The next frontier of the Internet of Behaviors: data-driven nudging in smart tourism

Andrei O. J. Kwok

Abstract

Purpose – *This conceptual study examines the implications of the Internet of Behaviors (IoB) for tourism stakeholders in a hyper-connected and data-driven world.*

Design/methodology/approach – *Based on nudge theory, a literature review and empirical evidence from multidisciplinary research, this study explores the implications of the IoB for smart tourism.*

Findings – *This study reviews the literature, presents a conceptual framework and proposes a research agenda with areas for future research.*

Originality/value – *The research on the IoB is nascent. Therefore, it is critical to understand how data-driven nudging influences tourist behavior.*

Keywords *Nudge theory, Internet of things, Smart tourism, Big data, Behavioral psychology, Decision-making*

Paper type *Viewpoint*

Andrei O. J. Kwok is based at the Monash University Malaysia, Subang Jaya, Malaysia.

Introduction

Emerging technologies are driving cyber-physical fusion in such a way that creates a highly connected ecosystem for better control in work, travel and everyday life. The next frontier is the Internet of Behaviors (IoB). The IoB is intricately interwoven into a user's experience through personalization and authenticity, as it captures digital traces to potentially influence user behavior. This study examines the prevalent economic, business, social and ethical implications of the IoB for tourism stakeholders and prepares them for potential opportunities and challenges in an increasingly complex and multidimensional world. Based on the nudge theory, a literature review and empirical evidence from multidisciplinary studies, this conceptual study explores the implications of the IoB for smart tourism and presents a conceptual framework. Its findings also provide areas for a new research agenda.

Technology ubiquity, rapid urbanization, consumer population growth, government smart city initiatives and the recent COVID-19 pandemic have accelerated the digital transformation of businesses and changed how people adopt technology for their daily work, travel and leisure. Such factors drive the opportunities for behavioral analytics engagement. With an increasing reliance on digital platforms, businesses now have greater access to valuable and intangible assets, i.e. data. As consumers increasingly use smart Internet-linked devices, or the Internet of Things (IoT), as touchpoints, their digital behaviors that range from online transactions to biometrics and even to user location readily allow businesses to harvest user-controlled consumer data (e.g. digital footprints) (Ng and Wakenshaw, 2017). The volume, velocity, variety and veracity of this data allow businesses to go beyond predictive and analytics modeling (Iorio *et al.*, 2020) to gain the opportunity to modify or influence consumer behavior with prescriptive analytics.

Received 15 November 2022
Revised 20 January 2023
Accepted 8 February 2023

In short, raw data harvested via the IoT or online can be processed and organized to derive meanings, which can then be contextualized into insights about user behaviors. The term 'Internet of Behaviors' was coined by Nyman (2012) as a proposed solution which, much like the IoT, is meant to capture individuals' "meaningful behavior patterns." Identified by Gartner as one of the top strategic trends of 2021, IoB refers to the process of gaining insights into consumer behavioral psychology by collecting user-controlled data from various online and IoT sources, analyzing those behaviors (e.g. habits, preferences and inclinations) and linking them to their behavioral intentions (e.g. purchasing decisions) (Panetta, 2020).

Especially for smart tourism destinations (Buhalis and Amaranggana, 2013), the IoB can blur the lines between physical infrastructure and digital platforms. Independent travelers are then presented with prospective destinations based on dominant features and relevant characteristics (such as gastronomy, cultural attraction or architecture). This change is made possible by understanding the crucial aspects of a tourist's visit intention, travel and purchasing behavior. While information richness derived from travelers can be beneficial, in that it improves the overall experience quality; similarly, the cocreation of tourist desires can nudge tourists toward the desired outcomes (Xiang *et al*., 2021). The use of such an unprecedented amount of human behavioral data can fuel the transformation in the travel and hospitality industry by providing data-driven benefits to public and private stakeholders, e.g. overall business improvement and better customer service (Elayan *et al*., 2022; Halgekar *et al*., 2021; Javaid *et al*., 2021).

This study explores the intersection between emerging technologies and behavioral psychology in a hyperconnected and data-driven world. The IoB remains an understudied concept, which is a fact that hampers theoretical advancements and practical applications in this area. The recency of this concept, heightened by a lack of relevant articles in academic journals, makes a literature review of this topic challenging. As such, this study specifically examines the IoB in the context of tourism, presents a conceptual framework and provides findings that structure a research agenda with areas that scholars from various disciplines can actively study and expand: (1) the nudge theory's exploration underpins the efficiency of behavioral interventions in altering travel behavior, (2) use cases and the potential influence on users' hospitality, travel and tourism consumption need to be examined and (3) the study frames a discourse on the social dilemma associated with IoB. This study will contribute to areas of significant interest among both tourist practitioners and academics.

Data-driven nudging

Thaler and Sunstein (2008, p. 6) defined a nudge as "any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives." Individuals do not always make rational choices, so they can be nudged to make better choices, meaning that they can be subconsciously influenced by the information presented by choice architects in the choice environment. According to Hansen and Jespersen (2013), there are four intervention types of nudging: (1) transparent facilitation of consistent choice, (2) transparent influence (technical manipulation) of behavior, (3) manipulation of choice and (4) nontransparent manipulation of behavior. Other scholars have studied such nudges in various domains and contexts, e.g. innovation nudging (Stieler and Henike, 2022), distinguishing via boost (Grüne-Yanoff *et al*., 2018) or using artificial intelligence (Wagner, 2021).

Due to digitalization, users are increasingly making choices in online environments, such that the design of the digital choice environment (i.e. user interface) can significantly influence users' behavioral outcomes (digital nudging) (Weinmann *et al*., 2016). For instance, an automatic opt-in for seat reservations at a small additional cost when customers purchase train tickets on its website boosted the annual profits of a large national railroad in Europe by $40m (Goldstein *et al*., 2008). While such design-centric nudges are static, data-driven nudges based on big data analytics; hypernudges are dynamic and can be highly influential (Yeung, 2017).

Given the ubiquity of the IoT, real-time individual feedback, for instance, using an automated hand hygiene system with light-guided nudging and personal performance data, has been found to improve healthcare practitioners' hand hygiene compliance in hospitals (Iversen *et al*., 2021). Therefore, by using the IoB, businesses can take a further step as choice architects and use the insights gained from their customers' behavioral data to personalize the user interface to specifically cater to each customer's inherent qualities and nudge them toward the desired outcomes. The development and evolution of nudge theory, specifically the conceptual frameworks and models in relation to emerging technologies in the tourism context, requires further examination. Since travelers are infrequently repeat customers or, in most cases, first- or one-time customers, it is vital to understand the kinds of behavioral data businesses can aggregate into meaningful analytics and to what extent nudging can effectively influence behavioral outcomes. Furthermore, the design of data-driven cyber-physical devices can interplay with cognitive–affective functions (Mele *et al*., 2021). As there are limits in nudging capability, the possible direct and indirect effects of data-driven nudging on consumer psychology and behavior require further examination.

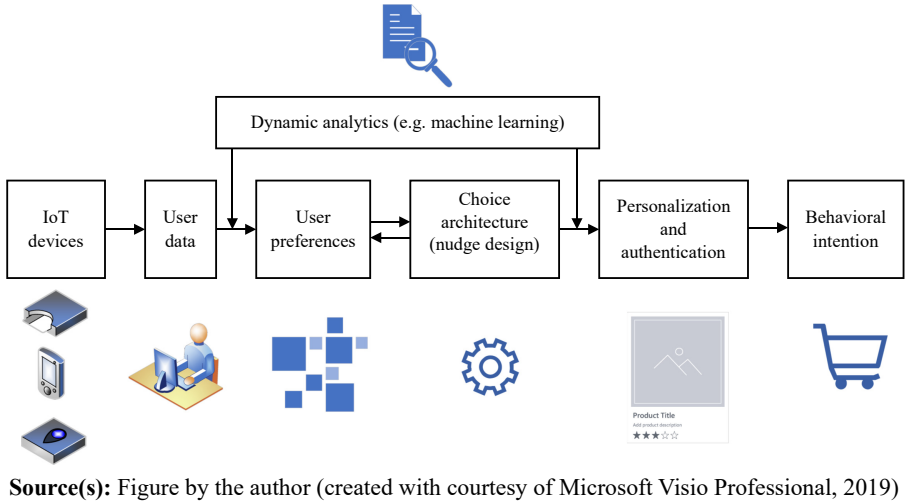
Figure 1 illustrates how user data derived from IoT devices can be used to develop a choice architecture that meets user preferences and nudges them toward an intended behavior.

IoB in smart tourism destination use cases

Smart tourism denotes a technologically integrated and interoperable ecosystem that dynamically connects travelers via the IoT and offers efficient real-time services that cater to their idiosyncratic needs, thus enhancing their visit experience (Buhalis and Amaranggana, 2013). Since travelers originate from different parts of the world, it has become increasingly challenging to manage their expectations. Therefore, businesses need to go beyond the use of mere historical preferences and daily activity records to enhance travel and hotel bookings and tour personalization to improve both process flow and product design.

As Pillai *et al*. (2022) evidenced, items presented with better information content, better image appeal and better-designed navigation systems have more robust persuasion effects on consumer attitudes and purchase intentions. Therefore, smart tourism design supports the IoB in cocreating and connecting tourists' experiences via destination design and management (Xiang

Figure 1 How the Internet of Behaviors can be used to influence behavioral intention



Source(s): Figure by the author (created with courtesy of Microsoft Visio Professional, 2019)

et al., 2021). For instance, Salis (2021) demonstrated that travelers could easily access integrated airport information, such as navigating airport facilities, obtaining recommended value-added services and enjoying special promotions via a machine-learning-driven mobile application that maps and tracks user's behavior and compares it with that of other users. Another example is Disney World Resort's MagicBand, which is a radio frequency identification (RFID) enabled wristband that consolidates visitors' park admission and hotel room access and customizes their purchase preferences (Aguiar-Castillo *et al*., 2021).

Businesses can use the IoB when cocreating value-added services with consumers (tourists) to improve marketing, enhance customer engagement and increase purchase intentions (Pershke, 2021). As ordinary devices become increasingly smart, the potential types of consumer-centric technology that can benefit from the IoB among businesses and consumers include, for instance, mobile phone technology (e.g. applications, mobile payment), contactless technology (e.g. sensors, RFID, biometrics), immersion technology (e.g. virtual/augmented reality and metaverse) and service robots. The relevant questions that arise thus relate to what extent the nonprofit adoption of the IoB can occur in a public space, the purposes thereof and the benefits it could offer to public and private stakeholders, particularly tourists. In nonprofit situations, the use of default choice architecture has demonstrated that tourists can be nudged toward prosocial behavior such as air travel carbon offsetting (Tyers, 2018) or charitable giving (Nelson *et al*., 2019). Thus, with the use of personal data, nudging can be used to drive public commuting in smart cities to enhance sustainability (Gardner, 2019).

Social dilemmas

While many facets of the IoB offer immense benefits, they also pose several new dilemmas. Due to a regulatory lag for emerging technologies, technology governance and protection for vulnerabilities such as security, privacy and confidentiality are still inadequately addressed (Kwok and Koh, 2021a, 2021b), since businesses may want to trade them off for revenue and access, and users may want to trade them off for cost and convenience (Ng and Wakenshaw, 2017). Manipulation, specifically at the subliminal level, remains contentious in regards to morality, ethics and autonomy (Stanton *et al*., 2017). Businesses that benefit from asymmetric information over their customers may create avenues for unethical gains. Given the fragmented nature of the travel industry, it is difficult and costly to obtain information; therefore, the potential for data bias arises. For example, there have been cases of artificial intelligence driven decision-making discriminating in terms of race or gender due to the amplification of preexisting biases (Ntoutsi *et al*., 2020). As such, it might be challenging to generalize the varying characteristics and idiosyncrasies of every tourist group, thereby potentially leading to data biases. In such cases, if deployed incorrectly, the problem becomes the level of harm that the IoB could inflict on users when a nudge becomes a push that works against user intentions (Shmueli, 2020). It is thus imperative to understand what kinds of data biases exist and to what extent they pose risks and challenges to IoB deployment (McFarland and McFarland, 2015).

As Pan *et al*. (2021) proposed, the power and interests of all stakeholders (i.e. businesses and tourists) should be considered and well balanced. To safeguard user privacy and security, mechanisms can be made available for users to opt in or opt out of data sharing (Caraban *et al*., 2019). Furthermore, there is a need for existing laws to adequately protect data privacy. If they do not, then new regulations are required. For instance, Van Der Sloot and Lanzing (2021) raised legal and ethical concerns regarding government smart city initiatives in Singapore, Toronto and Eindhoven, where increasing public–private partnership will commercialize their public spaces, allowing private entities greater access and opportunity to control and exploit private data. In view of the above dilemma, the question that arises concerns how regulators can ensure the responsible use of the IoB to prevent violations and to what extent users are un/aware or made aware of the manipulation inherent in nudging. In such incidences, it is vital that businesses and consumers balance free will with determinism. Regulatory frameworks must therefore reconcile protecting consumer privacy with allowing commercial efficiency and profitability. Furthermore,

these may not be limited to citizens but extended to global travelers and may therefore have unintended international consequences. The International Code for the Protection of Tourists (ICPT) adopted post-pandemic seeks to offer international assistance for emergencies and protect tourists' consumer rights including digital tourism services (World Tourism Organization, 2022, p. 30).

Due to the COVID-19 pandemic, contactless payment forms have increased with the implementation of biometrics for automated identification such as fingerprints, iris scans, voice recognition or facial recognition, making data harnessing even more precise and efficient. Especially in the retail environment, consumers have found it convenient to make payments at Amazon Go's cashier-less stores just by using their palms (Perez, 2021). As Moriuchi (2021) has demonstrated for biometric adoption, IoB adoption is also likely contingent on the self-efficacy that moderates consumers' perceived value (performance expectation and perceived risk), which influences their willingness to share their personal data. Trust attitudes could differ across different regions, cultures and contexts. For example, facial recognition is more readily accepted in China than in Germany, the United States or the United Kingdom (Kostka *et al*., 2021). However, the proliferation of the IoB in commercial, and especially public, spaces could raise the specter of a surveillance society.

As the IoB is highly reliant on real-time connectivity, it has the propensity to thrive in smart cities, in more developed countries, and in highly networked locations with generally large and tech-savvy young consumer populations who will generate more demand and have a greater willingness to integrate technology in their daily lives. For instance, Singapore, Zurich and Oslo are ranked as the world's smartest cities (IMD, 2021). On the other hand, remote regions and less developed countries that lack the necessary infrastructure, system or connectivity may not see significant progress in their IoB adoption.

Conclusion

This study discusses how IoB can offer prevalent business and social insights for stakeholders. The findings open the following research agenda areas: (1) development of the nudge theory in the use of data to alter travel behavior, (2) smart tourism use cases and the IoB's influence on tourism consumption and (3) the associated social dilemmas arising from the use of the IoB. Despite its applied significance, its potential benefits and the associated risks remain controversial. This study contributes to a deeper understanding of the digital transformation due to the increasing reliance on tourism destinations fueled by technologies. As research on the IoB is nascent, scholars and practitioners are encouraged to expand on this study. Scholars can undertake behavioral and psychological experiments, use case exploration and perform theoretical development to examine both the positive and negative aspects, as well as the regulatory aspects, of this emerging technology.

References

Aguiar-Castillo, L., Guerra, V., Rufo, J., Rabadan, J. and Perez-Jimenez, R. (2021), "Survey on optical wireless communications-based services applied to the tourism Industry: potentials and challenges", *Sensors*, Vol. 21 No. 18, p. 6282, available at: https://www.mdpi.com/1424-8220/21/18/6282.

Buhalis, D. and Amaranggana, A. (2013), "Smart tourism destinations", *Information and Communication Technologies in Tourism 2014, Cham*.

Caraban, A., Karapanos, E., Gonçalves, D. and Campos, P. (2019), "23 ways to nudge: a review of technology-mediated nudging in human-computer interaction", *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*.

Elayan, H., Aloqaily, M., Karray, F. and Guizani, M. (2022), "Internet of behavior (Iob) and explainable AI systems for influencing Iot behavior", *IEEE Network*, pp. 1-8, doi: 10.1109/MNET.009.2100500.

Gardner, B. (2019), "Nudging for sustainable mobility", December 5, available at: https://datasmart.ash.harvard.edu/news/article/nudging-sustainable-mobility.

Goldstein, D.G., Johnson, E.J., Herrmann, A. and Heitmann, M. (2008), "Nudge your customers toward better choices", *Harvard Business Review*, Vol. 86 No. 12, pp. 99-105.

Grüne-Yanoff, T., Marchionni, C. and Feufel, M.A. (2018), "Toward a framework for selecting behavioural policies: how to choose between boosts and nudges", *Economics and Philosophy*, Vol. 34 No. 2, pp. 243-266, doi: 10.1017/S0266267118000032.

Halgekar, A., Chouhan, A., Khetan, I., Bhatia, J., Shah, N. and Srivastava, K. (2021), "Internet of behavior (IoB): a survey", *2021 5th International Conference on Information Systems and Computer Networks (ISCON)*, 22-23 Oct. 2021.

Hansen, P.G. and Jespersen, A.M. (2013), "Nudge and the manipulation of choice: a framework for the responsible use of the nudge approach to behaviour change in public policy", *European Journal of Risk Regulation*, Vol. 4 No. 1, pp. 3-28, doi: 10.1017/S1867299X00002762.

IMD (2021), "Smart city index 2021", IMD-SUTD Smart City Index Report, available at: https://www.imd.org/globalassets/wcc/docs/smart_city/smart_city_index2021.pdf.

Iorio, C., Pandolfo, G., D'Ambrosio, A. and Siciliano, R. (2020), "Mining big data in tourism", *Quality and Quantity*, Vol. 54 No. 5, pp. 1655-1669, doi: 10.1007/s11135-019-00927-0.

Iversen, A.M., Stangerup, M., From-Hansen, M., Hansen, R., Sode, L.P., Kostadinov, K., Hansen, M.B., Calum, H., Ellermann-Eriksen, S. and Knudsen, J.D. (2021), "Light-guided nudging and data-driven performance feedback improve hand hygiene compliance among nurses and doctors", *American Journal of Infection Control*, Vol. 49 No. 6, pp. 733-739, doi: 10.1016/j.ajic.2020.11.007.

Javaid, M., Haleem, A., Singh, R.P., Rab, S. and Suman, R. (2021), "Internet of Behaviours (IoB) and its role in customer services", *Sensors International*, Vol. 2, 100122, doi: 10.1016/j.sintl.2021.100122.

Kostka, G., Steinacker, L. and Meckel, M. (2021), "Between security and convenience: facial recognition technology in the eyes of citizens in China, Germany, the United Kingdom, and the United States", *Public Understanding of Science*, Vol. 30 No. 6, pp. 671-690, doi: 10.1177/09636625211001555.

Kwok, A.O.J. and Koh, S.G.M. (2021a), "COVID-19 and extended reality (XR)", *Current Issues in Tourism*, Vol. 24 No. 14, pp. 1935-1940, doi: 10.1080/13683500.2020.1798896.

Kwok, A.O.J. and Koh, S.G.M. (2021b), "Deepfake: a social construction of technology perspective", *Current Issues in Tourism*, Vol. 24 No. 13, pp. 1798-1802, doi: 10.1080/13683500.2020.1738357.

McFarland, D.A. and McFarland, H.R. (2015), "Big Data and the danger of being precisely inaccurate", *Big Data and Society*, Vol. 2 No. 2, 2053951715602495, doi: 10.1177/2053951715602495.

Mele, C., Russo Spena, T., Kaartemo, V. and Marzullo, M.L. (2021), "Smart nudging: how cognitive technologies enable choice architectures for value co-creation", *Journal of Business Research*, Vol. 129, pp. 949-960, doi: 10.1016/j.jbusres.2020.09.004.

Moriuchi, E. (2021), "An empirical study of consumers' intention to use biometric facial recognition as a payment method", *Psychology and Marketing*, Vol. 38 No. 10, pp. 1741-1765, doi: 10.1002/mar.21495.

Nelson, K.M., Partelow, S. and Schlüter, A. (2019), "Nudging tourists to donate for conservation: experimental evidence on soliciting voluntary contributions for coastal management", *Journal of Environmental Management*, Vol. 237, pp. 30-43, doi: 10.1016/j.jenvman.2019.02.003.

Ng, I.C.L. and Wakenshaw, S.Y.L. (2017), "The Internet-of-Things: review and research directions", *International Journal of Research in Marketing*, Vol. 34 No. 1, pp. 3-21, doi: 10.1016/j.ijresmar.2016.11.003.

Ntoutsi, E., Fafalios, P., Gadiraju, U., Iosifidis, V., Nejdl, W., Vidal, M.-E., Ruggieri, S., Turini, F., Papadopoulos, S., Krasanakis, E., Kompatsiaris, I. and Staab, S. (2020), "Bias in data-driven artificial intelligence systems—an introductory survey", *WIREs Data Mining and Knowledge Discovery*, Vol. 10 No. 3, p. e1356, doi: 10.1002/widm.1356.

Nyman, G. (2012), "Internet of behaviors (IoB)", *Gote Nyman's (Gotepoem) Blog*, March 16, available at: https://gotepoem.wordpress.com/2012/03/16/internet-of-behaviors-ib/.

Pan, B., Lin, M.S., Liang, Y., Akyildiz, A. and Park, S.Y. (2021), "Social, ethical, and moral issues in smart tourism development in destinations", *Journal of Smart Tourism*, Vol. 1 No. 1, pp. 9-17, doi: 10.52255/SMARTTOURISM.2021.1.1.3.

Panetta, K. (2020), "Gartner top strategic technology trends for 2021", available at: https://www.gartner.com/smarterwithgartner/gartner-top-strategic-technology-trends-for-2021.

Perez, S. (2021), "Amazon expands its biometric-based Amazon One palm reader system to more retail stores", February 1TechCrunch, available at: https://techcrunch.com/2021/02/01/amazon-expands-its-biometric-based-amazon-one-palm-reader-system-to-more-retail-stores/.

Pershke, J. (2021), The internet of behavior: smarter technology's next frontier is our human experience, *Forbes*, August 30, available at: https://www.forbes.com/sites/forbesbusinessdevelopmentcouncil/2021/08/30/the-internet-of-behavior-smarter-technologys-next-frontier-is-our-human-experience/?sh=13132b844819.

Pillai, S.G., Kim, W.G., Haldorai, K. and Kim, H.-S. (2022), "Online food delivery services and consumers' purchase intention: integration of theory of planned behavior, theory of perceived risk, and the elaboration likelihood model", *International Journal of Hospitality Management*, Vol. 105, 103275, doi: 10.1016/j.ijhm.2022.103275.

Salis, A. (2021), "Towards the Internet of Behaviors in airports with a fog-to-cloud approach", *arXiv preprint arXiv:2112.06006*.

Shmueli, G. (2020), ""Improving" prediction of human behavior using behavior modification", *arXiv preprint arXiv:2008.12138*.

Stanton, S.J., Sinnott-Armstrong, W. and Huettel, S.A. (2017), "Neuromarketing: ethical implications of its use and potential misuse", *Journal of Business Ethics*, Vol. 144 No. 4, pp. 799-811, doi: 10.1007/s10551-016-3059-0.

Stieler, M. and Henike, T. (2022), "Innovation nudging—a novel approach to foster innovation engagement in an incumbent company", *Creativity and Innovation Management*, Vol. 31 No. 1, pp. 35-48, doi: 10.1111/caim.12475.

Thaler, R.H. and Sunstein, C.R. (2008), *Nudge: Improving Decisions about Health, Wealth, and Happiness*, Yale University Press, New Haven.

Tyers, R. (2018), "Nudging the jetset to offset: voluntary carbon offsetting and the limits to nudging", *Journal of Sustainable Tourism*, Vol. 26 No. 10, pp. 1668-1686, doi: 10.1080/09669582.2018.1494737.

Van Der Sloot, B. and Lanzing, M. (2021), "The continued transformation of the public sphere: on the road to smart cities, living labs and a new understanding of society", in Nagenborg, M., Stone, T., González Woge, M. and Vermaas, P.E. (Eds), *Technology and the City: Towards a Philosophy of Urban Technologies*, Springer International Publishing, pp. 319-345, doi: 10.1007/978-3-030-52313-8_16.

Wagner, D. (2021), "On the emergence and design of AI nudging: the gentle big brother?", *ROBONOMICS: The Journal of the Automated Economy*, Vol. 2, pp. 18-18.

Weinmann, M., Schneider, C. and Brocke, J.v. (2016), "Digital nudging", *Business and Information Systems Engineering*, Vol. 58 No. 6, pp. 433-436, doi: 10.1007/s12599-016-0453-1.

World Tourism Organization (2022), *International Code for the Protection of Tourists*, UNWTO, doi: 10.18111/9789284423361.

Xiang, Z., Stienmetz, J. and Fesenmaier, D.R. (2021), "Smart tourism design: launching the annals of tourism research curated collection on designing tourism places", *Annals of Tourism Research*, Vol. 86, 103154, doi: 10.1016/j.annals.2021.103154.

Yeung, K. (2017), "'Hypernudge': Big data as a mode of regulation by design", *Information, Communication and Society*, Vol. 20 No. 1, pp. 118-136, doi: 10.1080/1369118X.2016.1186713.

Corresponding author

Andrei O. J. Kwok can be contacted at: andrei.kwok@monash.edu