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Challenges and Opportunities for Marketing Scholars in Times of the Fourth Industrial Revolution

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Abstract

Artificial Intelligence (AI) and 5G connectivity have been identified as drivers of the so-called Fourth Industrial Revolution (FIR). AI and 5G, through emerging technologies such as blockchain, gene editing, Internet of Things sensors, nanotechnology, or 3D printing accelerate a blurring of boundaries between digital, biological, and physical spheres. In this editorial, we introduce the term *boundary object*, or boundary technology, that can help process more information (syntactic boundary) for enhanced learning (semantic boundary) and that can create a higher-level intelligence (pragmatic boundary). Boundary objects are also a means of representing, learning about, and transforming knowledge at a given boundary. We propose that crossing syntactic, semantic, and pragmatic boundaries is facilitated by three FIR phenomena (big data, machine learning, and AI). Each of these phenomena possesses a unique capability (processing, learning, and adaptation) to help communities learn about their differences and dependences. We also show how the six articles in this special issue are related to boundary and sphere challenges, and we provide an overview of directions for future research. All in all, marketing scholars should focus on enhancing their abilities in knowledge integration across boundaries to sustain their role as cutting-edge scientists.

Keywords: Artificial intelligence (AI); Boundary object; CRM; Fourth industrial revolution (FIR); Physical, digital, and biological spheres

Challenging the Boundaries Between Physical, Digital, and Biological Spheres

The birth of modern Artificial Intelligence (AI) is associated with the work of Turing (Turing, 1950), which significantly shaped the way in which we think about AI and the capabilities it provides. These capabilities are associated with human intelligence, namely to store and access knowledge, learn and make decisions, and to adapt to the environment (Russell & Norvig, 2010). Interest in new technologies—such as the Internet-of-Things (IoT), Virtual Reality (VR), digital assistants, blockchain, and the like—has surged in recent years as part of the Fourth Industrial Revolution (FIR). FIR is advocated to bring significant opportunities as well as risks for businesses, customers, governments, and society at large. Klaus Schwab at the World Economic Forum noted that emerging technologies are blurring the boundaries between physical, biological, and digital spheres (Schwab, 2017; see also Agrawal, Gans, & Goldfarb, 2018). These spheres refer to the activities, interactions, and processes, in the physical, digital, and biological processes as well as the underlying science communities and disciplines, respectively. FIR—through the emergence of new technologies—will significantly contribute to the integration of different knowledge domains, and thus speed up the innovation process (Pitsis, Beckman, Steinert, Oviedo, & Maisch, 2020). By definition, these technologies are the ones that can help or hinder connections between those domains. Analyzing these boundaries through exploring the value that can be created for customers, suppliers, and society allows us to understand how marketing as a

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discipline can play a role in breaking boundaries (MacInnis et al., 2020; Puntoni, Reczek, Giesler, & Botti, 2020).

FIR will contribute to a more rapid innovation, where companies, governments, and other entities will need to manage knowledge across boundaries. FIR underlines the convergence between spheres, which can help contribute to eliminating arbitrary divisions of thought, which are deeply embedded in disciplines and disciplinary journals. Our editorial, as well as this special issue, aims to motivate marketing scholars to understand what opportunities this convergence entails and how to engage in dialogs that take place in other disciplines. In particular, our objective is to provide a research framework and potential research directions for marketing academics that allow them to connect to other disciplines on important (vs. mere relevant) research issues (Kohli & Haenlein, 2020).

In examining the process of how technologies can blur the boundaries between the physical, digital, and biological spheres, we introduce an underutilized term in the marketing literature, called “boundary object,” to explore the diverse roles that technology can assume and the relationship we have with it. Boundary objects are “… plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites” (Star & Griesemer, 1989, p. 393). These boundary technologies help us process more information (syntactic boundary) for enhanced learning (semantic) and to create a higher-level intelligence (pragmatic). This article proposes that crossing these three (syntactic, semantic, and pragmatic) boundaries are facilitated by three FIR phenomena (big data, machine learning, and AI), each of which possesses a unique capability (processing, learning, and adaptation) to help communities learn about their differences and dependences.

Emerging Technologies Blurring the Boundaries Between Spheres and Disciplines

FIR underlines the phenomenon of blurring the boundaries between physical, digital, and biological spheres through technologies (Schwab, 2017). These spheres capture a large number of things including digital, physical, and biological activities, interaction, and processes as well as various stakeholders and communities. Blurring the boundaries between these spheres is the result of the emergence of new technologies that help connect these spheres. The connection between the *physical* and *digital* spheres is represented by physical technologies (e.g., RFID, IoT sensors) that create digital information about objects or activities in the physical world, or digital technologies (e.g., blockchain, 3D printing) that allow digital information to be transformed into physical form. The connection between the *physical* and *biological* realms is represented by physical technologies (e.g., biomedical equipment and devices) and biological technologies (e.g., gene editing, nanotechnology). The connection between *digital* and *biological* spheres is represented by digital technologies (e.g., health apps, virtual assistants, social networks) and physical technologies (e.g., smart devices) that help digitize human biology, activities, and interaction. Although several technologies can connect these spheres, in our manuscript, we aim only to provide examples of groups of technologies and do not claim that those examples represent an exhaustive list.

In addition to connecting these spheres, these technologies have the power and capabilities of creating connections and overcoming discontinuities between disciplines. In doing so, they help further collaborations across disciplinary boundaries, and hence contribute to advancing and accelerating knowledge creation. The need for collaboration among diverse communities is well-recognized in organizational literature (Carlile, 2004). However, differences between communities (disciplines) in terms of their terminology (language), mental models, goals, as well as interests represent significant challenges to overcome in these collaborations (Akkerman & Bakker, 2011). Due to these innate differences in how knowledge is structured within disciplines, crossing disciplinary boundaries requires effort on each side of the boundary. In order for marketing to leverage the opportunities that FIR offers and to create value for customers, and society at large, we need to engage with researchers from other disciplines. These emerging technologies, however, do not belong to any of these spheres or disciplines; instead, they are situated at the boundaries. In order for us to understand how technologies can help cross these boundaries between different scientific communities, we introduce the concept of boundary objects and the type of boundaries they help cross.

Crossing Syntactic, Semantic, and Pragmatic Boundaries

The concept of boundary objects was developed by Star and Griesemer (1989) in the field of sociology. Due to their plasticity and interpretive flexibility, boundary objects are means of representing, learning about, and transforming knowledge at a given boundary. The longevity of the concept and a large number of citations of the Star and Griesemer (1989) article (over, 10.000 in Google Scholar) is likely to be due to its very intuitive nature and the broad-ranging applicability of the concept. Since its inception, the concept has sparked significant scholarly interest across various academic disciplines beyond sociology, such as management (Fenton, 2007), educational research (Akkerman & Bakker, 2011), information systems (Doolin & McLeod, 2012), and health care (Allen, 2009), but less so in marketing (Jefferies, Bishop, & Hibbert, 2019; Sajtos, Kleinaltenkamp, & Harrison, 2018; Sajtos, Rouse, Harrison, & Parsons, 2014). Boundary objects can serve as means of translation, compromise, and integration between diverse perspectives and communities (Allen, 2009; Carlile, 2004; Keshet, Ben-Arye, & Schiff, 2013; Kimble, Grenier, & Goglio-Primard, 2010; Star & Griesemer, 1989; Suchman & Trigg, 1993; Zwick & Dholakia, 2006). The emerging technologies of FIR can be considered boundary objects as they reside in many (research) communities with their own idiosyncratic interpretation (interpretive flexibility). Concurrently, they also exist in common knowledge (across boundaries) that establish a shared context (common ground) between communities, which different communities can use to communicate across domains (Carlile, 2002; Star & Griesemer, 1989). Hence, these technologies as boundary objects can help overcome arbitrary divisions of thought between disciplines.

In order for marketing to engage with researchers from other disciplines, we need to understand the types of boundaries that boundary objects can help cross. In doing so, this manuscript introduces Carlile's (2004) work to discuss an effective way of sharing and accessing knowledge across boundaries. Carlile's framework was developed based on Shannon and Weaver's (1949) work that has its origins in the mathematical theory of communication. We believe this framework is highly applicable in the age of the fourth industrial revolution as it helps demonstrate the challenges that researchers and decision-makers need to overcome when crossing boundaries. Carlile's framework describes three progressively novel and complex forms of boundaries—syntactic, semantic, and pragmatic—and three adjacent capabilities—transfer, translation, and transformation—for managing knowledge across boundaries. Syntactic, semantic, and pragmatic boundaries refer to differences in terminology (among communities), in meaning and interpretation and in goals and interests, respectively (Carlile, 2004). Crossing syntactic, semantic, and pragmatic boundaries represent more difficult boundaries to cross with increasing potential for learning (Wenger, 1998).

Syntactic boundaries represent known differences and dependencies in knowledge between communities, and they correspond to the lowest boundary between domains. The key challenge at this boundary is the differences that exist between scientific communities in language, terminology, and representation of knowledge. To help cross this boundary it will require scholars and decision-makers to process and *transfer* more information and knowledge across boundaries. Technologies – through knowledge transfer and establishing a shared terminology – allow more and more diverse data to be collected, processed, and digitized, at speed. Technologies that facilitate data collection and processing will help communities to understand differences in terminology and to contribute to the development of a shared terminology. Compared to syntactic boundaries, a semantic boundary is more complex. This boundary represents more unknowns between spheres in terms of knowledge differences and dependencies. The challenge at the semantic boundary is the differences in meaning of concepts or differences in mental models of particular phenomena across communities. To overcome this boundary, scholars need to *translate* their idiosyncratic knowledge, make implicit knowledge explicit (Polanyi, 1966), and create shared meanings across boundaries. In contrast to syntactic boundaries that underline transferring knowledge through using the technology's capability to collect and process more information, crossing semantic boundaries draws attention to translation of knowledge across communities. Technologies—at this boundary—that contribute the most are the ones that can facilitate learning at speed, which can contribute to the translation of knowledge across disciplines. The most complex boundary in this framework is the pragmatic or political boundary that represents differences in interests across communities. Crossing pragmatic boundaries should recognize that knowledge is inherent in a particular practice of community, and at this boundary, the existence of knowledge that was developed in a particular discipline is at stake. Conflicting interests around knowledge requires scholars across domains to manage this tension with regard to differences in knowledge as well as to the scholars' values and identities (Bechky, 2003; Bowker & Star, 1999). Crossing pragmatic boundaries requires establishing common interests and *transforming* (rather than merely translating) domain-specific knowledge. In the presence of different interests between communities, communities need to negotiate interests and make trade-offs, which is a political process (Carlile, 2004). Technologies that help cross this boundary can understand various stakeholders' interests—as part of an ecosystem—and contribute to the emergence of a new (joint and higher level) intelligence. In contrast to semantic boundaries that underline translation of knowledge, crossing pragmatic boundaries draw attention to transforming knowledge through creating a new level of intelligence.

In all, the very same characteristics and structure of knowledge that drives one discipline, easily hinders at the same time collaborations across disciplines. Our manuscript underlines that technologies—as boundary objects—blur the boundaries between spheres, and they also help cross disciplinary boundaries and contribute to collaborative efforts between disciplines. In the process of blurring the lines between disciplines and scientific communities, there are three (increasingly complex) boundaries that need to be crossed. We develop and present a conceptual framework based on the focus (or locale) of integration (i.e., spheres) and the type of boundaries (syntactic–semantic–pragmatic). Table, 1 provides an overview of the three sets of spheres, exemplary technologies (boundary objects), the three types of boundaries, and their respective challenges and goals at each sphere–boundary intersection. Table, 1 also provides an overview of the six articles of this dedicated issue on "Big Data, Technology-Driven CRM & Artificial Intelligence" and how they relate to our conceptual framework developed in the following section.

Conceptual Framework

Technologies help us process more information (syntactic boundary) for enhanced learning (semantic) and to create a higher-level intelligence (pragmatic). Our framework (Table, 2) proposes that crossing these three (syntactic, semantic, and pragmatic) boundaries are facilitated by three phenomena that is associated with FIR, namely "big data" (i.e., the capability to collect and process large volumes of diverse data at speed), "machine learning" (i.e., algorithmic interpretation of, and learning from data), and "AI" (i.e., flexible adaption of learnings in a given context), respectively. Each of big data, machine learning, and AI possesses a key (AI) capability (processing, learning, and adaptation), which allows technologies to be *effective* at each boundary as they provide avenues for communities to learn about their differences and dependences. Big data applications' (e.g., image and speech

Table 1
Boundary and sphere challenges.

Spheres: Locale of Integration (Exemplary Boundary Object Technologies)	Challenges and Goals	Syntactic difference: Language Focus: Information Processing	Semantic difference: Meaning Focus: Learning	Pragmatic difference: Interest Focus: Intelligence	Manuscript in this issue
	Boundary Goals	Developing a shared terminology through **knowledge transfer**	Developing a shared understanding through **knowledge translation**	Developing a shared interest through **knowledge transformation**	
Physical ↔ Digital (Robots, AR/VR/MR, IoT/RFID, 3D printing, drones, autonomous vehicles, Social networks, Blockchain, AI algorithms)	Challenge	Differences in representation of knowledge at the physical-digital interface	Differences in meaning of knowledge at the physical-digital interface	Differences in interests in using knowledge at the physical-digital interface	Hoyer et al., Gupta et al., Rangaswamy et al., Libai et al. De Bruyn et al.
	Goal	Capture, process and digitize (more and diverse) behaviors and interactions at the physical-digital interface	Translating tacit into explicit knowledge and create mental models from experiences at the physical-digital interface	Transforming knowledge at stake by understanding knowledge-in-context (goals, task, etc.) at the physical-digital interface	
Digital ↔ Biological (Smart devices/wearables, Genetic editing and sequencing)	Challenge	Differences in representation of knowledge at the digital-biological interface	Differences in meaning of knowledge at the digital-biological interface	Differences in interests in using knowledge at the digital-biological interface	Grewal et al., Hoyer et al., De Bruyn et al.
	Goal	Capture, process and digitize (more and diverse) physiological and biological activities and processes at the digital-biological interface	Translating tacit into explicit knowledge and create mental models from experiences at the digital-biological interface	Transforming knowledge at stake by understanding 6knowledge-in-context (goals, task, etc.) at the digital-biological interface	
Physical ↔ Biological (Nanomaterials/nano-technology, Biosensors, bionics/prosthetics)	Challenge	Differences in representation of knowledge at the digital-biological interface	Differences in meaning of knowledge at the digital-biological interface	Differences in interests in using knowledge at the digital-biological interface	Grewal et al.
	Goal	Capture and process (more and diverse) physiological and biological activities and processes at the physical-biological interface	Translating tacit into explicit knowledge and create mental models from experiences at the physical-biological interface	Transforming knowledge at stake by understanding knowledge-in-context (goals, task, etc.) at the physical-biological interface	

Notes: AI: Artificial Intelligence; AR: Augmented Reality; VR: Virtual Reality; MR: Mixed Reality; IoT: Internet of Things; RFID: Radio-frequency Identification.

recognitions, information extraction, and analytics) data processing capability will help develop data repositories and new streams of data (syntactic boundary), which, if mined, modeled, and analyzed through machine learning applications (e.g., natural-language understanding or NLU), can help extract a meaningful story (semantic boundary). Go, Chess, and other game applications—using machine learning applications—are crossing the semantic boundary, which learnt knowledge would be insufficient to cross pragmatic boundaries with conflicting goals and interests that need to be considered and meaningfully reconciled. Finally, AI applications' adaptation capability can help create a higher-level intelligence through representing different interests and (fair and moral) values (pragmatic boundary).

This article underlines that marketing scholars need to understand the ways in which technologies blur the boundaries between spheres and communities, in order for them to engage in cross-disciplinary collaborations. In Table 2, we provide a framework that highlights some important avenues of research based on the three sets of spheres and the three boundaries. In particular, we underline that human and brand interactions, experiences and journeys, human life and well-being, and human enhancements lie at the heart of physical–digital, digital–biological, and physical–biological interfaces, respectively. Technologies that facilitate collaborations between marketing and other disciplines will do so by enhancing scholars' capabilities to capture and process more data, understand patterns and relationship between concepts and finally, by help understand differences in values and goals, at syntactic, semantic, and pragmatic boundaries, respectively. Pragmatic boundaries represent the most difficult types of collaborations. At the physical–digital interface, collaborations at the pragmatic level will require technologies to facilitate the development of shared values and goals regarding issues of ownership of and access to (sensitive) data and autonomy between humans and machines in making decisions. At the digital–biological interface, collaborations at the pragmatic level will require technologies to facilitate the development of shared values and goals regarding what constitutes "normal health" for human beings and whether medicine should focus on prevention or treating diseases. For instance, genetic sequencing can improve people's health and longevity through enhancing health and preventing illnesses. Finally, at the physical–biological interface, implants, bionics, and other types of enhancements will shift the focus—at the pragmatic level—to defining new standards for what constitutes a human being (vs. a cyborg).

From a managerial perspective, successful firms in FIR need to be conscious of these boundaries and systematically focus on developing their own technologies and capabilities to process

Table 2
Directions for future research.

Boundary	Syntactic	Semantic	Pragmatic	Manuscript in this issue
FIR phenomenon ➔	Big Data	Machine Learning	Artificial Intelligence	Krafft, Sajtos and Haenlein
AI capabilities	Processing	Learning	Adaptation	
AI applications	Natural Language Processing, Image/Speech/ Face recognition, Computer vision, Information extraction and Analytics, Cloud Computing, Recommender Systems	Natural Language Understanding (NLU), Optimization/Prediction, Artificial Narrow Intelligence	Natural Language Generation, Artificial General Intelligence	
Examples Physical ↔ Digital	**Capturing human and brand interactions, experiences and journeys**	**Understanding human and brand interactions, experiences and journey**	**Transforming human and brand interactions, experiences and journeys**	
	Digitizing physical activities, behaviors and interactions	*Meaning of combining physical and digital experiences*	*Sharing, ownership and use of physical and digital experiences*	
Examples Digital ↔ Biological	**Capturing human life and well-being**	**Understanding human-life and well-being**	**Transforming human life and well-being**	
	Digitizing the human body's physiological and biological activities and processes	*Meaning of combining physiological, biological processes and digital experiences*	*Defining new standards for healthy humans*	
Examples Physical ↔ Biological	**Capturing human enhancements**	**Understanding human enhancements**	**Transforming humanity**	
	Altering the human body's physiological and biological activities and processes and replacing human body parts	*Meaning of combining physiological and biological processes and experiences*	*Defining new standards for 'normal' human body*	

Notes: AI: Artificial Intelligence; FIR: Fourth Industrial Revolution.

data, learn from it, and adapt to a rapidly changing environment. Companies need to find places where they can gather new data or places where different types of data meet and create opportunities for their business, such as on digital business platforms. Once captured they can start employing technologies to learn from these new sets of data, which will help create new value propositions for their stakeholders, and, ultimately, a competitive advantage for the business. As FIR unfolds, more and more companies are likely to adopt ways to create new experience and deliver them in novel ways. This trend will transcend boundaries between traditional sectors and industries with new industries emerging.

Manuscripts in This Special Issue

In this dedicated issue on big data, technology-driven CRM, and artificial intelligence, we include six articles.

The manuscript by Rangaswamy et al., (2020) titled "The Role of Marketing in Digital Business Platforms" focuses on digital business platforms that connect the digital and physical spheres. In particular, by distinguishing digital business platforms from other types of platforms (e.g., innovation, transaction, etc.), these authors examine the role and impact of marketing on such platforms. Their manuscript highlights that marketing's fundamental role in a digital business platform is to increase the number and quality of interactions. In particular, an interesting question that researchers could explore in *future studies* is the interplay of factors such as network effects, user heterogeneity, search costs and match quality, and further, their joint contribution to the success of a digital business platform.

The manuscript by Libai et al., (2020) titled "Brave New World? On AI and the Management of Customer Relationships" focuses on AI capabilities in the physical–digital spheres. In particular, this manuscript proposes that CRM is transformed through AI capabilities – that is, leveraging big data and mimicking human communication and understanding – into AI-CRM. These human-like interactions between AI-driven systems and customers will help target and acquire prospective customers, retain these customers through personalization and habit formation, and develop them more effectively through leveraging social network data. AI-CRM systems have the potential of exacerbating the inequities between customers through differentiation, prioritization, and discrimination (Tillmanns, Ter Hofstede, Krafft, & Goetz, 2017), thus "establishing optimal social contracts with customers" (Krafft, Arden, & Verhoef, 2017, p. 40). *Future research* should focus on exploring the circumstances in which potential benefits and harms of these AI-CRM systems might occur, and in particular how potential negative effects could be overcome through soft and hard regulation.

The manuscript by Hoyer et al., (2020) titled "Transforming the Customer Experience through New Technologies" focuses on the role and impact of individual technologies in the customer's journey, concerning the physical–digital and digital–biological spheres. In particular, this manuscript conceptualizes the role of three distinct groups of new technologies (i.e., Internet of Things, Augmented/Virtual/Mixed Reality, and virtual assistants) in contributing to different facets of experiential values (cognitive, sensory, and social) and impacting different phases (pre-transaction, transaction, post-transaction) of the customer journey. *Future research* can explore the critical, perceptual dimensions of these technologies – from the customers' perspective, and how these critical dimensions positively or negatively influence customers' experience in technology-facilitated environments.

The manuscript by Gupta et al., (2020) titled "Digital Analytics: Modeling for Insights and New Methods" focuses on the role of digital analytics in creating consumer insights in the digital–physical sphere. In particular, the authors propose a framework that connects external forces to capabilities in generating insights and value for the firm and customers. *Future research* should focus on examining individual technologies' roles in facilitating data- or analytics-driven strategies and insights, or both. Furthermore, scholars need to understand how these strategies—facilitated by these technologies—will enable better outcomes for companies, such as building stronger, deeper, and longer relationships with customers, as well as for customers, such as personalization and satisfaction.

The manuscript by De Bruyn et al., (2020) titled "Artificial Intelligence and Marketing: Pitfalls and Opportunities" focuses on the potential risks and benefits associated with the emergence of AI in the physical–digital and digital–biological spheres. In particular, the authors delineate AI applications and differentiate them from traditional modeling approaches, and illustrate these applications with examples. The authors posit that AI will fall short of its promises unless tacit knowledge can be effectively translated into explicit knowledge. *Future research* should explore strategies to translate and transfer human tacit knowledge to AI applications, and in turn how this transfer is likely to impact marketing as a function and profession. Understanding the forms and sources of tacit knowledge will help us learn about our work processes, our know-how and ultimately, our discipline and profession.

The manuscript by Grewal et al., (2020) titled "Frontline Cyborgs at Your Service: How Human Enhancement Technologies Affect Customer Experiences in Retail, Sales, and Service Settings" focuses on technologies that connect both the digital–biological and physical–biological spheres. In particular, it addresses how human enhancement technologies can influence customers' experiences with frontline employees in cases when frontline employees are enhanced either physically, cognitively, or emotionally. *Future research* should explore how various aspects of human enhancement technologies should be positioned and communicated in customer service settings to contribute to customers' acceptance of them. Furthermore, although employing these technologies is likely to be heavily regulated in customer-facing interactions, it is important for researchers to understand the implications of being or not being transparent about their use in these customer–employee interactions.

Conclusion

Researchers have been focusing on AI and AI–human interactions since the 1950s when this field was established (Haenlein & Kaplan, 2019; Kaplan & Haenlein, 2019). Throughout history, including the current wave of FIR, people either supported or resisted AI and put forward many predictions as to when AI and machines will replace humans (Licklider, 1960). Although the trajectory and the speed of these technological developments are difficult to predict, FIR underlines an essential message for (marketing) academics; that is, the current disciplinary boundaries will be blurred at an accelerated pace. Thus, FIR represents increasing levels of novelty for academics, practitioners, and policymakers. Considering the significant impact of these emergent technologies, there is an inherent risk in allowing industry-led solutions—with likely narrower focus and interest—to become dominant. In this environment, all stakeholders need to enhance their abilities to process more information, learn faster, and create knowledge.

In this manuscript, we underline the increasing differences and dependencies in knowledge inherent at crossing syntactic, semantic, and pragmatic boundaries. In this endeavor, there will be a need for significantly more interaction among scientists, technologists, policymakers, and other stakeholders, thus bringing many disciplines (e.g., engineering, computer science, biology, social science) to the table and creating a bridge between them. Universities and research foundations around the world have already started establishing cross-functional or cross-funding initiatives that push disciplines and scholars to open their minds to new vocabularies, new interpretations as well as new goals and interests that exist in other disciplines. Crossing these syntactic, semantic, and pragmatic boundaries requires effort on each side of the boundary. In light of the technological advancements and increasing regulatory complexities, marketing scholars should focus on enhancing their abilities in becoming effective knowledge integrators across boundaries if they want to sustain their role as cutting-edge scientists.

Final Remarks

All papers published in this special issue have gone through at least two rounds of reviews and revisions, and a team of three reviewers per submission provided valuable and constructive feedback. We are grateful to the following 18 reviewers, affiliated to universities in 6 different countries (in alphabetical order): Lerzan Aksoy, Fordham University; Michelle Andrews, Emory University; Yakov Bart, Northeastern University; Tammo H. A. Bijmolt, University of Groningen; Alina Ferecatu, Erasmus University; Christoph Fuchs, Technical University of Munich; Sonja Gensler, University of Muenster; P. K. Kannan, University of Maryland; Arne De Keyser, EDHEC Business School; Praveen Kopalle, Tuck School of Business at Dartmouth; Dominik Mahr, Maastricht University; Detelina Marinova, University of Missouri; Guda van Noort, University of Amsterdam; Peter Popkowski Leszczyc, University of Queensland; Koen H. Pauwels, Northeastern University; Venky Shankar, Texas A&M University; Florian von Wangenheim, ETH Zurich; and Jaap E. Wieringa, University of Groningen.

As guest editors of this issue dedicated to the topic of big data, technology-driven CRM, and artificial intelligence, we were responsible for two submissions each. This special issue would not have come true without the great support by Valeriya Salter from Elsevier and Sonya Wurster, Director of Academic Content & Conferences at Marketing EDGE. Brian Ratchford and Wendy Moe have encouraged us to initiate a dedicated issue to address current topics such as big data, CRM, robotics, or AI. They provided us with advice and support but also left many degrees of freedom to us. Instrumental to the submission and review process was a thought leader conference in Lisbon in March 2019. Generous financial support by the School of Business & Economics, the Marketing Center, and the Chair of Marketing Management at the University of Muenster as well as by MUUUH! Consulting is gratefully acknowledged.

We hope that all articles in this issue dedicated to current and future developments on "Big Data, Technology-Driven CRM & Artificial Intelligence" will stimulate more research bridging gaps or boundaries between digital, biological, physical, or other essential spheres.

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