1. Theorizing technology and international relations: prevailing perspectives and new horizons

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1 SELECTIVE ATTENTION TO TECHNOLOGY IN INTERNATIONAL RELATIONS

This chapter presents an introduction to and brief overview of the study of technology and international relations, including a discussion of research gaps and new horizons. In particular, this contribution addresses whether and how prevailing theoretical approaches have been able to analyze the relationship between technological and international political change. This includes how the personal, social, societal, and, to an extent, also biological worlds are becoming increasingly interconnected through new technologies – what has been referred to as the ‘fourth industrial revolution’ (Newlove-Eriksson and Eriksson, 2021; Schwab, 2017).

How then is technology addressed within the field of international relations (IR)? Given the considerable attention IR literature pays to globalization and global structural change – core themes of contemporary IR – it might be expected that the role of technology in world politics would be a major focus. What would global politics and globalization be if the rapid development and diffusion of global information and communications technologies (ICTs) were not taken into account? It would seem, nonetheless, that technology has received rather mixed and selective attention within IR.

On the one hand, notions of ‘information society’ and ‘network society’ (Castells, 2000) have certainly been picked up in IR, as is also the case in many other social sciences (Keohane and Nye, 1998; Mayer, Carpes and Knoblich, 2014; McCarthy, 2018; Nye, 2004). This body of scholarship comprises several more specific topics on which there is now a considerable amount of IR research – for example, Internet governance (Carr, 2015; Eriksson and Giacomello, 2009; Mueller, 2010; Price, 2018); cyber-security (Deibert, 2017;

Dunn Cavelty, 2008; Eriksson and Giacomello, 2007; Valeriano and Maness, 2018); digital diplomacy (Bjola and Holmes, 2015); international surveillance (Bauman et al., 2014; Lyon, 2007); and the role of social media in world politics (Hamilton and Shepherd, 2016). Some of the IR literature has also developed its work in the area of weapons of mass destruction (WMD), particularly nuclear weapons (Herrera, 2006; Herz, 1950; Masco, 2018; Sagan and Waltz, 2002; Waltz, 1981).

On the other hand, several other technological developments, which arguably impact on the shape and conduct of world politics, have until recently largely gone unnoticed in IR, including: artificial intelligence (AI), autonomous weapon systems (AWS), robotics, nanotechnology, 5G, the Internet of Things (IoT), space technology, bioengineering, neurotechnology, microelectronics, and combinations thereof. Valerie Hudson's 1991 book on AI and international politics arguably remains the most comprehensive work on this topic within IR, despite the rapid development of AI. Technology with military applications has mainly been dealt with within the subfield of strategic studies, including analyses of the consecutive revolutions in military technology (Bousquet, 2017). There is growing interest within strategic studies concerning the more recent development of AWS and drones (Bode and Huelss, 2018; Bousquet, 2017; Fleischmann, 2015; Schwartz, 2016; Williams, 2015). Space policy has become a small but multidisciplinary field of its own (see branch journals *Space Policy* and *Astropolitics*), but only a few contributions have been explicitly anchored within IR, either through publishing in IR journals or book series, or through application of IR theory (Eriksson and Privalov, 2020; Newlove-Eriksson and Eriksson, 2013; Peoples, 2018; Sheehan, 2007). The general impression is that many of the new technological developments are studied in subfields, with little communication with the wider literatures and theories of IR.

Recently, however, several new contributions have been published that explicitly address technology and international relations (Drezner, 2019; Hoijsink and Leese, 2019; Kaltofen, Carr and Acuto, 2019; Mayer et al., 2014; McCarthy, 2018; Singh, Carr and Marlin-Bennett, 2019). These publications urge for a more explicit focus on technology within IR, and they also make several original observations on specific technologies, as well as on the relationship between technology, society and politics more generally. These contributions are certainly useful in both expanding and deepening theory and research on technology and world politics. It is by no means certain, however, that they will have a wider impact on general IR theory. Will the debates on general IR and theories on, for example, globalization, international security and global governance pick up these important findings and contributions? We assert that they should, but given the increasingly heterogeneous and frag-

mented nature of IR, there is a clear risk that technology and IR will simply develop into another subfield.

While there are growing subfields and niche bodies of literature that address technology and world politics, they have thus far had negligible impact on major IR theories and in major IR textbooks. Widely used textbooks such as the popular *Globalization of World Politics* edited by Baylis, Smith and Owens (2019) have in their more recent editions incorporated ‘new’ theories, specifically feminism and post-colonialism in addition to the established realist, liberal, Marxist and constructivist paradigms. Yet there is still no trace of a distinct IR theory of technology in major textbooks. More surprisingly, with the traditional exception of WMD, technology is typically not even addressed in the thematic or empirical sections of major textbooks. Textbooks explicitly dealing with topics such as globalization, terrorism, new wars and global governance – in which technology arguably plays a significant role – pay scant attention to technology and existing theories on technology and politics.

In particular, the still-dominant theories of IR – realism, liberalism, Marxism and largely also constructivism – tend to treat technology as external to politics, not as something integral to how contemporary politics and world affairs are carried out (Eriksson and Giacomello, 2007; Fritsch, 2014; Leese and Hoijtink, 2019; Mayer et al., 2014). Moreover, despite subfield growth and diversification of research on technology and international relations, articles on ‘science’ and ‘technology’ do not amount to more than around a percentage of articles in major IR journals (Mayer et al., 2014, p. 14).

Noteworthy attempts have recently been made to incorporate technology in IR theorizing, including the emerging paradigm of ‘techno-politics’, which draws largely on the separate yet multidisciplinary field of science and technology studies (STS) (Drezner, 2019; Hoijtink and Leese, 2019; Kaltofen et al., 2019; Mayer et al., 2014; McCarthy, 2018; Newlove-Eriksson and Eriksson, 2021; Singh et al., 2019). Moreover, with some success, technology has become an explicit topic (among many others) in major social science associations, such as the International Studies Association (ISA). The ISA, like most social science organizations, has become more diversified, with an ever-increasing number of sections. In 2013, technology finally and explicitly made its way into the ISA family, through the creation of the STAIR section, an acronym for Science, Technology and Arts in International Relations (cf. Singh et al., 2019). A similar project was established within the European International Studies Association (EISA) (cf. Hoijtink and Leese, 2019).

Despite these new contributions – and the arguably tremendous impact of globalization of the Internet, the increasing societal dependency on so-called critical information infrastructures (CII), the development of AI, robotics, nanotechnology and AWS (Bode and Huelss, 2018; Schwab, 2017) – there is much room for new theory and research that do not merely treat technology as

a subfield of IR, but also put it at the very core of IR theory (cf. Hoijsink and Leese, 2019; Kaltofen et al., 2019; Mayer et al., 2014; McCarthy, 2018; Singh et al., 2019). Given this room – and indeed necessity – for progress in the field, we turn now to a discussion and review of technology theorizing within the IR community.

2 PREVAILING PERSPECTIVES

Whereas technology is not yet a focal point in major IR theories and textbooks, there is now certainly a large but also quite diverse and fragmented literature on technology within various subfields of IR. Hence, it is impossible for a short introductory chapter to provide a comprehensive and nuanced overview of existing approaches. Notwithstanding, we have found that, despite the variety in detail and theoretical sophistication, it is relevant and useful to categorize contributions in terms of dominant IR paradigms (here limited to broadly conceived realism, liberalism and constructivism), with the addition of the heterogeneous paradigm of ‘techno-politics’, largely inspired by the field of STS (Fritsch, 2014; Leese and Hoijsink, 2019; Mayer et al., 2014; McCarthy, 2018).

However, there are certainly other ways to categorize theorizing on technology. Social science studies of technology, in IR, sociology and elsewhere, have been categorized along a scale of determinism and non-determinism – that is, whether technological development is seen as a ‘social product’ (Collins, 1983, p. 193) and whether it is seen to shape politics in a certain direction (Mayer et al., 2014; McCarthy, 2018, p. 14; Singh et al., 2019). Towards the deterministic end of this continuum, we find strongly optimistic as well as strongly pessimistic perspectives. Notably, the optimistic–pessimistic continuum cuts across the realist–liberal divide, and partly also across constructivism and other non-rationalist paradigms. As argued below, however, determinism is strongest among the rationalist realist and liberal paradigms, and optimistic perspectives are most commonly associated with liberalism, especially in theories of modernization and technologically fueled human and societal progress. Non-deterministic perspectives are located primarily within the constructivist and wider non-rationalist camp. Somewhere in between we isolate the multifaceted paradigm of techno-politics. Examples of this identification and localization follow.

Realism

Realism – whether in its classical or neo version (also referred to as structural realism), defensive or offensive – is focused on states as actors, and security and material power are the main analytical categories. Within realism, technology

is traditionally regarded a ‘force multiplier’, or more generally as belonging to the category of ‘material capabilities’ of states (Eriksson and Giacomello, 2007; Fritsch, 2014; Leese and Hoijtink, 2019). While realists acknowledge the significance of technology for achieving superiority in terms of military power, surveillance and communication, realists also tend to observe the series of ‘military revolutions’ – from archery to machine guns, nuclear weapons, satellites and cyber-warfare. The notion of a ‘revolution in military affairs’ (RMA) captures the development of and dependency on digital information and communications technology and development in robotics, materials and AI for command and control in modern warfare (Arquilla and Ronfeldt, 2001; Bode and Huelss, 2018; Bousquet, 2017; Hoijtink and Leese, 2019).

Despite recognition of the significance of technology as a means of power and warfare, realists tend to nevertheless hold the view that technology does not change the nature of international relations (Drezner, 2019; Eriksson and Giacomello, 2007; Fritsch, 2014; Leese and Hoijtink, 2019). Even in globally connected highly technologized society, basic realist conceptualizations persist: the conception of a state-centric and ‘anarchic’ international system; the strategic notions of hegemony, balance of power, bandwagoning, buck-passing and so forth; and the supremacy of material power capabilities. From a realist perspective, technology may change, and technology may also impact on international relations, but the nature of politics remains essentially the same.

Hence, realists focusing on technology have observed how, for example, the development of nuclear weapons was crucial for the post-war ‘terror balance’ between the two superpowers, and more generally for the relative stability of the bipolar system of the Cold War era (Herz, 1950; Sagan and Waltz, 2002; Waltz, 1981). Indeed, if there is one particular technology that realists (and IR more generally) have addressed, it is nuclear weaponry. While realists seldom attribute technology with negative or positive values, they do tend to claim that the distribution of technological capacity can have pivotal effects on the balance of power, and thus on whether there is stable peace or heightened risk of war.

Given that realism has a fundamentally pessimistic view of international relations, and that it tends to treat technology as unable to change the nature of politics, it may seem as if realists are also preconditioned to view technological development in pessimistic terms. This is not necessarily the case, however. Kenneth Waltz, the ‘father’ of neorealism, made the oft-cited claim that with respect to the global spread of nuclear weapons, ‘more may be better’ (Waltz, 1981; Sagan and Waltz, 2002). This assumption was inferred from the realist concept of deterrence – contending that states that equip themselves with nuclear weapons will use their new capabilities to deter threats and preserve peace.

While realists acknowledge that technological capacity can be pivotal for power, war and peace, they maintain their rationalist, state-centric and materialist perspective. Factors emphasized by contending theoretical paradigms – such as the emergence of non-state actors in world affairs, the significance of norms, domestic politics, international institutions, identity, culture, or the notion that technology, although it is a product of human invention, may ultimately change both the nature of politics and what it means to be human – have not entered mainstream realist conceptions of politics and technology.

Liberalism

As an IR paradigm, liberalism incorporates a multitude of theories on, for example, complex interdependence, globalization, international institutions and linkages between domestic and foreign policy (for an overview, see Dunne, 2016). Liberalism emphasizes plurality of actors, including the growth in numbers and influence of non-state actors in world politics. Liberalism also opens up the ‘black box’ of the state in world affairs, showing how both the bureaucracy and organization of state apparatuses, as well as domestic actors and opinion, can shape international politics. Moreover, liberalism has inspired theories of international institutions, integration and global governance, showing how and under what conditions international agreements, norms and principles can make states comply and even voluntarily surrender autonomy. In addition, liberalism has emphasized a much wider agenda than the military security agenda of realism, suggesting both a widened security concept, and that non-security issues can have equal or greater priority on political agendas. Liberalism shares a rationalist epistemology with realism, and most liberal theories also take ‘anarchy’ (as absence of central government) in international affairs into account, although liberalism suggests ways in which the anarchic self-help system can be overcome.

With regard to technology, liberal theorists generally, although not exclusively, adopt an optimistic perspective. This is evident particularly in the many instances and applications of modernization theory. Traditional optimistic liberal ideas on the possibility – if not inevitability – of societal, economic, political and possibly also human progress are found in writings on technology and international relations. The first wave of globalization studies, which was generally guided by liberal ideas, was very optimistic, if not utopian in character. This body of liberal literature includes the much-cited ‘end of history’ debate (Fukuyama, 1989), and related topics such as ‘the end of sovereignty’ (Camilleri and Falk, 1992; Rosenau, 1990) and the alleged (yet much critiqued) emergence of a ‘borderless world’ (Ohmae, 1991).

In particular, the emergence and diffusion of the Internet has often been interpreted as a major liberalizing force, empowering social movements, and

in itself considered a form of democratization, providing platforms for communication and agenda-setting far exceeding that of political and economic elites. For example, in a 1998 *Foreign Affairs* article, Keohane and Nye updated their highly influential theory on 'complex interdependence' to the 'information age', basically claiming that global information and communications technology enhanced their original assumptions on power and interdependence (Keohane and Nye, 1998). Moreover, Nye addressed the diffusion of Internet access across the globe, which he claimed implied a form of democratization (Nye, 2004).

The global diffusion of social media has become a topic in a second wave of Internet studies, which liberal theorists frequently interpret as a means for challenging or even toppling autocratic governments. Several studies along these lines have been conducted on the use of social media during the 2011 Arab Spring – for example, Khondker (2011) and Comunello and Anzera (2012). Admittedly, literature on social media and IR more generally, let alone that on the case of the Arab Spring, has become rather heterogeneous.

Unsurprisingly, the liberal optimism of a cyber-fueled borderless and democratic future has faced critique from not only realists and critical theorists, but also from within liberalism. For example, in his book *The Net Delusion*, Evgeny Morozov, himself a disillusioned democratic activist, challenges the allegedly naive belief that 'Internet freedom' is a democratizing force that can topple autocracy (Morozov, 2011). According to his analysis, the global interconnectedness of people, states and societies through cyberspace has allowed much greater and more intrusive systems of state surveillance and political control than ever before. The emergence of Wikileaks and the 2013 Snowden revelations further inspired this liberal pessimism. Critical studies of counterterrorism and surveillance sprouted into new and growing multi-disciplinary fields of studies (see the specialized journal *Critical Studies on Terrorism*). Some of these contributions observe similarities in surveillance in liberal democracies and autocratic states, such as Sweden and China (Eriksson and Lagerkvist, 2016).

The new liberal pessimism could also be observed in foreign policy change, particularly exemplified by the US under Obama. The reigning approach to democratization by intervention was abandoned along with notions of the US as global guardian of democracy and 'freedom', which some have referred to as the American 'world police' (not a novel way of conceptualizing American hegemony and interpretations thereof, cf. Nye, 1995). Today, 30 years after the fall of the Berlin Wall, post-millennial dystopianism seems to have taken the place of the liberal utopianism of the early 1990s, fueled by the spread of insular and reactionary ideas: authoritarian nationalism, economic isolationism and the rise of post-truth society. Research and debate on how democracies die (Levitsky and Ziblatt, 2019) might not have replaced the optimistic themes of

democratization and democratic peace, but they have at least become equally significant.

Scholarship combining ‘liberal’ observations of complex interdependence, network society and the dangers of technological dependency existed before the more recent pessimistic turn, however. For example, Scott Sagan rejected Kenneth Waltz’s claim that the spread of nuclear weapons is beneficial for world peace. Sagan’s argument rested on rationalist organization theory, emphasizing the risk of theft, accident or intentional decisions to use nuclear weapons (Sagan and Waltz, 2002). Moreover, Ulrich Beck’s notion of (global) risk society and Charles Perrow’s ‘normal accidents’ concept are of relevance (Beck, 1992, 2012; Perrow, 1999). What Beck, Perrow, ‘high-reliability organization’ (HRO) scholars (cf. La Porte and Consolini, 2007) and critical theorists that followed (cf. Weick, 2011) have shown is that complex and tightly coupled socio-infrastructure systems – such as airports, electricity infrastructure and railway interchanges – imply not only interdependency, but also high levels of risk. Societies that are dependent on highly complex and integrated technologies and infrastructures are also highly vulnerable to serious accidents and disasters. However, these concepts and bodies of literature have hardly been picked up in the wider IR literature (a noteworthy exception is Jarvis and Griffiths, 2007). Within the realm of IR, the liberal contribution to understanding risk and dangers has, rather, been through a widened security concept. With the exception of cyber-threats, however, the literature on widened security rarely deals with technology or technologically induced risk.

Notwithstanding, liberalism has not undergone an overwhelmingly pessimistic shift. In addition to the more deterministic approaches – ranging from largely optimistic modernization theory to primarily pessimistic accounts of global risk society – there is a multitude of approaches emphasizing conditionality and contextuality. Some liberal approaches also emphasize the simultaneous globalization and fragmentation of world politics – what Rosenau (2000) referred to as ‘framgregation’ – noting that this involves opportunities as well as risks. Such more balanced or mixed approaches seem to be common in analyses of, for example, Internet governance and climate politics – two of the most salient topics in which technology is problematized (Eriksson and Giacomello, 2009; Mueller, 2010; Price, 2018). Whether determinist or non-determinist, however, liberal approaches share a rationalist ontology, emphasizing plurality of state and non-state actors, linkages of domestic and international politics, the significance of international institutions, and globally networked complex interdependence. In general, liberalism assumes the possibility of systemic change, for better or worse, concerning both the substance and structure of global politics.

Constructivism

Constructivism emerged as a new and rapidly influential IR paradigm in the early 1990s, initially through critique of then-dominant rationalist realist and Liberal paradigms (for an overview, see Barnett, 2018). Leading constructivists claim that in order to understand the interests, preferences and actions of political actors, we must first understand how interests and preferences are shaped. Constructivists have placed an emphasis on how interests cannot be taken for granted, suggesting that interests and preferences are shaped by the identity of actors, whether identity is defined in terms of nationhood, class, religion, or something else. While constructivists do not necessarily share conceptual frameworks, they defy determinism and essentialism. Moreover, constructivists emphasize the ‘logic of appropriateness’ over the ‘logic of consequences’ (cf. Sending, 2002), explaining why actors – including states and non-state actors in international relations – behave according to established social norms, such as respecting the territorial integrity of a neighboring state or, when violating the norm, either deny it or seek to legitimize it with reference to certain core values, such as ‘national security’.

With respect to technology, a number of studies have been undertaken on cyber-communities, the mobilizing power of, for example, Jihadism (e.g., Ranstorp, 2007), and on the social construction of cyber-threats such as the notion of an ‘electronic Pearl Harbor’ (Dunn Cavelty, 2008; Eriksson and Giacomello, 2007). Many of these studies can be said to share a constructivist epistemology, emphasizing the pivotal role of identity, culture and social norms. Regarding the one technology explicitly addressed by both realists and liberals – nuclear weapons – the constructivist paradigm contributes by suggesting a new explanation as to why, for example, the nuclear arsenal of some states is seen as unproblematic, while those of others, however small, is considered an existential threat. In the words of Wendt: ‘500 British nuclear weapons are less threatening to the United States than 5 North Korean nuclear weapons, because the British are friends with the United States and the North Koreans are not, and amity and enmity are functions of shared understandings’ (Wendt, 1995, p. 73). Thus, according to constructivism, nuclear posturing and procurement are shaped less by material capacity and ‘relative gains’ as realists would have it, and more so by shared understandings and identities.

Constructivist contributions to studies of technology and IR are now both numerous and diverse, yet are sometimes lumped together as social construction of technology studies (SCOT; cf. Bijker, 2017; Pinch and Bijker, 1984). If there is one common ground though, it is that technology is not equipped with any pre-given or ‘essential’ meaning. Technology is what actors make of it, and in this sense it is ‘politically neutral’, or rather possible to politicize in many different ways (Carr, 2016; Manjikian, 2018). Technology – for example, the

vast and complex Internet – does not have any built-in propensity towards any particular political outcome, according to constructivist thinking. This draws on Alexander Wendt's critique of the realist (and partly liberal) assumption of anarchy in world politics. Wendt (1992), in his influential article, claimed that 'anarchy is what states make of it', despite the absence of central government in world affairs, states may foster many different types of international relations, some in which common norms are established and accepted, and others in which violation or aggression is considered possible, if not even excused. What matters, at the end of the day, is processes of socialization and identity formation, which take time, and which can seldom be intentionally shaped by any single actor. Thus, with regard to technology, constructivists do not theorize on how technology shapes politics, but rather on how identities, norms and interests regarding technology are formed.

Many constructivists make it a starting point to criticize technological determinism in other approaches, notably that of liberal modernization theory, but also that of realist theory – for example, on deterrence. In her constructivist study of US cyber policy, Carr makes this point very clear: 'technology does not determine outcomes' (Carr, 2016, p. 78; cf. Manjikian, 2018). Constructivists claim that perceptions of technology are shaped more by identities, ideas and processes of socialization than by technological development in and of itself. For example, a handful of studies have been conducted on the securitization of technology and infrastructure – demonstrating how actors identify and selectively frame technology and infrastructure as either threat or opportunity (Dunn Cavelty, 2005, 2008; Eriksson, 2001). In so doing, constructivists are not asking whether threats are 'real', but rather how, why and with what consequences something is labeled and treated as if it is a threat. This research highlights the political potency of 'national security' rhetoric, which legitimizes extraordinary measures, including the use of force.

While constructivists tend to adopt a 'neutral' stance on technological development, emphasizing how outcomes are shaped by social and political factors rather than by technology itself – that is, viewing technology as embedded in socio-political layers (cf. Leese and Hoijsink, 2019) – there are elements of dystopianism among theorists further away on the post-rationalist continuum. Post-structuralists, feminists and some critical theorists – while generally adopting a non-determinist methodology – have published several openly pessimistic studies of technological development. They have done so particularly by adopting normative theory, rejecting, for example, automated weapons and surveillance systems, from ethical and moral standpoints (e.g., Rainey and Goujon, 2011). Most of these contributions, however, have not been made in IR, but in sociology, cultural studies, STS and other disciplines.

Constructivists and other post-rationalists have also made several more specific observations on technology and international relations. Of particular

significance is the reflection that many novel technologies can reshape perceptions of distance. For example, it has been argued that war in the digital age distances actors from the bloody reality of war, as in the case of remotely controlled drone pilots or computer hacking, which may, for example, immobilize air traffic control or nuclear power plants (Der Derian, 2009; Eriksson and Giacomello, 2007, p. 20). In addition to distancing from the effects of actions – which is basically a continuation of the effect achieved from indirect fire (artillery) or aerial bombing – digitalization creates a sense of virtual reality. Remotely controlling a drone armed with missiles is similar to playing a computer game – the ‘pilot’ sits in a room in a location often far away from the killing site, looking at a computer screen, only using a keyboard and a joystick (Coeckelbergh, 2013; Fleischmann, 2015; Schwartz, 2016; Williams, 2015).

Techno-politics

The fourth overarching paradigm to be discussed has been termed techno-politics (Hoijtink and Leese, 2019; Kaltofen et al., 2019; Mayer et al., 2014; McCarthy, 2018; Singh et al., 2019). This is a relatively new, broad, multifaceted, rapidly growing and therefore also loosely formed ‘paradigm’. It draws heavily on the multidisciplinary field of STS. IR theory plays a limited role herein, just as STS more generally has largely developed through disciplines other than IR and political science. Yet, a few pioneers have recently tried to develop techno-politics with an explicit attempt to contribute to IR – that is, to make techno-politics a subdiscipline of IR (Carr, 2016; Fritsch, 2014; Hoijtink and Leese, 2019; Kaltofen et al., 2019; Mayer et al., 2014; McCarthy, 2018; Singh et al., 2019).

Unlike the general theories of IR, STS is to a much greater extent based on empirical, conditional and contextualized theory, emphasizing variety and idiosyncrasy (Fritsch, 2014; Kaltofen et al., 2019). This also means that techno-politics is much more loosely presented than any of the major IR paradigms. Nevertheless, there seem to be some shared assumptions among scholars within the techno-politics paradigm, at least among those who seek to make explicit contributions to IR.

First, technology is considered neither good, bad nor neutral (Fritsch, 2014, p. 115; Kranzberg, 1986; Newlove-Eriksson and Eriksson, 2021). This statement is meant to clarify that in contrast to major IR paradigms (including constructivism), technology is considered to be ‘deeply political’, and that technology is intertwined with or embedded within society and politics, rather than to be seen as an exogenous factor. As Fritsch puts it: technology is an ‘ambivalent endogenous core component of the global system’ (Fritsch, 2014, p. 115). The paradigm of techno-politics seeks to ‘cover the deserted area between technological determinism and human agency’ (Mayer et al., 2014).

Thus, it shares a non-deterministic approach with constructivism, but unlike constructivism it does not see human agency as the ultimate explanation for political outcomes. By contrast, techno-politics implies that technology and politics (as well as social systems more generally) shape and reshape each other.

Second, there are multifaceted ways in which technology and politics are intertwined and shape and reshape each other. Scholars of techno-politics often address large-scale socio-technical systems, also called ‘assemblages’ (Mayer et al., 2014; cf. Singh et al., 2019). Assemblages imply that technology and politics continuously shape each other in complex and unpredictable ways. The Internet is an obvious and probably the most closely studied ‘assemblage’ – a global infrastructure that relies on hardware in the form of cables on land, under water, and in the sky, routers, computers and other devices; software in the form of technical protocols (TTP/IP), the domain name system (DNS), browsers and other applications; and a multifaceted governance structure ranging from Internet service providers to national governments and the stakeholders of global Internet governance, including the company at its core, The Internet Corporation for Assigned Names and Numbers (ICANN). How the hardware, software, governance and human utilization of the Internet shape each other is in focus in much scholarship on the Internet (Price, 2018). Increasingly, research is being done on how the Internet is not simply a separate socio-technical system, but also integrated with everything from our ‘smart’ phones, to ‘smart’ homes, ‘smart’ healthcare and ‘smart’ cities – including the so-called Internet of Things powered by fifth-generation (5G) networks (cf. Abomhara and Kølén, 2015; Weber, 2010).

Other socio-technical systems are also addressed, such as railway interchanges and airports – mega-sites that increasingly combine speedy transportation of people and goods with other commercial functions, such as shopping, leisure and entertainment. Notably, in such junctions, public–private partnerships are built into both the physical infrastructure and into its organization and governance (Newlove-Eriksson, 2020).

Third, studies on techno-politics have made more specific contributions, some of which have already been picked up by the wider IR literature. Particularly noteworthy is the notion of time–space compression – the observation that the development of global information and communications technology has allowed real-time communication on a global scale, regardless of where people are located. The notion of time–space compression, which has been elaborated in STS (Fritsch, 2014), became a core element of the literature on globalization – a core theme in IR (Scholte, 2005). More recently, the field of surveillance studies has elaborated new forms of power and control – regarding, for example, self-imposed censorship, governmental and commercial utilization of Internet search histories, and how online algorithms

shape and adapt to people's interests and communities (Bauman et al., 2014; Lyon, 2007).

There are also some studies suggesting that new techno-social systems change the very meaning of agency, theorizing non-human agency both in the form of wider system actor-like capacity and in the form of self-learning AI (Mayer et al., 2014; Srnicek, 2018). The 'cyborg' and AI theme also raises questions of ethics, whether laws and constitutional rights apply to non-humans, and whether 'cyborgs' may seek independence from and eventually turn against human society – themes that have been more thoroughly explored in science fiction than in science (cf. Olander and Greenberg, 1978).

3 GAPS AND NEW HORIZONS

To begin with, IR general theory and textbooks need to pay explicit attention to technology. Advanced theory and research on technology and societal development has progressed in other disciplines, not just in STS, but this theme is still largely absent from major IR textbooks, and IR research conducted on technology is largely treated as a subfield. With IR theory and textbooks being largely silent on the rapid development and increasing societal dependency on complex and highly integrated technologies and infrastructure, the discipline and teaching of IR run the risk of becoming increasingly irrelevant. Theories on war and peace, globalization and global governance – to name but a few core IR topics – will continue to lack depth, explanatory power and societal saliency if they are not explicitly focusing on the role of technology. Techno-political perspectives, which are currently rapidly developing, deserve their own chapters in IR textbook sections on theory, and specific technologies and infrastructural 'assemblages' deserve a place in sections on cases and issues, in addition to the traditional chapters on WMD, and the occasional piece on Internet governance as a case of global governance. If technology is not explicitly problematized in the major textbooks we use to train and educate future generations of IR scholars, progress will likely still happen, but it will be much slower than it needs to be, and IR theory will be perceived as largely lagging behind not just real-world developments, but also behind other disciplines.

We also acknowledge that for many scholars interested in technology and world politics, it does not really matter what disciplinary identity their research is associated with, as long as it gets acknowledged by peers (from whatever discipline) who are interested in similar themes. This may also reflect the general fragmentation and diversification not just within IR, but also most of the social sciences. Whether IR is in the midst of an identity crisis with an uncertain future has been debated (Dunne, Hansen and Wight, 2013). This may seem to be the case with respect to how IR approaches technology. Yet it would

be a mistake if ‘technology and global studies’ developed into a new subfield, with its own conferences and publishing outlets. The relationship between technology, society, governance and human agency is far too important to be relegated to specialized journals – it needs to be a core theme in studies of world politics, regardless of what discipline individual scholars come from.

Having made this exhortation, we would also like to point out some specific gaps and new horizons. First, there is considerable room for theory and research on the *interconnectedness* of multiple techno-societal systems. Social media, big data, cloud services and the IoT are not developing in isolation from each other, but are increasingly integrated and influential in the daily activities of individuals, organizations and governments – domestically as well as internationally. Governmental and commercial services such as electricity, transportation, financial services, news media, education, health and medicine are connected through global ICT. This new and deeper form of complex interdependence, techno-political transformation, fourth industrial revolution or whatever this new reality is called – goes beyond the emergence of ‘information society’. This new structural shift is about the *fusion* of the physical, biological, digital and social worlds – through interconnected technologies (Schwab, 2017; Newlove-Eriksson and Eriksson, 2021). The smartphone is the most literal expression of what this means – a hand-held multipurpose digital device that in itself implies a fusion of the social, the societal, the global, the personal and even the biological (e.g., through applications that can assess your health). When almost every societal sector, infrastructure and walk of life are integrated and interconnected, crucial and still largely unanswered questions arise. What is the nature of this development, what are the causes of it, what are the consequences, and how can they be dealt with?

Second, while there is now a relatively large body of literature on specific technologies, particularly WMD, AWS and ICTs, there is a noteworthy absence of IR-oriented research on, for example AI, robotics, nanotechnology and genetic editing (but see Hoijsink and Leese, 2019; Mayer et al., 2014; McCarthy, 2018). As noted in the introduction, there are some specialized journals and subfields conducting social science research on these technologies, but much of it is rather weak on theory, often lacking any attempt to provide systematic generalizations or contributing to wider theories on global change.

Finally, the relationship of technology, politics and popular culture deserves further attention. While a handful of noteworthy contributions have raised this within IR, particularly with regard to IR and science fiction and fantasy, most of the still rather few studies are focused on how fiction illustrates real-world politics and political discourse (e.g., Kiersey and Neumann, 2013). There are some noteworthy contributions, however, that deal more deeply with how politics and popular culture not only reflect but also shape each other, and

that they are increasingly entangled, sometimes in a literal sense (Der Derian, 2001; Crilley, 2020). There is considerable room for more theory and research on these themes, however. For example, what is the connection between the simultaneous release in October 2015 of the motion picture *The Martian*, and NASA's then new project 'Journey to Mars'? What are the implications of China's 2019 release of the science fiction movie, *The Wandering Earth*, the simultaneous successful Chinese landing of a probe on the far side of the Moon, the opening of a Mars settlement exhibition, and the development of a new Chinese space station orbiting Earth? There appears to be a new horizon for theory and research that goes beyond how popular culture reflects or inspires what goes on in the real world, but also focuses on how technology, politics and popular culture are increasingly integrated, sometimes in explicit techno-political-cultural projects.

4 CONCLUSION

This chapter confirms past observations on how general IR and major textbooks have largely failed to take into account technology either as a core theme of theory or as issue-areas. The major IR theories of realism, liberalism and constructivism have in various degrees and forms addressed technology, but focus has largely been on WMD and ICT. This chapter also corroborates the observation that these theories largely treat technology as an exogenous factor – that is, it has not been assigned a core role in explaining politics and power. By contrast, a more loosely organized paradigm of techno-politics, inspired more by STS than by IR, has increasingly addressed core topics of IR, including war and peace, governance and global power shifts. This nascent but rather fragmented literature emphasizes that technology is not essentially good or bad, but also that it is not neutral but has deep political implications, albeit in a non-deterministic way. Techno-political studies have yet to make a significant mark in IR, but they are making progress with regard to conceptualization of, for example, the fusion of new technologies with the social, the political and even the biological. There is also room for new theory and research both on such structural techno-political shifts and on the politics of specific technologies, including AI, automated weapons and bioengineering.

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