied a systematic screening of collected articles' titles, abstracts, and keywords to ensure their relevance with the research topic. The inclusion criteria of *online dating* included terms *online dating*, *dating app, dating site, hook-up app, online romance* and online dating platforms' brand name. The terms excluded from the selection were *date counseling, social media, SNS* and *(offline) dating*. The inclusion criteria of *algorithm* included terms *algorithms, recommendation system, user profiling, swipe* and *mathematic program*. The terms excluded from the selection were *robot, software, virtual reality, (algorithm) engineering* and *UI design*. After eliminating irrelevant and duplicated articles, totally 32 articles are selected for the systematic review. The result of the systematic literature search was presented in Appendix A and Table 1 (see Appendix B).

Since the goal of the systematic literature review is to identify major social issues of online dating algorithms, I used thematic synthesis to extract, code and analyze data from selected literature. Thematic synthesis enables researchers to grasp critical features from the data pool by integrating data from different literature into analytical themes, which are developed according to research questions (Thomas & Harden, 2008). In this work, I identified six themes through a preliminary review of ten randomly selected articles. These themes included human development, culture, social equality, business, political issues and ethics. Next, I extracted and coded data from the rest articles based on these six themes. During this process, I identified the seventh theme as privacy. Therefore, I repeated the thematic synthesis over all literature and analyzed data according to the seven themes

mentioned above. The findings were both quantitatively and qualitatively reported.

Technoethical assessment

Technoethical assessment is a useful tool of technoethical inquiry. According to Luppicini (2010, p. 76), technoethical assessment is developed based on the assumption that "the assessment of technology cannot be limited to scientific evaluation but must be sensitive to broader social and ethical elements within society." Namely, technoethical assessment aims to provide a better understanding of "ethical responsibilities created by technological innovations" by investigating the interaction between technologies and social actors (Luppicini, 2010, p. 76).

Technoethical assessment provides a five-step framework to assess both opportunities and challenges raised by technologies (Luppicini, 2010, pp. 77-79):

Step 1: Evaluate the intended ends and possible side effects to discern overall value (interest);

Step 2: Compare the means and intended ends in terms of technical and nontechnical (moral, social) aspects;

Step 3: Reject any action where the output (overall value) does not balance the input in terms of efficiency and fairness;

Step 4: Technoethical inquiry is multi-perspective. Ensure that perspectives from all stakeholders groups and those affected are included in Steps 1-3;

Step 5: Because technological projects can have multi-level influences (i.e., biological, physical, psychological, social, environmental), technoethical inquiry must consider technological relations at a variety of levels.

Based on this framework, technoethical assessment not only requires multi-perspective examination of technologies' social influences but also investigates technologies' ethical design from perspectives of means, intended ends, side effects and overall values.

As the present work aims to scrutinize the ethical innovation in online dating algorithms' design, I conducted a technoethical assessment over online dating algorithms based on the findings of the systematic literature review. The assessment was carried out following the five-step framework and presented in the "discussion" section.

Chapter 4: Findings and discussion

Findings

A systematic analysis of collected articles discloses seven major social and ethical issues around online dating algorithms, which are (1) personal development, (2) culture, (3) social equality, (4) business, (5) political concerns, (6) ethics and morals, and (7) privacy.

"Personal development" is concerned with online dating algorithms' impacts on users' mental health and personal development. "Culture" discusses how online dating algorithms shape and are shaped by social norms and online dating culture. "Social equality" examines whether algorithms reinforce or mitigate the social discrimination and gender inequality in online dating. "Business" presents how dating platforms profit from algorithms and influence online dating markets. "Political concerns" refers to the asymmetric power relationship between online dating developers, algorithms and users. "Ethics and morals" questions algorithms' impacts on online daters' decision-making capabilities. Finally, "Privacy" is concerned with data safety issues raised from algorithms' collection and exploitation of online daters' personal data. Notably, these issues are correlated with each other. Altogether, they outline how online dating algorithms affect almost every aspect of society and individuals' lives. The percentage of each theme and the distributive pattern of articles were shown in Table 2 (see Appendix C) and Figure 1 (see Appendix D).

- *Personal development*

Personal development (21.2%) is the most frequently mentioned concern of online dating algorithms. Scholars mainly examined online dating algorithms' influential potential on individuals' mental health, self-perceptions, and personal capabilities. To begin with,

algorithmic online dating can increase daters' confidence by making the dating process more enjoyable. Algorithms' double opt-in design can simplify the introduction process between daters and alleviate the awkwardness of self-introduction (Jia et al., 2018). Daters also feel less stressed and disappointed if they are rejected in online dating as the matching algorithms only notify successful matches (Schwartz & Velotta, 2018).

However, more scholars raised concerns about algorithms' negative impacts on online daters' mental health. As Degen and Kleeberg-Niepage (2020, para. 35) indicated, although users rarely receive direct rejections from other users, they may still experience "sadness, anger, uncertainty and self-doubt" if they are not matched or liked. This unsuccessful experience will either lower users' self-esteem (David & Cambre, 2016) or force them to brag and even lie in their profiles (Schwartz & Velotta, 2018). For instance, David and Cambre (2016) showed a Tinder user who regarded himself as an ugly man after posting his photos for 48 hours but failing to receive a "like." Haywood (2018) further suggested that since the rejection in online dating is implicit, male users may pretend to be indifferent about the rejection to protect their pride. This reaction may reinforce a problematic perception of masculinity as they refuse the perceived reality that they are less attractive to women.

It is also controversial whether algorithmic online dating positively impacts marginalized groups (e.g., disabled people, racial minorities, LGBTQs, etc.). On the one hand, online dating provides an efficient channel for marginalized groups to connect with similar people and get more social support (Duguay et al., 2020; Mazur, 2020). While on the other hand, they may encounter more negative online dating experiences compared with dominant groups. For example, Mazur (2020) found that many disabled young adults struggle

to create profiles regarding to what extent they should disclose their disabilities. They are afraid of being harassed by users with particular sexual orientations as "disability" can be a filter criterion in algorithmic matching. In this scenario, "users with visible disabilities begin to feel like the people online are dating your wheelchair, rather than dating you" (Mazur, 2020, p. 107).

In addition to algorithms' potential impacts on daters' mental health, scholars identified identity issues in online dating. While some believed younger generations can explore their personalities and produce selves creatively in online dating (Gieseking, 2017; Schwartz & Velotta, 2018), others suggested that daters may find it difficult to present themselves appropriately in online dating (Bivens & Hoque, 2018; David & Cambre, 2016; MacLeod & McArthur, 2019; Wang, 2020). For instance, Wang (2020) found the personality tags in Blued, a Chinese gay dating app, can overlap in meanings. David and Cambre (2016) and MacLeod and McArthur (2019) also pointed out the binary gender option in some algorithmic recommendation systems; users can only identify their gender as "male" or "female." This confusing design may cause emotional distress for those whose gender is different from their sex as they cannot present their identity properly in online dating (Bivens & Hoque, 2018). MacLeod and McArthur (2019, p. 831) further criticized the nature of binary classification: "'gender' within the apps is not about identity as such but rather is a way of sorting users into groups that make matches more likely." Therefore, efficiency and usefulness outweigh user welfare in online dating's algorithm design, forcing users to accept the prescribed classification instead of expressing their own identities.

Previous studies also examined how online dating algorithms affect personal

capabilities. For example, Tong et al. (2016*a*) found that algorithmic recommendations can facilitate users' decision-making process, helping them overcome the "decidophobia." This may be because "algorithmic feedback provides daters with a form of external validation of their choice" (Tong et al., 2016*a*, p. 654).

- *Culture*

Culture (18.8%) is another major issue concerning online dating algorithms. Although dating app companies claimed that online dating merely reflects social norms instead of resetting them (Kari, 2017), scholars tended to believe in the mutual influence between dating algorithms and culture (Albury et al., 2017; Bivens & Hoque, 2018). As Bivens and Hoque (2018, p. 443) suggested: "[We] recognize technological design as a social and political act that is both influenced by surrounding sociocultural and political-economic contexts and actively involved in constructing such contexts." Therefore, online dating algorithms can not only magnify biased cultures and perceptions concerning gender, date, and intimate relationships but also create new cultures and social norms of dating.

On the one hand, scholars demonstrated that online dating algorithms may reinforce gender stereotypes and further marginalize gender minorities. This is because algorithms can learn values, including cultural bias and discriminations, from designers as well as the big data (Rolle, 2019). Bivens and Hoque (2018) suggested that although Bumble's founder claimed this dating app to be feminist, its algorithms were designed based on cisgender ideologies. For instance, Bumble launched a "best friend forever" (BFF) feature, enabling users to make friends instead of finding partners in the app. However, this feature can only match users with other same-gender users, discouraging lesbian and gay users from using this

function. In this scenario, the binary gender classification also intensifies a dominant gender interpretation which conflates gender, sex and sexuality.

Scholars also raised concerns about algorithmic recommendation's ability to commodify and objectify users. David and Cambre (2016) and Rolle (2019) examined Tinder's swipe logic and found that the quick swipe over potential partners tends to make users forget about real human beings existing behind pictures and profiles. Haywood (2018, pp. 145-146) further explained: "The process of swiping through multiple profiles can be seen as similar to browsing a shopping catalogue, where the process of choosing is an affective experience. … Women become treated as a product, considered comparatively against other women." It is in this way that algorithms dehumanize users – both swipers and swipees – into repetitive machines and iconic objects.

This accelerated matching process also encourages daters to make a quick decision of potential partners depending on their external appearance (Abolfathi & Santamaria, 2020). Kao (2016) argued that online dating algorithms have no influence on individuals' partner preference as people also pay more attention to partners' physical attraction than other personal traits in in-person dating. Nevertheless, Schwartz and Velotta (2018) concerned the swipe logic may mislead daters, especially younger generations, to excessively care about their external attractiveness and reshape their perceptions of "perfect" partners.

Besides reinforcing existing biased perceptions, algorithms, on the other hand, also stimulate a new algorithmic culture in online dating. One remarkable example is Tinder's swipe mechanism. Tinder not only introduced a swipe gesture into app design but also afforded this gesture a new cultural meaning: swiping right for "yes," and swiping left for

"no" (Costa Rodrigues & Baldi, 2017). Kari (2017) and Haywood (2018) also mentioned that while swipe algorithms speed up the matching process, they provide a "pre-date" stage for users to filter partners and express intentions, slowing down the dating process as a whole. Therefore, online dating algorithms can shift users' dating habits and create new "dating norms" on the internet.

Moreover, as algorithms rule how users interact with others in online dating (Costa Rodrigues & Baldi, 2017), how users game and win algorithmic recommendation systems form a new digital culture. For instance, online daters may ask for suggestions from famous bloggers and data analysts about how to attract algorithms' attention so as to increase their visibility in algorithmic recommendations (Albury et al., 2017; Degen & Kleeberg-Niepage, 2020). Dating companies, in turn, will update their algorithms to achieve better efficiency and fairness. In this way, as Albury et al. (2017, p. 6) suggested, "user practices, business models and app functionality co-evolve to produce new data cultures."

- *Social equality*

The third concern of online dating algorithms' social impact is social equality (17.5%). To begin with, scholars discussed whether algorithmic recommendation enables equal access and use of online dating. Schwartz and Velotta (2018) upheld that algorithmic filtering can help racial, cultural, gender, and religious minorities match with users from similar communities. In this way, algorithms increase online dating's accessibility, enabling more people to find potential partners regardless of their social background.

Nevertheless, more scholars pointed out that dating companies can exploit algorithms to limit equal use of products' features (Cohen, 2018; Courtois & Timmermans, 2018; Jia et

al., 2018). Cohen (2018) indicated that most dating apps (e.g., Tinder, Grinder, Bumble, etc.) are based on the freemium model in which basic services are free to all users but premium services (e.g., more dater recommendations and more times of swiping right) are charged additional fees. This strategy compromises the dating experience of users who cannot afford the premium services and further exacerbates the economic inequality among users. Moreover, the freemium strategy also reinforces the commodification of users in online dating as the more the users pay, the more recommended users they can select from (Haywood, 2018; Sharabi, 2020).

In addition, as mentioned in "personal development," minority users are more likely to encounter harassment in online dating. Duguay et al. (2020) found that queer users are prone to quit dating apps if they frequently receive inappropriate matches and aggressive messages. As most dating apps' algorithms are designed for perceived dominant groups (i.e., white cisgender young adults) (Bivens & Hoque, 2018), these apps hardly leave room for minority groups to present themselves and find a perfect match, making their voice less likely to be heard.

Gender minorities' miserable experiences in online dating also raised scholars' attention to dating algorithms' impacts on social discrimination. Gieseking (2017) examined OkCupid's algorithmic classification and found that some users in OkCupid were marked as "attractive" and received more attention from other users. Rolle (2019) also suggested that Tinder may reinforce user discrimination by running an algorithmic system called "Elo-score." This system ranks users according to their previous in-app behaviors and recommends users with those who have the same score. In this way, online dating algorithms can

determine who can be more visible and further reinforce stereotypes towards minority groups (Bartlett & Gulati, 2016).

Online dating algorithms may also enlarge gender inequality by encouraging problematic masculinity (Haywood, 2018). Haywood (2018) pointed out that the ranking algorithms enable users, especially male users who traditionally exercise power over women, to compare women as if comparing commodities. It is likely for more attractive users to transform online dating platforms into a hunting ground where they can demonstrate their romantic skills and show off the "prey" they captured. This ideology can be even toxic for young adults as their self-perceptions are not fully developed (David & Cambre, 2016).

- *Business*

The algorithm is also a crucial factor that shapes the online dating industry (16.2%). Prior studies identified that all stakeholders, including platforms, third parties and users, can profit from online dating algorithms.

Online dating platforms can increase revenue mainly through three methods: 1) promoting the swipe logic, 2) increasing premium users, and 3) exchanging user data (Abolfathi & Santamaria, 2020; Courtois & Timmermans, 2018; Rita et al., 2020; Sepulveda & Vieira, 2019). First, Abolfathi and Santamaria (2020) indicated that it was the swipe logic that made Tinder stand out. Swipe matching, which is more entertaining than traditional survey-based matching, attracted younger generations' attention and successfully penetrated this previously overlooked market. To date, swipe algorithms have changed the online dating industry and become a fundamental technology for Tinder and other dating apps.

Second, Courtois and Timmermans (2018) examined how algorithmic

recommendation works in Tinder and found that the platform manipulates search outcomes so as to push users to buy premium services. They stated:

> Especially for the free service, the key is to keep users sufficiently satisfied so they do not abandon the service too quickly, but not too satisfied so they would be inclined to convert to paying services. This means that the algorithm needs to dynamically alternate between encouraging users and restricting them (Courtois & Timmermans, 2018, p. 7).

This explains how algorithms implicitly encourage users to consume on dating platforms.

Besides, dating companies, together with advertising companies, relative corporations and private sectors, can profit from the user data collected through algorithmic profiling. Kari (2017) suggested that survey-based dating platforms collect users' personal information, including religion, culture, sex, and hobbies. See-and-screen dating platforms (e.g., Tinder) also collect users' information from Facebook and Instagram (Cohen, 2018). These data feed algorithmic profiling and are sold to advertising companies and exchanged with relevant corporations (Albury et al., 2017). Albury et al. (2017) also indicated that some dating platforms even allow drug companies to sell their products and send personalized advertising on platforms. Although users largely criticize this marketing practice, dating platforms are reluctant to regulate themselves. This is because, according to Howard (2018, p. 33), "filtering and policing that content will cause their traffic to shrink, their expenses to rise, and their revenues to fall."

Dating platforms can also use user data collected through algorithms to understand user behaviors so as to promote products and vary service prices. Cohen (2018, p. 1721)

found that online dating algorithms will personalize service price depending on users' previous behaviors, including "how often they look at the website, their past searches, the day of the week, the device they are using (mobile versus computer), whether they are using an ad blocker, their geo-localization, etc." Namely, online dating companies increase their revenues through their unfair treatment of consumers and the exploitation of the data consciously or unconsciously uploaded by users.

Users can also make a profit in online dating through algorithms, though it is less common than platforms and third parties' business practices. Wang (2020) observed that users on Blued are inclined to use "*yanzhi*" algorithms, which score users' external appearance and polish their pictures and videos so as to increase their attractiveness. This algorithm can help users gain extra income from online dating platforms as the more attractive they look, the more review and rewards they receive.

- *Political concerns*

The political issues (12.5%) about online dating algorithms include algorithmic governance in online dating and the government's exploitation of algorithms as political tools.

Informed by social constructionism, some scholars believe that algorithms govern the way online daters use platforms and implicitly shape their perceptions and social behaviors (Albury et al., 2017; Duguay et al., 2020). For instance, Tinder's swipe logic limits users' interaction in a superficial and disposable way; users can only indicate "yes" or "no" at the preliminary stage of dating (Costa Rodrigues & Baldi, 2017; David & Cambre, 2016). Rolle (2019, para. 16) also highlighted algorithms' decisive role in mate matching: "Tinder

algorithms can actively decide to deny you a match, or several matches, simply by not showing them to you." Moreover, scholars observed an "algorithmic belief" in online dating (Sharabi, 2020). Scientists' unjustified claims about algorithms as being completely scientific, neutral, and intelligent may lead users to uncritically accept algorithmic recommendations (Schwartz & Velotta, 2018). Namely, algorithms not only govern whom to recommend but also influence how users perceive their recommendations.

Additionally, platforms and politicians increasingly take advantage of algorithms to manipulate users and conduct political campaigns and propaganda in online dating. Kari (2017) indicated that online dating platforms may censor users' behaviors and speeches to prevent undesirable harassment and discrimination. While this act can make dating platforms a safer space, it is suspicious that dating companies may exert excessive power over users in the name of legal censorship (Albury et al., 2017).

Howard (2018) also mentioned that politicians are trying to reach the public and fulfill their political goals through algorithmic recommendations on dating platforms. For instance, some politicians may pretend to be daters and distribute flirt messages. Their conversations will eventually turn to politics and persuade more people to vote for them in elections. Governments are also willing to cooperate with dating apps to increase public welfare (e.g., educate users about sexually transmitted diseases and collect user data for health research) (Albury et al., 2017). This raises privacy problems about to what extent dating platforms should disclose customers' personal data to government institutions and whether the cooperation between platforms and government reinforces governmental surveillance over the public.

- *Ethics and morals*

Ethics and morals (8.8%) is one of the least mentioned issues concerning online dating algorithms. Scholars mainly question whether it is ethical to put daters' fate totally in the hand of algorithmic decision-making. Since most daters are not aware of how algorithms work in online dating, they may simply regard algorithm-curated recommendations as default choices and replace their rational thinking with algorithmic decisions (Tong et al., 2016*b*). However, as Parisi and Comunello (2020) indicated, even algorithm designers may have little knowledge about algorithmic recommendation's mechanism as the system works depending largely on machine learning. Schwartz and Velotta (2018) even suggested that behavioral scientists have not completely validated some decision models embedded in online dating matching algorithms. In this scenario, it is unethical to excessively rely on algorithms in mate matching.

Research also identified several technological deficiencies of online dating algorithms that may raise ethical concerns. For example, since algorithmic profiling is incapable of verifying the authenticity of user accounts, personal information and pictures uploaded to connected social media (MacLeod & McArthur, 2019; Miguel, 2018), this deficiency can be exploited in multiple ways, including deception, sexual harassment and personal attack (Albury et al., 2017). Bivens and Hoque (2018, p. 453) also cast doubt on algorithms' judgement criteria: "the measurable type of good and bad is based exclusively on what is available to measure." This indicates a possibility that online daters may feel offended if they find the algorithmic profiling differs considerably from their perceived identities.

- *Privacy*

While previous literature paid the least attention to online dating algorithms' privacy concerns (5%), users' data safety matters significantly as users' personal information collected on dating platforms is more sensitive than on other social media (Kim et al., 2018).

Albury et al. (2017) examined how users' personal data is protected on Tinder and Grindr. They found that both apps clarified what and when users' data were collected and promised they would not share identifiable data with third parties in their Privacy Policy. However, aggregated data, which can be de-identified through data analysis, was not under protection. Tinder also acknowledged that they would actively exchange users' data with other companies in the Match Group. This, according to Albury et al. (2017, p. 5), threatens users' right to control their personal data: "data created through one social media application, shifts and thus is stored across multiple proprietary servers, and, increasingly, move outside of end-user control."

Platforms and third parties may also exploit users' data through malpractices that are not stated and prevented in the Privacy Policy. Kim et al. (2018) indicated that online dating companies can track users' location to predict their movement. Howard (2018) also suggested that online dating platforms are incapable of and unwilling to regulate politicians who exploit algorithmic recommendations for political purposes. These misbehaviors increasingly endanger users' privacy in online dating.

Discussion

To better understand online dating algorithms' social impacts and ethical concerns associated with algorithm innovations, this section examined online dating algorithms through a technoethical assessment approach. The ultimate goal of this assessment is to

identify areas where online dating algorithms exert unethical influences and provide suggestions to better the relationship between algorithm technologies, online daters, dating platforms, government, and other relevant stakeholders.

Informed by the findings of the systematic literature review, I assessed online dating algorithms from nine perspectives, including 1) theory, 2) socio-culture, 3) economy, 4) politics, 5) stakeholders, 6) levels of influence, 7) intended ends and possible side effects, 8) comparison of means and intended ends, and 9) overall assessments in terms of efficiency and fairness. Overall, this technoethical assessment presents a comprehensive analysis of online dating algorithms' social and ethical impacts through the lens of technoethics. A summary of the technoethical assessment is presented in Table 3 (see Appendix E).

- *Theoretical perspectives*

This section assessed online dating algorithms' design from two perspectives of ethical theories: right ethics and relational ethics.

To begin with, focusing on individuals' inherent right, the right ethics assumes that every individual possesses a natural-born right to be treated equally in society (Locke, 1690). Namely, an ethical action should not build on the harm and deprivation of others' rights but to widely promote social justice and liberty under institutions and organizations' help (Rawls, 1970).

From the right perspective, online dating algorithms can be less ethical than expected. Indeed, algorithms' matching and filtering features offer minority groups, who are traditionally marginalized in online and offline dating, equal opportunities to seek potential partners as dominant groups (Mazur, 2020). However, the ranking and profiling system

cannot guarantee equal visibility for each user. Rolle (2019, para. 5) argued: “some information of a certain group is prioritized, which affords them greater visibility, while others are rendered invisible.” Besides, dating platforms incite more users to pay for premium services by restricting the number of algorithmic recommendations (Courtois & Timmermans, 2018). Therefore, certain groups (usually social minorities and lower-class users) can be deliberately invisibilized by either algorithms or dating platforms, resulting in a violation of users’ fundamental rights.

Relational ethics is another important perspective in ethics theories. Focusing on the communication between individuals, this perspective believes that ethical actions are derived from productive and healthy relationships built and maintained by mutual and reciprocal communications (May et al., 2013). For example, people can show respect to others by listening carefully to their talks and express their goodwill with caring words (Gilligan, 2008). This reciprocal conversation will eventually encourage bi-directional ethical actions such as trust and responsibility.

In this scenario, online dating algorithms may not promote ethical actions because this technology hinders daters’ reciprocal interactions. As MacLeod and McArthur (2019) mentioned, online dating algorithms mainly serve to facilitate the profiling and matching function instead of helping users build intimate relationships with others. In survey-based dating platforms, users need to fill in a long questionnaire concerning their personalities, hobbies, religions, mate preferences, etc. However, this profiling method complicates the dating process as few offline daters ask such sensitive questions on their first date (Kao, 2016). See-and-screen dating platforms, on the other hand, limit users’ interaction to a simple

gesture of swiping and a binary option to indicate their dating intentions (David & Cambre, 2016). Therefore, according to Degen and Kleeberg-Niepage (2020, para. 58), users' interaction in online dating can be hardly reciprocal as daters only "check partner suggestions passively as they are received." This probably explains why although online dating algorithms become increasingly efficient, they still fail to facilitate long-term romantic relationships.

- *Socio-cultural perspectives*

Informed by Actor-Network Theory, online dating algorithms mediate, influence and are influenced by cultural and social contexts (Albury et al., 2017). This is to say, online dating algorithms, on the one hand, reflect programmed social and cultural values and bias, while on the other hand, actively magnify or shift these ideologies through their interactions with users and other social actors.

Dating culture is the one that has been considerably shaped by online dating's swipe logic. As Finkel et al. (2012, p. 19) mentioned, "not only has online dating rapidly become a pervasive means through which singles seek to meet potential romantic partners, but it has fundamentally altered the acquaintance process." Daters regard online dating as a "pre-date" stage that allows daters to think about their mate preference, implicitly explore others' dating intentions and make cautious decisions about their future partners (Haywood ,2018). This "pre-date" concept was created after dating platforms introduced algorithmic profiling and matching, which, at the very beginning, were designed by dating platforms to demonstrate online dating's superiority and attract more people to use their products (Gillespie, 2014). At present, with numerous online dating companies advertising their algorithms' efficiency in

finding “perfect” matches, algorithmic profiling and recommendation have become an essential stage in both online and offline dating (Sharabi, 2020). The swipe gesture even gains a cultural meaning of “yes” and “no,” and indicating dating intentions with the swipe gesture also becomes a dating norm before online daters chat and meet each other (Costa Rodrigues & Baldi, 2017).

While the dating culture is getting more dynamic after its blend with algorithmic culture, it is noteworthy that online dating algorithms are also gaining power in ruling daters as well as the public’s perceptions of gender and identity. As Bivens and Hoque (2018) mentioned, how genders are conceived and presented in online dating algorithms can be problematic. Gender minorities may find it difficult to present themselves as in some dating apps, gender options are limited to “male” and “female.” This binary and cisgendered algorithm design not only indicates an existing social ignorance of gender minorities but also reinforces gender bias and discriminations towards LGBTQ groups (Bivens & Hoque, 2018). Additionally, as Haywood (2018, p. 148) argued, “a crucial aspect of masculinity is that it is constituted through how men exercise power over women and create the conditions for how relationships take place.” In this scenario, Tinder’s swipe logic may reinforce the stereotype of masculinity through its commodification of users, especially women users.

Moreover, algorithmic matching in online dating may compromise daters’ self-perceptions. According to Cooley’s (1922) looking-glass-self theory, people’s self-perceptions are constantly changing depending on how they perceive others view them. This is to say, different social settings may lead to different ways of interpreting self (Hinde, 2001). In online dating, as algorithms construct the “reality” through screening and filtering,

people's self-perceptions can be greatly affected by dating platforms' social affordance (Jones, 2015). Therefore, algorithms' decisions on whom to recommend, how to profile users, and what to present will largely influence users' perceptions of "online dating reality" and eventually shift their self-concepts.

Overall, it is imperative to raise the public as well as online dating platforms' awareness of algorithms' influential potential on dating culture, gender ideologies and users' personal development. Algorithms should not only provide efficient recommendations but also increase users' welfare and do social good. Therefore, algorithm designers should pay more attention to existing social and cultural biases and try to avoid programming them in algorithms.

- *Economic perspectives*

As analyzed in previous sections, it is the algorithm that attracts more users to online dating platforms and boosts the online dating industry. First, the swipe logic based on algorithmic profiling and recommendation successfully opened niche markets such as younger generations, marginalized groups and aging adults (Abolfathi & Santamaria, 2020; Erjavec & Fiser, 2016). This is because swipe algorithms simplify the dating process, which is convenient for elderly users and entertaining for youngers, and enable users to personalize mate recommendations according to their unique preferences.

In addition, online dating platforms make a considerable contribution to the data-driven economy where users' personal data are monetized through an automatic and algorithm-driven process of collection, aggregation, curation, analysis and exchange (Kumar et al., 2018). Online dating platforms can utilize user data to update online dating algorithms

and exchange the aggregated data with advertising companies and other relevant organizations (Albury et al., 2017). Advertising companies can also benefit from data analysis as they can better understand consumer behaviors (Courtois & Timmermans, 2018). Wang (2020*a*) also argued that as some dating apps are featured with live streaming, users can also live stream on online dating platforms and profit from virtual gifts and likes sent by other users.

At first glance, algorithms seem to have completely positive impacts on the online dating industry and data economy. A closer look, however, reveals dating platforms' implicit exploitation of user data as well as digital labors. To begin with, Cohen (2018) and Nuccio and Guerzoni (2019) demonstrated that users' personal data and using behaviors collected through algorithmic profiling and recommendation can be important sources of pricing strategy. While this strategy directly increases online dating platforms' revenue, it also betrays consumers' trust by ranking users, violating market fairness and reinforcing economic discrimination. Wang (2020*b*, p. 506) also pointed out an asymmetric economic power between online dating platforms and live streamers: "gay men's performative labor have been increasingly institutionalized, professionalized, and datafied as corporate assets. Thus transformed, these assets are used by Blued to expand sexually affective data production." In this scenario, it is increasingly necessary to introduce regulations and policies on how, to what extent and for what purposes that dating platforms and relevant organizations can access and use daters' personal data.

- *Political perspectives*

This perspective explores how dating platforms and government influence the

functions and innovations of online dating algorithms and exert power over online daters through “algorithmic beliefs.”

One ethical dilemma raised in previous studies is whether governments and organizations should use online dating platforms for social good. For example, Albury et al. (2017) mentioned that U.S. National Institute of Health collected data of gay users’ dating platform usage and sexual behaviors for national research on HIV prevention. While this research may contribute valuable data to advancing health studies, it also provides a legitimizing reason for governments to collect private data. Furthermore, the government’s access to online dating data can also expand and normalize national surveillance under the guise of “the common good.” Online dating companies are also suspected of reinforcing governmental control over the public by lending government excessive rights to their databases. Albury et al. (2017, p. 8) indicated: “digital companies are rarely willing to discuss the details of law enforcement and intelligence agencies’ access to their customer databases, or the degree to which they assist or resist such access.” In this way, online dating algorithms can be exploited as surveillance tools and further threaten online democracy.

Moreover, online dating platforms can use algorithms to influence daters’ perceptions so as to achieve hidden political and economic goals. As Schwartz and Velotta (2018) mentioned in previous sections, online dating platforms tend to advertise their products as scientific and efficient, though parts of their algorithmic models have not been totally accepted by experts. Sharabi (2020) supported this finding and further argued that it is through this inaccurate claim that online dating companies foster an “algorithmic belief” among users. This belief in algorithms’ objectiveness and superiority increases customer

stickiness and ensures more revenue for online dating platforms. Therefore, we should be cautious about online dating algorithms' political potential and prevent them from being exploited as surveillance and manipulating tools.

- *Stakeholders' perspectives*

This perspective examines the relationship between online dating algorithms' stakeholders and questions whether online dating algorithms exert positive influences on stakeholders.

There are six major stakeholders associated with online dating algorithms, including online dating platforms, algorithm programmers, users/online daters, advertising companies, relevant corporations and organizations (e.g., pharmacies and research centers), and governments (Albury et al., 2017; Howard, 2018; Schwartz & Velotta, 2018). Clearly, the power relationship between stakeholders can be asymmetric; all the other five stakeholders can benefit from online daters' interaction with algorithms. This power imbalance is achieved through dating platforms' manipulation of online dating algorithms and their monetization of user data collaboratively with advertising companies and external organizations. In addition, few online dating companies disclose how their algorithms are designed and regulated (Schwartz & Velotta, 2018). This situation exacerbates the unequal relationship as users have little knowledge of how their online behaviors are ruled and their personal data are collected by algorithms.

It is also noteworthy that "upper-class" stakeholders may also conflict with each other. For example, as Albury et al. (2017) mentioned, online dating platforms are cautious when cooperating with government institutions as it is difficult to decide to what extent

platforms should disclose their users' personal data. Algorithm programmers also face an ethical dilemma: whether and to what extent they should transfer daters into consumers (Wayner, 2014). While platforms wish to increase their revenue by increasing the number of paying users, they may require algorithm programmers to limit the amount of algorithmic recommendation in free services and equip algorithms with user ranking systems (Courtois & Timmermans, 2018). Algorithm programmers, as a result, are caught in the middle between platforms and users.

- *Levels of influence*

As algorithmic profiling and recommendation have been prevalently used in various transnational dating platforms, these technologies have a global influence at both individual level as well as social level.

At an individual level, as mentioned in previous sections, online dating algorithms directly determine how to profile users and what information can be shown to users. It may also influence users' self-perceptions and gender ideologies through the interaction. Besides, Sepulveda and Vieira (2019) suggested that it can be difficult for online daters to be aware of algorithms' existence. This indicates a more profound influence that online dating algorithms may have over users beyond our expectations.

At a social level, online dating algorithms enable singles from different places to seek their romance regardless of cultural background. Especially during the COVID-19 pandemic, with most regions being under the lockdown policy, an increasing number of people turned into online dating and chatted with people worldwide. This, however, raises a problem that the values embedded in algorithms can be unethical in other cultural backgrounds (Cohen,

2018). Also, as Albury et al. (2017) mentioned, online dating's globalization poses a huge risk on the transnational regulation of online dating industry. For example, while the EU launched General Data Protection Regulation (GDPR) to protect social media users' privacy and information transparency in European Economic Area, other countries and regions (e.g., China), may not have similar regulations or cover the same protection areas (GDPR-Info, 2018; Huang, 2019). As this situation is getting ever complicated, it is necessary to examine online dating algorithms' global influences and have worldwide nations regulate online dating industries and users' data safety collaboratively.

- *Intended ends and possible side effects*

From the user perspective, online dating algorithms' intended end is to provide "perfect" mate recommendations according to users' mate preferences. While algorithmic profiling and matching make online dating more efficient, this intended end can have negative impacts on users' perceptions (e.g., cause identity crisis and lower self-esteem when users fail to get matched and receive appropriate profiling), dating culture (e.g., overemphasize algorithmic matching as an important stage in online dating) and human-algorithm relationships (e.g., reinforce algorithmic governance on users' decision-making process) (David & Cambre, 2016; Degen & Kleeberg-Niepage, 2020; Gieseking, 2017).

From the perspective of online dating platform, except for the intended end mentioned above, advanced algorithms can also help online dating platforms stand out and achieve economic goals (e.g., attract more active users and increase subscribers and paying users). So far, algorithms can fulfill these intended ends as Albury et al. (2017) indicated that all Grindr's revenue is based on algorithm-driven features (i.e., subscription to premium services

and in-app advertising). However, these intended ends raise significant side effects over users. These side effects range from compromising user experience (e.g., limit the number of recommendations, conduct pricing discrimination, commodify users, etc.) to threatening users' data safety (e.g., sell and exchange data with advertising companies and third parties, conduct implicit user profiling, etc.) (Albury et al., 2017; Courtois & Timmermans, 2018; Haywood, 2018).

In this scenario, future research should pay more attention to online dating algorithms' side effects on users' personal development, culture, human-technology relationship, user experience and privacy issues.

- *Comparison of means and intended ends*

Online dating algorithms are indispensable means to achieve most intended ends mentioned above. As online dating's foundational technology, algorithms serve as online dating platforms' core component and ultimately boost the global online dating industry. While online dating algorithms are getting increasingly efficient and professional in sorting and matching, previous studies still identified several technical problems that hinder algorithms from achieving their intended end. These problems include failing to distinguish false and aggressive information and messages (Miguel, 2018), oversimplifying profiling and matching criteria (MacLeod & McArthur, 2019), and using unjustified theories and models to predict user behaviors and preferences (Schwartz & Velotta, 2018). As these technical issues may exacerbate algorithms' side effects over users' mental health and gender perceptions (Gieseking, 2017), online dating platforms and algorithm designers should take algorithms' social impacts into account and avoid programming cultural bias in their algorithms.

However, regarding intended ends of increasing paying users' amount and facilitating in-app advertising, the algorithm may not be an appropriate avenue. On the one hand, making a profit from user profiling and pricing discrimination may not only raise ethical problems but also leave online dating users a sense of betrayal. While on the other hand, algorithm-based revenue supports a large part of the online dating industry, which makes it difficult for online dating platforms to completely forgo this income (Albury et al., 2017). Also, Hosanagar and Jair (2018) suggested that informing users of how algorithms function in online dating and profit from users poses a challenge to platforms as this act may decrease their competitiveness. This situation raises significant questions for future research and the online dating industry to think about. For example, should online dating companies profit through algorithmic user profiling? Should and how can online dating companies abate their reliance on algorithm-based revenues? And to what extent should online dating platforms disclose their algorithm mechanism? (Webb et al., 2019) Overall, the goal is to promote an ethical innovation in algorithms' design and ameliorate their potential harm to user experience and data safety.

- *Overall assessment in terms of efficiency and fairness*

As Finkel et al. (2012) mentioned, compared with traditional in-person dating, which involves considerable effort and time in mate-seeking, matching and decision-making, algorithmic online dating significantly improves the efficiency of this process. However, it is controversial whether algorithms improve the efficiency of communication in online dating. Previous sections examined how the binary gender option hinders users from presenting their identity (MacLeod & McArthur, 2019), and how the swipe logic over-accelerates the dating

process and turns mate matching into online shopping (Degen & Kleeberg-Niepage, 2020; Haywood, 2018). Instead of making the matching process more efficient, algorithms institutionalize users' mate matching in an over-simplified and unidirectional way, discouraging users from reciprocal interactions. It is necessary for online dating platforms to be aware of the fact that an algorithm is not merely a mathematic program but an influential technology that interacts with users as well as mediating the interactions between users. Thus, to fulfill algorithms' intended goals of connecting users, online dating companies should be cautious of algorithms' influential potential and program their algorithms to encourage more creative self-presentation and more productive interactions between users in mate matching.

Besides, as a technology that intends to promote equal opportunities for users to find romance on the internet, algorithms may grant more privilege to those favored by capitalists and render marginalized groups even invisible (Rolle, 2019). As Albury et al. (2017, p. 2) mentioned, "seemingly mundane technical features of digital media platforms, apps and devices mediate among the competing interests of the corporations providing the platforms, the advertisers and data miners who exploit the data generated by users, and diverse communities of users themselves." In this scenario, online dating companies should take all stakeholders, especially online daters' interests into consideration and avoid exploiting algorithms as economic and political tools.

Chapter 5: Conclusion

Summary of research findings

Informed by social constructionism, Actor-Networking Theory and Technology Mediation Theory, this research explored online dating algorithms' social impacts and ethical innovations through a systematic literature review and a technoethical assessment of online dating algorithms' design and application.

Through the systematic literature review, this work identified seven major social and ethical issues around online dating algorithms, including personal development, culture, social equality, business, political concerns, ethics and morals, and privacy. This result reveals online dating algorithms' potential influences from multiple levels and perspectives.

At an individual level, while online dating platforms provide opportunities for singles – especially introverts and minority groups – to find potential partners through the internet, online dating algorithms' problematic mechanism and category design may trigger negative impacts on users' mental health and identity formation. At a social level, dating culture, gender perceptions and social structures co-evolve through the interaction between online dating algorithms and social actors. On the one hand, algorithm designers may program biased perceptions (including cultural bias and economic and political aims) into algorithms' architecture. On the other hand, these biased perceptions are intensified through algorithmic profiling and recommendation, further reinforcing biased social norms and culture in reality. At an institutional level, online dating algorithms can be exploited by corporations and institutions to increase revenue and fulfill political purposes (e.g., propaganda and manipulation of public behaviors and perceptions). This exploitation also poses daters'

privacy and data safety under threats as individuals have little control of their personal data, nor they know how and when algorithms dig their data. At an ethical level, it is controversial whether online dating algorithms deprive daters' rights of making decisions and whether it is ethical to allow algorithms to judge humans according to pre-set or machine-learned criteria.

Based on the result of systematic literature review, a technoethical assessment of online dating algorithms' innovation discloses ethical concerns from perspectives of theory, socio-culture, economy, politics, stakeholders, levels of influence, intended ends and possible side effects, comparison of means and intended ends, and overall assessments in terms of efficiency and fairness. These ethical concerns include 1) algorithms' deprivation of reciprocal communication, 2) cultural and social bias reinforced by irresponsible algorithm design, 3) online dating industry's exploitation of user data, 4) pricing discrimination reinforced by algorithm classification, 5) institutional power mediated through algorithms, 6) online dating platforms' surveillance potential, and 7) algorithm transparency. This result demonstrates that online dating algorithms' design shares the same ethical problems as those identified in previous literature, i.e., autonomy, accountability, and transparency.

Implications

The present work contributes strategic information on the opportunities and challenges of online dating algorithms' ethical design. Overall, it calls for more public awareness of online dating algorithms' influential potential and online dating platforms' responsible design, use and regulation of online dating algorithms.

First, the technoethical assessment revealed an insufficient attention given to online dating algorithms' potential influences on users, culture and social norms in their design.

While most online dating platforms focus on algorithms' efficiency, superiority and complexity, it is of equal importance for platforms to ensure their algorithms are human-centered and serving to facilitate reciprocal communication and healthy relationships between users. Algorithm designers should be aware of their responsibilities to design unbiased or less-biased algorithms. This requires online dating platforms and programmers to fully evaluate perceptions, cultures and values embedded in their products and take all stakeholders' (especially elders, disabled people, gender and racial minorities) interests into account.

Besides, it is necessary to reinforce regulations on for what purpose that online dating platforms and institutions can exploit algorithms and users' personal information. As Katzenbach and Ulbricht (2019, para. 26) indicated, "in many cases, data collection, data analysis and governance measures lie in the responsibility of both police agencies and private companies, often in complex constellations." Although many countries and regions launched laws and regulations (e.g., The Personal Information Protection and Electronic Documents Act (PIPEDA) in Canada and GDPR in EU) to protect individuals' privacy from governmental surveillance and business exploitation, some of them are not measurable and executable given the complicated internet environment (Blacklaws, 2018). For instance, both PIPEDA and GDPR restrict the protection of "personal information" to identifiable information (GDPR-Info, 2018; Office of the Privacy Commissioner of Canada., 2014). Online dating platforms may take advantage of this regulation to exploit aggregated data and profit from the data exchange. Therefore, this research calls for more applicable regulations catered for online dating algorithms to prevent algorithms from negative exploitations.

Limitations and future directions

Regarding this study's limitations, the first to be noticed is an insufficient comprehensiveness of literature selection. Although there is an increasing number of studies focusing on online dating algorithms' social impacts and ethical concerns, most of these studies limited their attention to online dating algorithms' problematic gender settings and their influences on gender inequality. Therefore, the mutual influences between online dating algorithms, dating cultures, individuals' self-perceptions, online dating platforms' business model and governmental surveillance are not well explicated in the present study. I encourage future studies to pay more attention to the diverse role that online dating algorithms play in online dating platforms as well as in society.

Another limitation of this study is the lack of empirical data on online dating algorithms' design and mechanism. As few online dating companies disclosed how algorithms work in their platforms, in this study, I conducted the technoethical assessment based on second-hand data collected in previous studies. This may limit the depth and scope of the technoethical assessment. Therefore, future studies are encouraged to investigate online dating algorithms' ethical design based on first-hand data and empirical experience. Besides, I also encourage future research to examine online dating algorithms from interdisciplinary perspectives, collaboratively contributing professional insights into algorithms' innovation from perspectives of communication, sociology, engineering, psychology, ethics, politics and economics.

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Appendices

Appendix A: Articles selected for the systematic literature review

1. Abolfathi, N., & Santamaria, S. (2020). Dating disruption—How Tinder gamified an industry. *MIT Sloan Management Review, 6*.
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Appendix B: Table 1 – The result of systematic literature search

Table 1 The result of systematic literature search

Year: 2016 to 2020/Databases/Hits	SCOPUS	Springer	Web of Science	ABI
With title, abstract and keywords terms: *("online dating" OR "dating app" OR "dating site") AND (algorithm* OR "recommendation system")*	41	96	49	1,315
With subject terms: *ethics* OR social**	18	54	22	26
Elimination of irrelevant articles	15	7	16	7
Total number of articles chosen from four databases			45	
Elimination of duplicated articles			32	
Number of the final selection			32	

Appendix C: Table 2 – Themes and distribution of literature

Table 2 Themes and distribution of literature

Article/ Construct	Human development	Culture	Social equality	Business	Political issues	Ethics and morals	Privacy
1		✓		✓			
2	✓	✓	✓	✓	✓	✓	✓
3			✓				
4	✓	✓	✓	✓	✓		
5			✓	✓			
6		✓					
7			✓	✓		✓	
8	✓	✓			✓		
9	✓	✓					
10	✓		✓		✓		
11		✓					
12	✓	✓	✓				
13	✓	✓	✓				
14	✓			✓	✓		✓
15	✓		✓	✓			
16	✓	✓					
17		✓		✓	✓		
18							✓
19	✓					✓	
20						✓	✓
21	✓		✓				
22		✓					
23				✓			
24				✓	✓		
25				✓	✓		
26	✓	✓	✓		✓	✓	
27	✓		✓				
28		✓	✓		✓	✓	
29	✓		✓				
30	✓					✓	
31	✓	✓		✓			
32				✓			
Frequencies	17	15	14	13	10	7	4
Percentage	53.1%	46.9%	43.8%	40.6%	31.3%	21.9%	12.5%
Distributed %	21.2%	18.8%	17.5%	16.2%	12.5%	8.8%	5%

Appendix D: Figure 1 – Distributive pattern of literature

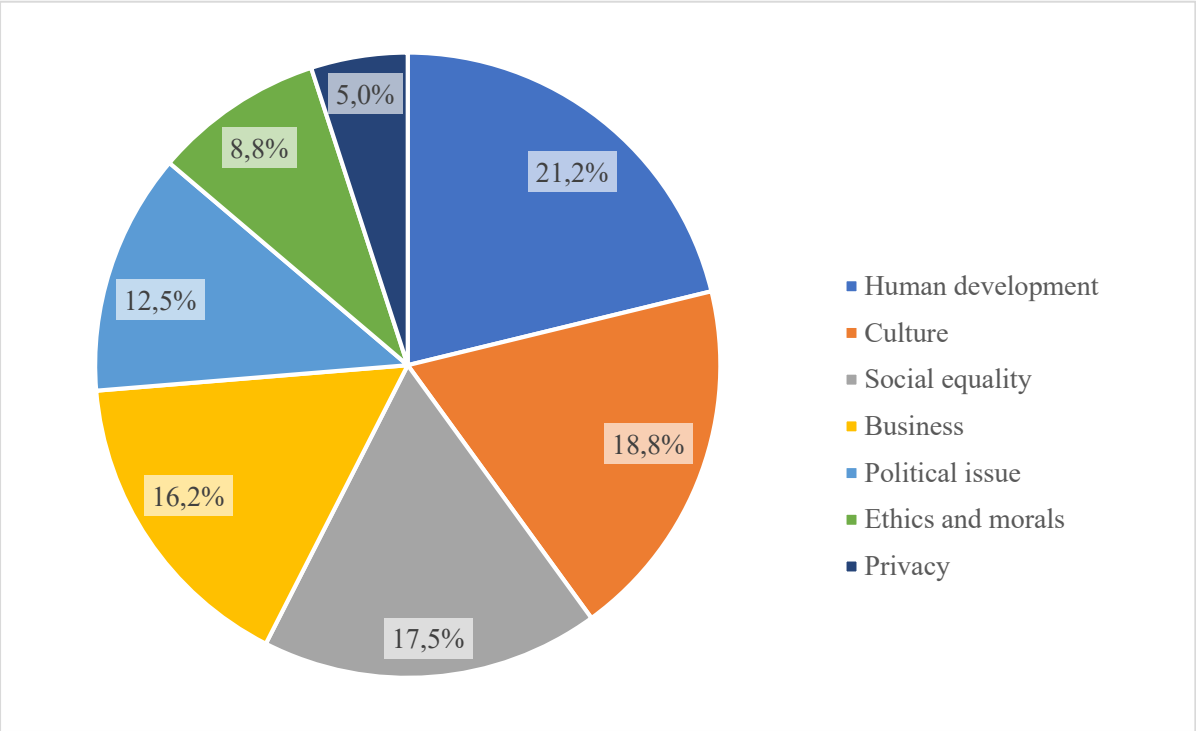

Figure 1 Distributive pattern of literature

Appendix E: Table 3 – Summary of technoethical assessment of online dating algorithms

Table 3 Summary of technoethical assessment of online dating algorithms

Theoretical perspectives • Right ethics: Online dating algorithms should ensure equal visibility and charge of every user (Locke, 1690; Rolle, 2019) • Relational ethics: Online dating algorithms should encourage reciprocal interactions and healthy relationships between users (Gilligan, 2008; MacLeod & McArthur, 2019).
Socio-cultural perspectives • Online dating algorithms shape dating cultures by introducing "pre-date" stage and swipe gestures (Costa Rodrigues & Baldi, 2017; Haywood, 2018) • Existing binary and cisgendered design of categories and algorithm logic (Bivens & Hoque, 2018) • Algorithmic mediation may reinforce biased culture and perceptions (Haywood, 2018) • Need for more public awareness of online dating algorithms' influential potential
Economic perspectives • The entertaining nature of swipe algorithms boosts online dating industries (Abolfathi & Santamaria, 2020) • Almost all stakeholders, including platforms, third parties and users, can benefit from algorithmic profiling and recommendation (Albury et al., 2017; Wang, 2020*a*) • Online dating algorithms can be used by platforms to exploit user data and digital labors (Wang, 2020*b*) • Need for more executable regulations on platforms' exploitation of algorithms
Political perspectives • Online dating algorithms can be exploited by institutions as surveillance tools (Albury et al, 2017; Howard, 2018) • Be cautious about an "algorithmic belief" promoted by platforms (Sharabi, 2020) • Need to prevent institutions from manipulating the public through algorithmic governance

Stakeholders' perspectives

- The power relationship between stakeholders can be asymmetric
- An ethical dilemma that whether and to what extent should platforms transfer daters into consumers (Wayner, 2014)
- Need to take all stakeholders' interests into account when designing and regulating online dating algorithms

Levels of influence

- Online dating generates a global influence as it is prevalently used worldwide
- Ensure that embedded values are acceptable to all cultural and social groups (Cohen, 2018)
- Need to reinforce transnational regulation of algorithms and data safety

Intended ends and possible side effects

- Intended ends: facilitate mate matching and expand the online dating industry
- Possible side effects: negative impacts on user experience, culture, and user privacy

Comparison of means and intended ends

- Several technical problems may hinder algorithms from achieving intended ends (Miguel, 2018; Schwartz & Velotta, 2018)
- Need to explore the extent of algorithm transparency (Hosanagar & Jair, 2018)

Overall assessment in terms of efficiency and fairness

- Algorithms improve the efficiency of the dating process but fail to facilitate efficient and productive communication between users
- Online dating platforms should not regard algorithm merely as a machine but as an avenue for daters to build intimate relationships
- Need to increase fairness in online dating