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In Memoriam: A Beacon of Resistance and Hope

The second volume of the Canadian Journal for the Academic Mind is dedicated to Professor Refaat Al-Areer, a distinguished Palestinian writer, poet, professor, and activist. Born in Gaza City in 1979, Al-Areer has always said that his life and work were deeply influenced by the Israeli occupation.

As a professor at the Islamic University of Gaza, Al-Areer's dedication to literature and creative writing inspired countless students. His vision extended beyond the classroom through the co-founding of We Are Not Numbers, an organization that empowered young Gazan writers by pairing them with experienced authors, harnessing the power of storytelling as a form of resistance and resilience.

On 6 December 2023, Professor Alareer was murdered in an Israeli airstrike in northern Gaza, along with several members of his family.

In honouring Professor Refaat Al-Areer, we acknowledge his unconquerable spirit, his contributions to literature, and his enduring legacy of resistance through storytelling. His words and actions continue to inspire and resonate with all who strive for justice and peace.

If I must die,
you must live
to tell my story
to sell my things
to buy a piece of cloth
and some strings,
(make it white with a long tail)
so that a child, somewhere in Gaza
while looking heaven in the eye
awaiting his dad who left in a blaze—
and bid no one farewell
not even to his flesh
not even to himself—
sees the kite, my kite you made,
flying up above
and thinks for a moment an angel is there
bringing back love

If I must die
let it bring hope
let it be a tale.

- Dr. Refaat Alareer (2023).
"If I must die, let it be a tale"

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Honouring Indigenous Knowledge and Fostering Decolonization

The Canadian Journal for the Academic Mind recognizes that it is headquartered on the traditional, unceded land of the Omàmìwininìwag, Anishinabewaki, Kanien'kehá꞉ka, and Haudenosaunee nations.

We honour the rich knowledge systems and cultural contributions of Indigenous peoples and aim to create a space that values Indigenous ways of knowing and being. We acknowledge the detrimental impact of colonization on individuals, communities, and knowledge systems. By seeking to decenter dominant Western paradigms, we aim to embrace diverse epistemologies, methodologies, and research approaches. Our goal is to challenge traditional boundaries, promote cross-cultural dialogue, and dismantle systems of oppression embedded in academic structures.

Together, we can forge a scholarly community that reflects our shared commitment to equity, inclusivity, and positive change. Join us in our collective endeavor to reshape the academic landscape, advance knowledge rooted in justice, and create a more equitable future.

Letter from the Editorial Board

Dear Readers,

We are delighted to present the second volume of the *Canadian Journal for the Academic Mind* (CJAM). The enthusiastic response to our inaugural issue has been both humbling and inspiring, and we are thrilled to continue fostering a platform for the exchange of innovative ideas and groundbreaking research. As we navigate a world marked by unprecedented challenges and transformative change, the role of academia in generating knowledge, fostering critical thinking, and driving innovation has never been more crucial.

Academics are the architects of our future, with their research illuminating pathways to a more sustainable, equitable, and just world. By probing the depths of human understanding, they equip society with the tools to address complex local and global issues.

Education is the bedrock upon which progress is built. It equips individuals with the tools to understand complex issues, to question the status quo, and to contribute meaningfully to their communities. CJAM is dedicated to amplifying the voices of students who are at the forefront of this intellectual journey.

Building upon the foundation laid in our first volume, we are committed to expanding the scope and impact of CJAM. This issue showcases a diverse range of scholarly contributions that reflect the dynamism and complexity of the academic landscape. We are particularly proud of the participation from both undergraduate and graduate students, whose fresh perspectives and original thinking enrich our journal.

We extend our sincere gratitude to the authors who entrusted us with their work, and to the dedicated peer reviewers who generously shared their expertise. Your contributions are essential to the journal's success and to the advancement of knowledge in your respective fields. We also wish to acknowledge the ongoing support of our faculty advisors, whose guidance and mentorship continue to be invaluable.

The articles within these pages represent a diverse range of perspectives and disciplines, reflecting the interconnected nature of the challenges we face. From New Public Management to Telomere replication, from Canadian broadcasting policy to artificial intelligence, the work presented here offers valuable insights and potential solutions.

As we look to the future, we are excited about the potential for CJAM to become an even more influential force in the academic community. We invite researchers, scholars, and students from all disciplines to submit their work for consideration. Together, we can shape the intellectual discourse and contribute to a more informed and engaged society.

We extend our gratitude to our authors, reviewers, and mentors for their continued commitment to academic excellence. Together, we are shaping the future.

Yours sincerely,

Nir Hagigi, Editor-in-Chief, Carleton University
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Section I
Public Affairs

A Critical Study of Artificial Intelligence in Healthcare: Prospects and Perils

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ABSTRACT: The modern era has ushered the proliferation of new technologies, especially witnessed in the emergence of the nascent artificial intelligence (AI) sector. The use of AI is largely multifaceted, proving useful in various industries such as healthcare - however, it may also allow for deleterious effects to occur. The use of AI in healthcare settings can work to extend and augment the quality of patients' lives. Notwithstanding this, health AI enshrines various perils including the lack of patient privacy, and algorithm bias - particularly on marginalized and racialized communities. This is ultimately compounded by the absence of ethical frameworks governing the usage of AI in healthcare settings. Specifically, this article seeks to explore whether or not the use of health AI is a potential prospect or peril; considering its duality. To investigate the nuances of health AI, this article will utilize an interdisciplinary approach – drawing upon research from domains such as: sociology, socio-legal and socio-medical climates. This study finds that health AI remains a greater prospect – as it reinforces the quality and elongates the duration of the human lifespan. It concludes with a call to action to inform the success of health AI in praxis: namely, the need to incorporate the aforementioned topics within medical pedagogy and ethical frameworks.

KEYWORDS: sociology of AI, social determinants of health, bioethics, artificial intelligence, medical education

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Introduction

As the world continues to evolve and morph, society faces many prospects and perils that can safeguard or threaten the mere existence of humanity. Imminent existential threats are derived from anthropogenic risks, which are, "induced entirely or predominantly by human activities and choices".[1] In recent years, the nascent AI sector has begun to grow, which has led society to consider if it will a prospect or peril to the future of humanity. Ord writes that the purpose of AI is to, "build machines rival[l]ing humans in their intelligence".[2] It is preeminent to acknowledge that the use of AI should not inherently be labelled as 'good' nor 'bad'. Rather, the categorization of AI into this dichotomy is dependent on implementation, oversight, and mitigating measures in praxis. AI can be utilized for a multitude of purposes, and has the potential to augment healthcare experiences.

When utilized in healthcare, AI can have global, wide-spread implications as it can positively contribute to the overall life expectancy and quality of life experienced by any given nation's citizens. However, it can also be weaponized and contribute to inequitable healthcare treatment of marginalized communities, drastically decreasing life expectancy and quality of life. The relevance of AI in healthcare and its usage by medical practitioners are inherently collateral objectives. It is ultimately supported by medical professionals' sheer obsession on the conquest of death, which seeks to avoid death for as long as humanly possible utilizing modern technology.[3] In the healthcare domain, the use of AI can pose as an existential risk due to the lack of patient privatization in data collection, presence of algorithmic bias, and absence of ethical/legally binding framework. This type of unaligned AI has the potential to be weaponized against nations, and impact aspects of globalization. Alternatively, AI in healthcare can also be a prospect if it has a security factor such as laws and regulations that protect patient privacy in data collection, as it can result in sustainable innovation by removing bias. This paper will explore if AI in healthcare should be considered a greater prospect or peril due to the nature of its duality.

Methodology

To study this, this paper will utilize a comparison method to provide a robust explanation as to how AI can present itself as a prospect and/or peril. The objective of this paper is neither a systematic review of the literature nor a scoping review. Furthermore, it will utilize an interdisciplinary lens that draws from different domains such as, sociology (social determinants

of health), socio-legal, and socio-medical climates. Quantitative and qualitative research will be explored in order to gather both numerical and non-numerical data which can be used to provide further explanation. Evidence will be mainly sourced from peer-reviewed journal articles, institutional reports, books and contemporary alternative sources. Hypothetical and empirical case studies will be utilized to conceptualize and demonstrate the impact of AI in healthcare.

Advances Towards Ethical Practices of AI

Notwithstanding the nascency of AI, many states have become increasingly aware of the vast potential that AI holds and are now in the beginning stages of policy development. Canada's Bill C-27, *An Act to enact the Consumer Privacy Protection Act, the Personal Information and Data Protection Tribunal Act and the Artificial Intelligence and Data Act* and to make consequential and related amendments to other Acts, serves as a prime example.[4] Additionally, others have already passed AI-related policies. On March 13, 2024, the European Parliament (EP) passed the *Artificial Intelligence Act*, which provides a human-rights focused legal framework to regulate the market and augment public trust in AI.[5] Advancement in proposed Canadian and EP policies are beneficial as they protect and mitigate the potential ill effects that AI may have on its citizens. However, it is equally critical to note that the AI sector is subject to rapid advancement, and thus, may require more a complex and specific legal framework over time.

Similarly, advances in AI scholarship have fostered progress within medical school curricula. As part of their educational

programs, at least 11 medical schools in Canada, the United States, and South Korea offer AI related programming.[6] Such progress is commendable as it serves to introduce medical students to health AI in praxis by providing instruction on navigating rudimentary technological advancements in modern medicine. It remains critical that such programs are disseminated to additional medical schools to provide all students with robust and equitable educational opportunities.

The Intersections of Privacy and AI Predictions

AI data collection in healthcare poses a duality as it can provide for more precise predictions, yet have implications in privacy breaches. A South Korean research company, Seegene, used AI to complete a big data analysis using RNA information found in online datasets to develop polymerase chain reaction (PCR) test kits.[7] RNA datasets used by AI can serve as a place for scientists to collect large amounts of information. This allowed for researchers to identify predictions in RNA activity, which enabled the development of PCR tests. These tests have played a huge part in greater society as they were used for public health measures during the COVID-19 pandemic. Typically, AI's governance of privacy and use of human data collection varies by bureaucratic structure (often by nation, region, and/or municipality). This means that human data may or may not be permissible to utilize for health AI development and research. Bak et al. notes that data that is used in health AI cannot guarantee full anonymization due to the inclusion of genetic sequences.[8] Data collection for datasets oftentimes run on the premise that a patients' identifiers are protected. However, this is not inherently the case as full anonymization of data is not possible due to the presence of genetic identifiers. The conundrum of privacy in data collection emulates the poor and lack of legally- binding regulations, which can pose as an overall e-risk.

Ord touches on how technological advancement can increase societal potential with regards to the duration of the human lifespan.[9] Through utilizing AI in healthcare, computers are able to analyze

datasets to efficiently produce far superior results than researchers alone. The importance of technological advancement in healthcare is especially imperative as medical professionals are on the conquest of death.[10] The application of AI extending the duration of human life is exemplified in the aforementioned example of the COVID-19 pandemic. It allowed for healthcare professionals to effectively and efficiently diagnose and treat cases of COVID-19, in turn, extending the duration of ill patients. Moreover, the use of AI in healthcare can augment societal potential by preserving lives. Annually, the use of Health AI has the potential to save an upwards of 403,000 lives.[11] Denoting these statistics, it is assumed that patients will have augmented treatment outcomes and quality of life. AI has the ability to greatly impact and extend human life, however the implications surrounding a lack of privacy can inhibit its advancement.

Notwithstanding these prospects, the lack of privacy regarding AI in healthcare settings can potentially enable more privacy breaches through data leaks. Alder indicates that the lack of reporting transparency makes it difficult to quantify the magnitude of healthcare data breaches, and concur that the use of AI will lead to increased number of data breaches.[12] The absence of legal framework and regulatory body, results in a lack of statistics on the frequency of current and projected data breaches. Datasets can serve as a major identifier for individuals due to genetic markers, compromising one's identity. While the importance of privacy is not lost, the integration of AI both works to save lives, and specifically, the use of RNA datasets allowed for accelerated research as results were compiled more efficiently. This ultimately enabled society to fight against a global health crisis, the COVID-19 pandemic. It is important to note that concerns surrounding privacy can be mitigated via a security factor, such as the implementation of control regulations to ensure that access is restricted.

The Crossroads of Algorithms and Marginalized Communities

The use of algorithms in health AI can provide for superior reasoning which can augment clinical decisions. However, it can also

provide for algorithm bias to flourish as many health AIs fall prey to utilizing small input data group(s). The use of AI can remove potential medical and/or social biases a physician may have, thereby leading to improved patient prognosis. A case study illustrates how AI can be used in clustering techniques to determine categories of patients with sinus rhythm and atrial fibrillation responding to β-blockers.[13] In this vignette, AI can be regarded as superior in human ability as it efficiently organizes and clusters patients on their relative response rate to β-blocker therapy compared to manual input. As a result, physicians are able to mitigate any potential preconceived notions of health of the patient, which in effect remove social and medical biases. This can consequently improve the lives of racialized, gendered and classified bodies, in a systematically-affirming manner. These simple tasks completed by AI enables physicians to engage in more direct aspects of patient care as it alleviates occupied time doing cumbersome tasks.

However, it is integral to note that algorithms are not inherently neutral; social and medical bias can also manifest in AI through forms of algorithmic bias. Due to the presence of algorithmic bias, the effectiveness of such AI is reduced. Machine learning can be defined as a segment of AI which utilizes algorithms to imitate the human learning experience, and honing accuracy.[14] One study found that an x-ray AI technology only drew aspects of machine learning from racially and ethnically monolithic datasets.[15] It is important to realize that AI is not inherently neutral as popular belief stipulates, and that rather often includes instances of systemic discrimination. Traditionally, marginalized and objectified communities in healthcare such as bodies of colour and young women end up underdiagnosed. This could consequently work to perpetuate this marginalization, and further contribute to health inequity.

In clinical application, the presence of algorithmic bias, the effectiveness of the AI becomes self-inhibiting as it can dramatically worsen patient outcomes. Kamulegeya et al. determined that an AI imaging app developed by First-Derm had a 17% diagnostic accuracy on Fitzpatrick V and VI skin types versus a 69.9% accuracy rate on type I and II skin, resulting in an underdiagnosis of fungal infections

in the former group.[16] In such scenario, marginalized and specifically racialized communities did not receive an adequate diagnosis utilizing AI; allowing their skin infections to persist. By utilizing monolithic datasets, AI continues to perpetuate this marginalization which results in health inequity – by worsening clinical outcomes in racialized communities. To combat the issue of algorithmic bias, a security factor must be used, such as incorporating regulation that requires the use of diverse datasets in machine learning for healthcare AI.

In chapter eight, Ord discusses how society has the potential to extend the duration of human lives through technology development.[17] Through further research, using AI in healthcare domains can assist society in achieving a longer lifespan. In Canada, the shortage of family physicians impacts primary care, Li et al. indicates that, ”every additional FP per 10,000 people increases life expectancy by 51.5 days.[18] A virtual primary care clinic, K Health, had diagnostic algorithms that were trained on a dataset of 2 million people, first yielding a 96.6% accuracy rate, with nominal discrepancies across demographics.[19] Used correctly, the collection of diverse age, ethnical, and racial datasets allowed for rigorous and robust algorithm training, which engaged in systemically affirming care. By alleviating some of the workload on primary care physicians, this allows them to provide more efficient and effective care. This particular AI could encourage more individuals to access primary care to address their current health concerns, thereby potentially extending the duration of their lives. Simultaneously, it may also serve as an opportunity to treat underserved demographics (i.e. individuals with health conditions, or from rural communities) through providing remote primary care.

Situating Ethics in Health AI: Research, Implementation and Education

Lastly, the lack of an ethical framework of health AI can allow for accelerated development, but can also contribute to unsustainable practices and development of health AI. As of 2018, the

FDA started approving health AI devices for human usage – as of 2021, there are over 160 FDA approved devices.[20] This has insinuated the rapid development of health AI as researchers look to gain FDA approval. The nature of which these devices are approved can be alarmingly inappropriate as more medical professionals, specifically physicians will be expected to know how to use them. Katznelson and Gerke note that there is a lack of education on AI ethics for medical school students.[21] As new generations of medical doctors enter a new generation of medicinal practices, they will be at a disadvantage. Health AI requires a robust understanding before it can be implemented in healthcare appropriately, medical school graduates will remain unaware of ethical conundrums at play. This has the potential to create unique and precarious situations, as the lack of ethical knowledge surrounding the usage of AI can inhibit sustainable practices and contribute to the overall e-risk of health AI.

In application, the implications of the absence of ethical framework often manifests within the complex construction and usage of the AI itself. Corti, a machine learning software that analyzes emergency phone calls to determine if the caller has cardiac arrest; however, Corti's inventor does not fully understand how the algorithm deducts decisions, a phenomenon known as a black box.[22] The usage of this health AI has the potential to save lives by accurately identifying the health status of the caller, and work to expedite emergency services. The absence of ethical frameworks promotes potentially hazardous activities, as witnessed in the fact that healthcare practitioners and inventors do not fully understand the deductive reasoning of the algorithm. Due to this, healthcare professionals remain limited in their interpretive scope to identify the logical reasoning behind the algorithm which may incidentally reinforce notions of bias.

An ethical framework on Health AI could focus on principles such as autonomy and justice. Beauchamp and Chambliss conceive the principle of justice by focussing on distributive justice which is the entitlement to just, equitable and apt treatment, through accounting for unique social identities.[23] Noting that AI is subject to unprecedented growth, the aforementioned principle could work to

centre and acknowledge the potential peril of algorithmic bias (i.e. social, gendered, and racial bias) in the context of treatment. This could work to inform the developers and researchers of health AI, which can mitigate the development of AI on the basis of social stereotypes. Furthermore, ensuring patient autonomy could work to strengthen the use of health AI in treatment and research. Autonomy refers to the idea that patients are able to hold their own perception and make decisions based on their values and beliefs.[24] The notion of autonomy could work to strengthen the involvement of patients in determining the integration of advanced health technology in the course of their treatment. It also reinforces the need to attain informed consent when collecting data for pioneering research of health AI. Conceptualizing specific ethical principles (i.e. transparency) warrants further discussion as there are various factors to consider (i.e. cultural context).

Further, Ord discusses how risk landscape of a particular e-risk can be calculated utilizing this formula as seen in (1):[25]

$$Cost\ effectiveness = Importance \times Tractability \times Neglectedness \quad (1)$$

The use of this formula has its limitations: 1) e-risks are quantifiable, and 2) the importance of AI is subject to individual interpretation. While it can be argued that the use of a formula remains inappropriate to calculate e-risk potential. Consequently, for the purposes of this paper, the

intention of using this formula is not to assign a particular numeral value to the particular risk, but rather provide an overview of the e-risk. Prescribing a more qualitative approach to discussing AI's risk factors would be most effective. However, if the main concepts from the formula are utilized, it is evident that AI is not adequately addressed and remains a substantial e- risk.

Therefore, in order to address the e-risk posed by AI in healthcare, society must seek active international cooperation. The use of AI has the potential to transcend borders of the state, and can be developed transnationally, therefore, there is a need to focus on global governance.[26] The usage of health AI is not strictly limited to

one state, and has the potential to radically transform patient experiences in healthcare. In 2023, the UN launched the Advisory Body for AI which aims to augment advice for the international governance of AI.[27] The integration of an international advisory body is notable, and with further development has the potential to develop and/or become a governing entity. While global governance could provide for overall oversight, it is important to ensure multi-tier governance to address gaps that may not be accounted for in an international body, and hold actors within the state accountable. Adopting a multi-level governance approach could be beneficial in ensuring regulation is met at regional, national, and international levels. The importance of multi-level governance for health AI is integral as this can potentially provide for sustainable research and development.

Conclusion

This paper ultimately worked to explore if AI in healthcare is a greater prospect or peril due to the nature of its duality. As counterclaims discuss AI's lack of privacy, algorithm bias and absence of ethical framework, these can be easily mitigated. The implementation of AI in healthcare can allot for privacy breaches as information is utilized to create datasets on the premise that the information would be fully anonymized. However, Bak et al. illustrate that the concept of anonymity is not possible.[28] While protecting patient privacy remains of utmost concern, these can be mitigated using security factors surrounding who is privileged in accessing and isolating genetic identifiers. These datasets can provide a wide breadth of genetic information which can be utilized in AI, and ultimately work to drastically extend a patient's life. While AI datasets can be racially and ethnically exclusive, leading to an underdiagnosis in marginalized patients, this can be offset by collecting more diverse data. The collection of diverse data can be ensured using the security factor of drawing upon ethical regulations that include notation on the requirements to compile and utilize diverse datasets in health AI.

The potential of extending humanity's lifespan, and ameliorating the quality of life, in perspective, makes the peril appear negligible. These consequences can also be addressed via a security factor - the implementation of security factors such as international cooperation in implementing ethical, legally-binding frameworks. This will work to ensure that the scope of the health AI is within set parameters and provides equitable, fair, and just healthcare for all. Through the robust analysis in earlier discussion, it is evident that AI remains a far greater prospect than peril as it has enduring effects such as improving the duration and quality of human life. This is established as it can provide better predictions through machine learning, mitigate physician bias, and can be grounded by the implementation of ethical frameworks. Overall, it is imperative to engage in critical study to implement legally-binding ethical framework and regulations on an international level to mitigate potential e-risks that AI in healthcare poses.

Notes

[1] United Nations Office for Disaster Risk Reduction. “Hazards,” Accessed November 29, 2022. https://www.undrr.org/terminology/hazard

[2] Toby Ord. *The Precipice: Existential Risk and the Future of Humanity,* (New York, Hatchett Books, 2020). 139

[3] Dagmara Woronko. “Technology and Medicalization” (PowerPoint Slide, York University, 2022)

[4] Government of Canada, “Bill C-27: An Act to enact the Consumer Privacy Protection Act, the Personal Information and Data Protection Tribunal Act and the Artificial Intelligence and Data Act and to make consequential and related amendments to other Acts,” 2023, https://www.justice.gc.ca/eng/csj-sjc/pl/charter-charte/c27_1.html.

[5] European Parliament, “Texts Adopted: Artificial Intelligence Act” (https://www.europarl.europa.eu/doceo/document/TA-9-2024-0138EN.pdf, 2024), 4

[6] Faiza Alam, Mei Ann Lim, Ihsan Nazurah Zulkipli, “Integrating AI in Medical Education: Embracing Ethical Usage and Critical Understanding,” *Frontiers in Medicine* 10, (2023): 1, doi: 10.3389/fmed.2023.1279707.

[7] June Park. “Governing a Pandemic with Data on the Contactless Path to AI: Personal Data, Public Health, and the Digital Divide in South Korea, Europe and the United States in Tracking of COVID-19,” *Partecipazione E Conflitto* 14, no. 1 (2021): 80-82. doi: 10.1285/i20356609v14i1p79.

[8] Marieke Bak, Vince Istvan Medai, Marie-Christine Fritzsche, Michaela Th Mayrhofer, Stuart McLennan, “You Can’t Have AI Both Ways: Balancing Health Data Privacy and Access Fairly,” *Frontiers in Genetics* 13, (2022): 3, doi: 10.3389/fgene.2022.929453.

[9] Ord. *The Precipice: Existential Risk,* 217-241

[10] Dagmara Woronko. “Technology and Medicalization”

[11] Deloitte. “The Socio-Economic Impact of AI in Healthcare,” (2020): 3, https://www.medtecheurope.org/wp-content/uploads/2020/10/mte-ai_impact-in-healthcare_oct2020_report.pdf

[12] Steve Alder, “Editorial: Why AI Will Increase Healthcare Data Breaches,” *HIPPA* Journal, (2023): https://www.hipaajournal.com/editorial-why-ai-will-increase-healthcare-data-breaches/

[13] Andreas Karwath, Karina V Bunting, Simrat K Gill, Otila Tica, Samantha Pendleton, Furqan Aziz, "Redefining β-blocker response in heart failure patients with sinus rhythm and atrial fibrillation: a machine learning cluster analysis," *The Lancet* 298, no. 10309 (2021): doi: 10.1016/S0140-6736(21)01638-X

[14] IBM Cloud Education. "What is Machine Learning?," 2020. https://www.ibm.com/cloud/learn/machine-learning

[15] Laleh Seyyed Kalantari, Haoran Zhang, Matthew B. A. McDermott, Irene Y. Chen, Marzyeh Ghassemi. Underdiagnosis bias of artificial intelligence algorithms applied to chest radiographs in under-served patient populations," *Nature Medicine* 37, (2021): 2176-2182, https://doi.org/10.1038/s41591-021-01595-0

[16] Louis Kamulegeya, John Bwanika, Mark Orkello, Davis Rusoke, Faith Nassiwa, William Lubega, Davis Musinguzi, Alexander Börve. "Using Artifical Intelligence on Dermatology Conditions in Uganda: A Case for Diversity in Training Data Sets for Machine Learning," *African Health Sciences* 23, no. 2 (2023): 1-10, doi: 10.4314/ahs.v23i2.86.

[17] Ord. *The Precipice: Existential Risk,* 217-241

[18] Kaiyang Li, Anna Frumkin, Wei Guang Bi, Jamie Magrill, Christie Newton, "Biopsy of Canada's Family Physician Shortage," *Family Medicine and Community Health* 11, no. 2 (2023): 1, doi: 10.1136/fmch-2023-002236.

[19] Dan Zeltzer, Lee Herzog, Yishai Pickman, Yael Steuerman, Ran Ilan Ber, Zehavi Kugler, Ran Shaul, Jon O. Ebbert, "Diagnostic Accuracy of Artificial Intelligence in Virtual Primary Care," *Mayo Clinic Proceedings: Digital Health* 1, no. 4 (2023): 480-489, doi: 1016/j.mcpdig.2023.08.002

[20] Gali Katznelson and Sara Gerke, "The need for health AI ethics in medical school education," *Advances in Health Sciences Education* 26, (2021): 1448, doi: 10.1007/s10459-021-10040-3.

[21] Ibid., 1448. doi: 10.1007/s10459-021-10040-3.

[22] Sara Gerke, Timo Minssen, Glenn Cohen, "Chapter 12 – Ethical and Legal Challenges of Artificial Intelligence-driven Healthcare," in *Artificial Intelligence in Healthcare*, eds. Adam Bohr and Kaveh Memarzadeh (Academic Press, 2020), 295-336, doi: 10.1016/B978-0-12-818438-7.00012-5

[23] Tom L. Beauchamp and James F. Childress, "Justice" in *Principles of Biomedical Ethics* (New York: Oxford, 2019), 267-268

[24] Tom L. Beauchamp and James F. Childress, "Respect for Autonomy" in *Principles of Biomedical Ethics* (New York: Oxford, 2019), 99-122

[25] Ord. *The Precipice: Existential Risk,* 1816

[26] Jonas Tallberg, Eva Erman, Markus Furendal, Johannes Geith, Mark Klamberg, Magnus Lundgren, "The Global Governance of Artificial Intelligence: Next Steps for Empirical and Normative Research," *International Studies Review* 24, no. 3 (2007): 3 , doi: 10.1093/isr/viad040.

[27] United Nations AI Advisory Body. "About," Accessed March 31, 2024. https://www.un.org/en/ai-advisory-body/about.

[28] Bak, Medai, Fritzsche, Mahyrhofer, and McLennan. "You Can't Have AI," doi: 10.3389/fgene.2022.929453.

Bibliography

Alam, Faiza, Mei Ann Lim, Ihsan Nazurah Zulkipli. “Integrating AI in Medical Education: Embracing Ethical Usage and Critical Understanding.” Frontiers in Medicine 10, (2023): 1-4, doi: 10.3389/fmed.2023.1279707.

Alder, Steve. “Editorial: Why AI Will Increase Healthcare Data Breaches.” HIPPA Journal, (2023): https://www.hipaajournal.com/editorial-why-ai-will-increase-healthcare-databreaches/

Bak, Marieke, Vince Istvan Medai, Marie-Christine Fritzsche, Michaela Th Mayrhofer, and Stuart McLennan. “You Can’t Have AI Both Ways: Balancing Health Data Privacy and Access Fairly.” *Frontiers in Genetics* 13, (2022): 1-7. doi: 10.3389/fgene.2022.929453.

Beauchamp, Chambliss L., and James F. Childress. *Principles of Biomedical Ethics*. New York: Oxford University Press, 2019. See esp. chap. 4, “Respect for Autonomy”, and chap. 7, “Justice”

Deloitte. “The Socio-Economic Impact of AI in Healthcare.” (2020): 1-48. https://www.medtecheurope.org/wp-content/uploads/2020/10/mte-ai_impact-in-healthcare_oct2020_report.pdf.

European Parliament, “Texts Adopted: Artificial Intelligence Act.” https://www.europarl.europa.eu/doceo/document/TA-9-2024-0138_EN.pdf, 2024.

Gerke, Sara., Timo Minssen, Glenn Cohen. “Chapter 12 – Ethical and Legal Challenges of Artificial Intelligence-driven Healthcare.” in *Artificial Intelligence in Healthcare*, eds.

Adam Bohr and Kaveh Memarzadeh (Academic Press, 2020), 295-336, doi: 10.1016/B978-0-12-818438-7.00012-5

Government of Canada, "Bill C-27: An Act to enact the Consumer Privacy Protection Act, the Personal Information and Data Protection Tribunal Act and the Artificial Intelligence and Data Act and to make consequential and related amendments to other Acts." 2023. https://www.justice.gc.ca/eng/csj-sjc/pl/charter-charte/c27_1.html.

IBM Cloud Education. "What is Machine Learning?." 2020. https://www.ibm.com/cloud/learn/machine-learning

Li, Kaiyang., Anna Frumkin, Wei Guang Bi, Jamie Magrill, Christie Newton. "Biopsy of Canada's Family Physician Shortage," *Family Medicine and Community Health* 11, no. 2 (2023): 1-4, doi: 10.1136/fmch-2023-002236.

Ord, Toby. *The Precipice: Existential Risk and The Future of Humanity.* New York, Hatchett Books, 2020.

Kamulegeya, Louis, John Bwanika, Mark Orkello, Davis Rusoke, Faith Nassiwa, William

Lubega, Davis Musinguzi, Alexander Börve. "Using Artifical Intelligence on Dermatology Conditions in Uganda: A Case for Diversity in Training Data Sets for Machine Learning." African Health Sciences 23, no. 2 (2023): 1-11, doi: 10.4314/ahs.v23i2.86.

Karwath, Andreas, Karina V. Bunting, Simrat K. Gill, Otila Tica, Samantha Pendleton, Furqan Aziz. Redefining β-blocker response in heart failure patients with sinus rhythm and atrial fibrillation: a machine learning cluster analysis. *The Lancet* 298, no. 10309 (2021): 14271435, doi: 10.1016/S0140-6736(21)01638-X.

Katznelson, Gali and Sara Gerke. "The need for health AI ethics in medical school education." *Advances in Health Sciences Education* 26, (2021): 1447-1458, doi: 10.1007/s10459-021-10040-3.

Park, June. "Governing a Pandemic with Data on the Contactless Path to AI: Personal Data, Public Health, and the Digital Divide in South Korea, Europe and the United States in Tracking of COVID-19." *Partecipazione E Conflitto* 14, no. 1 (2021): 79-112. doi:

10.1285/i20356609v14i1p79.

Seyyed Kalantari, Laleh., Haoran Zhang, Matthew B. A McDermott, Irene Y Chen, Marzyeh Ghassemi. Underdiagnosis bias of artificial intelligence algorithms applied to chest radiographs in under-served patient populations." *Nature Medicine* 37, (2021): 21762182. doi: 10.1038/s41591-021-01595-0.

Tallberg, Jonas., Eva Erman, Markus Furendal, Johannes Geith, Mark Klamberg, Magnus Lundgren. "The Global Governance of Artificial Intelligence: Next Steps for Empirical and Normative Research." *International Studies Review* 24, no. 3 (2007): 1-23 , doi:

10.1093/isr/viad040.

United Nations AI Advisory Body. "About." Accessed March 31, 2024. https://www.un.org/en/ai-advisory-body/about.

United Nations Office for Disaster Risk Reduction. "Hazards." Accessed November 29, 2022. https://www.undrr.org/terminology/hazard.

Woronko, Dagmara. Technology and Medicalization." PowerPoint Slide, York University, 2022

Zeltzer, Dan., Lee Herzog, Yishai Pickman, Yael Steuerman, Ran Ilan Ber, Zehavi Kugler, Ran Shaul, Jon O. Ebbert. "Diagnostic Accuracy of Artificial Intelligence in Virtual Primary Care." *Mayo Clinic Proceedings: Digital Health* 1, no. 4 (2023): 480-489, doi: 1016/j.mcpdig.2023.08.002

‘Canadianism,’ the Welfare State, and Policy Growth: Assessing the role of identity on the healthcare privatization discourse in Canada

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ABSTRACT: This paper will explore Canadianism and its relationship to universal healthcare. *Canadianism*, a term derived for the purpose of this text, is used to conceptualize an ‘Idea’ born out of Canadian identity and Economic Nationalism during commonwealth movements of the later 20th century. The idea is studied to understand how Canadian civil society favors Universal systems, particularly in this paper healthcare, over private initiative. This paper will assess the roots of the privatization debate and argue the rivalrous nature between Canadianism and New Public Management [NPM]. A key deliberation will be had on the significant role that ethics plays in Canadianism, and how this had success in limiting the influence of NPM on Healthcare. This paper will also examine a current ‘privatization’ case, Bill C-60, and its potential threat to Keynesian Economics’ opportunity-for-all approach to healthcare. A second key deliberation will be had on the concept of ‘Trust,’ how it informs Canadianism and why this makes Bill C-60’s discourse convoluted. Conclusively, a discussion will be had on the issues with Canadianism in healthcare discourse through considering Phantasms and policy growth. The limits of Canadianism will be briefly highlighted. This paper finds that Canadianism is essential to comprehend when considering why healthcare reform in Canada is difficult to manage.

KEYWORDS: Canadianism, welfare, identity, idea, new public management, Keynesian- economics, infrastructure, phantasm, healthcare

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Political Scientist Benedict Anderson’s *Imagined Communities* described Nationalism as “the pathology of modern developmental history, as inescapable as ‘neurosis’ in the individual... the equivalent of infantilism for societies.”[1] Anderson constructed the world of nationalism as one with the potential to redefine history, that gives cultural definition to a cause, and as the “imaginable” communion tying a nation into living existence.[2] Nationalism had initially found its roots in academia during the 19th century; a pivotal era in philosophical history which prioritized nation-building and new conceptualizations of political identities. Through the academic popularity of Humanism and scientific analyses, there led the initial stray away from religion. Therefore, academia at this time sought out novel ways to communicate a common “language of continuity”, one providing a nation with the power to link its “dead to its yet unborn", and as a conceptual simulation of ‘social immorality’.[3] Nationalism became the leading form of pathologizing this language into literature and was understood as the way a nation could traverse time within an impermanent world.

Firstly, to argue that nationalism solely originates as a response to an erosion of religious certainties is a reductionist consideration. More so, a conscionable argument is seen as how an erosion of religion propelled nationalism’s inclusion in developmental social theories of Canadian politics. Anderson insisted that Nationalism does not produce “its own grand thinkers; no Hobbeses, Tocquevilles, Marxes or Webers”.[4] However, the study of Nationalism is an essential core to understanding the development of a benevolent welfare state, democracy, and public trust in institutions. Nationalism shapes societal consciousness and politics in a multitude of ways; Social policy is heavily centered around the way in which Nationalism is carried out by political actor’s choices and, conversely, social policies are central instruments of nation building.[5] A prime example of the nationalism-to-institutional-reform pipeline is seen through the emergence of the social welfare position over healthcare in Canada. Emeritus professor Donald Swartz at the school of Public Policy and Administration at Carleton University explores the development of the Canada Health Act of 1984 through assessing the

growing nationalist rhetoric over labor productivity and union rights. Swartz's "The Limits of Health Insurance" research piece discusses the origins of health insurance as the inherent "outgrowth of working class struggles against the ravages of Capitalist development", and the working-class Socialist movements push for social security reform – including unemployment insurance, pensions and most significantly health.[6] As Swartz draws references between nationalism to Canada's universal health advocacy, his work also reflects why the Canadian government at the time began to set out the foundations of how a Federal system should look out for its citizens.[7]

The development of social welfare in Canada originated in 1945 with the family allowances program, out of the fundamental need to bridge gaps due to a higher cost of living and a decrease in the Canadian purchasing power during the post-war era.[8] However, this policy initiative had initially struck major controversy within parliament. The speech from the 1944 throne highlighted the Minister of Justice's concerns over a series of detriments jeopardized by a potential allowance program; such as compromises to an effective economy by lowering wages, the lack of wellbeing improvements due to an unjust allocation of funds between poorer and richer families, and the expensive and complex nature over administrations of a national welfare program.[9] Majorly, the crux of the early welfare debates were between the provinces and the Federal over which government could distribute their services more efficiently to its people. Following the establishment of the Canadian dominion act in 1867, the country ceased to operate as a "natural unit of geography or geology", rather it operated with "great economic disparity in its different regions with profound determinants on social standards and living conditions.".[10] The allowances act was almost seen as a litmus test for what could be achieved in Canadian welfare, highlighting an ability to implement a unified social policy system across the nation's diverse landscape and socioeconomic variances. As argued by Keith Banting and Stan Corbett, policy implementations over any national program in a Federalist structure is difficult when participation and cooperation is required by at least two levels of government.[11] However, the onus of allowances was

considered a federal responsibility due to an underlying administrative philosophy that Canada's centralized state would "direct monetary payments on a uniform basis" to fix societal divisions.[12]

The Capitalist economic base of Canada which inaugurated itself on individualism, competition, and private profit had been what ultimately shaped the accessibility of health services and physician's "social availability". Medical insurance under a for-profit guise promoted regional and class discrepancies with service consumption as physicians benefitted from serving in overrepresented and higher income-earning areas as compared to addressing under-utilized lower-income groups with unmet needs.[13] Emeritus professor Keith Banting at the school of Policy Studies at Queen's university states that "the original conception of the Welfare State was social integration or social cohesion".[14] Canadian society is highly divided due to its distinctive historic-settlement trends; including the French in Quebec, British in the Maritimes, and the American loyalists in BC and Alberta. The "Mosaic" identity of Canada had created the early foundations for economic inconsistencies between social groups, creating an urgency for social cohesion and equity programs in Canada. Social cohesion was an essential concept in the developmental history of the Canadian healthcare system. When the Cooperative Commonwealth Federation party of Saskatchewan (CCF) won the Provincial election in 1944, it had marked a pivotal shift as former Premier Tommy Douglas introduced the first universal health program in North America: the Saskatchewan Hospital Services Plan 1947.[15] This then led to former Prime Minister St. Laurent passing the 1957 Health Insurance and Diagnostics Services Act (HIDS) into parliament as the first shared cost program to act on comprehensiveness and accessibility.[16] However, Despite major pushback from the Canadian Medical Association (CMA) and the Canadian Health Insurance Association (CHIA) who termed the transition as inefficient "socialized medicine", the Canadian public and policymakers turned their attention to increasing publicly funded outpatient care as they aligned greater with Canadian values.[17] This is evident of how Canadian

identity had influenced the policymaking process to confront complex political perspectives and the negative social repercussions faced by Canadians over health.

Eventually, the 1960 provincial election in Saskatchewan became known as the "Medicare Election", winning the CCF 37 seats in provincial government to fulfill their promise in creating a fully publicly funded health system that reimburses physicians.[18] The collective values of commonwealth working-class groups at the time aligned congruently to successfully propose infrastructural reform, appealing to a healthier and unified Canadian society. Ultimately, shaping the foundations for a "Canadian" national standard approach in greater government responsibility over its citizens. As health services became fully universalized to all citizens within Saskatchewan, this was not the same across the nation. Even with HIDS, only 5 provinces had signed on and there were major discrepancies over who would be covered and who wouldn't under this insurance program.[19] As well, the CMA had advocated in only insuring the poor yet opposed broader efforts made like in Saskatchewan.[20] The CMA, alongside former Prime Minister John Diefenbaker, had advocated for the implementation of the Hall Commission into healthcare led by Justice Emmet Hall as an initial strategic rhetoric to shape public policy in favouring "moderate" and "conservative" modifications; such as retaining provincial responsibilities over the healthcare system.[21] At its core, the Commission highlighted the rivalrous nature between two main stakeholders in health politics; private sector advocates like insurance companies and physician associations vs public consumer groups.[i] Over time, the Commission began to evaluate and recognize consumer groups as harbingers of collective Canadian values who wish to advance several "socially desirable objectives" and the Commission then endorsed the Saskatchewan model.[22] The Federal government then introduced a new shared-cost program that

[i] This complex duality between private and public stakeholders in shaping healthcare policy will be an important further discussion within the 'privatization and network trust' subsection of this paper.

modelled the successes of Saskatchewan's full physician reimbursement system, titled the *Medical Care Insurance Act 1966.*[23] The extent to which Ideas, identity and ideologies have formulated the unique history of Canadian healthcare portrays an important side to Canadian politics that is underscored throughout this paper.

The later 20th century had seen an exponential number of scholarly researchers who had assessed the case of Canadian identity through 3 main components: as a product of settler-migration, as a product of Political Socialization from US-Canada relations, and through their ability to garner institutional social reform. Such works include Holmgren, "Ireland to Canada" (2021); Forbes, "Hartz-Horowitz at Twenty" (1987); Rotstein, "Canada: The New Nationalism" (1976). These examples refer to only a fraction of the recent literature entertaining these standpoints. Conversations over Canadian identity have continuously evolved to accurately fit a Globalized time-period better - an era promoting unity, independence, and advocacy for neoliberal markets. Therefore, two questions are mainly explored with further consideration in this paper: [1] What is the relationship between a specific type of Canadian identity, 'Canadianism', and Canada's largest social program Medicare? [2] As statistics show Medicare's efficiency rates on the decline, what is the current discourse around infrastructural reform and how does Canadianism inform these debates?

Understanding Canadianism: Policy Ideas and Economic Nationalism

Ideas, Canadianism and influences on policy paradigms

'Canadianism' is a unique institutionalized ideological framework which was born out of Nationalism and manifests as a specific type of 'Idea' within policy development. To understand 'Canadianism,' one must first understand the 'Idea' in the context of public policy. As per political sociologist Daniel Beland's literature, "Policy change and healthcare research", the Idea is a framework that forms embedded social and economic assumptions guiding the choices of political actors, thematizes and defines what a "meaningful

problem" is, and eases actor coordination.[24] This may also be understood as the Policy Paradigm - the set of norms which governs the Policy Process by specifying aims and distributing instruments.[25] Beland argues the Idea is a powerful framing tool that can help to legitimize an actor's decisions on either policy reform or reproduction. Therefore, understanding what Ideas might drive an actor can help researchers learn how monumental changes to policies occur over time.[ii]

'Canadianism' works like Beland's Idea, shaping the paradigms and perceptions of policies to offset the effects of political socialization from the United States. Political socialization considers itself as all the defining geopolitical, socioeconomic, interpersonal and influential factors that shapes an individual political identity; a process where one's values and beliefs evolve through gradual development and socialization into adulthood.[26] Political socialization is neither premediated nor preordained, however, it is arguable that socialization from US politics have played a strong role in shaping the personalities and perspectives of Canadians throughout the century. Economist Abraham Rotstein (1976) writes greatly on the impacts of American influence on Canadian Nationalism by arguing that the Canadian psyche stands at an internal "deadlock". The American ownership over telecommunications media, oil industries in Alberta, potash industries in Saskatchewan, and ideological prevalence's in government, private businesses and academia all contribute severely to configure an atmosphere that is consumed by all Canadians.[27]

Studies have revealed that political socialization has varying dominating effects dependent on regional variations.[28] In places where staple resources like oil in Alberta hold significant value and pride to identity, US influences impact the regional development of 'Alberta Nationalism' more rigorously due their prevalent involvement within provincial affairs. This effect is also seen within

[ii] The notions of how Path Dependency and paradigms shape how political actors craft policymaking will become an important exploration during the final discussions over phantasms in this paper.

Saskatchewan following the rise of the Saskatchewan Party in the late 1990's, marking an ideological shift to the right caused by coalitions of former Conservative and Liberal party members. However, scholars like Dale Eisler point out that the shifts from the socialist roots of the CCF to the market-oriented Saskatchewan party is complex and overstated for a couple of reasons which highlight the uneven 'susceptibility' of fragmented provincial politics. For one, Saskatchewan's universal health program remained untouched and portrayed continuity in policy initiatives set by the CCF.[29] Secondly, the global economic trends and context of the time needed to be considered[iii] as shifts in policy preferences may seem ideologically driven but were responses of practical needs, which Eisler argues ultimately led to economic growth within the province.[30] Thirdly, Saskatchewan's strong public traditional values in favouring community-oriented welfare support tempered any true extremist shifts to the right.[31]These all highlight the importance of fragment theory in Canada, and how these fragments can either become receptive or resistant to the effects of political socialization from external influences.

Canadianism possesses an inherent aim of escaping and rewriting American socialization by governing the Policy Paradigm. During the "Medicare Elections" of Saskatchewan in 1960, doctors led strikes in the Keep Our Doctors movement (KOD) which were subject to American political influences, creating "neighbor to neighbor" divisions within the province.[32] All the more, this pushed more activism into establishing a Medicare system which Saskatchewan's former Premier Tommy Douglas had to embrace in order to avoid political uncertainty.[33] The result set into play a subconscious imbedding of Canadianism into the development of Saskatchewan's healthcare system.

Canadianism is a subset of national identity which specifies its aims in preserving the collectivist approaches to welfare and distributes its instruments through federal funding. Therefore, the

[iii] These global economic trends of the 1990's, mostly known as New Public Management, will be explored further in the later sections of this paper.

argument is made that the Paradigms of Canadianism is a foundational infrastructure to Medicare.

Infrastructures, Economic Nationalism and Canadianism

Economic Nationalism is a crucial and contributing element to 'Canadianism', explaining how and why social programs became integral to the Federal government and in shaping Canadian political identity. In the political and economic rebranding of Canada during the early globalization period of the 1960's-1970's, new considerations over what values and Ideas should shape Canada's critical infrastructural networks, such as the economy, began to play into question. Anthropologist Akhil Gupta's research explains how the infrastructure can illuminate social futures by embodying the "aspirations, anticipations, and imaginations of the future . . . what people think their society should be like, what they might wish it to be, and what kind of statement the government wants to make about that vision.".[34] Infrastructures are definitively future-oriented, and the concept of the 'infrastructure over time' is significant as their impacts extend to bring uneven relationalities of the past into the future. The attention to temporality highlighted by Gupta articulates why considerations for a perfect future vision of Canada under its "Mosaic" identity leads to iterations of fractured and competing ideas when navigating and finding Canada's own distinct voice from America.

Infrastructures are powerful framing tools formed of networks with the ability to control the flow of goods, people and Ideas which transcend across time.[35] In principle, the infrastructure iterates longevity logics identical to that to which an ideology does, like Nationalism. So, infrastructures and ideologies are highly linked. The values held by Canadians complicate the policymaking around welfare and social infrastructures; as put by Conrad and Cudahy, "the popular press depicts Canadians as holding core values that are more communitarian than individualistic." and favoring "the maintenance and extension of a postwar welfare state.".[36] During the early implementation phases of Canadian welfare, it became essential to national identity that they would replicate the sentiments of

‘Canadian virtues’ to deliver an upheld clear message through time: Canadian infrastructures were fabricated to serve citizens equitably, responsibly and in a ‘Canadian’ way.

The policymaking process begins with Ideas, to which “agents synthesize into ideologies, with all of the attendant sectoral differences, conflicts, social and political inequities, contradictions, and power imbalances.”.[37] Canadianism is not a necessarily common shared type of identity that is visually distinctive. A single actor does not have to “possess” Canadianism like with other types of identities or ideologies. Rather, Canadianism is an institutionalized Idea of prioritizing collectivist values and expectations within the paradigms of healthcare policy making both subconsciously and consciously. Canadianism is an idea used in policymaking that considers national identity, Economic Nationalism, and advocates over how infrastructures should work in the long run. The perfect vision of Canadian welfare drew ideas from post-war collectivist commonwealth movements who were the early actors of Canadianism in politics. The establishment of a Universal healthcare system explains why Medicare is unique and unchangeable to Canada as it became the first welfare infrastructure to have been practically and systematically imbedded with the strong Ideas of Canadianism.

The Canadian approach to economic policy had historically favored protectionism, centralization, and intervention due to influences from American trade relations. Scholar Hubert Rioux’s research, “Canada First vs. America First: Economic Nationalism and the Evolution of Canada-U.S. Trade Relations”, explains how Canada’s urge to shift its economy away from its Americanized influences was paramount to the development of the country’s current Universal approach to welfare infrastructures. By the 1960’s-1990’s, overseen by the Trudeau and Pearson government, the economy had undergone a market liberalization period with endeavors to “Canadianize” the economy.[38] The adjustment from protectionism to a free market in a newly Globalizing world was crucial to the construction of a Canadian economic identity that aligned with Nationalist values, morals, and politics. As Canadian social policies began to adapt to work within a system that stratifies

the lines between a pure Capitalist-Socialist state, Canadianism began to imbed itself into social infrastructures. Infrastructures and their networks have a cooperative relationship over shaping the definition of issues on the political agenda, ultimately, accounting for a crucial part of shaping the outcome of policies which get into the government chambers.

Canadianism and healthcare; Three Worlds of Welfare Capitalism

Canadianism fabricates a 'fear of erasure' over Universal welfare infrastructures as they are advantageous to Canadian political identity, and this fear is built within policy cycles to reproduce certain outcomes and decisions. Canadianism desires an economy which presents characteristics of charitability, a social stigmatization of Canadian identity. The results of Canadianisms influence over the healthcare system can be summarized through sociologist Epsing-Andersen's work, "Three Worlds of Welfare Capitalism". Epsing-Andersen classifies Canada as a "means-tested" Liberal welfare regime requiring "strict entitlement criteria" heavily linked to social security arrangements.[39] Canadian welfare programs favor proportionately disadvantaged individuals, hence Epsing-Anderson classification of Canada's high "Health Decommodification" score is important in understanding Medicare. Health Decommodification considers the extent to which an individual's access to health services are independent from their relative position to the market and market-driven incentives. Canada scores a 50 on its Health Index scale, the measurement of an individual country's score to the mean labor market data globally on Health Decommodification. This ranks Canada among the highest out of the 18 OECD countries for Health Decommodification.[40] Medicare runs in a unique way that is vastly different to other infrastructures in Canada shown by the high Health Decommodification score; further, it ranks the strongest in terms of universal access compared to other public healthcare systems in the G7 summit.

As put by Epsing-Andersen, "A program can be seen to harbor greater de-commodification potential if access is easy, and if rights to an adequate standard of living are guaranteed

regardless". Equal access to healthcare services were the initial driving forces which led to the creation of Medicare. Medicare is a political upper-hand to the idea of Canadianism as it presents the virtuous nature of Canada's political economy through an ability to consider its population equally - an example of the Economy perpetuating charitability. Out of the developed countries, Canada is the most Federal in how it operates its political system around areas of health. By utilizing a concurrent-powers model for healthcare between the provinces and the Federal, the Medicare system was one essential binding tool amongst many used to unite the provinces under one constitution. Therefore, this means that there are multiple pressure points within the healthcare system where resistance to policy initiatives or blocking programs is easily achieved, and there must be recognition in how different provinces with different needs.[41] This can explain why privatization debates and attempts at Policy Layering [iv] with Medicare is difficult. Under Canadianism, there is no ideological basis for consistent privatization in application due to the excessive anti market-driven incentives which sustain it.

Establishing the essentials of Canadianism and how they inform decisions is key in understanding the convoluted political discourse surrounding Canadian healthcare policies; the ensuing sections focus on testing Canadianism with New Public Management and Keynesian Economics.

Canadianism vs New Public Management [NPM]

Fundamentals of NPM in Canada

The 1980's-1990's in Canadian political management had tried shifting the managerial structures of provincial governments to find new ways of delivering welfare services to the public. One of the most prevalent initiatives made were with the applications of New Public Management [NPM]. An economic structure centered around the Ideas of efficiency, downsizing, value for money, incentives, and profit-maximization.[42] NPM in Canada aimed to transform

[iv] a policy audit made to incrementally shift institutions over time.

bureaucratic organizations to resemble a private sector approach to managerial organization; redefining and diminishing the role of the federal state by turning service delivery into a "supermarket" of options. The intention of NPM were to ensure consumers efficient deliveries of services through subcontracting with private establishments and prioritizing the needs of individuals over collectivist approaches.[43]

NPM's greatest outcome had been the introduction of the Alternate Service Delivery agencies [ASD], a dimension of improving government performance of program service deliveries to Canadians through non-traditional means outside of the public sector, using partnership arrangements to be more business centered.[44] Agencies of ASD's had variances in popularity depending on province; Alberta, Manitoba, and Ontario had initially fully implemented ASD's, defunded municipalities and centralized power to the provincial governments to enable more NPM methods over social programs.[45] Mulroney's anti-government rhetoric in 1984 had strongly advocated for these reforms by pushing for program cuts and reductions to subsidies. These reforms carried on out with the election of Chrétien's government in 1993, which saw greater cuts to civil service jobs, agriculture and transportation sector subsidies, and increased commercialization and restructuring of private businesses.[46]

Setbacks to NPM in healthcare; Ethics and Canadianism

Implementation of NPM over Canadian healthcare had major overall pushback due to Canadianism's strong clasp on Medicare. The uptake process of NPM overall in Canada was more "gradualistic, experimental and episodic" compared to Australia and the USA which had "rapid initiatives".[47] Specifically, full scale implementation of NPM was more difficult to institute over healthcare. Currently, NPM is in operational use through some forms of ASD agencies - examples include the Canadian Food Inspections Agency, the Canadian Parks Agency and the Canada Customs and Revenue Agency.[48] NPM was successful in challenging the Universality of some Canadian social programs (like Pensions and

Employment Insurance), yet not for Healthcare and Education.[49] This phenomenon highlights 2 important considerations: [1] of the significance that Canadian Nationalism, ethics, and Ideas can play to shape or void the sphere of influence of NPM's reach over social programs. [2] the extent to which Healthcare is crucial to the Canadian population. Canadianism and NPM explain a dichotomic history for privatization debates within Canada.

An essential proponent to why NPM and ASD's failed implementations in Federal healthcare is because of the ethical considerations that privatization poses to the Canadian image. The 1995 attempts to introduce user-pay methods to "jump the queue" for healthcare service deliveries saw a great divide within the Canadian public.[50] Initiatives to adopt private contracting such as private nursing agencies had an overwhelming negative response by the public, displaying how "ethical debates" triumph considerations for market efficiency.[51] The influence of Canadianism over healthcare is clear; emphasis is placed on the preservation of an economy that endorses more public sector spending into social programs over a private sector approach. NPM was an attempt to reform the public sector from within by fostering private-public partnerships, and this reform was met with limited progress to counter the 'fear of erasure' seen significant to Canadianism.[52]

The issue of inconsistency

An issue of inconsistency is presented when Canadianism is subject to the paradigms of some infrastructures, whilst NPM informs others. Implementation of different Ideas into different social programs leads to horizontally inconsistent approaches to policy making, creating a greater national polarization between for-profit and nonprofit markets. Horizontal inconsistency in the public policy context refers to the integration of policies across the wider space as the conscious act to limit contradictions in policies from one field to another, ensuring a greater cohesion of "government philosophy".[53] When policy consistency is not upheld it can jeopardize stability, and a greater concern is when inconsistencies intersect as they limit integration for individuals with complex cases. For example: In

Canada, primary care is a standard to comprehensive healthcare integration as it is the first source of contact to which consumer must interact with to access services. However, as Canada is made up of 10 provincial and 3 territorial healthcare plans due to the Federalist divisions of powers set by the constitution, different provinces deliver primary care through different means. To achieve comprehensive primary care, there must be shared strategic policies and governance over social services and community support which is inconsistent across the provinces.[54] Coordination is crucial to ensuring that health policies are effective across different regions and that there are equitable standards of care.

As mentioned in Scott et. Al's research (2023), youth aged 0-25 years and elderly aged 65 years and above are two major target groups who suffer the most from these provincial inconsistencies, requiring more access to "home care; mental health and addictions services; timely transitions between urgent, emergency and acute care; respite care; and medication reconciliation by community pharmacies".[55] The provinces with greater governance proximity between primary care and priority services are Manitoba, Ontario, New Brunswick, Nova Scotia and Prince Edward Island. These provinces are considered most supportive of integration solutions.[56] The overall consistency across the wider policy fields and between spaces is threatened when there are more distinctions between provinces as the population is faced with conflicting approaches to accessing services in comparably efficient ways. The use of more selective vs generalized approaches to some service deliveries and not others result in different qualities of public access to these social programs, making some services more accessible than others and affecting overall public user-engagement. This horizontal inconsistency in managerial structures for social program deliveries is important and highlights how Canadianism, alongside other Ideas which shape and influence policy, is crucial to considering how hindrances in policy growth can occur.

Canadianism and Keynesian Economics

Bill C-60, the 'Microcosm', and Keynesian Economics

The healthcare "privatization" debate which swept political discourse in 2023 had been over Bill C-60. Ontario Premier Doug Ford received scrutiny and heavy criticism over his provincial Conservative government's passing of Bill C-60, titled the Your Health Act, 2023. The bill's Royal Assent status convoluted the socio-political sphere with divided considerations over its efficacy and potential 'detriment' to the integrity of the Universal Medicare system. Under the bill, both for-profit and nonprofit clinics would be allowed to conduct cataract surgeries, MRI and CT scans, minimally invasive gynecologic surgeries and, eventually, knee and hip replacements under the Ontario Health Insurance Plan.[57] To advocates of C-60, it is considered a marginal step in addressing the fundamental issues in Canadian Healthcare: Inadequate health access, staffing shortages specifically in primary care divisions and prolonged surgery wait time deaths, insufficient immigration services for skilled labor and overall dissatisfaction with the work-place environment.[58]

Propositions for this bill had risen at a tumultuous time in Canadian political history, a post-pandemic period where healthcare discourse had the urgent window of opportunity to reach policy venues at a faster rate. However, to many actors and scholars, this Bill posed as a threat to the essence of Canadianism. Groups, such as the NDP, had come forth mentioning how the bill incites a "fatal blow to our treasured Medicare", disregarding "care based on needs", and favoring investor partnership and private sector involvement in healthcare.[59] The role to which political ideologies informed the direct actors involved in the conversation shifted the debate into a for-profit vs nonprofit war. Groups such as the Ontario Nurses Association (ONA) and the NDP desired an expansion of the public sector over Ford's Conservative party's methods of a private sector approach to service delivery. Therefore, Bill C-60 highlighted two important considerations: [1] It represents the modern attempt at bringing NPM further into the healthcare system, and [2] oppositional reactions show a 'microcosm' of the fear of erasure of public-investment into social programs that is seen with Canadianism.

The Microcosm of fear seen through oppositional discourse is motivated by Canadianism and its inherent disposition to favor the economic philosophies of Keynesian Economics. The perspective of post-Keynesian economics recognizes that the market is better at generating wealth, yet not at guaranteeing fairness and opportunity for all.[60] The post-Keynesian position in healthcare is one which finds the fair opportunity of service access as being a foundational right, and comprehensive access to healthcare resources as a beneficial input for effective human-society contribution. Public Capital can influence welfare since investing in infrastructures can contribute positively to private productivity, increasing income and welfare. Therefore, the question on whether society would benefit from more resources being directed into public investment reaches the forefront of the privatization debate.[61]

Privatization, networks and public trust

Following implementations of the Canada Health Act in 1984, there had been various efforts laid out by private stakeholder groups such as the CMA and their provincial affiliates over the "unsustainability" of the Federal health system.[62] These groups had advocated for the desirability of private medicine market incentives, which has gained "considerable currency" by medical communities.[63] CMA polling's highlighted that 70% of doctors favour a two-tier system, and with growing discussions in recent years over "privatizing" it presents a dilemma to the main stakeholder groups involved within health policy.[64] The discourse and fears over privatization are reactionary responses to the potential threat it poses to Keynesian Economics; a foundational part of Canada's unique Economic Identity that has arguably resurfaced within current years following Prime Minister Justin Trudeau's policies. This model focuses more on directing ways to strengthen the nation's overall GDP through means like greater public healthcare resource access as health has strong implications for economic growth. Canadianism in Medicare is clear on this perspective as seen by its policies which advocates for higher Health Indexes and decommodification. Methods of healthcare investment contribute greatly to productivity,

efficiency, and macroeconomic stability. Bill C-60 instigates a threat to the Keynesian position that public expenditure should primarily focus on its functional value, known as the “functional finance”, and as well threatens the aggregate supply and demand of healthcare by disrupting network trust.[65]

Trust in this context refers to a socially embedded quality which integrates itself within the health-network, linking political actors, medical professionals, and the public in a shared relationship. This relationship involves a cyclical cooperation and an established consensus over mechanisms of ‘how the system works’, overall leading to the effective resource allocations of health.[66] Privatization challenges consumer supply and demand by breaking the already built ‘trust’ and preconceived guise within the health-network that care in Canada works under an irrevocable “opportunity for all” philosophy. This trust in the system entails a security in keeping healthcare ‘Canadian’ with the perspective of privatization being the ‘Americanization’ influence over the healthcare system. This demonstrates how strong Nationalist views aim to keep social welfare a staple foundation to the Canadian identity. The creation of bill C-60 highlights the problematic condition of a fragile relationship between conflicting political-ideological motives and the security of inaugural trust within different social networks built upon a fundamental economic thought. By introducing a bill considered “unfair,” this description highlights the dominance of Canadianism in the healthcare discourse and the role that it has on network trust inordinately.

Discussion: The Phantasm and policy growth

Moving forward from the ways in which Canadianism limits the privatization of federal healthcare, it is substantial to account for the ways in which Canadianism may limit the scope of the conversation on what should be done to reform the system. As with any strong Nationalist thinking, bias has a strong hold over reshaping the semantics of political debates. These semantics can directly influence the growth of policies and government by deciding the

salience of an issue, posing as either a hindrance or an accelerator for policy growth in social programs. When the conversation around privatization becomes one over a 'fear of erasure' it can act as a slippery slope, allowing for the conservation or rejection of certain ideas to support what is unique to that Nationalist group. This case is inescapable with Canadianism's application within healthcare; the extent to which a misconstruction for the debate on exploring policy alternatives for Medicare, out of fears of an 'Americanized' result, restricts the ability to have open dialogue on the issue and what might be the best approach to maximize health service delivery.

Here enters the philosophical phenomenon of the Phantasm in the perspective of Jacques Derrida. Derrida argues the Phantasm as relational to Plato's "Simulacra", a representation of an image without the substance or quality of its original form seen as the "illusion" of thought.[67] Two contrasting concepts, death and prolonging life, are essential components to Derrida's conception of the Phantasm as it is described as a disagreement of the "finitude" - the Phantasm is a "Masked Imagination", a deconstruction of variations in ideologies which entraps individuals within a "repetition of sameness" sustained over time.[68] The imagination is inextricably bound to death and time. Derrida describes the imagination as a "Trojan Horse", running under a scripture leaving its subjects with an impression of having power and control over it, as a possessive noun to its subject.[69] Phantasm's also perfectly construct an "immaculate maintenance" of oppositional ideas, reducing knowledge in a way which delimitates reality. Hegel argues that Phantasms measures the value of truth, and so a society working with multiple Phantasms depreciates truths and often furthers the spread of misinformation passed through political media.

Canadianism can operate like a Phantasm in the Policy Paradigm; a reactionary response producing shallow and limited tunnel-visioned lenses over what should be done to advance public policy. Advocating for more government spending into public-sector delivery of care rationalized as a 'Canadian' position emphasizes a singular narrative, reducing the complexity of the issue's problem definition that shifts the policy process to only having one solution.

Canadianism as a Phantasm acts as an obstacle leading to the ‘drift’ of alternative types of policies, repetitions of sameness, and the disallowing of innovative ideas from reaching the political agenda of actors. The Ideas or rhetoric at play heavily frame public discourse and political implementations, therefore policy growth can be severely limited on healthcare reform due to the dominance of Canadianism’s embedded and systemic nature. A fixed-bound imagination can entrap the paradigms of policy makers and political actors as fears in losing the “Canadian values” of welfare infrastructures clouds judgement over novel approaches to policies. As with Beland’s “Idea” theory, Phantasms which gain control over an individual’s Idea benefit to gain control over the framing tools which legitimize actor’s decisions. The challenges are that ideas can act to oversimplify or complicate an issue and affects democratic transparency in policymaking. Policy change, whether incremental or critical, is threatened from reaching healthcare discourse as the masked imagination over governing structures of Medicare are reproduced.

Conclusion

Canadianism is a complexity within systemic infrastructures and manifesting itself throughout Canadian social welfare discourse in varying strengths. With strong ties to ethics and network trust, Canadianism is a crucial point of observation to examine when assessing social welfare, economics, and the ideologies or identities informing actors within Canadian politics. The study of Canadianism is important for investigating the extents and legitimacies of privatization debates for Canadian social welfare, offering considerable insights into the failures of NPM takeover and the solidity of Keynesian Economics advocacy within Canadian healthcare. Like Anderson’s “Imagined Communities” on Nationalism, Canadianism highlights the significance of learning about how infrastructures transcend through time and bridges the gaps of an ideology between generations of the past and future.

In resembling Nationalism, Canadianism asks what social values hold the most value to Canadians, and what vision do they want to stand the test of time in bringing forth a constructed 'historical memory of Canada' to future generations? Canadianism is neither good nor evil, rather, it simply is a functioning fragment of Canadian politics and informs actor choices, infrastructures, and institutions just like any other Idea. It is crucial to assess the phantasms that come at play, such as Canadianism, when studying the political mechanisms behind how healthcare policies are shaped to properly predict future trajectories of Medicare.

Health is one of the most crucial institutions to a society, as powerful healthcare systems tend to demonstrate a nation's security, economy, and overall societal function. As future political discussions over Medicare may begin to lean towards finding alternate solutions, the findings of this research are important to anatomize and comprehend when considering why healthcare reform in Canada is difficult to manage. As well, demonstrates how Canadian welfare infrastructures may still serve as a defensive and reactionary means to enforce a distinct, charitable and good-hearted vision of Canadian economic identity to escape the sociopolitical clutches of its southern-border neighbor.

Notes

[1] Benedict Anderson, “Imagined Communities: Reflections on the Origins and Spread of Nationalism” (London: Verso1963), 4-6

[2] Anderson, “Imagined Communities”, 4-6

[3] Anderson, “Imagined Communities”, 11

[4] Anderson, “Imagined Communities”, 5

[5] Yannick Dufresne, Sanjay Jeram, and Alexander Pelletier, “The True North Strong and Free Healthcare? Nationalism and Attitudes Towards Private Healthcare Options in Canada”, *Canadian Journal of Political Science*, *47*(3), 569–595.

[6] Donald Swartz, “The Limits of Health Insurance” in “The ‘Benevolent’ State”, ed. Allan Moscovitch and Jim Albert (Toronto: Garamond Press, 1987), 256-257

[7] Donald Swartz, “The limits of Health Insurance” in “The ‘Benevolent’ State”

[8] Bernice Madison, “Canadian Family Allowances and Their Major Social Implications”, *Journal of Marriage and Family 26, no. 2* (1964), 135

[9] Brigette Kitchen, “Wartime Social Reform: The Introduction of Family Allowances”, *Canadian Journal of Social Work and Education 7, No.1 (1981), 45-46*

[10] Charlotte Whitton, “The Family Allowances Controversy in Canada”, *the social service review 18, no.4 (1944), 422*

[11] Keith Banting and Stan Corbett, “Health Policy and Federalism: An Introduction” in *Health Policy and Federalism: A Comparative Perspective on Multi-Level Governance*, (2002),

[12] Bernice Madison, “Canadian Family Allowances and Their Major Social Implications”, 136

[13] Donald Swartz, “The limits of Health Insurance” in “The ‘Benevolent’ State”, 260

[14] Keith Banting, “Visions of the Welfare State”, in *the future of Social Welfare Systems in Canada and the United Kingdom*, ed. Shirley B. Seward (Meech Lake, the institute for Research on Public Policy, 1987), 150

[15] Martin et. Al, “Canada’s Universal health-care system: achieving its potential”, National library of Medicine.

[16] Martin et. Al, "Canada's Universal health-care system: achieving its potential."

[17] Charles Conrad and Chris Cudahy, "Rhetoric and the Origins of the Canadian Medicare System", 551

[18] John Archer, "Saskatchewan: A Political History", *Canadian Parliamentary Review 8, No. 3* (1985)

[19] Martin et. Al, "Canada's Universal health-care system: achieving its potential."

[20] Charles Conrad and Chris Cudahy, "Rhetoric and the Origins of the Canadian Medicare System", 553

[21] Charles Conrad and Chris Cudahy, "Rhetoric and the Origins of the Canadian Medicare System", 554

[22] *Commission, vol. I, 740* in Charles Conrad and Chris Cudahy, "Rhetoric and the Origins of the Canadian Medicare System", 555

[23] Antonia Maioni, "Federalism and Health Care in Canada", in "*Health Policy and Federalism: A Comparative Perspective on Multi-Level Governance", (2002), 179-180*

[24] Daniel Beland, "policy change and healthcare research", Journal *of health Politics, Policy and Law 35, no.4* (2010), 623.

[25] Denis O'Sullivan, "The Concept of Policy Paradigm: Elaboration and Illumination" *The Journal of Educational Thought (JET) / Revue de La Pensée Éducative 27, No.* 3 (1993), 246–272.

[26] Mark Carl Rom et al., "Political Socialization: The Ways People Become Political", Introduction to Political Science No. 2 (2022): 6.1.

[27] Abraham Rotstein, "Canada: The New Nationalism", 99-101

[28] Mark Carl Rom, "Political Socialization: The ways people Become Political", 6.1

[29] Dale Eisler, "From Left to Right: Saskatchewan's Political and Economic Transformation" University of Regina,

[30]Dale Eisler, "From Left to Right: Saskatchewan's Political and Economic Transformation" University of Regina,

[31]Dale Eisler, "From Left to Right: Saskatchewan's Political and Economic Transformation" University of Regina,

[32] John Archer, "Saskatchewan: A Political History"

[33] John Archer, “Saskatchewan: A Political History”,

[34] Hannah Appel, Nikhil Annand and Akhil Gupta, “The Infrastructure Toolbox: Suspension”, Society for Cultural Anthropology 24, no. 1 (September 2014)

[35] Brian Larkin, “The Politics and Poetics of Infrastructure”, *The annual review of anthropology 42,* no. 343 (2013), 340

[36] Charles Conrad and Chris Cudahy, “Rhetoric and the Origins of the Canadian Medicare System”, 544

[37] Charles Conrad and Chris Cudahy, “Rhetoric and the Origins of the Canadian Medicare System”, 547

[38] Hubert Rioux, “Canada First vs. America First: Economic Nationalism and the Evolution of Canada-U.S. Trade Relations”, *Journal of European Review of International Studies 6,* no. 3 (2019), 34

[39] Gøsta Epsing-Andersen, “Three Worlds of Welfare Capitalism”, (Cambridge, UK: Polity Press, 1990) 56-57

[40] Clare Bambra, “Worlds of Welfare and the Health Care Discrepancy”, *Social Policy and Society 4, No.1* (2005), 34

[41] Charles Conrad and Chris Cudahy, “Rhetoric and the Origins of the Canadian Medicare System”, 556

[42] Eleanor D. Glor, “HAS CANADA ADOPTED THE NEW PUBLIC MANAGEMENT”, the Public Management Review 3, no. 1 (December 2010): 121-130

[43] Tom Christensen, Per Laegreid, Lois R. Wise, “Transforming Administrative Policy”, *Public Administration 80, no.1* (2002), 153 – 178.

[44] Government of Canada, “*Assessing Alternative Service Delivery Arrangements”, of the A. G. of C.* (September 2007)

[45] Bryan Evans, Halina Sapeha and Andrea Spender, “Perspectives of Public Service Elites Post Financial Crisis: A Comparison of Canadian and Australian Public Executives”*, International conference on Public Policy (Milan, Italy: Catholic University of Sacro Cuore: July 2015) 2-3*

[46] G. C. Harcourt and Peter Kriesler, “POST-KEYNESIAN THEORY AND POLICY FOR MODERN CAPITALISM”, JOURNAL OF AUSTRALIAN POLITICAL ECONOMY No 75 (2015) 31-33

[47] G. C. Harcourt and Peter Kriesler, “POST-KEYNESIAN THEORY AND POLICY FOR MODERN CAPITALISM”, 35

[48] Government of Canada, "Policy on Alternative Service Delivery", (2002)

[49] Eleanor Glor, "HAS CANADA ADOPTED THE NEW PUBLIC MANAGEMENT?", *Public Management Review 3, no.*1 (2001), 121–130.

[50] Eleanor Glor, "HAS CANADA ADOPTED THE NEW PUBLIC MANAGEMENT?",134.

[51] Kathleen Power Cory, "*New Public Management: Impact on Canadian Healthcare Reform", Academia.edu, (2019), 9*

[52] Kathleen Power Cory, "*New Public Management: Impact on Canadian Healthcare Reform",10*

[53] Leslie Pal, "Beyond Policy Analysis: Public Issue Management in Turbulent Times" in "Policy Consistency", *The Atlas of Public Management ed Ian Clark (Toronto: Word Press: 2017)*

[54] Catherine M. Scott et. Al, "Inconsistent Governance Structures for Health and Social Services Limit Service Integration for Patients with Complex Care Needs", healthcare policy 19, no.1 (October 2023)

[55] Catherine M. Scott et. Al, "Inconsistent Governance Structures for Health and Social Services Limit Service Integration for Patients with Complex Care Needs"

[56] Catherine M. Scott et. Al, "Inconsistent Governance Structures for Health and Social Services Limit Service Integration for Patients with Complex Care Needs"

[57] The Canadian Press, "*Ontario passes health-reform bill that expands private delivery of care", CBC (May 2023)*

[58] John Nater, "Pre-Budget Submission 2023: Canada's Health Care Crisis", Open Letter to the Minister of Finance, (Ottawa: 2023)

[59] CTV News Toronto, "Ontario passes health-care bill allowing private clinics to conduct more surgeries", (2 023)

[60] James R. Crotty, "Post-Keynesian Economic Theory: An Overview and Evaluation", *The American Economic Review 70, no.* 2 (1980), 20–25

[61] Andrew F. Haughwout, "Public infrastructure investments, productivity and welfare in fixed geographic areas", Journal of Public Economics 83 (2002)

[62] Antonia Maioni, "Federalism and Health Care in Canada", *187-188*

[63] Antonia Maioni, "Federalism and Health Care in Canada", 188

[64] Antonia Maioni, "Federalism and Health Care in Canada", 188

[65] Stephen P. Dunn, “Prolegomena to a Post Keynesian health economics”, *Review of Social Economy* 64*, no.*3 (2006), 273–299

[66] G. C. Harcourt and Peter Kriesler, “POST-KEYNESIAN THEORY AND POLICY FOR MODERN CAPITALISM”, 38 *and* Stephen P. Dunn, “Prolegomena to a Post Keynesian health economics”, 280

[67] Gilles Deleuze, “*Logique du sens”* trans. Mark Lester and Charles Stivale (London: The Athlone Press: 1990), 245-252

[68] Jacques Derrida, “Digressions: Essays on Jacques Derrida”, Sofia Iztok-Zapad (2013) pp. 91-140 in Darin Tenev, “La Déconstruction en enfant: the Concept of Phantasm in the Work of Derrida”, Academia.edu (2022)

[69] Jacques Derrida, “Parergon”, *La Vérité en peinture,* (Paris: Flammarion:1978), 162

Bibliography

Anderson, Benedict. *Imagined Communities: Reflections on the Origin and Spread of Nationalism*. London, Verso, 1983.

Archer, John. "Saskatchewan: A Political History", *Canadian Parliamentary Review*, *Www.revparl.ca*, www.revparl.ca/english/issue.asp?param=114&art=625

Banting, Keith. *Visions of the Welfare State*. *The Future of Social Welfare Systems in Canada and the United Kingdom*, IRPP, 1987.

Banting, Keith, and Stann Corbett. *Health Policy and Federalism: A Comparative Perspective on Multi-Level Governance*. *Google Books*. IIGR, Queen's University, 2002. https://www.google.ca/books/edition/Health_Policy_and_Federalism/WTdDCpHT8KAC?hl=en&gbpv=1&printsec=frontcover.

Beland, Daniel. "Policy Change and Health Care Research." *Journal of Health Politics, Policy and Law*, vol. 34, no. 4, Aug. 2010, pp. 623 https://doi.org/10.1215/03616878-2010-019.

Béland, Daniel. "Ideas and Institutional Change in Social Security: Conversion, Layering, and Policy Drift." *Social Science Quarterly*, vol. 88, no. 1, Mar. 2007, pp. 20–38, www.jstor.org/stable/42956169?seq=1, https://doi.org/10.1111/j.1540-6237.2007.00444.x.

Bambra, Clare, et al. "Towards a Politics of Health." *Health Promotion International*, vol. 20, no. 2, 18 Feb. 2005, pp. 187–193, academic.oup.com/heapro/article/20/2/187/827479, https://doi.org/10.1093/heapro/dah608.

Crotty, James. "Post-Keynesian Economic Theory: An Overview and Evaluation." *The American Economic Review*, vol. 70,

no. 2, May 1980, pp. 20–25, www.jstor.org/stable/1815433?seq=1.

Cory, Kathleen. “New Public Management Canadian Healthcare Reform.” Jan. 2013. https://www.academia.edu/6003864/New_Public_Management_Canadian_Healthcare_Reform

Conrad, Charles, and Chris Cudahy. “Rhetoric and the Origins of the Canadian Medicare System.” *Rhetoric and Public Affairs* 13, no. 4 (2010): 543–79. https://www.jstor.org/stable/41940502?searchText=saskatchewan+party+1990&searchUri=%2Faction%2FdoBasicSearch%3FQuery%3Dsaskatchewan%2Bparty%2B1990%26so%3Drel&ab_segments=0%2Fbasic_search_gsv2%2Fcontrol&refreqid=fastly-default%3Adce97cdea17c1b342f9c98c6f57637db&seq=2.

Christensen, Tom, et al. “Transforming Administrative Policy.” *Public Administration*, vol. 80, no. 1, Jan. 2002, pp. 153–178, onlinelibrary.wiley.com/doi/10.1111/1467-9299.00298, https://doi.org/10.1111/1467-9299.00298

Clark, Ian. “Policy Consistency – Atlas of Public Management.” *Atlas of Public Management*, Apr. 2017, www.atlas101.ca/pm/concepts/policy-consistency/.

Dufresne, Yannick, et al. “The True North Strong and Free Healthcare? Nationalism and Attitudes towards Private Healthcare Options in Canada.” *Canadian Journal of Political Science*, vol. 47, no. 3, Sept. 2014, pp. 569–595, https://doi.org/10.1017/s0008423914000894.

Derrida, Jacques, and Craig Owens. “The Parergon.” *October*, vol. 9, 1979, p. 3, www.jstor.org/stable/778319, https://doi.org/10.2307/778319.

Eisler, Dale. “From Left to Right: Saskatchewan’s Political and Economic Transformation”. login.proxy.library.carleton.ca. University of Regina, April 23, 2022. https://ebookcentral-

proquest-com.proxy.library.carleton.ca/lib/oculcarleton-ebooks/reader.action?docID=6949895.

Esping-Andersen, Gøsta. *The Three Worlds of Welfare Capitalism*. Cambridge Polity Press, 1990, pagotto.files.wordpress.com/2018/05/the-three-worlds-of-welfare-capitalism-1990.pdf

Evans, Bryan, and Halina Sapeha. *Perspectives of Public Service Elites Post Financial Crisis: A Comparison of Canadian and Australian Public Executives*. 2015. https://www.ippapublicpolicy.org/file/paper/1433954668.pdf

Glor, Eleanor D. "HAS CANADA ADOPTED the NEW PUBLIC MANAGEMENT?" *Public Management Review*, vol. 3, no. 1, Jan. 2001, pp. 121–130, www.researchgate.net/publication/247517659_Has_Canada_adopted_the_new_public_management, https://doi.org/10.1080/14616670010009414. Accessed 3 Aug. 2019.

Gupta, A, et al. "Introduction: The Infrastructure Toolbox." *Cultural Anthropology*, 24 Sept. 2015, journal.culanth.org/index.php/ca/article/view/ca30.4.04/202

Gilles Deleuze, et al. *The Logic of Sense*. New York, Columbia University Press, 1990, www.elimeyerhoff.com/books/Deleuze/Deleuze%20-%20Logic%20of%20sense.pdf.

Haughwout, Andrew F. "Public Infrastructure Investments, Productivity and Welfare in Fixed Geographic Areas." *Journal of Public Economics*, vol. 83, no. 3, Mar. 2002, pp. 405–428, uh.edu/~bsorense/Houghwout%20JPubE.pdf, https://doi.org/10.1016/s0047-2727(00)00164-x

Harcourt, G C., and Peter Kriesler. *POST-KEYNESIAN THEORY and POLICY for MODERN CAPITALISM*. JOURNAL OF AUSTRALIAN POLITICAL ECONOMY No 75,

https://www.ppesydney.net/content/uploads/2020/05/Post-Keynesian-theory-and-policy-for-modern-capitalism.pdf

Kitchen, Brigitte. “Wartime Social Reform: The Introduction of Family Allowances.” *Canadian Journal of Social Work Education / Revue Canadienne d’Éducation En Service Social* 7, no. 1 (1981): 29–54. https://www.jstor.org/stable/23458245?searchText=&searchUri=&ab_segments=&searchKey=&refreqid=fastly-default%3Adb4242afca90d67c7326ffbdd921f23e&seq=17.

Larkin, Brian. “The Politics and Poetics of Infrastructure.” *Annual Review of Anthropology*, vol. 42, no. 1, 21 Oct. 2013, pp. 327–343, www.annualreviews.org/doi/pdf/10.1146/annurev-anthro-092412-155522, https://doi.org/10.1146/annurev-anthro-092412-155522.

Madison, Bernice. “Canadian Family Allowances and Their Major Social Implications.” *Journal of Marriage and the Family* 26, no. 2 (May 1964): 134–41. https://doi.org/10.2307/349719.

Martin, Danielle, Ashley P Miller, Amélie Quesnel-Vallée, Nadine R Caron, Bilkis Vissandjée, and Gregory P Marchildon. “Canada’s Universal Health-Care System: Achieving Its Potential.” *The Lancet* 391, no. 10131 (April 28, 2018): 1718–35. https://doi.org/10.1016/s0140-6736(18)30181-8.

Mitchell, Keith. “Pre-Budget Submission 2023: Canada’s Health Care Crisis.” *John Nater*, 10 Mar. 2023, johnnater.ca/open-letter-to-the-minister-of-finance/

Moscovitch, Allan, et al. *The “Benevolent” State*. Toronto: Garamond Press, 1987.

ISBN: 0920059481

O’Sullivan, Denis. “The Concept of Policy Paradigm: Elaboration and Illumination.” *The Journal of Educational Thought (JET) / Revue de La Pensée Éducative*, vol. 27, no. 3, 1993, pp. 246–272, www.jstor.org/stable/23767396 .

Pal, Leslie A, et al. *Beyond Policy Analysis: Public Issue Management in Turbulent Times*. Toronto, Ontario, Nelson, 2020.

Rom, Mark Carl. "6.1 Political Socialization: The Ways People Become Political - Introduction to Political Science | OpenStax." *Openstax.org*, openstax.org/books/introduction-political-science/pages/6-1-political-socialization-the-ways-people-become-political.

Rotstein, Abraham. "Canada: The New Nationalism." *Foreign Affairs*, vol. 55, no. 1, 1976, p. 97, https://doi.org/10.2307/20039629

Rioux, X. Hubert. "Canada First vs. America First: Economic Nationalism and the Evolution of Canada-U.S. Trade Relations." *Canadian Journal of Political Science*, vol. 52, no. 4, 15 Oct. 2019, pp. 657–675, www.jstor.org/stable/26914892?seq=5, https://doi.org/10.1017/s0008423919000568.

Scott, Catherine M., Et. al. "Inconsistent Governance Structures for Health and Social Services Limit Service Integration for Patients with Complex Care Needs." *Healthcare Policy*, vol. 19, Oct. 2023, www.longwoods.com/content/27180/inconsistent-governance-structures-for-health-and-social-services-limit-service-integration-for-pati, https://doi.org/10.12927/hcpol.2023.27180.

Tenev, Darin. "La Déconstruction En Enfant: The Concept of Phantasm in the Work of Derrida." *Www.academia.edu*, 2022, www.academia.edu/81702445/La_D%C3%A9construction_en_enfant_the_Concept_of_Phantasm_in_the_Work_of_Derrida?ri_id=370599

Whitton, Charlotte. "The Family Allowances Controversy in Canada." *Social Service Review* 18, no. 4 (1944): 413–32. https://www.jstor.org/stable/30014255?searchText=&search

Uri=&ab_segments=&searchKey=&refreqid=fastly-default%3Aca21f3236e79fcd3172364d20f943bc8&seq=5.

Section II
Arts & Humanities

Canadian Broadcasting Policy, Capitalism, and CanCon: Balancing Economic and Cultural Objectives with the Online Streaming Act

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ABSTRACT: In April 2023, Bill C-11, the *Online Streaming Act,* received Royal Assent, amending Canada's 1991 *Broadcasting Act* to regulate American-based online streaming services that do not inherently promote a unique 'Canadian identity.' Under this new and contentious legislation, Internet streaming services, alongside radio and television, must now prioritize the use of Canadian creative resources in their programming or contribute to these resources equitably. Additionally, these services are required to support the production and distribution of original Canadian content (CanCon) in both official languages. From a critical political economic perspective, this paper examines Bill C-11 as a legislative effort to counteract the dominance of major online streaming platforms. According to Section 3(1) of the 1991 *Broadcasting Act*, the Canadian broadcasting system aims to protect, enrich, and enhance the nation's cultural, political, social, and economic fabric. However, achieving cultural goals depends on first meeting economic ones. This paper argues that the *Online Streaming Act* aims to safeguard Canada's cultural industries by prioritizing CanCon, thereby protecting it from the pervasive influence of transnational corporations in a capitalist market, although the success of Bill C-11 requires a delicate balancing of economic and cultural objectives.

KEYWORDS: broadcasting policy, cultural industry, Canada, Online Streaming Act

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Introduction

After 32 years, the Canadian government has legislated a technologically transformative revision to the twentieth-century policy governing the Canadian broadcasting system. This system, traditionally modelled as a hybrid or mixed system comprised of a national public broadcaster, commercial broadcasters, and community and campus broadcasters, emerged as the product of a dispute-ridden history.[1] In April of 2023, Bill C-11, the *Online Streaming Act*, was given Royal Assent to amend Canada's 1991 *Broadcasting Act* to regulate transnational, American-based online streaming services that lack intrinsic reason to enhance and foster conceptions of a distinctive 'Canadian identity.' Under this contentious new scope of broadcasting legislation, alongside radio and television, Internet streaming services are now required to, among other things, make *maximum or predominant use of Canadian creative resources* in the creation, production, and distribution of programming or otherwise contribute to those Canadian resources in an equitable manner. Streaming services now must also support the production and distribution of certified Canadian content (CanCon) in both official languages: English and French.

From a critical political economic perspective, this introductory paper explores how Bill C-11 is a legislative measure aimed at countering the economic and cultural hegemony of online streaming giants. As set forth in Section 3(1) of the 1991 *Broadcasting Act,* the Canadian broadcasting system should *safeguard, enrich, and strengthen the cultural, political, social, and economic fabric* of the nation; however, cultural objectives cannot be met without first achieving economic objectives. This paper argues that the *Online Streaming Act* seeks to safeguard Canada's cultural industries by ensuring that CanCon is prioritized, preserved, and protected against the encroachments of a relentless capitalist market driven by transnational corporations, which necessitates a delicate balancing of economic and cultural objectives.

Conceptualizing Canadian Broadcasting Policy

The Beginnings of Canadian Broadcasting Policy

The year 1922 signifies the preliminary beginnings of contemporary Canadian broadcasting policy, as it marks the commercial licensing of radio stations for the first time.[2] With the proliferation of radio came the need to regulate the airwaves—*controlling traffic* to prevent major signal interference, including interference from American broadcasters on dials allocated to Canadian stations throughout the 1920s and 30s.[3] While radio frequency spectrum scarcity was and still remains an important justification for government broadcasting regulation, a more salient justification, albeit less technologically determined, quickly materialized in Canadian public policymaking debates: the use of broadcasting to pursue cultural policy objectives. The desired outcomes in this pursuit include preserving cultural sovereignty and promoting the political-cultural cause of Canadian national identity in a world seemingly flooded by American-made media messages.[4]

Marc Raboy explains how Canada's mixed-ownership broadcasting system—within which an independent regulatory body, the Canadian Radio-television and Telecommunications Commission (CRTC), possesses supervisory control in accordance with cultural policy objectives delineated in communication law since 1968—results in private and public broadcasting networks existing in mutual tolerance irrespective of differences in interests.[5] Raboy therefore suggests a theoretical conceptualization of broadcasting "as a multifaceted activity taking place in the public sphere and contested by actors situated in the areas of the state, the economy and civil society" guided by economic and cultural objectives.[6] As Tanner Mirrlees succinctly states, "Capitalism is the base of the cultural industries in Canada, but these industries are also shaped by the state",[7] in essence creating a three-way cycle between transnational capitalist market demands, the domestic broadcasting industry, and the nationalist dreams and desires of cultural policymakers in Canada.

Navigating the New Media Era

Zoë Druick and Danielle Deveau note that with the turn of the twentieth century, governing bodies in Canada became

significantly less preoccupied with the protection of a distinctive cultural identity through subsidization of the arts and media. Cultural policy exists to support the production of Canadian-made messages, although these creative works must increasingly succeed in global markets to survive.[8] Therefore, Ryan Edwardson asserts that for many cultural industries, the shift towards post-nationalism in the export economy has coincided with a key shift in cultural objectives of public policy.[9] In line with this culture of post-nationalist globalization, the CRTC has generally exercised a *laissez-faire* approach to broadcasting regulation, "responding as required to industry needs, not wishing to impede what has been perceived to be a creative and dynamic sector with significant potential for Canada."[10] Des Freedman accordingly argues that market forces and consumer satisfaction have historically driven regulatory regimes in neoliberal times, wherein ruthless capitalist market logics place heavy pressure on media enterprises to maximize economic return while minimizing expenditure risk.[11] The most desirable objective of cultural policy becomes achieving industrial viability, as it aligns most closely with these market imperatives.

Bill C-11—proposed after Bill C-10 of the same title died on the order paper on August 15, 2021—undertakes the ambitious task of regulating online streaming services to fulfil the economic and cultural goals outlined in Canadian cultural policy; however, cultural policymakers must grapple with delicately balancing the need to create jobs which mainly originate from foreign streaming service productions with the need to preserve Canadian culture through producing and distributing Canadian content to tell distinctly *Canadian stories*.[12] The bill aims to address the political economic challenge confronting the Canadian cultural industries, whereby the market's private structure and media ownership patterns cause a reliance on advertising revenue—to be perpetually optimized in the pursuit of profit—and influences what kinds of cultural products are produced, distributed, and consumed by the masses.

Speaking to the battle between public versus private interests, Gregory Taylor explores the debate surrounding the role of Canadian public service television, declaring that policy panders increasingly

to the needs of the market despite rapid technological advancements. Taylor asserts that while national regulation of mass communication has been relevant since the creation of the printing press and is generally justified in the name of public access and interest, disruptive technologies, beginning with the advent of digital television, reveal glaring economic and regulatory challenges that cannot be easily legitimized by arguments of nation-building.[13] Indeed, Bill C-11 is no exception to this rule, given the degree of pushback that the policy amendment has received in parliamentary debates, namely from Conservative members of parliament, for restricting consumer freedoms in a free market. Some adversaries of the bill criticize the amendment for placing an undue emphasis toward state intervention into the economy of Canada's cultural industries, raising questions surrounding whether the bill can truly prioritize both economic and cultural objectives *fairly.* With the enactment of the *Online Streaming Act,* the CRTC must seek to engage both domestic and international producers in the creation of high-quality CanCon, who will ultimately aim to attract global audiences while telling *Canadian stories*.

Examining the major technological shift from analogue to digital—the most powerful development in the history of communication in the past century—Taylor argues that digitalization fanned flames of controversy, becoming "the site of a political and economic struggle that directly affects Canadian living rooms."[14] Offering a perspective on broadcasting policy development and neoliberalism, David Skinner claims that the acceleration of the availability and influence of foreign broadcast programming can be viewed as a product of the ever-changing dynamics of regulation swayed by private sector interests or free market forces.[15] For cultural policymakers and politicians who pushed for the enactment of the *Online Streaming Act* in parliament*,* the availability and influence of foreign broadcast programming has come to the fore as a justification for state intervention—mirroring fiery twentieth-century Hansard debates that interrogated questions surrounding how to balance Canada's industrial and cultural imperatives effectively.

Thirty-two years passed until the most recent amendment to the 1991 *Broadcasting Act.* Mariane Bourcheix-Laporte addresses this emergent gap, arguing that Bill C-11 repossesses nationalist logic—perpetuating a settler colonial vision of cultural citizenship skewed by the paradox of multiculturalism,[1617] thereby elucidating how streaming platforms culturally disrupt the manufacturing of a distinctive 'Canadian culture.' While additional academic research has critiqued the *Online Streaming Act* in terms of its potential effects on audience attention and freedom of expression in Canada's liberal democracy,[18] this paper takes particular interest in the relationship between Bill C-11 and the need to tactfully balance the traditional economic and cultural objectives outlined in the 1991 *Broadcasting Act.*

Raboy declares that the development of Canada's broadcasting system is defined by and reflective of three sets of tensions: "(a) between private capital and the state, over the economic basis of broadcasting; (b) between the state and the public, over the sociocultural mission of broadcasting; and (c) between competing visions of the relationship of broadcasting to the politics of Canadian nationhood."[19] While these three tensions operate in tandem with one another, this paper focuses on how Bill C-11 is concerned, first and foremost, with the regulation of transnational, American-based Web streaming giants by the federal government for *industrial* purposes, subsequently setting the stage for the achievement of *cultural* objectives. Still, to align with Section 3(1) of the 1991 *Broadcasting Act*, the bill in action must harmonize these priorities.

The Economic and Cultural Work of Bill C-11

Vincent Mosco articulates the political economy of communication "*as the study of the social relations, particularly the power relations, that mutually constitute the production, distribution, and consumption of resources*."[20] Within this conceptual framework, the primary resources within the communication marketplace consist of communicative products, encompassing various media forms, whether new or traditional, along with their corresponding

audiences.[21] In other words, according to Mosco, the political economy of communication deals with the production, distribution, and consumption of media, "concentrat[ing] on a specific set of social relations organized around power."[22] In line with Mosco's operationalization of the concept, Janet Wasko states that "it is essential to understand relationships between media power and state power."[23] Mirrlees thus contends that "in twenty-first century Canada, 'culture' is primarily valued by politicians, cultural policy makers, and the corporations that make it for its benefit to the 'economy'" which "suggests that culture is in no way autonomous from capitalism."[24]

Bill C-11, as a legislative amendment, can be interpreted as a form of resistance against the burgeoning power of the new media industry. In this sense, the *Online Streaming Act* is written to pre-emptively safeguard the CRTC against regulatory capture by audiovisual online streaming services that hold market dominance within the Canadian creative economy. This policy amendment addresses concerns pertaining to the production and distribution of distinctly 'Canadian' programming within a monopoly capitalist system. In doing so, the amendment seeks to counterbalance neoliberal sensibilities.[25]

The enactment of Bill C-11 specifically amends the 1991 *Broadcasting Act* to "add online undertakings — undertakings for the transmission or retransmission of programs over the Internet — as a distinct class of broadcasting undertakings."[26] With stipulations for regulating media content in digital displays, Bill C-11 took a remarkably contentious step in navigating the new media era by, in essence, equating traditional domestic broadcasters with Web streaming giants in a piece of legislation. When tabling Bill C-11in the House of Commons in 2022, then Honourable Minister of Canadian Heritage, Pablo Rodriguez, emphasized the gravity of *levelling the playing field* between domestic broadcasters and foreign streaming platforms:

> Unlike traditional Canadian broadcasters, platforms profit from our culture but have no obligation to contribute to it. With money leaving traditional broadcasters, day after day,

> to go to these platforms, this is putting our creators, our industry, our jobs and even our culture at risk. We have to act.[27]

Rodriguez' pressing call to action is somewhat bolstered by Dwayne Winseck's finding that "[t]otal revenue for the online media sectors soared to $24.2 billion in 2022, widening the gap with the traditional content media sectors after surpassing them four years earlier."[28] Moreover, Winseck discovers that the digital media industries, inclusive of online advertising, "outstripped revenue for traditional media in 2019 and currently account for just under a quarter of all revenue across the network media economy."[29] Winseck additionally reveals that the online video service market remains highly concentrated, with the leading four services—Netflix, Crave, Disney+, and Rogers—accounting for 78.1% of revenue in 2022; however, Winseck notes that these levels are down considerably from when the top four platforms held a market share of 92%.[30] Nevertheless, the *Online Streaming Act* is firmly determined to level the foreign competition for domestic broadcasters in Canada's market; transnational online video distributors entered the Canadian market and beyond as robust competitors, shouldering none of the burdens that have belonged to their Canadian counterparts in some form or another since the 1920s.

Bill C-11 seeks to foster a distinctive 'Canadian' culture through ensuring that online streaming services support the production and distribution of CanCon. Importantly, though, *how* Canada's industrial and cultural imperatives are balanced on the path forward will likely determine the effectiveness and public reception of the bill, as foreign streaming services must be adequately convinced that contributing to Canadian culture in accordance with the CRTC's forthcoming regulatory plan is a reasonable, and perhaps more germane, *profitable* long-term investment.

David Taras and Marc Raboy assert that contrary to opponents who argue against foreign media ownership based on transnational corporate convergence, the basis of national cultural production remains crucial in an era of globalization marked by the proliferation of neoliberal ideologies—especially in a country with a

geopolitical situation as precarious as Canada's, where cultural sovereignty entails power over the nation's media environment.[31] 91 years ago, the impassioned Graham Spry, co-founder of the Canadian Radio League, made a case for this exact precarity when testifying for the establishment of a national public broadcaster as a witness for the 1932 Special Committee on Radio Broadcasting:

> The radio problem is no mere question of more or better entertainment, of more or less advertising. It is a question of public opinion, of the basis of free government. The choice before this Committee is clear; it is a choice between commercial interests and the people's interests. It is a choice between the State and the United States.[32]

What Spry deemed the *radio problem* may be repurposed in the digital age as the *online streaming service* problem; Marc Raboy keenly declares that debates over broadcasting policy objectives of the twentieth century have "been passed down to us" and "continue in much the same guise today."[33] Perhaps nowhere is Raboy's insight clearer than in the rhetoric used by Pablo Rodriguez in the House of Commons in 2022, which directly mirrors that of Spry's in 1932:

> [Bill C-11] starts with making sure that online streamers contribute to the strength and vitality of Canada's cultural sector. Let us remember Canada's strong culture is no accident. We made that decision. We decided and we chose to be different. We chose to be different from our neighbours to the south. We chose cultural sovereignty.[34]

The "choice" that Spry and Rodriguez both speak of is ultimately one of state broadcast intervention—although cultural sovereignty cannot be pursued without the prerequisite of economic sovereignty.

From a more contemporary perspective, Marc Raboy and Jeremy Shtern contextualize *why* these debates have been passed down to us much in the same guise today: advancements in information and communication technologies as well as changing social trends including multiculturalism and globalization have stretched the existing policy frameworks for Canada's communication system beyond their limits.[35] Therefore, Bill C-11 has

begun tackling the fiery issue of Internet streaming regulation. As Marc Raboy and Geneviève Bonin posit, domestic broadcasters deal with a "high-end trade-off" to operate in the Canadian market "protected from competition, especially foreign competition."[36] This protection enforces contributions to the economic and cultural objectives of the 1991 *Broadcasting Act*—contributions that Web streaming giants have avoided in their pursuit of transnational market dominance (at least, until now). Hence, Rodriguez contends that this high-end trade-off has provided powerhouse platforms with an automatic competitive advantage in the Canadian audiovisual media market while diminishing *Canadian cultural values.*

Bill C-11, CanCon, and the Cultural Industries

Dallas Smythe famously asserts that in a monopoly capitalist system, the commercial mass media manufactures the *audience commodity*, a means to realize the ends of political economic and thus cultural power.[37] This valuable product is produced, sold, and purchased by industry players. Yet, with Bill C-11, online streaming services are required to help produce and distribute certified CanCon that is historically much less lucrative than content from our neighbour to the South: a well-oiled cultural production machine.[38] This machine churns out popular, "fat head" content for mass audiences to generate maximum profit.[39]

As examined by Steven Globerman, the overwhelmingly pervasive influence of American society in shaping popular culture production has been analogized to imperialism, whereby marginal regions become economically subservient to metropolitan powers. In this line of argument, the foreign production of media texts is catered toward the American audience, requiring state intervention by way of funding agencies to support the production of domestic content—domestic production that is equally essential both economically *and* culturally. Although equating Americanization with imperialism would be both overstated and anachronistic, Globerman notes that American producers reap the benefits of a competitive edge in the international market, attributed to the vast scale of their domestic

market as well as their extensive expertise in crafting programs of mass-appeal for global commercial distribution.[40] Political economic concerns regarding diminished consumption of certified Canadian programming—the creation, production, and distribution of which is mandated by the 1991 *Broadcasting Act* and certified by the CRTC's point system—amid the market disruption caused by transnational Web streaming giants, parallel concerns reminiscent of the anxieties surrounding Americanization during the commercial radio era of the 1920s and 30s, as well as the early film and television eras.[41]

Canadian broadcasting regulation has therefore been *constructed* by cultural policymakers as a conduit to secure economic power and maintain national unity in the face of the culturally imperialist media goliath that is the United States. In the 2016 article "Requiem for the Long Tail," Philip M. Napoli critiques the idea of cultural democratization which may be best detailed in Chris Anderson's influential book, *The Long Tail.*[42] Anderson delineates the apparatus by which digital content distribution has the potential to "democratize and diversify the production and consumption of media and cultural products" by reducing the constraints of resource capacity with analog media.[43] The Internet's complexities, in a political economy of content aggregation and fragmentation,[44] muddle this optimistic perspective. With radical openness has come an overwhelming influx of audiovisual content generated by users and industries from America and beyond—arguably negating the economic and cultural impact of CanCon regulations (which have yet to be modernized since their 1971 introduction as of June 2024).

Napoli re-visits Anderson's 2006 theory of cultural democratization in the Internet age: that alleviating conditions of media scarcity and championing conditions of digital interactivity would develop a new media environment wherein "the aggregate, the low-popularity content (the long tail) would represent an equal or greater share of audience attention than the 'fat head' (the popular content)."[45] Aligning well with Anderson's theorized definitions, Canadian programming can be conceptualized as *the long tail*: the low-popularity content that has led cultural policymakers to facilitate state intervention into the domestic broadcasting market since the

twentieth century. The long tail often flies under the radar, unlike *the fat head:* popular American (and other global) content. However, the very act of mandating the promotion of CanCon over the Internet represents a broken promise—a *requiem for the long tail,* if you will—raising the debate of whether the imposition of Bill C-11 goes against the principles of openness of Cyberspace, or if modernizing Canadian broadcasting policy is the inevitable next step toward economic and subsequently cultural sovereignty in Canada's liberal democracy.

Prior to April 27, 2023, when the *Online Streaming Act* received Royal Assent, online streaming services did not fall under any legislative framework requiring the platforms to actively contribute to fostering *Canadianness* through the content they helped create, produce, and/or distribute. The programming on these platforms is strategically selected to capture a *global* audience, maximizing profit via mass consumption, whereas in Canada, national broadcasters are mandated, through legislation, to prioritize capturing the *Canadian* audience by following CanCon regulations, first introduced by the CRTC in 1971 for radio broadcasting. Charles H. Davis and Emilia Zboralska contend that a consumerist approach has historically overshadowed legacy broadcasting policy motives which has given freer rein to online streaming services, [46] and Bill C-11 intends to change this tide. The future success of the bill will hinge on the CRTC's ability to effectively navigate its industrial and cultural priorities, helping ensure that quality Canadian content—which tells *Canadian stories*—can attain domestic and, more ideally, global significance.

Mirrlees incisively observes that "the cultural industries are shaped by capitalism, but make possible the changing of capitalism too, meaning struggles in and over the cultural industries may be a key way of engaging with and contesting capitalist power in society more broadly."[47] In principle, then, a policy amendment such as the *Online Streaming Act* must actively confront and challenge capitalist power within Canadian society by making possible increased economic viability in Canada's broadcasting industry, balancing this objective with strengthening

and cultivating perceptions of a unique 'Canadian' identity. The bill evidently recognizes that by accumulating economic and thus cultural power, massive corporations like Netflix can exercise market authority as hegemonic, anti-competitive gatekeepers.[48] This reality is particularly troublesome, as Robin Mansell emphasizes the potential for monopolistic concentration in cultural commodity production to reproduce deep-seated socioeconomic inequities in new media.[49] In an effort to prevent the systemic perpetuation of socioeconomic inequities (and other forms of oppression), Section 3(3)(iii) of Bill C-11 amends the 1991 *Broadcasting Act* to declare that the Canadian broadcasting system (now including online streaming services) should,

> through its programming and the employment opportunities arising out of its operations, serve the needs and interests of all Canadians — including Canadians from Black or other racialized communities and Canadians of diverse ethnocultural backgrounds, socio-economic statuses, abilities and disabilities, sexual orientations, gender identities and expressions, and ages — and reflect their circumstances and aspirations, including equal rights, the linguistic duality and multicultural and multiracial nature of Canadian society and the special place of Indigenous peoples and languages within that society.[50]

While economic sovereignty is a fundamental state-level value, a cultural diversity of voices is also crucial to liberal democracies.

It is important to emphasize that non-hegemonic groups and communities are still thirsting for representation in mainstream film and television—both on screen and behind the screen—and Bill C-11 seeks to produce greater opportunity for diverse cultural labour in this sector. As Charles H. Davis, Jeremy Shtern, Michael Coutanche, and Elizabeth Godo find regarding the division of cultural labour, the screenwriting occupation in English-speaking Canada is characterized by "exclusionary networks dominated by white middle-aged anglophone males," thereby stifling innovation in the Canadian

screen industry.[51] This conclusion is supported by Toronto-based journalist Serena Lopez, who argues that the lack of representation in Canada's television and film industries is failing BIPOC creatives.[52] Similarly, Emilia Zboralska, Charles H. Davis, Jeremy Shtern, and Vanessa Ciccone uncover how cultural diversity reporting in the Canadian audiovisual industry lacks the methodological coherence necessary to ascertain whether or not the representation of cultural diversity in Canadian television has made meaningful progress in terms of on screen and behind the screen labour.[53] The degree to which the Canadian broadcasting system will be able to achieve these ideals of inclusivity with the assent of the *Online Streaming Act* is uncertain and cause for controversy, considering the immeasurable difficulty in meaningfully representing the identities of *all* Canadians—especially in a country where a singular 'Canadian identity' has been defined in politics for over a century by power-struggling English Canadian nationalists.[54]

Conclusion: Rationalizing a New Broadcasting Policy

In a time of once-unfathomable media abundance, dominant players in the media market are fixated, more hyper than ever, on competing for audience attention; media platforms are "repositioning themselves to capture the hearts and eyeballs of viewers who have never had so much to distract them."[55] This introductory paper provided an overview of how Bill C-11 has emerged as a legislative measure to combat the economic and cultural challenges posed by online streaming giants. These platforms, by popularizing American and other global productions, are understood by policymakers as jeopardizing Canada's cultural sovereignty by threatening the economic sustainability of its cultural industries. This paper has argued that in mandating the inclusion and promotion of CanCon, Bill C-11 must navigate carefully between economic sustainability and cultural preservation to avoid a missed opportunity for policymakers, producers, and platforms to address deeper issues in the Canadian creative economy.

Pablo Rodriguez tells us that "[w]hen the Internet came along, we all thought that it was great and wonderful, that we would let it develop on its own, that [the government] would not get involved at all, and that it would create new opportunities, strengthen democracy and connect people," but claims that online streaming services "will continue to harm Canadians, chip away our cultural sovereignty and weaken our digital society."[56] Undoubtedly, the unregulated years of the Internet will continue to shape and alter communication policy, in Canada and across borders. Whether or not the protectionist intervention of the *Online Streaming Act* can successfully provide greater economic and cultural strength to Canada's cultural industries, rationalizing this new scope of broadcasting regulation, certainly remains to be seen.

Notes

[1]Anne F. MacLennan, "Circumstances Beyond our Control: Canadian Radio Program Schedule Evolution During the 1930s," PhD diss., (Concordia University, 2001); Anne F. MacLennan, "Canadian Community/Campus Radio: Struggling and Coping on the Cusp of Change," in *Radio's Second Century: Past, Present, and Future Perspectives*, edited by John Allen Hendricks. (New Jersey: Rutgers University Press, 2020), 193-206; Marc Raboy*, Missed Opportunities: A Story of Canada's Broadcasting Policy* (Montreal and Kingston: McGill-Queen's University Press, 1990); David Skinner, "Divided Loyalties: The Early Development of Canada's "Single" Broadcasting System," *Journal of Radio Studies* 12, no. 1 (2005): 136-155; Mary Vipond, "The Beginnings of Public Broadcasting in Canada: The CRBC, 1932-1936," *Canadian Journal of Communication* (1994).

[2]Anne F. MacLennan, "Learning to Listen: Developing the Canadian Radio Audience in the 1930s*," Journal of Radio & Audio Media* 20, no. 2 (2013): 311-326.

[3]Robert Armstrong, *Broadcasting Policy in Canada* (2nd ed.) (Toronto: University of Toronto Press, 2006); Anne F. MacLennan, "Resistance to Regulation Among Early Canadian Broadcasters and Listeners," in *Islands of Resistance: Pirate Radio in Canada*, edited by Andrea Langlois, Ron Sakolsky, and Marian van der Zon (Vancouver: New Star Books, 2010), 35-48; Anne F. MacLennan, "Private Broadcasting and the Path to Radio Broadcasting Policy in Canada," *Media and Communication* 6 no. 1 (2018): 13-20.

[4]Marc Raboy, "Media," in *Media Divides: Communication Rights and the Right to Communicate in Canada*, edited by Marc Raboy and Jeremy Shtern (Vancouver: UBC Press, 2010), 91-119.

[5]Marc Raboy, "The Role of the Public in Broadcasting Policy-Making and Regulation: Lesson for Europe from Canada," *European Journal of Communication* 9, no. 1 (1994): 5.

[6]Ibid., 5.

[7]Tanner Mirrlees, "A Political Economy of the Cultural Industries in Canada," in *Change and Continuity: Canadian Political Economy in the New Millennium*, edited by Mark P. Thomas, Leah F. Vosko, Carlo Fanelli, and Olena Lyubchenko (Montreal and Kingston: McGill-Queen's University Press, 2019), 215.

[8]Zoë Druick and Danielle Deveau, "Cultural Production in Canada," *Canadian Journal of Communication* 40, no. 2 (2015): 157-163.

[9]Ryan Edwardson, *Canadian Content: Culture and the Quest for Nationhood* (Toronto: University of Toronto Press, 2008).

[10]Brian O'Neill, "CBC.ca: Broadcast Sovereignty in a Digital Environment," *Convergence* 12, no. 2 (2006): 184.

[11]Des Freedman, "The Resilience of TV and its Implications for Media Policy," in *The Routledge Companion to the Cultural Industries*, edited by Kate Oakley & Justin O'Connor (London and New York: Routledge, 2015), 120-129.

[12]Nordicity*, The Digital Media Universe: Measuring the Revenues, the Audiences, and the Future Prospects* (Toronto: NGL Nordicity Group Limited, 2023).

[13]Gregory Taylor, *Shut Off: The Canadian Digital Television Transition* (Montreal and Kingston: McGill-Queen's University Press, 2013).

[14]Ibid., 3.

[15]Skinner, "Divided Loyalties."

[16]Mariane Bourcheix-Laporte, "Canadian Cultural Nationalism in the Time of Digital Platforms: Reframing Proposed Amendments to the Broadcasting Act," *Canadian Journal of Communication* 48, no. 1 (2023): 81-102.

[17]See Eve Haque, *Multiculturalism Within a Bilingual Framework: Language, Race, and Belonging in Canada.* Toronto: University of Toronto Press, 2012.

[18]See Stuart Cunningham and Oliver Eklund, "State Actor Policy and Regulation Across the Platform-SVOD Divide," in *Digital Platform Regulation: Global Perspectives on Internet Governance*, edited by Terry Flew and Fiona R. Martin (Cham: Palgrave Macmillan), 191-208; Gord Dimitrieff, "Broadcasting Reform in Canada: The Case for a Georgist View of the Audience Commodity," *Canadian Journal of Communication* 48, no. 1 (2023): 103-123; Michael Geist, "Reshaping Canada's Broadcasting Act: Solutions in Search of a Problem?," in *Perspectives on Platform Regulation*, edited by Judit Bayer, Bernd Holznagel, Päivi Korpisaari, and Lorna Woods (Baden-Baden: Nomos, 2021): 291-328.

[19]Ibid., 9.

[20]Vincent Mosco, *The Political Economy of Communication* (2nd ed.) (New York: Sage, 2019), 32.

[21]Ibid.

[22]Ibid., 32.

[23]Janet Wasko, "The Study of the Political Economy of the Media in the Twenty-First Century," *International Journal of Media & Cultural Politics* 10, no. 3 (2014): 263.

[24]Ibid., 203.

[25]See Dallas W. Smythe, "On the Political Economy of Communications," *Journalism Quarterly* 37, no. 4 (1960): 563-572; Dallas W. Smythe, "On the Audience Commodity and Its Work," *Media and Cultural Studies: Keyworks* 230 (1981): 230-256; Robert W. McChesney, "Noam Chomsky and the Struggle Against Neoliberalism," *Monthly Review* 50, no. 11 (1999): 40-48.

[26]*An Act to amend the Broadcasting Act and to make related and consequential amendments to other Acts* (44th Parl., 1st sess., April 27, 2023). https://www.parl.ca/DocumentViewer/en/44-1/bill/C-11/royal-assent

[27]Canada, Parliament, *House of Commons Debates* (16 February 2022 (Pablo Rodriguez, MP)), 2320. https://www.ourcommons.ca/Content/House/441/Debates/032/HAN032-E.PDF

[28]Dwayne Winseck, *Media and Internet Concentration in Canada, 1984–2022* (Global Media and Internet Concentration Project, 2023), 162.

[29]Ibid., 93.

[30]Ibid.

[31]David Taras and Marc Raboy, "The Politics of Neglect of Canadian Broadcasting Policy," *Policy Options* 25, no. 3 (2004): 63-68.

[32]Canada, Parliament, House of Commons, Special Committee on Radio Broadcasting, *Minutes of Proceedings and Evidence* (1932), 46.

[33]Raboy, *Missed Opportunities*, 21.

[34]Canada, Parliament, *House of Commons Debates*, 2320.

[35]Marc Raboy and Jeremy Shtern, "Introduction," in *Media Divides: Communication Rights and the Right to Communicate in Canada*, edited by Marc Raboy and Jeremy Shtern (UBC Press, 2010), 3-25.

[36]Marc Raboy and Geneviève A. Bonin, "From Culture to Business to Culture: Shifting Winds at the CRTC," in *For Sale to the Highest Bidder: Telecom Policy in Canada*, edited by Marita Moll and Leslie Regan Shade (Ottawa: Canadian Centre for Policy Alternatives, 2008), 61.

[37]Smythe, "On the Political Economy."

[38]Davis and Zboralska, "Transnational Over-The-Top Media"; Wade Rowland, *Saving the CBC: Balancing Profit and Public Service* (Toronto: Linda Leith Pub, 2013); Richard Stursberg, *The Tangled Garden: A Canadian Cultural Manifesto for the Digital Age* (Toronto: James Lorimer & Company, 2019); Taras and Raboy, "The Politics of Neglect."

[39]Philip M. Napoli, "Requiem for the Long Tail: Towards a Political Economy of Content Aggregation and Fragmentation," *International Journal of Media & Cultural Politics* 12, no. 3 (2016): 341-356; Chris Anderson, *The Long Tail* (New York: Random House Business, 2006).

[40]Steven Globerman, "Foreign Ownership of Feature Film Distribution and the Canadian Film Industry," *Canadian Journal of Communication* 16, no. 2 (1991).

[41]Anne F. MacLennan, "Resistance to Regulation Among Early Canadian Broadcasters and Listeners," in *Islands of Resistance: Pirate Radio in Canada*, edited by Andrea Langlois, Ron Sakolsky, and Marian van der Zon (Vancouver: New Star Books, 2010), 35-48.; Christopher Ali, "A Broadcast System in Whose Interest? Tracing The Origins of Broadcast Localism in Canadian and Australian Television Policy, 1950–1963," *International Communication Gazette* 74, no. 3 (2012): 277-297; Armstrong, *Broadcasting Policy*; Andrew Rodger, "Some Factors Contributing to the Formation of the National Film Board of Canada," Historical Journal of Film, Radio and Television 9, no. 3 (1989): 259-268.

[42]Anderson, *The Long Tail*; Napoli, "Requiem for the Long Tail."

[43]Napoli, "Requiem for the Long Tail", 342.

[44]Ibid.

[45]Ibid., 342.

[46]Davis and Zboralska, "Transnational Over-The-Top Media."

[47]Mirrlees, "A Political Economy," 224.

[48]Des Freedman, *The Politics of Media Policy* (Cambridge and Malden: Polity, 2008); Dwayne Winseck, *Media and Internet Concentration in Canada, 1984– 2019* (Canadian Media Concentration Research Project, 2020).

[49]Robin Mansell, "Political Economy, Power and New Media," *New Media and Society* 6, no. 1 (2004): 99.

[50]*An Act to amend the Broadcasting Act and to make related and consequential amendments to other Acts*.

[51]Charles H. Davis, Jeremy Shtern, Michael Coutanche, and Elizabeth Godo, "Screenwriters in Toronto: Centre, Periphery, and Exclusionary Networks in Canadian Screen Storytelling," *in Seeking Talent for Creative Cities: The Social Dynamics of Innovations*, edited by Jill Grant (University of Toronto Press, 2013), 77.

[52]Lopez, Serena, "The Lack of Representation in Canada's TV and Film Industry is Failing BIPOC Creatives," CanCulture, December 5, 2020, https://www.canculturemag.com/film/2020/12/5/yeytgw118f6qecdzxntx40ng83b1kb.

[53]Emilia Zboralska, Charles H. Davis, Jeremy Shtern, and Vanessa Ciccone, "Cultural Diversity Reporting in the Canadian Audiovisual Industry: Making Monitoring Meaningful," *Quaderns del CAC* 43 (2017): 73-85.

[54]Raboy, *Missed Opportunities*.

[55]Raboy and Bonin, “From Culture to Business,” 79.

[56]Canada, Parliament, *House of Commons Debates*, 2320.

Bibliography

Ali, Christopher. "A Broadcast System in Whose Interest? Tracing The Origins of Broadcast Localism in Canadian and Australian Television Policy, 1950–1963." *International Communication Gazette* 74, no. 3 (2012): 277-297.

An Act to amend the Broadcasting Act and to make related and consequential amendments to other Acts, 44th Parl., 1st sess., April 27, 2023. https://www.parl.ca/DocumentViewer/en/44-1/bill/C-11/royal-assent

Anderson, Chris. *The Long Tail.* New York: Random House Business, 2006.

Armstrong, Robert. *Broadcasting Policy in Canada* (2nd ed.). Toronto: University of Toronto Press, 2006.

Bourcheix-Laporte, Mariane. "Canadian Cultural Nationalism in the Time of Digital Platforms: Reframing Proposed Amendments to the Broadcasting Act." *Canadian Journal of Communication* 48, no. 1 (2023): 81-102.

Broadcasting Act, S.C. 1991, c. 11. https://laws.justice.gc.ca/eng/acts/B-9.01/

Canada. Parliament. *House of Commons Debates,* 16 February 2022 (Pablo Rodriguez, MP). https://www.ourcommons.ca/Content/House/441/Debates/032/HAN032-E.PDF

Canada. Parliament. House of Commons. Special Committee on Radio Broadcasting. *Minutes of Proceedings and Evidence,* 1932.

Cunningham, Stuart, and Oliver Eklund. "State Actor Policy and Regulation Across the Platform-SVOD Divide." In *Digital Platform Regulation: Global Perspectives on Internet*

Governance, edited by Terry Flew and Fiona R. Martin, 191-208. Cham: Palgrave Macmillan, 2022.

Davis, Charles H., Jeremy Shtern, Michael Coutanche, and Elizabeth Godo. "Screenwriters in Toronto: Centre, Periphery, and Exclusionary Networks in Canadian Screen Storytelling." In *Seeking Talent for Creative Cities: The Social Dynamics of Innovations,* edited by Jill Grant, 77-98. Toronto: University of Toronto Press, 2013.

Davis, Charles, and Emilia Zboralska. "Transnational Over-The-Top Media Distribution as a Business and Policy Disruptor: The Case of Netflix in Canada." *The Journal of Media Innovations* 4, no. 1 (2017): 4-25.

Dimitrieff, Gord. "Broadcasting Reform in Canada: The Case for a Georgist View of the Audience Commodity." *Canadian Journal of Communication* 48, no. 1 (2023): 103-123.

Druick, Zoë, and Danielle Deveau. "Cultural Production in Canada." *Canadian Journal of Communication* 40, no. 2 (2015): 157-163.

Edwardson, Ryan. *Canadian Content: Culture and the Quest for Nationhood.* Toronto: University of Toronto Press, 2008.

Freedman, Des. "The Resilience of TV and its Implications for Media Policy." In *The Routledge Companion to the Cultural Industries,* edited by Kate Oakley & Justin O'Connor, 120-129. London and New York: Routledge, 2015.

Freedman, Des. *The Politics of Media Policy*. Cambridge and Malden: Polity, 2008.

Geist, Michael. "Reshaping Canada's Broadcasting Act: Solutions in Search of a Problem?." In *Perspectives on Platform Regulation*, edited by Judit Bayer, Bernd Holznagel, Päivi Korpisaari, and Lorna Woods, 291-328. Baden-Baden: Nomos, 2021.

Globerman, Steven. "Foreign Ownership of Feature Film Distribution and The Canadian Film Industry." *Canadian Journal of Communication* 16, no. 2 (1991).

Haque, Eve. *Multiculturalism Within a Bilingual Framework: Language, Race, and Belonging in Canada.* University of Toronto Press, 2012.

Lopez, Serena. "The Lack of Representation in Canada's TV and Film Industry is Failing BIPOC Creatives." CanCulture. December 5, 2020. https://www.canculturemag.com/film/2020/12/5/yeytgw118f6qecdzxntx40ng83b1kb.

MacLennan, Anne F. "Circumstances Beyond our Control: Canadian Radio Program Schedule Evolution During the 1930s." PhD diss. Concordia University, 2001.

MacLennan, Anne F. "Resistance to Regulation Among Early Canadian Broadcasters and Listeners." In *Islands of Resistance: Pirate Radio in Canada*, edited by Andrea Langlois, Ron Sakolsky, and Marian van der Zon, 35-48. Vancouver: New Star Books, 2010.

MacLennan, Anne F. "Learning to Listen: Developing the Canadian Radio Audience in the 1930s." *Journal of Radio & Audio Media* 20, no. 2 (2013): 311-326.

MacLennan, Anne F. "Private Broadcasting and the Path to Radio Broadcasting Policy in Canada." *Media and Communication 6* no. 1 (2018): 13-20.

MacLennan, Anne F. "Canadian Community/Campus Radio: Struggling and Coping on the Cusp of Change." In *Radio's Second Century: Past, Present, and Future Perspectives*, edited by John Allen Hendricks, 193-208. New Jersey: Rutgers University Press, 2020.

Mansell, Robin. "Political Economy, Power and New Media." *New Media and Society 6,* no. 1 (2004): 96-105.

McChesney, Robert W. “Noam Chomsky and the Struggle Against Neoliberalism.” *Monthly Review 50*, no. 11 (1999): 40-48.

Mirrlees, Tanner. “A Political Economy of the Cultural Industries in Canada.” In *Change and Continuity: Canadian Political Economy in the New Millennium*, edited by Mark P. Thomas, Leah F. Vosko, Carlo Fanelli, and Olena Lyubchenko, 203-226. Montreal and Kingston: McGill-Queen’s University Press, 2019.

Morneau, Francis William. *Growing the Middle Class.* Ottawa: House of Commons, 2016. http://www.budget.gc.ca/2016/docs/plan/budget2016-en.pdf

Mosco, Vincent. *The Political Economy of Communication* (2nd ed.). New York: Sage, 2019.

Napoli, Philip M. “Requiem for the Long Tail: Towards a Political Economy of Content Aggregation and Fragmentation.” *International Journal of Media & Cultural Politics* 12, no. 3 (2016): 341-356.

Nordicity. *The Digital Media Universe: Measuring the Revenues, the Audiences, and the Future Prospects*. Toronto: NGL Nordicity Group Limited, 2023.

O’Neill, Brian. “CBC.ca: Broadcast Sovereignty in a Digital Environment.” *Convergence* 12, no. 2 (2006): 179-197.

Raboy, Marc. *Missed Opportunities: A Story of Canada's Broadcasting Policy.* Montreal and Kingston: McGill-Queen's University Press, 1990.

Raboy, Marc. “The Role of the Public in Broadcasting Policy-Making and Regulation: Lesson for Europe from Canada.” *European Journal of Communication* 9, no. 1 (1994): 5-23.

Raboy, Marc. “Media.” In *Media Divides: Communication Rights and the Right to Communicate in Canada,* edited by Marc Raboy and Jeremy Shtern, 91-119. Vancouver: UBC Press, 2010.

Raboy, Marc and Geneviève A. Bonin. “From Culture to Business to Culture: Shifting Winds at the CRTC.” In *For Sale to the Highest Bidder: Telecom Policy in Canada,* edited by Marita Moll and Leslie Regan Shade, 61-69. Ottawa: Canadian Centre for Policy Alternatives, 2008.

Raboy, Marc and Jeremy Shtern. “Introduction.” In *Media Divides: Communication Rights and the Right to Communicate in Canada,* edited by Marc Raboy and Jeremy Shtern, 3-25. Vancouver: UBC Press, 2010.

Rodger, Andrew. “Some Factors Contributing to the Formation of the National Film Board of Canada.” *Historical Journal of Film, Radio and Television* 9, no. 3 (1989): 259-268.

Rowland, Wade. *Saving the CBC: Balancing profit and public service*. Toronto: Linda Leith Pub, 2013.

Skinner, David. “Divided Loyalties: The Early Development of Canada’s “Single” Broadcasting System.” *Journal of Radio Studies* 12, no. 1 (2005): 136-155.

Smythe, Dallas W. “On the Political Economy of Communications.” *Journalism Quarterly* 37, no. 4 (1960): 563-572.

Smythe, Dallas W. “On the Audience Commodity and Its Work.” *Media and Cultural Studies: Keyworks* 230 (1981): 230-256.

Stursberg, Richard. *The Tangled Garden: A Canadian Cultural Manifesto for the Digital Age*. Toronto: James Lorimer & Company, 2019.

Taras, David and Marc Raboy. “The Politics of Neglect of Canadian Broadcasting Policy.” *Policy Options* 25, no. 3 (2004): 63-68.

Taylor, Gregory. *Shut Off: The Canadian Digital Television Transition*. Montreal and Kingston: McGill-Queen’s University Press, 2013.

Vipond, Mary. “The Beginnings of Public Broadcasting in Canada: The CRBC, 1932-1936.” *Canadian Journal of Communication* (1994).

Wasko, Janet. “The Study of the Political Economy of the Media in the Twenty-First Century.” *International Journal of Media & Cultural Politics* 10, no. 3 (2014): 256-271.

Winseck, Dwayne. *Media and Internet Concentration in Canada, 1984– 2019.* Canadian Media Concentration Research Project, 2020.

Winseck, Dwayne. *Media and Internet Concentration in Canada, 1984– 2022*. Global Media and Internet Concentration Project, 2023.

Zboralska, Emilia, Charles H. Davis, Jeremy Shtern, and Vanessa Ciccone. “Cultural Diversity Reporting in the Canadian Audiovisual Industry: Making Monitoring Meaningful.” *Quaderns del CAC* 43 (2017): 73-85.

The Internet as a Democratic Hellscape: How Social Media Violates Natural Law

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ABSTRACT: This paper applies John Locke's political philosophy to analyze the 2018 Facebook-Cambridge Analytica data scandal, highlighting the harms of spreading misinformation in the digital sphere. Locke's *Two Treatises of Government* serves as a theoretical lens to explore how social media sites represent a facade of an impartial third party, when in reality they inflict harm upon the user by violating their liberty, and subsequently natural law as a whole. Using the Facebook-Cambridge Analytica data scandal as a case study, this essay argues that social media sites knowingly allow the spread of misinformation, which ultimately harms users in realms that extend beyond the digital. This paper urges users to be aware of social media sites' complacency in spreading misinformation and of the threats that misinformation poses to social and political life. The paper urges users of social media sites to play an active role in shaping digital spheres into spaces that can used to craft positive change in social and political life.

KEYWORDS: social media, social contract, democracy, public sphere, surveillance, digital privacy

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In the highly influential political text, *Two Treatises of Government*, John Locke establishes how just civil societies are formed.[1] Locke proposes the idea that the state of nature is one where all individuals are free and equal. He argues that there is a natural law which governs the state of nature. This law of nature is a set of objective moral rules, that apply to everyone, even when a formal government is absent. The law of nature is an innate feeling which teaches us that, "being all equal and independent, no one ought to harm another in his life, health, liberty or possessions."[2] The state of nature rests on the foundation of mutual love among all people, upholding each individual's natural rights to life, liberty, health and property.[3]

However, Locke acknowledges that the state of nature is precarious because there is no guarantee that all individuals will abide by the law of nature. In the state of nature, individuals live in a condition of fear and insecurity due to the constant threat of harm from outside parties. Consequently, Locke argues that a civil government must be formed to protect the natural rights of citizens. Thus, individuals consent to enter a social contract with an impartial third party to create a civil society. Essentially, individuals relinquish some rights and freedoms to obtain guaranteed protection and enjoyment of natural law. Although Locke focuses on describing the conditions for a just society in the context of traditional governments and social structures, his overarching theories can be extrapolated to contemporary social and political contexts.

Analyzing the social and political interactions on social media sites provides powerful insights into how an unjust civil society can manifest in an increasingly digital world. As the twenty-first century has progressed, technological advancements have rapidly increased. In the late 1990s, the Internet was essentially in a fetal state — its vast and open nature fostering optimistic ideas of a novel democratic space.[4] In the mid to late 2000s, the rise of social media sites like Facebook allowed users to generate and absorb content at unprecedented speeds, furthering scholarly faith in the use of the internet as a democratizing force.[5] However, more recently, other scholars have argued that these same novel technological

features can be used to consolidate the power of authoritarian regimes.[6]

This essay will use John Locke's conditions for a just and civil society to critically analyze the 2018 Facebook-Cambridge Analytica data scandal, and subsequently apply these findings to social media sites as a whole. The paper will first argue that many digital citizens use social media sites, like Facebook, as forums to collectively identify and discuss social issues — causing users to conceptualize social media sites as impartial third parties. It will then show that Facebook failed to adequately protect natural law as it knowingly promoted misinformation on its site. It will then argue that this violation of natural law renders Facebook an illegitimate third party, which harms its users. Using the Facebook-Cambridge Analytica data scandal as a case study, the paper will contend that it is unjust for social media sites to facilitate the spread of misinformation.

First, it is necessary to show that the unique communication format on social media holds great potential for social and political discussion and that many users realize this potential. Social media serves as a platform for users to share content and interact with one another. On social media sites, users can share content for a variety of reasons, whether to disseminate information or simply for amusement. However, the rapid and widespread flow of information contributes significantly to the potential for social and political discussion. Brown argues that online forums can facilitate democratic public speech, citing examples of social movements such as Idle No More that gained traction on social media.[7] Though scholars like Brown hold optimistic views about the democratizing potential of the Internet, others like Morozov take a more critical approach, pointing out that "social media platforms can be used intensively for manipulation purposes" by state and non-state actors.[8]

Despite disagreements among scholars regarding the Internet's democratizing potential, both sides agree that social media sites serve as spheres for social and political discussions. From organizing protests to politically charged memes, social media is rife with content about social and political life. In the contemporary

moment, many users are privy to the bias they may encounter when browsing social media and interacting with others.[9] However, many users remain unaware of how these platforms manipulate them. Social media platforms harvest and sell user data, allowing it to be weaponized to push specific agendas. Users often see social media sites as impartial third parties, not expecting an underlying bias. While users understand the risks of encountering misinformation, they generally do not expect platforms to knowingly aid in spreading targeted misinformation to vulnerable populations.

Before analyzing the effects of the Facebook-Cambridge Analytica data scandal, it is necessary to provide a brief background on the event. In March 2018, news broke that the political consulting firm Cambridge Analytica had harvested personal data from 87 million Facebook user accounts without their knowledge.[10] Cambridge Analytica used this data to create targeted marketing databases and sold them to political campaigns for advertising purposes.[11] Cambridge Analytica's algorithm employed advanced pattern recognition to create psychological profiles of users. Based on content users had 'liked,' Cambridge Analytica gathered private and sensitive user information to make strong predictions about which political party that user would vote for.[12] This information was used to deploy ads rife with misinformation (BBC video) and targeted toward populations identified as vulnerable or susceptible for numerous global political campaigns, including Trump's presidential campaign in 2016 and the pro-Brexit campaign 'Leave.EU' in 2015.[13]

As an impartial third party, the relationship between Facebook and its users is similar to Locke's social contract theory. When someone signs up for Facebook, they agree to the party's privacy policy — a document disclosing how Facebook collects and uses user data. The privacy policy is akin to Locke's idea of a social contract because digital citizens consent to relinquish some rights and freedoms, such as data about the content they interact with, in exchange for others, like the ability to engage in social and political discussion.[14] In line with Locke's idea of tacit consent, users continue to 'silently' consent to this contract by continuing to use Facebook. Only once a user closes their account this contract is broken, and

Facebook no longer has access to the user's data. However, this social contract is only just if it protects the natural rights of each person.[15]

Facebook's social contract is corrupt because it exploits the consent of digital citizens to violate natural law by deceiving and manipulating its users. In a civil society, that is, one wherein a social contract has established an impartial third party, Locke defines liberty as:

> …freedom of men under government is to have a standing rule to live by, common to every one of that society, and made by the legislative power erected in it. A liberty to follow my own will in all things where that rule prescribes, not to be subject to the inconstant, uncertain, unknown, arbitrary will of another man.[16]

Thus, even when individuals agree to a social contract, such a contract is unjust if individuals are subject to another person or group's whims. This constitutes a violation of liberty, failing to uphold natural law on the part of the impartial third party.

On Facebook, users agree to the privacy policy to use the site, rendering the entity of Facebook into an impartial third party that holds all users to the same standard or set of rules (e.g. no hate speech, no nudity, etc.). However, before 2018, Facebook freely granted mobile developers, such as Cambridge Analytica extensive access to user data without disclosing this to its users.[17] In this way, Facebook not only failed to hold all actors to the same standards but also deceived users about the terms of its social contract. By failing to disclose how user data was collected and used in its privacy policy, Facebook subjected its users to the unknown will of Cambridge Analytica, which used this data to manipulate users through political campaigns filled with misinformation.[18] Thus, Facebook violated the liberty of its users by subjecting them to the unknown will of Cambridge Analytica.

The effects of these liberty violations extend beyond the digital realm to influence and harm the life and health of digital citizens in the 'real world'. For example, Cambridge Analytica was involved in the 2015 Brexit 'Leave.EU' campaign.[19] Cambridge Analytica's targeted ads functioned as part of the campaign's

propaganda machine to sway individual political views, ultimately contributing to the success of Brexit. Brexit introduced significant trade barriers in the UK, resulting in economic difficulties that trickled down to the individual level.[20] Thus, the digital infringements of liberty which informed the creation of 'fake news' political campaigns impacted the 'real' lives and health of British citizens by damaging the economy. Tangible, real-world consequences on the lives of individuals can be traced back to violations of natural law in the digital world.

Through Locke's lens, the deception and manipulation that permeates Facebook transforms the site into a contemporary, digital form of an illegitimate government. For Locke, a legitimate government is an impartial third party that upholds natural law and works towards the common good of society. Locke states that "... no rational creature can be supposed to change his condition with an intention to be worse."[21] An individual only enters into a social contract with a third party because they believe the agreement will make them better off. Facebook users believe that using the site will create better conditions for numerous reasons (e.g. communication, creative pursuits, access to information etc.). In actuality, users are made worse off because their natural rights have been violated.

Although people are technically free to leave the site at any time, they do not feel a need to leave the site because they are blind to any infringements upon their liberty and the harms that may arise from such. When users are not aware of the conditions they have agreed upon to use a site like Facebook, they cannot make free and informed decisions because they lack the necessary information to do so. This is the most striking way that Facebook violates the liberty of their users — by robbing them of their agency.

Similarly, Cambridge Analytica robbed users of their agency by intentionally feeding them misinformation about social and political life. Democracy can only flourish with the active and truthful involvement of citizens. Misinformation jeopardizes its success by confusing or deterring voters from making informed decisions and skewing the views of political opponents. In both instances, the user

or citizen is not equipped with the tools and knowledge to become an agent over their own life, which is unjust.

After 2018 and the Facebook-Cambridge Analytica data scandal, many social media sites have updated their policies to be more transparent with how user data is collected and used. However, misinformation is still rampant across social media sites.[22] As Forbes reports, "A 2021 report from the online advocacy group Avaaz found that, in the eight months leading up to the [2020 US] election, Facebook could have stopped the 10.1 billion estimated view of misinformation from top-performing pages on its site." The Facebook-Cambridge Analytica data scandal is merely one case study to examine the threats posed by the spread of misinformation on social media sites. Although social media sites like Facebook are just one part of the misinformation machine, they are the most dangerous because they have the most power when it comes to protecting users from violations of their liberty but time and time again, they fail to do so.

Locke asserts that if a government is legitimate, it upholds the natural rights of citizens and therefore deserves obedience. However, when a government is illegitimate (i.e. has violated natural law), individuals have the right to resist and reform a government that is just and legitimate. Thus, digital citizens have a right to resist and rebel against the 'illegitimate governments' that social media sites represent. If policymakers and social media giants are not taking meaningful steps to protect users from misinformation, it is time for users themselves to take action and make changes.

However, resistance is only possible with collective awareness. Though beyond the scope of this paper to argue for a specific methodology of resistance, this paper uses a Lockean viewpoint to lay the groundwork for understanding the harms that social media sites inflict on users when facilitating the spread of misinformation. Through collective awareness, resistance becomes a tangible option, and individuals can work towards building just communities in the digital world. Whether one believes in the democratizing potential of the Internet or wants to avoid harm from authoritarian regimes, these outcomes can only be actualized if there

is intentional and critical thought behind the creation and regulation of digital public spheres.

Notes

[1] John Locke, *Two Treatises of Government* (London: Thomas Tegg, 1823).

[2] Locke, *Two Treatises of Government*, 107.

[3] Locke, 106-107.

[4] Kyle Brown, "Public Spheres in Private Spaces: How Capital Will Stop the Web's Democratic Potential," *The McMaster Journal of Communication* 10 (March 13, 2014), https://doi.org/10.15173/mjc.v10i0.282, 76.

[5] Brown, "Public Spheres", 77.

[6] YERLİKAYA, TURGAY, and SECA TOKER ASLAN. "Social Media and Fake News in the Post-Truth Era: The Manipulation of Politics in the Election Process." *Insight Turkey* 22, no. 2 (2020): 177–96. https://www.jstor.org/stable/26918129, 179.

[7] Brown, 75.

[8] YERLİKAYA, TURGAY, and SECA TOKER ASLAN, "Social Media and Fake News in the Post-Truth Era", 179.

[9] Reilly, Meg Little. "Facebook Is Still Top Social Platform for News but Users Are Wary, Pew Finds." Forbes, February 16, 2024. https://www.forbes.com/sites/meglittlereilly/2024/02/15/facebook-is-still-no1-social-media-site-for-news-but-users-are-wary/.

[10] Aja Romano, "The Facebook Data Breach Wasn't a Hack. It Was a Wake-up Call.," Vox, March 20, 2018, https://www.vox.com/2018/3/20/17138756/facebook-data-breach-cambridge-analytica-explained.

[11] Romano, "Facebook Data Breach"

[12] Carole Cadwalladr and Emma Graham-Harrison, "How Cambridge Analytica Turned Facebook 'Likes 'into a Lucrative Political Tool," The Guardian (The Guardian, March 17, 2018), https://www.theguardian.com/technology/2018/mar/17/facebook-cambridge-analytica-kogan-data-algorithm.

[13] Romano.

[14] BBC, "Facebook's Data-Sharing Deals Exposed," BBC News, December 19, 2018, https://www.bbc.com/news/technology-46618582.

[15] Locke.

[16] Locke, 114.

[17] Romano; Cadwallar and Graham-Harrison, “Cambridge Analytica.”

[18] Wylie, Christopher. “Cambridge Analytica Planted Fake News.” *BBC News*, March 20, 2018. https://www.bbc.com/news/av/world-43472347.

[19] Romano.

[20] Jonathan Portes, “The Impact of Brexit on the UK Economy: Reviewing the Evidence,” CEPR (Vox EU, July 7, 2023), https://cepr.org/voxeu/columns/impact-brexit-uk-economy-reviewing-evidence.

[21] Locke, 161.

[22]Reilly, “Facebook Is Still Top Social Platform for News”

Bibliography

BBC. “Facebook’s Data-Sharing Deals Exposed.” *BBC News*, December 19, 2018. https://www.bbc.com/news/technology-46618582.

Brown, Kyle. “Public Spheres in Private Spaces: How Capital Will Stop the Web’s Democratic Potential.” *The McMaster Journal of Communication* 10 (March 13, 2014). https://doi.org/10.15173/mjc.v10i0.282.

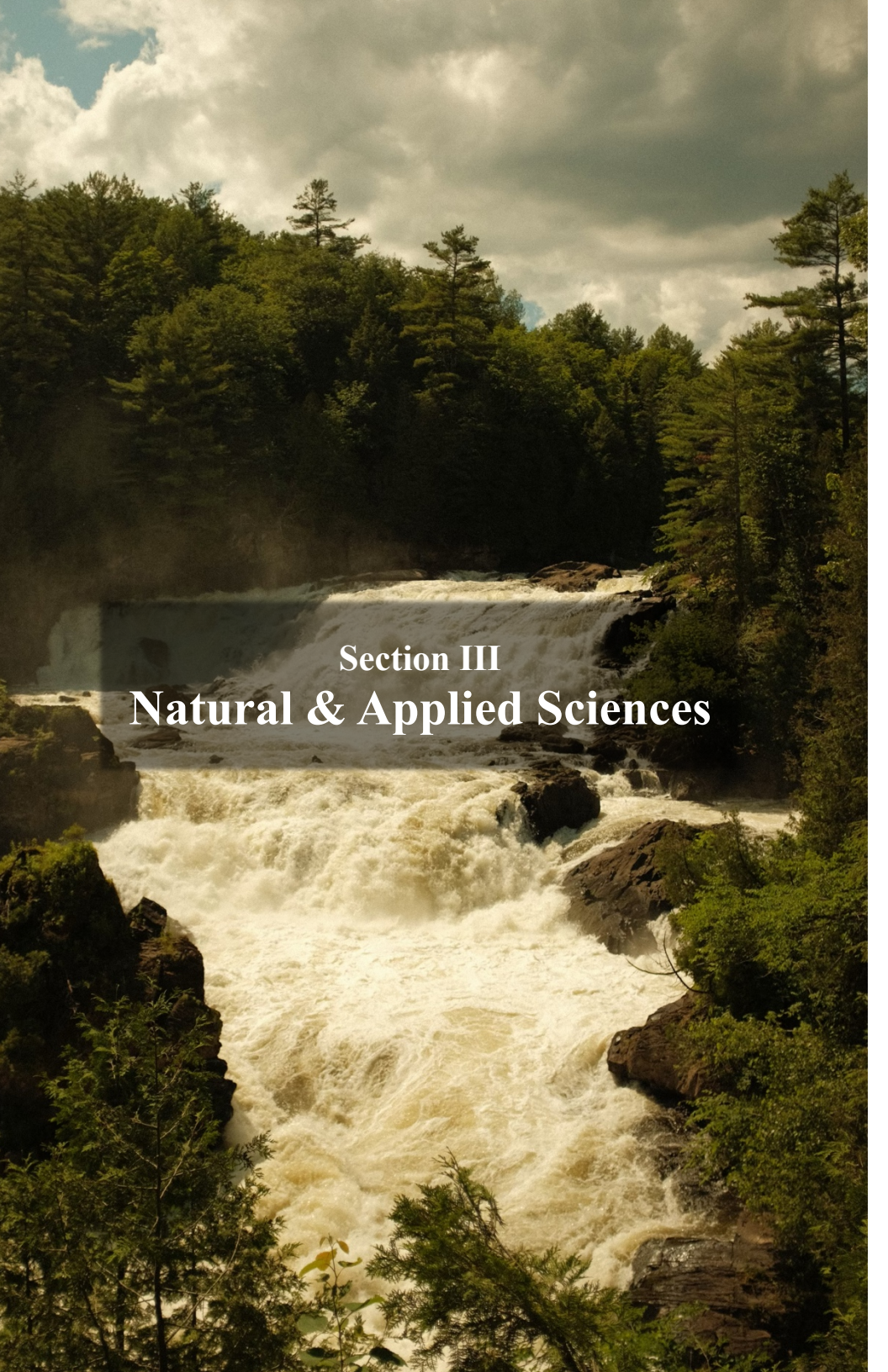
Cadwalladr, Carole, and Emma Graham-Harrison. “How Cambridge Analytica Turned Facebook ‘Likes ’into a Lucrative Political Tool.” The Guardian. The Guardian, March 17, 2018. https://www.theguardian.com/technology/2018/mar/17/facebook-cambridge-analytica-kogan-data-algorithm.

Locke, John. *Two Treatises of Government*. London: Thomas Tegg, 1823.

Nguyen, Terry. “PowerPoint Activism Is Taking over Your Friends ’Instagram Accounts.” Vox, August 12, 2020. https://www.vox.com/the-goods/21359098/social-justice-slideshows-instagram-activism.

Portes, Jonathan. “The Impact of Brexit on the UK Economy: Reviewing the Evidence.” CEPR. Vox EU, July 7, 2023. https://cepr.org/voxeu/columns/impact-brexit-uk-economy-reviewing-evidence.

Romano, Aja. “The Facebook Data Breach Wasn’t a Hack. It Was a Wake-up Call.” Vox, March 20, 2018. https://www.vox.com/2018/3/20/17138756/facebook-data-breach-cambridge-analytica-explained.



Section III
Natural & Applied Sciences

Unravelling the Intricacies of Telomere Replication: A Molecular Conundrum

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ABSTRACT: Telomeres are specialized structures at the ends of linear chromosomes that protect them from degradation and fusion. Its replication is a complex process that involves both DNA polymerases and a specialized enzyme called telomerase which is a ribonucleoprotein complex that synthesizes telomeric DNA by using an internal RNA template. However, it requires auxiliary factors for complete replication. Among these, the CST complex—comprising CTC1, STN1, and TEN1—acts as a critical mediator in telomere replication. The CST complex is essential for coordinating telomerase activity and C-strand fill-in synthesis, thereby ensuring the proper elongation and processing of telomeric DNA. In certain malignant cells, the ALT pathway, a telomerase-independent mechanism, is characterized by homology-directed repair via break-induced replication and this process, facilitated by RAD52 or RAD51AP1-mediated strand invasion, extends telomeres through the Pol δ accessory subunit POLD3 or induces telomeric sister chromatid exchanges. Telomeric replication stress in ALT cells, marked by DNA damage response activation, arises from secondary structures such as G-quadruplexes and RNA-DNA hybrids formed by TERRA transcription. The Fork Protection Complex, comprising TIMELESS and TIPIN, along with the shelterin complex and replisome components, ensures replication fidelity. Certain helicases like WRN and BLM, and proteins such as PCNA, are important for resolving G4 structures, facilitating replication continuity. Telomere replication is tightly regulated by various mechanisms, such as cell cycle checkpoints, telomere length homeostasis, and telomere position effect. Dysregulation of telomere replication can lead to genomic instability, cellular senescence, and cancer, thus underscoring the importance of understanding telomere replication's molecular complexities in aging and disease.

KEYWORDS: telomere, DNA replication, G-quadruplexes, shelterin, molecular biology

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Challenges and Dynamics of Telomere Replication

Eukaryotic cells have linear chromosomes that allow the shuffling of alleles between homologous chromosomes during meiosis, which thus increases genetic diversity [1]. However, linear chromosomes also have telomeres, which are the vulnerable regions at the ends of chromosomes that consist of thousands of repeats of the sequence 5′-TTAGGG-3′, with a single-stranded 3′ overhang that can form a loop structure by invading the double-stranded repeats [2]. During replication of DNA, the inability of DNA polymerase to fully replicate the terminal regions of the lagging strand results in progressively shorter chromosomes with each cell division. This condition arises because DNA polymerases require a primer to initiate synthesis, and as replication nears the end of a chromosome, there is insufficient template for the placement of a primer for the final Okazaki fragment. As a result, this last portion of the DNA strand remains un-replicated, leading to the gradual erosion of the telomeric DNA (end replication problem). Telomeres are bound by the shelterin complex, which includes TRF1(Telomeric Repeat-binding Factor 1), TRF2 (Telomeric Repeat-binding Factor 2), POT1(Protection of telomeres protein 1), TIN2 (TERF1-interacting nuclear factor 2), RAP1, and TPP1 (also called as adrenocortical dysplasia protein homolog (ACD) protein), and protects telomeres from DNA damage responses and end joining, which causes genomic instability, cell cycle arrest, senescence, or cell death [34]. To prevent telomere erosion, shelterin recruits telomerase, a reverse transcriptase that adds repeats to the overhang using its RNA component (TERC) [5]. Telomerase catalyses the addition of telomere repeats to the 3′ end of chromosomes, which is facilitated by the enzyme's two core components: the telomerase reverse transcriptase (TERT) and the telomerase RNA component (TER) [6]. TERT utilizes TER as a template to synthesize DNA repeats that are complementary to a segment of TER, typically encompassing 1.5 to 1.8 units of the telomere repeat sequence[7]. The TER itself is structured with an alignment region that precedes a templating region, guiding the accurate addition of telomeric repeats. The architecture of TERT is

characterized by domains which are similar to reverse transcriptases, including the reverse transcriptase domain with palm and fingers subdomains, and the carboxy-terminal element resembling a thumb[8]. These collectively contribute to the formation of a ring-like structure that is essential for the enzyme's function. TERT possesses a telomerase amino-terminal domain (TEN) linked to an RNA-binding domain (RBD) by an extensive linker region, further contributing to the enzyme's complex structure and function[9]. TER exhibits remarkable diversity across different organisms, varying significantly in length—from approximately 150 nucleotides in ciliates to over 2000 nucleotides in certain yeasts—and in structural motifs[10] and this variability is attributed to the rapid evolution of TER, a noncoding RNA that adapts to the diverse requirements of telomere maintenance[11]. In ciliates, TER is transcribed by RNA polymerase III, however in vertebrates, yeasts, and plants, it is the domain of RNA polymerase II. Such divergence has led to a variety of mechanisms for the biogenesis and processing of TER, its assembly with TERT, and its localization and recruitment to telomeres. However, despite the variabilities, TERs share conserved regions for interaction with TERT and these include the template/pseudoknot domain (t/PK), which forms a closed loop encompassing the template sequence and a pseudoknot structure, and the stem-terminus element (STE), which features a hairpin structure. The TER exhibits significant variability in regions outside the template/pseudoknot (t/PK) and stem-terminus element (STE), reflecting the diverse evolutionary adaptations of TER across different organisms. In ciliates, for instance, the La-related protein group 7 (LARP7) protein, specifically p65 in *Tetrahymena thermophila*, plays a crucial role in the protection of the 3′-end and in the assembly of TER with TERT [12]. Human TER, on the other hand, features a specialized H/ACA small Cajal body-specific RNA (scaRNA) domain that interacts with the H/ACA small Cajal body ribonucleoproteins (scaRNPs), facilitating the complex's assembly and function. Yeasts, particularly fission and budding yeasts, have larger TERs that associate with a distinct array of proteins, including Sm and LSm proteins, and in the case of budding

yeast, the Pop1–Pop6–Pop7 subcomplex derived from mitochondrial ribonuclease P[13].

Structural studies of these associations have been limited, with notable exceptions such as the crystal structure of the *Saccharomyces cerevisiae* Ku70/80–TER hairpin[14]. In humans, the core ribonucleoprotein (RNP) of telomerase binds to telomere-associated proteins that either enhance its processivity, such as TPP1 and POT1 (components of the shelterin complex), or inhibit telomerase activity and assist in recruiting DNA polymerase α-primase for the synthesis of the C-strand, as seen with the CTC1–STN1–TEN1 (CST) complex[15 16 17]. These interactions are needed for the functional regulation of telomerase at telomeres, which also promotes the lagging-strand synthesis[18]. The shelterin complex is made up of six proteins that come together at the ends of chromosomes, known as telomeres. These proteins are TRF1, TRF2, RAP1, TIN2, TPP1, and POT1 (Figure 1). TRF1 and TRF2 start the process by attaching to the telomere's DNA sequence, which is rich in the repeating units of TTAGGG. Once they are in place, they then help bring in the other four proteins[19]. Both TRF1 and TRF2 have a role in controlling the length of the telomeres by limiting the action of telomerase and POT1 also helps in this process by binding to the single-stranded part of the telomere DNA, which is important for stopping telomerase from working in that area. If any part of the shelterin complex doesn't work properly, it can cause the cell to mistakenly think the telomeres are damaged DNA. This can lead to the activation of the cell's repair systems, like ATM or ATR, and result in the cell stopping its division cycle and the chromosomes becoming unstable. When scientists look closely at how much of each shelterin protein is present in the cell compared to the number of places where TRF1 or TRF2 can bind, they found some interesting things. For example, there isn't an excess of TRF1 or TRF2 compared to their binding sites: in fact, there's about twice as much TRF2 as TRF1, suggesting that TRF1 and TRF2 might have different roles. Also, there are smaller groups within the shelterin complex, like TRF1-TIN2-TPP1/POT1 and TRF2-RAP1, which indicates that these proteins might work together in a more specific manner. The amount

of POT1 that gets attached to the telomeres seems to be limited by how much TPP1 is available, and TPP1 only binds to TIN2. This indicates that the balance of these proteins is important for the whole complex to work correctly. Other proteins that join the complex might be brought in by TRF1, TRF2, or POT1, and these proteins could vary a lot in how much they are present at the telomeres.

In 2024, Takai et al. reported a new study which revealed an additional challenge in telomere replication, specifically the incomplete synthesis of the lagging strand's C-rich telomeric repeats. This issue is addressed through fill-in synthesis by the CST–Polα-primase[20]. Experimental evidence suggests that priming for lagging-strand replication is absent at the 3′ overhang, halting synthesis approximately 150 nucleotides away from the template's end. Cells deficient in CST–Polα-primase exhibit significant shortening of lagging-end telomeres, losing 50–60 nucleotides of CCCTAA repeats with each cell division. Leading-end telomeres also experience shortening, approximately 100 nucleotides per division, likely due to resection forming 3′ overhangs. The observed overall reduction in C-strand length without CST–Polα-primase correlates with the sum of incomplete lagging-strand replication and leading-end resection. The findings suggest that standard DNA replication presents dual challenges at telomere ends, necessitating telomerase for G-strand maintenance and CST–Polα-primase for C-strand upkeep.

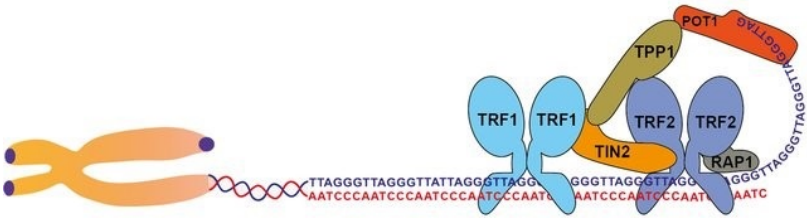

Figure 1. The role of shelterin in protecting and regulating telomeres. This is a diagram of how the shelterin complex attaches to the telomeric DNA. The shelterin components TRF1 and TRF2 form dimers that bind to specific regions of the telomeric DNA.

Image credit: Doksani Y. (2019). The Response to DNA Damage at Telomeric Repeats and Its Consequences for Telomere Function. Genes, 10(4), 318. https://doi.org/10.3390/genes10040318

ALT Telomere Shortening Mechanism

Cancer cells can bypass telomere shortening by activating telomerase or using the alternative lengthening of telomeres (ALT) mechanism[21]. ALT maintenance mechanism is frequently observed in certain malignancies, notably osteosarcomas and glioblastomas, where targeted therapies remain elusive. In cells utilizing ALT, telomeres exhibit spontaneous telomere dysfunction-induced foci (TIFs) and often coalesce with promyelocytic leukemia (PML) nuclear bodies to form ALT-associated PML bodies (APBs). These APBs are hypothesized to be the sites of telomere elongation within ALT cells and are characterized by the presence of DNA damage response (DDR) proteins. The integrity of ALT telomeres is thus compromised, leading to their mobilization and aggregation, a response to telomeric damage that can be mitigated through homology-directed repair (HDR), specifically via break-induced replication (BIR) which is initiated by RAD52 or RAD51AP1-mediated strand invasion. The outcome of BIR at ALT telomeres can manifest as either an extension of telomere length, reliant on the Polδ accessory subunit POLD3, or as telomeric sister chromatid exchanges (T-SCEs), which are typically unproductive. The aberrant repair activities in ALT cells give rise to distinctive telomeric structures,

such as fragmented DNA and extrachromosomal circles, including C-circles, which are partially single-stranded telomeric DNA circles rich in cytosine and the presence and abundance of C-circles serve as a hallmark for the identification of ALT activity, reflecting the recombinogenic nature of ALT telomeres that tend to be elongated and heterogeneous in length (Figure 2). The fragility of telomeres stems from inherent replication challenges, making them susceptible to DNA replication stress, which is notably heightened in ALT cells, which triggers DDR pathways that culminate in BIR-mediated telomere extension. The replication difficulties are partly due to the propensity of telomeric sequences to adopt complex secondary structures, such as G-quadruplexes (G4s) and RNA-DNA hybrids formed by the transcription of telomeric repeat-containing RNA (TERRA) from subtelomeric regions, which are more prevalent in ALT cells compared to non-ALT cells. ALT telomeres are also characterized by an abundance of telomeric variant degenerate repeat sequences that disrupt shelterin binding and attract recombinogenic factors. The mutations in histone chaperones ATRX and DAXX, which are implicated in the ALT pathway, lead to altered telomeric heterochromatin, contributing to increased sister chromatid cohesion and the manifestation of ALT phenotypes like APBs, C-circles, T-SCEs, and telomere elongation. ATRX and DAXX are responsible for depositing the histone variant H3.3 at telomeres and promoting the deposition of macroH2A1.2 during replication stress to enhance telomere stability. The depletion of ASF1 isoforms, ASF1a and ASF1b, in cells with elongated telomeres induces ALT phenotypes, suggest that ASF1 silencing triggers ALT through the induction of telomeric replication stress. Telomeres are thus the challenging regions for DNA replication, as they present multiple obstacles for the replication machinery and replication forks often slow down and stall near the telomeric chromatin, and may collapse if not resolved, leading to double-strand breaks and homologous recombination[22]. This can result in telomere loss or aberrations, which can be detected by FISH on metaphase chromosomes[23]. These abnormal structures may also reflect telomere entanglement or incomplete replication. Telomere replication is therefore a source of stress that threatens

telomere integrity and stability. The timing of telomere replication is also crucial for telomere homeostasis and telomerase regulation. In mammalian cells, telomeres replicate throughout the S phase, whereas in yeasts, they replicate at the end of the S phase[24]. However, short telomeres or global replication perturbations can advance the replication of telomeres, altering the telomere length equilibrium[25].

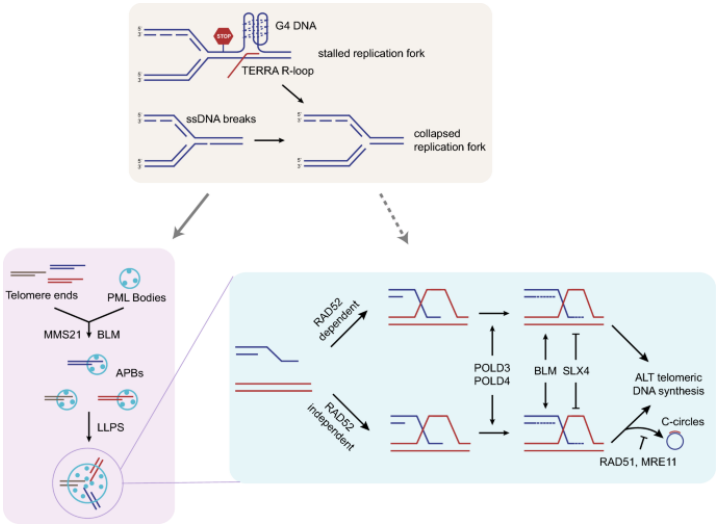

Figure 2. An overview of the ALT pathways. Telomere replication stress, potentially a catalyst for ALT activation, arises from the build-up of R-loops, G-quadruplexes, and single-strand DNA breaks. This accumulation can disrupt replication, leading to fork collapse and single-ended double-strand breaks (DSBs). APBs, rich in DNA repair and replication factors, may enhance ALT activity. Within APBs, BIR commences due to telomeric DSBs. ALT processes involve both RAD52-dependent and independent BIR pathways. POLD3/POLD4-dependent conservative replication during BIR is facilitated by BLM and hindered by SLX4. Conversely, RAD52-independent BIR generates C-circles and is restrained by RAD51 and MRE11.

Image credits: Zhang, J. M., & Zou, L. (2020). Alternative lengthening of telomeres: from molecular mechanisms to therapeutic outlooks. Cell & bioscience, 10, 30. https://doi.org/10.1186/s13578-020-00391-6

Unwinding of G4 Structures for Telomere Replication

The obstacles that slows down the replication fork include heterochromatin, T-loop, TERRA, RNA:DNA hybrids, and nuclear envelope attachment. One of the most challenging obstacles is the G4 structure, which is formed by four guanines stacking together in a planar arrangement. G4 can occur in the single-stranded G-rich lagging strand template during replication or transcription, and can block the fork or cause it to break, which leads to chromosome instability and telomere loss[26]. To prevent this, cells have several strategies to overcome the telomere replication problem, such as helicases, nucleases, and fork protection complex (FPC) which is part of the replisome and ensures proper fork pausing and passage[27]which safeguards the stability and proper functioning of the replisome during DNA replication. This complex is composed of the core components TIMELESS (TIM) and TIPIN, which are known as Swi1 and Swi3 in the yeast species *S. pombe*, and as Tof1 and Csm3 in *S. cerevisiae*. Alongside these, the proteins AND-1 and CLASPIN (CLSPN) serve as auxiliary factors that enhance the replisome's stability, facilitating smooth progression of the replication fork. The FPC functions as a scaffold, bridging the CMG helicase and the polymerase, which prevents the separation of their activities, which could otherwise lead to replication inefficiency. By maintaining a tight linkage between these two components, the FPC ensures that the replication machinery progresses efficiently along the DNA strand.

During times of replication stress, the FPC takes on an additional role by bolstering the ATR-CHK1 checkpoint signaling pathway, by promoting the interaction of TIM-TIPIN and CLSPN with RPA-coated single-stranded DNA at replication forks that have stalled[28]. This interaction is crucial for allowing CLSPN to facilitate the phosphorylation of CHK1 by ATR, a key step in the checkpoint signaling process. TIM and TIPIN are known to form a stable heterodimer, and interestingly, they do not possess any enzymatic activity. This lack of enzymatic function indicates that their role is primarily structural, contributing to the integrity of the replisome. The importance of the FPC is underscored by the fact that its loss leads to significant issues in DNA replication and overall genome stability, highlighting the necessity of the FPC's structural support in

maintaining the stability of the replication fork. Furthermore, studies have shown that TIM is upregulated in various types of cancers and this upregulation suggests that an increase in FPC activity could potentially counteract the replication stress encountered in tumor cells, which often results from the activation of oncogenes. The shelterin complex also helps to promote efficient telomere replication and prevent fork stalling and collapse[29]. Thus, both replisome and shelterin cooperate to maintain telomere stability. To prevent the interference of G4 structures with telomere replication, several helicases and single-strand DNA binding proteins (SSB) are recruited to unwind G4. For example, WRN and BLM, which are 3′–5′-directed helicases from the RecQ family that are mutated in Werner's and Bloom's syndromes, respectively[30]. WRN may be involved in G4 resolution at telomeres by interacting with replication protein A complex (RPA), PCNA, Pol δ, and TRF2[31]. RPA is known for its ability to attach to single-stranded DNA and initiate the unwinding of G4 structures. Despite not being classified as a helicase, research conducted in laboratory settings has demonstrated that RPA can disassemble G4 formations without the need for ATP. RPA can bind and unfold G4 structures by itself, or recruit other helicases through physical interactions[32]. It is posited such that HERC2, a HECT E3 ligase, is instrumental in this interaction, particularly during the S-phase of the cell cycle, by interacting with BLM, WRN, and RPA complexes. This interaction is crucial for the suppression of G-quadruplex DNA, as depletion of HERC2 has been shown to dissociate RPA from BLM and WRN complexes, leading to increased formation of G4 structures. Phosphorylation-dependent association of WRN with RPA is essential for the recovery of replication forks stalled at secondary DNA structures and when WRN fails to bind RPA, fork recovery is impaired, resulting in the accumulation of single-stranded DNA gaps, which are exacerbated by the structure-specific nuclease MRE11. Telomeric proteins, such as POT1 and the shelterin components TRF1 and TRF2, may also prevent G4 formation by binding to telomeric tails or acting as scaffolds for replication factors[33]. The proliferating cell nuclear antigen (PCNA) may coordinate this network by recruiting different factors to the

replisome[34]. PCNA associates with a cohort of factors that collectively regulate the resolution of G4 structures and ensure the continuation of replication. Among these, the interaction of PCNA with DNA polymerase δ/ε is crucial, as it facilitates the processivity of the polymerase during DNA synthesis. PCNA also engages with replication factor C (RFC) and DNA ligase 1 (Lig1), which are instrumental in the re-synthesis of new DNA fragments post-G4 resolution. Moreover PCNA's association with Flap Endonuclease 1 (Fen1) is essential for the removal of RNA primers and the subsequent joining of Okazaki fragments during lagging-strand synthesis. The interplay between PCNA and the FANCJ helicase is also worth mentioning; FANCJ is implicated in the unwinding of G4 structures, thereby facilitating the progression of the replication fork. This dynamic collaboration between PCNA and its partners not only mitigates the replication stress induced by G4 structures but also maintains the integrity of the genome. PCNA forms a ring-shaped clamp around DNA, which allows it to slide along the DNA strand. This sliding clamp function is essential because it helps DNA polymerases to stay attached to the DNA during replication, increasing their ability to add nucleotides efficiently (this process is known as processivity).

BLM may collaborate with TRF1, which has the FxLxP motif for BLM binding which recruit BLM to remove G4 and avoid telomere fragility[35]. Another helicase that can resolve G4 with a 5′–3′ polarity is RTEL1, which is essential for DNA replication and recombination. RTEL1 may be associated with the replisome by its PIP box domain that binds PCNA. BLM and RTEL1 have different roles, as their deficiency causes additive telomere fragility[36]. Therefore, helicases that are linked to the replisome or shelterin can unwind G4 and ensure telomere replication. The Pif1 helicase family is widespread in eukaryotes and has various roles in DNA metabolism, including G4 unwinding. In yeast, there are two Pif1 family members: ScPif1 and Rrm3. ScPif1 is a potent G4 unwinder that inhibits telomerase by displacing its RNA component from telomeric ends whereas Rrm3 travels with the replication fork and helps replicate telomeric repeats[37 38]. In humans and mice, PIF1 also

unwinds G4 and interacts with TERT[39]. In fission yeast, Pfh1 is essential for replicating difficult regions and resolving G4 at telomeres[40 41]. Another protein that may process G4 at telomeres is DNA2, a 5′–3′ helicase/nuclease that cleaves G4 in vitro and co-immunoprecipitates with TRF1–TRF2[42].

Overcoming Replication Challenges at Telomeres

The T-loop is a structure formed by the invasion of the telomeric 3′ overhang into the double-stranded part of the telomere, creating a D-loop. This protects the telomere from degradation, but also poses a challenge for DNA replication. To avoid replication fork collision and allow telomerase access, the T-loop needs to be disassembled in a timely manner. This is done by RTEL1, a helicase that participates in this process by interacting with the shelterin protein TRF2, that binds to the T-loop base[43]. RTEL1 also associates with the replisome through PCNA to promote replication[44]. How RTEL1 coordinates its interactions with PCNA and TRF2 throughout the cell cycle is a bit unclear, as well as how it distinguishes between different replication barriers such as G4, T-loops, or others (Figure 3). Helicases, such as WRN, BLM, and RECQL4, may also be involved in T-loop resolution[45]. If RTEL1 fails, the SLX1–SLX4 nucleases resolve the T-loop inappropriately, causing telomere instability[46]. TRF2 also recruits Apollo, a 5′-exonuclease that prevents topological stress at the T-loop base[47]. The regulation of T-loop resolution likely depends on a complex network of post-translational modifications, involving the shelterin proteins. TERRA is a type of non-coding RNA that is transcribed from the subtelomeric regions to the TTAGGG repeats at the ends of eukaryotic chromosomes[48]. TERRA can form RNA:DNA hybrids with the telomeric DNA, displacing the G-rich strand and creating R-loops.[4950] This R-loop can interfere with the replication of telomeric repeats and cause telomere fragility and genomic instability.[51] To prevent this, TERRA levels are regulated during the cell cycle, peaking at G1–S and declining from S to G2.[52 53] Moreover, several factors are involved in resolving TERRA R-loops, such as RNase H, which degrades the RNA strand, ATRX,

which is a chromatin remodeler that may recognize or modify G4 structures, and UPF1, which is a helicase that participates in telomere replication.[54] [55] [56] [57] These mechanisms ensure that TERRA does not impair the completion of leading-strand telomere replication and maintain telomere integrity.

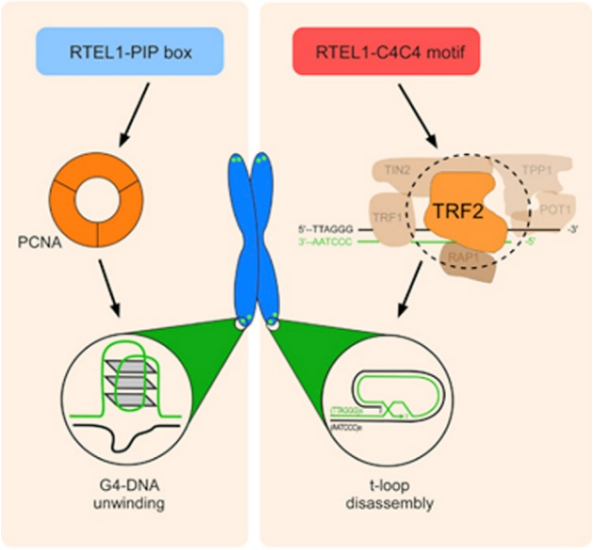

Figure 3. The image depicts two critical processes in telomere maintenance: G4-DNA unwinding and T-loop disassembly. The RTEL1-PIP box interacts with PCNA, shown as an orange circle, to unwind G4-DNA structures, which are green helical representations of DNA. On the other side, the RTEL1-C4C4 motif is associated with TRF2, indicated by an orange dashed circle, along with proteins TIN2, TPP1, POT1, and RAP1, to facilitate the disassembly of T-loops in telomeres. These processes are essential for the replication and protection of chromosome ends, ensuring genomic stability.

Image credits: Sarek, Grzegorz et al. "TRF2 recruits RTEL1 to telomeres in S phase to promote t-loop unwinding." Molecular cell vol. 57,4 (2015): 622-635. doi:10.1016/j.molcel.2014.12.024

TERRA also has many positive roles in telomere biology, such as regulating telomere length, replication, protection, chromatin structure, and mobility[58]. Therefore, TERRA levels and R-loop

formation must be tightly controlled to avoid replication–transcription conflicts. Several proteins can degrade or displace TERRA, such as Pif1 and FEN1 helicases, but the coordination and regulation of these mechanisms are not fully understood[59]. Telomeres also form a compact chromatin structure that protects them from DNA damage response, but also poses a barrier to the replication fork. TRF2 binds to telomeric DNA, modulates the topological state of telomeres and cooperates with Apollo and topoisomerase 2α to remove superhelical constraints[60]. Telomere anchoring is another source of topological stress that needs to be resolved during replication. The nuclear envelope (NE) and the nuclear matrix (NM) are two structures that constrain the localization and movement of telomeres, the ends of chromosomes. This structure called as telomere bouquet is a well-studied structure observed across a multitude of organisms during meiosis, where telomeres converge at the NE to facilitate homologous chromosome pairing, synapsis, and recombination. This conserved phenomenon, essential for the successful completion of meiosis, is controlled by the LINC complex—a fusion of KASH and SUN domain-containing trans-membrane proteins localized at the NE. The LINC complex serves as a bridge, connecting the NE to the cytoskeleton, thus generating the mechanical forces necessary for chromosomal movement. SUN domain proteins within this complex provide anchoring points for telomeres at the NE, ensuring their proper positioning. The shelterin complex, particularly TRF1 localizing at telomeres, assist in their tethering. A specialized "linker" system, comprising proteins such as TERB1, TERB2, and MAJIN in mice, forms a structural and functional bridge between the LINC and shelterin complexes, facilitating the bouquet's integrity[61]. The cyclin-dependent kinase CDK2, along with its activators SPDYA and Cyclin E, is also crucial for the formation of the telomere bouquet. Knockout studies in mice have demonstrated that the absence of CDK2, SPDYA, or Cyclin E results in the disassociation of telomeres from the NE, indicating a disruption in the LINC-linker-shelterin nexus. CDK2's kinase activity is modulated by the binding of typical cyclins, such as Cyclin E and A, and the atypical cyclin SPDYA, which leads to the

phosphorylation of T160 on the T-loop, thereby activating CDK2. Intriguingly, SPDYA can activate CDK2 independent of T-loop phosphorylation. Studies suggest that CDK2 phosphorylates SUN1, hinting at a potential role for CDK2 in fortifying the LINC-linker bond, a hypothesis that beckons further investigation to fully comprehend the molecular choreography underpinning the telomere bouquet's assembly and function[62].Telomeres are attached to the NE on one side of the nucleus and centromeres on the other in yeast cells[63]and this attachment is mediated by different proteins, such as Esc1–Sir4–Rap1 and yKu–Mps3 in budding yeast, and Bqt4 and Rap1 in fission yeast. Fft3, a chromatin remodeler, also contributes to this anchoring[64]. Human telomeres, however, are distributed throughout the nucleus and interact with the NM via shelterin and lamins[65]. Only some telomeres are found at the NE. To replicate telomeres, these topological constraints have to be overcome by detaching telomeres from the NE or NM. This is a potential research topic for the future.

Conclusion

The replication of telomeres, the ends of chromosomes, is a challenging process that requires overcoming several obstacles which includes secondary structures (G4 and T-loops), transcription, and topological constraints due to compaction and anchoring of telomeric chromatin which can cause replication stress and fork stalling at telomeres. Shelterin, a complex of telomere-binding proteins, protects telomeres from replication stress by modulating two distinct pathways. TRF1 prevents fork stalling and ATR activation in S phase, while TRF2 resolves supercoiling generated by fork progression. The coordination and regulation of these pathways, as well as the molecular interactions between shelterin and the replisome, are not fully understood and require further investigation. Post-translational modifications of TRF1 and TRF2 may also play a key role in this process[66]. Telomere replication also influences telomere length maintenance by telomerase enzyme. Two models have been proposed to explain how telomerase elongates short telomeres preferentially

and both of them involve the association of telomerase with the replication fork and the dissociation of telomerase due to natural barriers at telomeres which elucidate the fact that telomere replication and elongation are tightly linked processes[67]. The first model, often referred to as the "Replication Fork Model", posits that telomerase is recruited to the telomere during the replication process. As the replication fork progresses, it exposes the single-stranded 3' overhang of the telomere, which is the substrate for telomerase action. Telomerase, with its intrinsic RNA template, extends the overhang by adding telomeric repeats. This model suggests that the shorter the telomere, the more accessible it is to telomerase, as longer telomeres may have more complex secondary structures or bound proteins that hinder telomerase access. Once the lagging strand synthesis approaches completion, telomerase is displaced due to the physical barrier posed by the approaching replication machinery or the binding of protective shelterin complex proteins, which cap the telomere ends.

The second model, known as the "Telomere Positioning Model", proposes that telomerase elongation activity is regulated by the spatial positioning of telomeres within the nucleus. According to this model, telomeres are organized in such a way that shorter telomeres are preferentially located in regions of the nucleus that are enriched with telomerase. This spatial arrangement facilitates easier access of telomerase to shorter telomeres. The dissociation of telomerase in this context is thought to be influenced by the completion of telomere replication and the re-establishment of higher-order telomere structures, which may sequester the elongated telomeres away from the telomerase-rich nuclear regions. Both models underscore the concept that telomere length homeostasis is a highly regulated process, ensuring that telomeres are maintained at an optimal length to protect chromosome ends from degradation and to prevent the activation of DNA damage responses. The preferential elongation of short telomeres by telomerase is a thus key mechanism, allowing cells to sustain chromosomal integrity over successive rounds of replication. It is thus truly a quintessential molecular conundrum.

Notes

[1] de Lange, Titia. “T-loops and the origin of telomeres.” Nature reviews. Molecular cell biology vol. 5,4 (2004): 323-9. doi:10.1038/nrm1359

[2] Maestroni, Laetitia et al. “Solving the Telomere Replication Problem.” Genes vol. 8,2 55. 31 Jan. 2017, doi:10.3390/genes8020055

[3] de Lange, Titia. “Shelterin: the protein complex that shapes and safeguards human telomeres.” Genes & development vol. 19,18 (2005): 2100-10. doi:10.1101/gad.1346005

[4] Soudet, Julien et al. “Elucidation of the DNA end-replication problem in Saccharomyces cerevisiae.” Molecular cell vol. 53,6 (2014): 954-64. doi:10.1016/j.molcel.2014.02.030

[5] Nandakumar, Jayakrishnan et al. “The TEL patch of telomere protein TPP1 mediates telomerase recruitment and processivity.” Nature vol. 492,7428 (2012): 285-9. doi:10.1038/nature11648

[6] Blackburn, Elizabeth H, and Kathleen Collins. “Telomerase: an RNP enzyme synthesizes DNA.” Cold Spring Harbor perspectives in biology vol. 3,5 a003558. (2011), doi:10.1101/cshperspect.a003558

[7] Greider, C W, and E H Blackburn. “The telomere terminal transferase of Tetrahymena is a ribonucleoprotein enzyme with two kinds of primer specificity.” Cell vol. 51,6 (1987): 887-98. doi:10.1016/0092-8674(87)90576-9

[8] Wang, Yaqiang et al. “Structural Biology of Telomerase.” Cold Spring Harbor perspectives in biology vol. 11,12 a032383. (2019), doi:10.1101/cshperspect.a032383

[9] Wang, Yaqiang, and Juli Feigon. “Structural biology of telomerase and its interaction at telomeres.” Current opinion in structural biology vol. 47 (2017): 77-87. doi:10.1016/j.sbi.2017.06.010

[10] Podlevsky, Joshua D et al. “The telomerase database.” Nucleic acids research vol. 36,Database issue (2008): D339-43. doi:10.1093/nar/gkm700

[11] Podlevsky, Joshua D, and Julian J-L Chen. “Evolutionary perspectives of telomerase RNA structure and function.” RNA biology vol. 13,8 (2016): 720-32. doi:10.1080/15476286.2016.1205768

[12] Bousquet-Antonelli, Cécile, and Jean-Marc Deragon. “A comprehensive analysis of the La-motif protein superfamily.” RNA (New York, N.Y.) vol. 15,5 (2009): 750-64. doi:10.1261/rna.1478709

[13] Lemieux, Bruno et al. “Active Yeast Telomerase Shares Subunits with Ribonucleoproteins RNase P and RNase MRP.” Cell vol. 165,5 (2016): 1171-1181. doi:10.1016/j.cell.2016.04.018

[14] Chen, Hongwen et al. “Structural Insights into Yeast Telomerase Recruitment to Telomeres.” Cell vol. 172,1-2 (2018): 331-343.e13. doi:10.1016/j.cell.2017.12.008

[15] Chen, Liuh-Yow, and Joachim Lingner. “CST for the grand finale of telomere replication.” Nucleus (Austin, Tex.) vol. 4,4 (2013): 277-82. doi:10.4161/nucl.25701

[16] Rabbani, M. A. G., Tonini, M. L., Afrin, M., & Li, B. (2022). POLIE suppresses telomerase-mediated telomere G-strand extension and helps ensure proper telomere C-strand synthesis in trypanosomes. Nucleic acids research, 50(4), 2036–2050. https://doi.org/10.1093/nar/gkac023

[17] Cai, S. W., Takai, H., Walz, T., & de Lange, T. (2023). POT1 recruits and regulates CST-Polα/Primase at human telomeres. bioRxiv : the preprint server for biology, 2023.05.08.539880. https://doi.org/10.1101/2023.05.08.539880

[18] Chen, Liuh-Yow et al. “The human CST complex is a terminator of telomerase activity.” Nature vol. 488,7412 (2012): 540-4. doi:10.1038/nature11269

[19] Diotti, Raffaella, and Diego Loayza. “Shelterin complex and associated factors at human telomeres.” Nucleus (Austin, Tex.) vol. 2,2 (2011): 119-35. doi:10.4161/nucl.2.2.15135

[20] Takai, H., Aria, V., Borges, P. et al. CST–polymerase α-primase solves a second telomere end-replication problem. Nature 627, 664–670 (2024). https://doi.org/10.1038/s41586-024-07137-1

[21] Herbig, Utz et al. “Telomere shortening triggers senescence of human cells through a pathway involving ATM, p53, and p21(CIP1), but not p16(INK4a).” Molecular cell vol. 14,4 (2004): 501-13. doi:10.1016/s1097-2765(04)00256-4

[22] Miller, Kyle M et al. “Semi-conservative DNA replication through telomeres requires Taz1.” Nature vol. 440,7085 (2006): 824-8. doi:10.1038/nature04638

[23] Sfeir, Agnel et al. “Mammalian telomeres resemble fragile sites and require TRF1 for efficient replication.” Cell vol. 138,1 (2009): 90-103. doi:10.1016/j.cell.2009.06.021

[24] Arnoult, Nausica et al. “Replication timing of human telomeres is chromosome arm-specific, influenced by subtelomeric structures and connected to nuclear localization.” PLoS genetics vol. 6,4 e1000920. 22 Apr. 2010, doi:10.1371/journal.pgen.1000920

[25] Chang, Ya-Ting et al. “Fission yeast shelterin regulates DNA polymerases and Rad3(ATR) kinase to limit telomere extension.” PLoS genetics vol. 9,11 (2013): e1003936. doi:10.1371/journal.pgen.1003936

[26] Tarsounas, Madalena, and Marcel Tijsterman. “Genomes and G-quadruplexes: for better or for worse.” Journal of molecular biology vol. 425,23 (2013): 4782-9. doi:10.1016/j.jmb.2013.09.026

[27] Leman, Adam R, and Eishi Noguchi. “Local and global functions of Timeless and Tipin in replication fork protection.” Cell cycle (Georgetown, Tex.) vol. 11,21 (2012): 3945-55. doi:10.4161/cc.21989

[28] Rageul, Julie et al. “SDE2 integrates into the TIMELESS-TIPIN complex to protect stalled replication forks.” Nature communications vol. 11,1 5495. 30 Oct. 2020, doi:10.1038/s41467-020-19162-5

[29] Leman, Adam R et al. “Timeless preserves telomere length by promoting efficient DNA replication through human telomeres.” Cell cycle (Georgetown, Tex.) vol. 11,12 (2012): 2337-47. doi:10.4161/cc.20810

[30] Huber, Michael D et al. “G4 DNA unwinding by BLM and Sgs1p: substrate specificity and substrate-specific inhibition.” Nucleic acids research vol. 30,18 (2002): 3954-61. doi:10.1093/nar/gkf530

[31] Arnoult, Nausica et al. “Human POT1 is required for efficient telomere C-rich strand replication in the absence of WRN.” Genes & development vol. 23,24 (2009): 2915-24. doi:10.1101/gad.544009

[32] Safa, Layal et al. “5' to 3' Unfolding Directionality of DNA Secondary Structures by Replication Protein A: G-QUADRUPLEXES AND DUPLEXES.” The Journal of biological chemistry vol. 291,40 (2016): 21246-21256. doi:10.1074/jbc.M115.709667

[33] Wang, Hong et al. “Single molecule studies of physiologically relevant telomeric tails reveal POT1 mechanism for promoting G-quadruplex unfolding.” The Journal of biological chemistry vol. 286,9 (2011): 7479-89. doi:10.1074/jbc.M110.205641

[34] Déjardin, Jérôme, and Robert E Kingston. “Purification of proteins associated with specific genomic Loci.” Cell vol. 136,1 (2009): 175-86. doi:10.1016/j.cell.2008.11.045

[35] Zimmermann, Michal et al. “TRF1 negotiates TTAGGG repeat-associated replication problems by recruiting the BLM helicase and the TPP1/POT1 repressor of ATR signaling.” Genes & development vol. 28,22 (2014): 2477-91. doi:10.1101/gad.251611.114

[36] Vannier, J. B., Sarek, G., & Boulton, S. J. RTEL1: functions of a disease-associated helicase. Trends in cell biology, 24(7), (2014): 416–425. doi.org/10.1016/j.tcb.2014.01.004

[37] Zhou, Ruobo et al. “Periodic DNA patrolling underlies diverse functions of Pif1 on R-loops and G-rich DNA.” eLife vol. 3 e02190. 29 Apr. 2014, doi:10.7554/eLife.02190

[38] Paeschke, Katrin et al. “Pif1 family helicases suppress genome instability at G-quadruplex motifs.” Nature vol. 497,7450 (2013): 458-62. doi:10.1038/nature12149

[39] Rodriguez, Raphaël et al. “Small-molecule-induced DNA damage identifies alternative DNA structures in human genes.” Nature chemical biology vol. 8,3 301-10. 5 Feb. 2012, doi:10.1038/nchembio.780

[40] Wallgren, Marcus et al. “G-rich telomeric and ribosomal DNA sequences from the fission yeast genome form stable G-quadruplex DNA structures in vitro and are unwound by the Pfh1 DNA helicase.” Nucleic acids research vol. 44,13 (2016): 6213-31. doi:10.1093/nar/gkw349

[41] Maestroni, L., Audry, J., Luciano, P., Coulon, S., Géli, V., & Corda, Y. (2020). RPA and Pif1 cooperate to remove G-rich structures at both leading and lagging strand. Cell stress, 4(3), 48–63. https://doi.org/10.15698/cst2020.03.214

[42] Zhou, Chun et al. “Dna2 nuclease-helicase structure, mechanism and regulation by Rpa.” eLife vol. 4 e09832. 2 Nov. 2015, doi:10.7554/eLife.09832

[43] Sarek, Grzegorz et al. “TRF2 recruits RTEL1 to telomeres in S phase to promote t-loop unwinding.” Molecular cell vol. 57,4 (2015): 622-635. doi:10.1016/j.molcel.2014.12.024

[44] Vannier, Jean-Baptiste et al. “RTEL1 is a replisome-associated helicase that promotes telomere and genome-wide replication.” Science (New York, N.Y.) vol. 342,6155 (2013): 239-42. doi:10.1126/science.1241779

[45] Ghosh, Avik K et al. “RECQL4, the protein mutated in Rothmund-Thomson syndrome, functions in telomere maintenance.” The Journal of biological chemistry vol. 287,1 (2012): 196-209. doi:10.1074/jbc.M111.295063

[46] Vannier, Jean-Baptiste et al. “RTEL1 dismantles T loops and counteracts telomeric G4-DNA to maintain telomere integrity.” Cell vol. 149,4 (2012): 795-806. doi:10.1016/j.cell.2012.03.030

[47] Ye, J., Lenain, C., Bauwens, S., Rizzo, A., Saint-Léger, A., Poulet, A., Benarroch, D., Magdinier, F., Morere, J., Amiard, S., Verhoeyen, E., Britton, S., Calsou, P., Salles, B., Bizard, A., Nadal, M., Salvati, E., Sabatier, L., Wu, Y., Biroccio, A., … Gilson, E. TRF2 and apollo cooperate with topoisomerase 2alpha to protect human telomeres from replicative damage. Cell, 142, 2 (2010): 230–242. https://doi.org/10.1016/j.cell.2010.05.032

[48] Azzalin, Claus M et al. “Telomeric repeat containing RNA and RNA surveillance factors at mammalian chromosome ends.” Science (New York, N.Y.) vol. 318,5851 (2007): 798-801. doi:10.1126/science.1147182

[49] Costantino, Lorenzo, and Douglas Koshland. “The Yin and Yang of R-loop biology.” Current opinion in cell biology vol. 34 (2015): 39-45. doi:10.1016/j.ceb.2015.04.008

[50] Zeinoun, B., Teixeira, M. T., & Barascu, A. (2023). TERRA and Telomere Maintenance in the Yeast Saccharomyces cerevisiae. Genes, 14(3), 618. https://doi.org/10.3390/genes14030618

[51] Rippe, Karsten, and Brian Luke. "TERRA and the state of the telomere." Nature structural & molecular biology vol. 22,11 (2015): 853-8. doi:10.1038/nsmb.3078

[52] Flynn, Rachel Litman et al. "Alternative lengthening of telomeres renders cancer cells hypersensitive to ATR inhibitors." Science (New York, N.Y.) vol. 347,6219 (2015): 273-7. doi:10.1126/science.1257216

[53] Misino, S., Busch, A., Wagner, C. B., Bento, F., & Luke, B. (2022). TERRA increases at short telomeres in yeast survivors and regulates survivor associated senescence (SAS). Nucleic acids research, 50(22), 12829–12843. https://doi.org/10.1093/nar/gkac1125

[54] Clynes, David et al. "Suppression of the alternative lengthening of telomere pathway by the chromatin remodelling factor ATRX." Nature communications vol. 6 7538. 6 Jul. 2015, doi:10.1038/ncomms8538

[55] Chawla, Raghav et al. "Human UPF1 interacts with TPP1 and telomerase and sustains telomere leading-strand replication." The EMBO journal vol. 30,19 4047-58. 9 Aug. 2011, doi:10.1038/emboj.2011.280

[56] Gong, Y., & Liu, Y. (2023). R-Loops at Chromosome Ends: From Formation, Regulation, and Cellular Consequence. Cancers, 15(7), 2178. https://doi.org/10.3390/cancers15072178

[57] Fernandes, R. V., Feretzaki, M., & Lingner, J. (2021). The makings of TERRA R-loops at chromosome ends. Cell cycle (Georgetown, Tex.), 20(18), 1745–1759. https://doi.org/10.1080/15384101.2021.1962638

[58] Azzalin, Claus M, and Joachim Lingner. "Telomere functions grounding on TERRA firma." Trends in cell biology vol. 25,1 (2015): 29-36. doi:10.1016/j.tcb.2014.08.007

[59] Teasley, Daniel C et al. "Flap Endonuclease 1 Limits Telomere Fragility on the Leading Strand." The Journal of biological chemistry vol. 290,24 (2015): 15133-45. doi:10.1074/jbc.M115.647388

[60] Benarroch-Popivker, Delphine et al. "TRF2-Mediated Control of Telomere DNA Topology as a Mechanism for Chromosome-End Protection." Molecular cell vol. 61,2 (2016): 274-86. doi:10.1016/j.molcel.2015.12.009

[61] Wang, Guishuan et al. "Tethering of Telomeres to the Nuclear Envelope Is Mediated by SUN1-MAJIN and Possibly Promoted by SPDYA-CDK2 During Meiosis." Frontiers in cell and developmental biology vol. 8 845. (2020), doi:10.3389/fcell.2020.00845

[62] Mikolcevic, P., Isoda, M., Shibuya, H. et al. Essential role of the Cdk2 activator RingoA in meiotic telomere tethering to the nuclear envelope. Nat Commun 7, 11084 (2016). https://doi.org/10.1038/ncomms11084

[63] Nagai, Shigeki et al. “Roles for nuclear organization in the maintenance of genome stability.” Epigenomics vol. 2,2 (2010): 289-305. doi:10.2217/epi.09.49

[64] Steglich, Babett et al. “The Fun30 chromatin remodeler Fft3 controls nuclear organization and chromatin structure of insulators and subtelomeres in fission yeast.” PLoS genetics vol. 11,3 e1005101. 23 Mar. 2015, doi:10.1371/journal.pgen.1005101

[65] Kaminker, Patrick G et al. “A novel form of the telomere-associated protein TIN2 localizes to the nuclear matrix.” Cell cycle (Georgetown, Tex.) vol. 8,6 (2009): 931-9. doi:10.4161/cc.8.6.7941

[66] Walker, J. R., & Zhu, X. D. Post-translational modifications of TRF1 and TRF2 and their roles in telomere maintenance. Mechanisms of ageing and development, 133,6 (2012): 421–434. https://doi.org/10.1016/j.mad.2012.05.002

[67] Greider, Carol W. “Regulating telomere length from the inside out: the replication fork model.” Genes & development vol. 30,13 (2016): 1483-91. doi:10.1101/gad.280578.116

Bibliography

Arnoult, Nausica et al. “Human POT1 is required for efficient telomere C-rich strand replication in the absence of WRN.” Genes & development vol. 23,24 (2009): 2915-24. doi:10.1101/gad.544009

Arnoult, Nausica et al. “Replication timing of human telomeres is chromosome arm-specific, influenced by subtelomeric structures and connected to nuclear localization.” PLoS genetics vol. 6,4 e1000920. 22 Apr. 2010, doi:10.1371/journal.pgen.1000920

Azzalin, Claus M et al. “Telomeric repeat containing RNA and RNA surveillance factors at mammalian chromosome ends.” Science (New York, N.Y.) vol. 318,5851 (2007): 798-801. doi:10.1126/science.1147182

Azzalin, Claus M, and Joachim Lingner. “Telomere functions grounding on TERRA firma.” Trends in cell biology vol. 25,1 (2015): 29-36. doi:10.1016/j.tcb.2014.08.007

Benarroch-Popivker, Delphine et al. “TRF2-Mediated Control of Telomere DNA Topology as a Mechanism for Chromosome-End Protection.” Molecular cell vol. 61,2 (2016): 274-86. doi:10.1016/j.molcel.2015.12.009

Blackburn, Elizabeth H, and Kathleen Collins. “Telomerase: an RNP enzyme synthesizes DNA.” Cold Spring Harbor perspectives in biology vol. 3,5 a003558. (2011), doi:10.1101/cshperspect.a003558

Bousquet-Antonelli, Cécile, and Jean-Marc Deragon. “A comprehensive analysis of the La-motif protein superfamily.” RNA (New York, N.Y.) vol. 15,5 (2009): 750-64. doi:10.1261/rna.1478709

Cai, S. W., Takai, H., Walz, T., & de Lange, T. (2023). POT1 recruits and regulates CST-Polα/Primase at human telomeres. bioRxiv : the preprint server for biology,

2023.05.08.539880.
https://doi.org/10.1101/2023.05.08.539880

Chang, Ya-Ting et al. “Fission yeast shelterin regulates DNA polymerases and Rad3(ATR) kinase to limit telomere extension.” PLoS genetics vol. 9,11 (2013): e1003936. doi:10.1371/journal.pgen.1003936

Chawla, Raghav et al. “Human UPF1 interacts with TPP1 and telomerase and sustains telomere leading-strand replication.” The EMBO journal vol. 30,19 4047-58. 9 Aug. 2011, doi:10.1038/emboj.2011.280

Chen, Hongwen et al. “Structural Insights into Yeast Telomerase Recruitment to Telomeres.” Cell vol. 172,1-2 (2018): 331-343.e13. doi:10.1016/j.cell.2017.12.008

Chen, Liuh-Yow et al. “The human CST complex is a terminator of telomerase activity.” Nature vol. 488,7412 (2012): 540-4. doi:10.1038/nature11269

Chen, Liuh-Yow, and Joachim Lingner. “CST for the grand finale of telomere replication.” Nucleus (Austin, Tex.) vol. 4,4 (2013): 277-82. doi:10.4161/nucl.25701

Clynes, David et al. “Suppression of the alternative lengthening of telomere pathway by the chromatin remodelling factor ATRX.” Nature communications vol. 6 7538. 6 Jul. 2015, doi:10.1038/ncomms8538

Costantino, Lorenzo, and Douglas Koshland. “The Yin and Yang of R-loop biology.” Current opinion in cell biology vol. 34 (2015): 39-45. doi:10.1016/j.ceb.2015.04.008

de Lange, Titia. “Shelterin: the protein complex that shapes and safeguards human telomeres.” Genes & development vol. 19,18 (2005): 2100-10. doi:10.1101/gad.1346005

de Lange, Titia. “T-loops and the origin of telomeres.” Nature reviews. Molecular cell biology vol. 5,4 (2004): 323-9. doi:10.1038/nrm1359

Déjardin, Jérôme, and Robert E Kingston. “Purification of proteins associated with specific genomic Loci.” Cell vol. 136,1 (2009): 175-86. doi:10.1016/j.cell.2008.11.045

Diotti, Raffaella, and Diego Loayza. “Shelterin complex and associated factors at human telomeres.” Nucleus (Austin, Tex.) vol. 2,2 (2011): 119-35. doi:10.4161/nucl.2.2.15135

Fernandes, R. V., Feretzaki, M., & Lingner, J. (2021). The makings of TERRA R-loops at chromosome ends. Cell cycle (Georgetown, Tex.), 20(18), 1745–1759. https://doi.org/10.1080/15384101.2021.1962638

Flynn, Rachel Litman et al. “Alternative lengthening of telomeres renders cancer cells hypersensitive to ATR inhibitors.” Science (New York, N.Y.) vol. 347,6219 (2015): 273-7. doi:10.1126/science.1257216

Ghosh, Avik K et al. “RECQL4, the protein mutated in Rothmund-Thomson syndrome, functions in telomere maintenance.” The Journal of biological chemistry vol. 287,1 (2012): 196-209. doi:10.1074/jbc.M111.295063

Gong, Y., & Liu, Y. (2023). R-Loops at Chromosome Ends: From Formation, Regulation, and Cellular Consequence. Cancers, 15(7), 2178. https://doi.org/10.3390/cancers15072178

Greider, C W, and E H Blackburn. “The telomere terminal transferase of Tetrahymena is a ribonucleoprotein enzyme with two kinds of primer specificity.” Cell vol. 51,6 (1987): 887-98. doi:10.1016/0092-8674(87)90576-9

Greider, Carol W. “Regulating telomere length from the inside out: the replication fork model.” Genes & development vol. 30,13 (2016): 1483-91. doi:10.1101/gad.280578.116

Herbig, Utz et al. “Telomere shortening triggers senescence of human cells through a pathway involving ATM, p53, and p21(CIP1), but not p16(INK4a).” Molecular cell vol. 14,4 (2004): 501-13. doi:10.1016/s1097-2765(04)00256-4

Huber, Michael D et al. “G4 DNA unwinding by BLM and Sgs1p: substrate specificity and substrate-specific inhibition.” Nucleic acids research vol. 30,18 (2002): 3954-61. doi:10.1093/nar/gkf530

Kaminker, Patrick G et al. “A novel form of the telomere-associated protein TIN2 localizes to the nuclear matrix.” Cell cycle (Georgetown, Tex.) vol. 8,6 (2009): 931-9. doi:10.4161/cc.8.6.7941

Leman, Adam R et al. “Timeless preserves telomere length by promoting efficient DNA replication through human telomeres.” Cell cycle (Georgetown, Tex.) vol. 11,12 (2012): 2337-47. doi:10.4161/cc.20810

Leman, Adam R, and Eishi Noguchi. “Local and global functions of Timeless and Tipin in replication fork protection.” Cell cycle (Georgetown, Tex.) vol. 11,21 (2012): 3945-55. doi:10.4161/cc.21989

Lemieux, Bruno et al. “Active Yeast Telomerase Shares Subunits with Ribonucleoproteins RNase P and RNase MRP.” Cell vol. 165,5 (2016): 1171-1181. doi:10.1016/j.cell.2016.04.018

Maestroni, L., Audry, J., Luciano, P., Coulon, S., Géli, V., & Corda, Y. (2020). RPA and Pif1 cooperate to remove G-rich structures at both leading and lagging strand. Cell stress, 4(3), 48–63. https://doi.org/10.15698/cst2020.03.214

Maestroni, Laetitia et al. “Solving the Telomere Replication Problem.” Genes vol. 8,2 55. 31 Jan. 2017, doi:10.3390/genes8020055

Mikolcevic, P., Isoda, M., Shibuya, H. et al. Essential role of the Cdk2 activator RingoA in meiotic telomere tethering to the nuclear envelope. Nat Commun 7, 11084 (2016). https://doi.org/10.1038/ncomms11084

Miller, Kyle M et al. “Semi-conservative DNA replication through telomeres requires Taz1.” Nature vol. 440,7085 (2006): 824-8. doi:10.1038/nature04638

Misino, S., Busch, A., Wagner, C. B., Bento, F., & Luke, B. (2022). TERRA increases at short telomeres in yeast survivors and regulates survivor associated senescence (SAS). Nucleic acids research, 50(22), 12829–12843. https://doi.org/10.1093/nar/gkac1125

Nagai, Shigeki et al. “Roles for nuclear organization in the maintenance of genome stability.” Epigenomics vol. 2,2 (2010): 289-305. doi:10.2217/epi.09.49

Nandakumar, Jayakrishnan et al. “The TEL patch of telomere protein TPP1 mediates telomerase recruitment and processivity.” Nature vol. 492,7428 (2012): 285-9. doi:10.1038/nature11648

Paeschke, Katrin et al. “Pif1 family helicases suppress genome instability at G-quadruplex motifs.” Nature vol. 497,7450 (2013): 458-62. doi:10.1038/nature12149

Podlevsky, Joshua D et al. “The telomerase database.” Nucleic acids research vol. 36,Database issue (2008): D339-43. doi:10.1093/nar/gkm700

Podlevsky, Joshua D, and Julian J-L Chen. “Evolutionary perspectives of telomerase RNA structure and function.” RNA biology vol. 13,8 (2016): 720-32. doi:10.1080/15476286.2016.1205768

Rabbani, M. A. G., Tonini, M. L., Afrin, M., & Li, B. (2022). POLIE suppresses telomerase-mediated telomere G-strand extension and helps ensure proper telomere C-strand synthesis in trypanosomes. Nucleic acids research, 50(4), 2036–2050. https://doi.org/10.1093/nar/gkac023

Rageul, Julie et al. “SDE2 integrates into the TIMELESS-TIPIN complex to protect stalled replication forks.” Nature

communications vol. 11,1 5495. 30 Oct. 2020, doi:10.1038/s41467-020-19162-5

Rippe, Karsten, and Brian Luke. “TERRA and the state of the telomere.” Nature structural & molecular biology vol. 22,11 (2015): 853-8. doi:10.1038/nsmb.3078

Rodriguez, Raphaël et al. “Small-molecule-induced DNA damage identifies alternative DNA structures in human genes.” Nature chemical biology vol. 8,3 301-10. 5 Feb. 2012, doi:10.1038/nchembio.780

Safa, Layal et al. “5' to 3' Unfolding Directionality of DNA Secondary Structures by Replication Protein A: G-QUADRUPLEXES AND DUPLEXES.” The Journal of biological chemistry vol. 291,40 (2016): 21246-21256. doi:10.1074/jbc.M115.709667

Sarek, Grzegorz et al. “TRF2 recruits RTEL1 to telomeres in S phase to promote t-loop unwinding.” Molecular cell vol. 57,4 (2015): 622-635. doi:10.1016/j.molcel.2014.12.024

Sfeir, Agnel et al. “Mammalian telomeres resemble fragile sites and require TRF1 for efficient replication.” Cell vol. 138,1 (2009): 90-103. doi:10.1016/j.cell.2009.06.021

Soudet, Julien et al. “Elucidation of the DNA end-replication problem in Saccharomyces cerevisiae.” Molecular cell vol. 53,6 (2014): 954-64. doi:10.1016/j.molcel.2014.02.030

Steglich, Babett et al. “The Fun30 chromatin remodeler Fft3 controls nuclear organization and chromatin structure of insulators and subtelomeres in fission yeast.” PLoS genetics vol. 11,3 e1005101. 23 Mar. 2015, doi:10.1371/journal.pgen.1005101

Takai, H., Aria, V., Borges, P. et al. CST–polymerase α-primase solves a second telomere end-replication problem. Nature 627, 664–670 (2024). https://doi.org/10.1038/s41586-024-07137-1

Tarsounas, Madalena, and Marcel Tijsterman. “Genomes and G-quadruplexes: for better or for worse.” Journal of molecular biology vol. 425,23 (2013): 4782-9. doi:10.1016/j.jmb.2013.09.026

Teasley, Daniel C et al. “Flap Endonuclease 1 Limits Telomere Fragility on the Leading Strand.” The Journal of biological chemistry vol. 290,24 (2015): 15133-45. doi:10.1074/jbc.M115.647388

Vannier, J. B., Sarek, G., & Boulton, S. J. RTEL1: functions of a disease-associated helicase. Trends in cell biology, 24(7), (2014): 416–425. doi.org/10.1016/j.tcb.2014.01.004

Vannier, Jean-Baptiste et al. “RTEL1 dismantles T loops and counteracts telomeric G4-DNA to maintain telomere integrity.” Cell vol. 149,4 (2012): 795-806. doi:10.1016/j.cell.2012.03.030

Vannier, Jean-Baptiste et al. “RTEL1 is a replisome-associated helicase that promotes telomere and genome-wide replication.” Science (New York, N.Y.) vol. 342,6155 (2013): 239-42. doi:10.1126/science.1241779

Walker, J. R., & Zhu, X. D. Post-translational modifications of TRF1 and TRF2 and their roles in telomere maintenance. Mechanisms of ageing and development, 133,6 (2012): 421–434. https://doi.org/10.1016/j.mad.2012.05.002

Wallgren, Marcus et al. “G-rich telomeric and ribosomal DNA sequences from the fission yeast genome form stable G-quadruplex DNA structures in vitro and are unwound by the Pfh1 DNA helicase.” Nucleic acids research vol. 44,13 (2016): 6213-31. doi:10.1093/nar/gkw349

Wang, Guishuan et al. “Tethering of Telomeres to the Nuclear Envelope Is Mediated by SUN1-MAJIN and Possibly Promoted by SPDYA-CDK2 During Meiosis.” Frontiers in cell and developmental biology vol. 8 845. (2020), doi:10.3389/fcell.2020.00845

Wang, Hong et al. “Single molecule studies of physiologically relevant telomeric tails reveal POT1 mechanism for promoting G-quadruplex unfolding.” The Journal of biological chemistry vol. 286,9 (2011): 7479-89. doi:10.1074/jbc.M110.205641

Wang, Yaqiang et al. “Structural Biology of Telomerase.” Cold Spring Harbor perspectives in biology vol. 11,12 a032383. (2019), doi:10.1101/cshperspect.a032383

Wang, Yaqiang, and Juli Feigon. “Structural biology of telomerase and its interaction at telomeres.” Current opinion in structural biology vol. 47 (2017): 77-87. doi:10.1016/j.sbi.2017.06.010

Ye, J., Lenain, C., Bauwens, S., Rizzo, A., Saint-Léger, A., Poulet, A., Benarroch, D., Magdinier, F., Morere, J., Amiard, S., Verhoeyen, E., Britton, S., Calsou, P., Salles, B., Bizard, A., Nadal, M., Salvati, E., Sabatier, L., Wu, Y., Biroccio, A., … Gilson, E. TRF2 and apollo cooperate with topoisomerase 2alpha to protect human telomeres from replicative damage. Cell, 142, 2 (2010): 230–242. https://doi.org/10.1016/j.cell.2010.05.032

Zeinoun, B., Teixeira, M. T., & Barascu, A. (2023). TERRA and Telomere Maintenance in the Yeast Saccharomyces cerevisiae. Genes, 14(3), 618. https://doi.org/10.3390/genes14030618

Zhou, Chun et al. “Dna2 nuclease-helicase structure, mechanism and regulation by Rpa.” eLife vol. 4 e09832. 2 Nov. 2015, doi:10.7554/eLife.09832

Zhou, Ruobo et al. “Periodic DNA patrolling underlies diverse functions of Pif1 on R-loops and G-rich DNA.” eLife vol. 3 e02190. 29 Apr. 2014, doi:10.7554/eLife.02190

Zimmermann, Michal et al. “TRF1 negotiates TTAGGG repeat-associated replication problems by recruiting the BLM helicase and the TPP1/POT1 repressor of ATR signaling.”

Genes & development vol. 28,22 (2014): 2477-91.
doi:10.1101/gad.251611.114