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Editorial

Reinvention: Building a future from our past

I would like to welcome you to this new issue of *Reinvention: An International Journal of Undergraduate Research*, volume 13, issue 1 (13.1), produced under the strangest of circumstances during the Covid-19 pandemic. We hope all of our readers are keeping safe and well. We are thankful to have been able to continue the production of the issue, despite these circumstances and limitations of the lockdown, and we are lucky to bring you this work from the comfort of our homes to yours.

In these challenging times, society has collectively engaged with the past and future. Many of us have been looking back at past pandemics and times of crisis, or at memories with loved ones. Others have been looking back at core traditions and values, reassessing what is important in their lives. At the same time, we are looking into the future. Questions are being raised relating to how we will choose to move forwards after this crisis and pondering on the various aspects of life that are begging to be re-examined – from personal lifestyles to global politics.

Although the papers and reviews in this issue were written before the pandemic began, their engagement with these questions about the past and future is undeniable, reflecting a larger concern of our times. From looking into gender disparity in politics and re-evaluating medical practices to assessing relationships to future generations and rewriting history, this issue confronts subjects of the past in new ways and invites you to think about the potential impacts on or opportunities created for the future. This theme is also reflected in the way *Reinvention* is set up, particularly the support network formulated through the review process. As an undergraduate research journal, we ask for more detailed feedback than our academic

peer reviewers might typically provide, allowing our authors to expand their knowledge and take their research to the highest standard. Our book reviews, each written by a student and by an academic, also offer the student a chance to write collaboratively with an academic in the field of the book. This enhances the idea of intergenerational unity and allows for established academics to demonstrate their support for the future generation of researchers. Mary Dass has perfectly reflected these ideas in her concept of the intertwining of hands from different generations for the cover of this issue.

These ideas link to our discussions about *Reinvention* itself as we too are always looking into the past, reflecting on our core aims and values as a journal, but also into the future as we seek out new ways of development. Once again, this year we have gone back to the idea of accessibility, discussing its importance in the context of the future of research. For this issue, we have introduced a new way of promoting this – the introduction of glossaries – hoping to encourage an interdisciplinary readership that we, in turn, anticipate will contribute to more innovative research. At the same time, we are looking forwards and developing the breadth of our content, this time by expanding our current set of reviews to include exhibition reviews, which you will find in this issue.

Edition 13.1 brings you five original research papers, two sets of book reviews and two exhibition reviews. We hope that as you read this work, you will learn something new but also see the positivity the future holds, even in such troubling times.

Ptolemy Banks's paper 'Myriad-briefing: A pilot study into its effect on participation and its appropriateness for online research' is an exploration of a novel approach to briefing participants in research studies. It is a rigorous examination of the issues created by existing briefing methods and a guide to an entirely new one. The paper is a perfect demonstration of this year's theme and an important piece of work for future studies in various fields.

Avery Beam's 'Women's Representation in the Post-Soviet Space: Latvia and Lithuania' dives into the poignant issue of representation through a comparative study of the role of electoral systems in government in Latvia and Lithuania. Beam demonstrates great articulacy in discussing the nature of post-Soviet spaces and is insightful in her investigation of promoting progress.

Amos Ochieng Okutse's 'The Impact of Sleeping Duration on the Risk of Breast Cancer: A systematic review and meta-analysis of population-based cohort studies' is a detailed analysis of existing literature and studies on the link between sleep and breast cancer. By systematically bringing together this research, the author demonstrates their novel insight, which is significant not only for the medical community but also the general public.

Isa Hassan and Leda Mirbahai's 'The Role of the Autophagy Inducer Spermidine in Cardiovascular Ageing' is also a work that brings together previous research and literature, this time as an intricate review of spermidine. Through this review, the authors demonstrate a key element of undergraduate research by applying a novel perspective onto existing sources, bringing them together to say something new.

The final paper is Lieke Voorintholt's 'Discounting Beyond Death: An exploration of intergenerational distribution preferences'. This paper summarises our theme for the issue by making us think about how we value the welfare of future generations. Voorintholt looks at an apt issue through a novel study, examining the views different generations have towards the future as well as older generations' relationships with future ones.

The papers of this issue are directly complemented by our reviews. Katja Laug and Shayla Rance's review of *The New Silk Roads* by Peter Frankopan is an insightful dive into the differences between this volume and the original publication from 2015, pondering on the changes not just in the text but in the world they describe. Laug is an IAS Fellow and Sessional Tutor in English and Comparative Literary Studies, and Rance is a Politics undergraduate, specialising in International Relations at Monash. This book reflects the aims of the issue, but also of *Reinvention* more broadly, as the reviewers comment on its outstanding accessibility and ability to break down complex ideas of political economy for a lay reader.

Our second review is of *Invisible Women* by Caroline Criado Perez, reviewed by Dr Nese Ceren Tosun and Ridmi Dolamulla. The reviews highlight the author's air-tight argument, which leaves readers with no other option but to confront the reality of the incredibly important subject of gender equality. They also praise the book's ability to look beyond the usual suspects to give a fresh slice of hope on dealing with gender inequality through an interdisciplinary approach. Tosun is an interdisciplinary

researcher, lecturer and member of the IATL department at Warwick and Dolamulla is a Biomedical Science undergraduate at Monash.

Finally, for the first time, we present you with two exhibition reviews, reviewing *Last Supper in Pompeii* held at Oxford's Ashmolean Museum in 2019, an exhibition about the ancient city and particularly its relationship with food – an under-represented topic in the discussion of the city's history. The two reviews were written collaboratively by students in the department of Classics and Ancient History at the University of Warwick. They wonderfully capture the artefacts and presentation of the exhibition as well as critiquing and providing insight into its curatorial choices, while reflecting collaboration advocated by *Reinvention*.

In our last issue, former *Reinvention* editor Hannah Duffus outlined some advice for those thinking of submitting their research to us. She emphasised interdisciplinarity and accessibility. To this I would like to add the elements we have focused on in this issue – specifically the engagement with past concepts and literature, facilitating the ability to see them through a novel perspective, but also thinking about research in terms of its future implementations.

I would like to thank everyone who contributed to this issue and persevered to bring everything together, despite the challenges we are all currently facing in our daily lives. I hope this issue inspires undergraduates to pursue their research and gives optimism about the future to all our readers. We ourselves are looking forward to new collaborations for our next issue as we continue to develop and grow.

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Myriad-briefing: A pilot study into its effect on participation and its appropriateness for online research

Ptolemy D. W. Banks, Department of Psychology, University of Warwick, Coventry

Abstract

Briefing a participant is necessary to obtain informed consent. However, briefing can change a participant's behaviour; for example, knowledge of an upcoming memory test might cause you to attend to experimental stimuli more so that you look clever in the test. Studies that try to measure natural behaviour therefore use deception to avoid this behaviour change. However, this merely flips the problem from a methodological one to an ethical one. This paper guides future research of a potential solution: myriad-briefing is a technique of presenting a collection of possible procedures to ambiguate the nature of the experiment so that participants consent to the experimental procedure without knowing what the experiment will involve. Before more extensive investigation of the application of myriad-briefing, this paper investigated two salient concerns. Part 1 collects feedback from participants about myriad-briefing to see if presenting more procedures discourages participation. Results find no negative effect of myriad-briefing on participant interest. Part 2 tests whether participants pay attention to myriad-briefing in online studies. Results find that too few participants read the briefing to produce an observable effect, suggesting that myriad-briefing should be tested and applied to in-person experiments only.

Keywords: Briefing, informed consent, participant awareness, confounding results, deception, myriad-briefing

Introduction

Ethical protocol asks that researchers brief participants about an experimental procedure before collecting data (American Psychological Association, 2017; The British Psychological Society, 2017). However, most psychology research recruits psychology undergraduate students who are educated in the field (Gallander Wintre, North and Sugar, 2001; Levenson, Gray and Ingram, 1976), so participants may be able

to deduce what the experimenter is trying to investigate from the procedure. This is problematic because this awareness can change behaviour; for example, eating behaviour significantly changes when participants know their food intake is a measured variable (Robinson, Kersbergen, Brunstrom and Field, 2014). When attention influences the dependent variable in this way, the variable is confounded. To avoid this, researchers are forced to deviate from ethical code and deceive participants with a cover story. A cover story is a fictitious procedure told to participants to avoid them knowing the study aims and changing their behaviour. Thus, protecting the variables comes at the cost of ethical practice.

An example of this would be one study by Nairne, Thompson and Pandeirada's (2007) investigated factors that affect implicit learning of words. They asked participants to rate words, gave participants a distractor task, and then provided a surprise word-recall test. They did not inform the participants of the word-recall test during briefing because awareness of the test may have encouraged participants to focus on remembering words. This would mean measuring explicit learning rather than implicit learning. Awareness-sensitive variables lead to a prevalent use of deception in research (Davis and Holt, 1992; Gross and Fleming, 1982). The continuous use of deception is arguably leading to a bad reputation that psychologists are deceitful (Ledyard, 1995; Hey, 1991).

To resolve this, the author of this paper has designed myriad-briefing: a novel way to brief participants more ethically while avoiding deception. For myriad-briefing, a conventional briefing is simply split into individual tasks, then randomised with several other 'distractor tasks' (see Figure 1). The participant is told the number of tasks they will carry out but not told which tasks or what order.

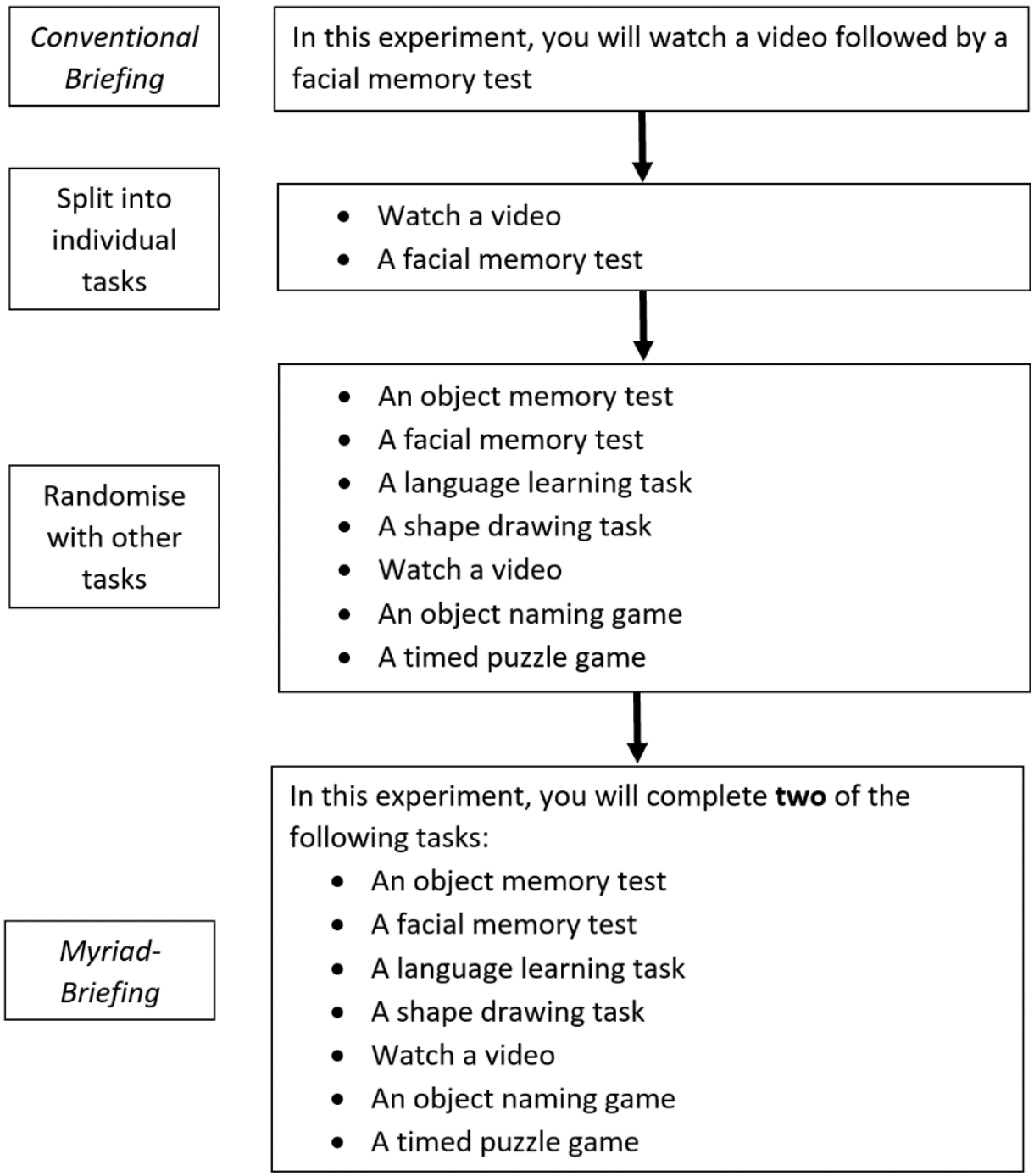

Figure 1: An example of turning conventional briefing into myriad-briefing

Participants are presented with the real procedure amongst several distractor procedures, but they read and consent to all of them. Thus, the experimenter has obtained informed consent to do the real tasks, consistent with ethical code, but the multitude of presented tasks creates a myriad of possible procedures. With so many possibilities of what the experiment may involve, participants do not know what to focus on. As far as the author is aware, this method of briefing has never been investigated despite its potential application to many studies.

A full review of the methodological and ethical considerations of briefing, and an experiment to verify the effectiveness of myriad-briefing are currently underway. This

paper describes an online pilot study with two parts to explore two preliminary concerns:

The first concern is that myriad-briefing shows participants a larger number of procedures compared to conventional briefing. Therefore, with myriad-briefing, participants may perceive the experiment to be arduous and become unwilling to participate. Part 1 investigates participants' attitudes towards myriad-briefing using qualitative and quantitative measures with the aim to determine whether myriad-briefing has a negative effect on willingness to participate. Participant feedback was also obtained to improve myriad-briefing for future research.

The second concern is that research suggests that most participants do not read online consent forms, including briefing (Perrault and Keating, 2018; Knepp, 2014; Varnhagen *et al.*, 2005). This suggests that myriad-briefing is redundant in online research because the briefing is ignored. Part 2 investigates whether different briefing techniques have any effect on performance online, and whether the briefing is read by participants online. The aim of this part is to determine whether online research is an appropriate context to test the effectiveness of myriad-briefing, and to further explore its applications.

Participants

All 238 participants were recruited from an online participant pool at the University of Warwick (SONA cloud-based subject pool) and completed both parts online via Qualtrics for a chance to win £10. By using the university participant pool, the sample was representative of a sample typically used in research at the institution. It is likely the participants were experienced in online studies.

Demographic data collected showed 136 (57%) were female, 81 (34%) male and 21 (9%) did not disclose. No other demographic data was deemed relevant. Of the 238 participants, 40 (16.8%) did not complete all parts of the experiment and were excluded from the data. Attrition analysis suggested no noteworthy findings of when participants dropped out, or what condition they were in.

The experiment lasted 12 minutes on average. This study is consistent with British Psychological Society code of ethics, and the protocol was approved by the Department of Psychology ethics committee at the University of Warwick before enrolment.

Part 1

Myriad-briefing may dissuade participants from taking part in a study because it presents more procedures compared to conventional briefing. Participants may see the list of tasks and drop out before seeing that they only do a few. To see if myriad-briefing is perceived more negatively than conventional briefing, participants were given hypothetical briefing forms and asked to provide qualitative and quantitative feedback.

This study also investigated whether the difficulty of procedures as well as the number of procedures has an effect on participant interest. Different groups were presented with different workloads. It was hypothesised that participants would be more interested if the distractor procedures had a lower workload, i.e. shorter/easier task.

Methods

Participants were randomised by a computer-generated sequence into one of four groups in a 1:1:1:1 ratio. Each group was presented with a different briefing. One group saw a conventional briefing (only mentioning a word memory test; n = 41). Three groups saw myriad-briefing; each of the myriad-briefing groups saw the same kind of tasks, but with a low (n = 56), medium (n = 43) or high (n = 55) workload using different quantifiers. Below are the tasks presented, with the low, medium and high quantifiers in brackets respectively.

- Watch a [5/10/15] minute video
- Learn [10/15/20] fictitious words
- A [colour/food/physics] quiz
- [5/10/15] maths questions
- Distinguish [5/10/15] pairs of images
- Read [a/two/three] short article[s]
- Complete a word memory test

A simple three-item scale was constructed, including 'how likely would you participate in the above experiment if you had the time?' (a neutral question), 'how likely could you find the above experiment boring?' (a negative question) and 'how likely could you find the above experiment enjoyable?' (a positive question). Each question was on a six-point scale between 'extremely unlikely' to 'extremely likely'. Having one neutral, one negative, and one positive question balanced the neutrality of the scale. The order

of questions was also randomised to avoid systematic order effects. The same scale was used across conditions.

For quantitative analysis, the six-point scale was given a numerical value from 'extremely unlikely' to 'extremely likely' (-3, -2, -1, 1, 2, 3). The question about likelihood of boredom was reversed (+3 to -3). Scores of all three questions were then summed and the mean sum of each condition was compared. Additionally, there was a text entry box where participants were asked to 'please express any opinions about the above study that you may have as a participant' for qualitative analysis. Thematic analysis was performed on comments relevant to the presentation of procedures.

Results and discussion of Part 1

For the quantitative analysis, a Kruskal–Wallis Test found no significant difference between groups for the rating scale ($\chi 2(3) = 2.653$, $p > .05$), seen in Figure 2. Firstly, this suggests that participants who saw the myriad-briefing were as interested in the hypothetical study as participants who saw the conventional briefing. That is to say, a larger number of procedures on the consent form did not discourage participant interest. Secondly, this suggests that participants who saw more difficult tasks were as interested in the hypothetical study as participants who saw the easier tasks. That is to say, the workload of procedures on the consent form did not discourage participant interest.

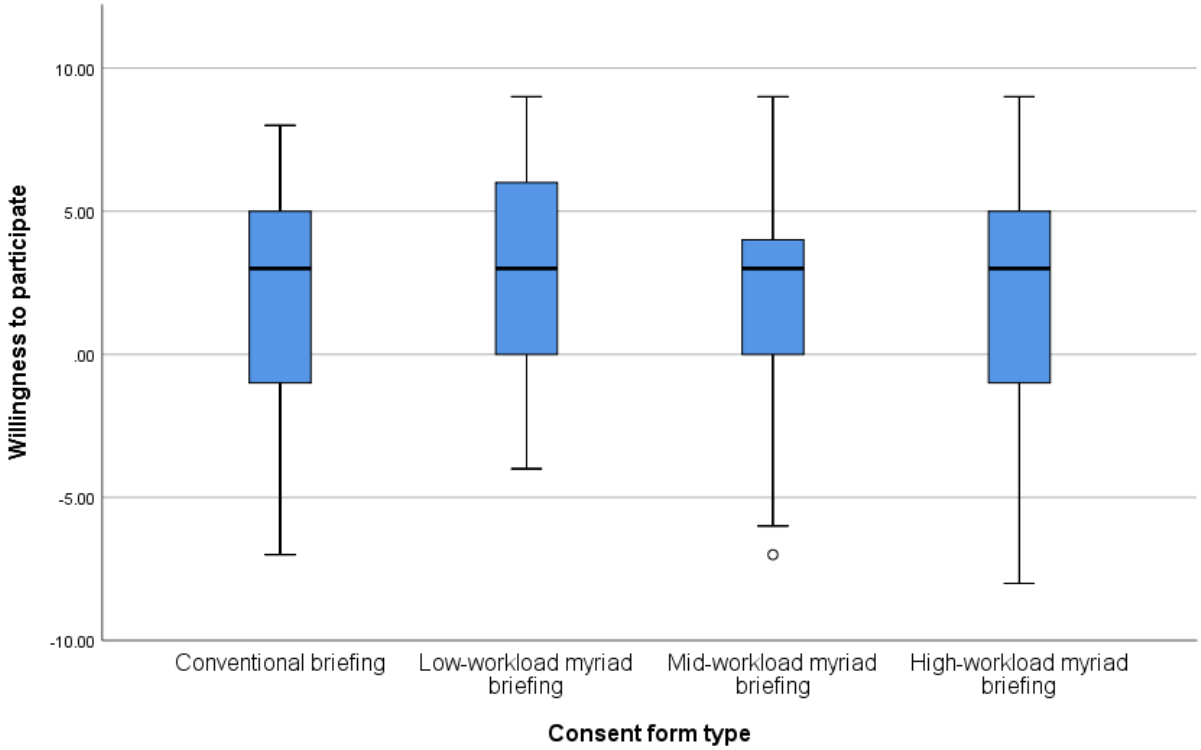

Figure 2: Willingness to participate between groups – an aggregate score from the three questions was used as a variable of overall willingness to participate

These findings are, however, limited by the unreliability of data collected online; participants may complete the questions with little or no consideration to minimise the time they spend doing the experiment. Without an experimenter present, there is little motivation to take time giving sincere answers.

For the thematic analysis, no participants gave any relevant comments on the conventional briefing. For all the myriad-briefing groups, there were positive comments of interest and curiosity about the multiple potential procedures, but many were qualified by a negative statement suggesting that there were too many tasks to complete. For example, 'too many tasks', 'way too much to do for one experiment' and 'interesting but challenging'. This suggests participants misinterpreted the briefing and believed that all the tasks must be completed. Some participants did complain of 'too [many] words' in the briefing. This suggests that myriad-briefing should make it absolutely clear that there are only a limited number of tasks to do.

Overall, the results of this experiment do not suggest that myriad-briefing compromises participants' interest. However, the results are not reliable enough to clearly dismiss this concern. This paper, therefore, recognises a need to further investigate the effect of myriad-briefing on willingness to participate in a more

reliable way than online. Additionally, the qualitative feedback provides valuable insight to improve how myriad-briefing is phrased to participants.

Part 2

Myriad-briefing could be an effective way to obtain consent without confounding variables but the technique must be reliably tested before being applied to research methodology. Testing myriad-briefing online could require less time and obtain a larger sample than experimenting in person, but literature suggests that extremely few participants read online consent forms (Perrault and Keating, 2018; Knepp, 2014). If participants ignore the consent form, the technique is no different from conventional briefing or even no briefing at all. Therefore, this part explores whether myriad-briefing should be evaluated through online research or not.

In this part, participants are presented with an online version of the Nairne, Thompson and Pandeirada's (2007) implicit learning study. Different groups are presented with different briefing techniques and the effect on learning is compared. In theory, conventional briefing informs participants of the upcoming memory test and results in higher learning due to greater effort to learn the stimulus words. But in practice, it is hypothesised that participants in all conditions ignore the briefing and there is no difference in learning.

As well as the effect on learning, to confirm whether participants read the briefing, participants were also tested on what tasks they saw in the briefing form. Therefore, it was also hypothesised that participants would ignore the online briefing and fail to recall contents of the briefing form.

Methods

Participants were randomised by a computer-generated sequence into one of three groups in a 1:1:1 ratio. Groups were either briefed conventionally (n = 64) whereby the word-recall test was explicitly stated, deceptively (n = 63), which mentioned the word-rating task without mention of a word-recall test, or with myriad-briefing (n = 72) whereby the tasks were randomised in a list of other distractor procedures. After briefing, there was a word-rating task, a distractor task and a surprise recall test of the words:

Word-rating task: all participants rated 30 words according to their relevance to a hypothetical situation. All participants were given the same hypothetical situation and saw the same words in the same order for five seconds each. Words were rated between 1 to 5 for relevance to the hypothetical situation (1 = not relevant; 5 = very relevant). The purpose of this task was simply to expose participants to the words; the ratings served no purpose. The scenarios and words were taken from the original Nairne, Thompson and Pandeirada (2007) study.

Distractor task: participants performed a digit-recall task twice. In each round, seven single digits flashed sequentially on screen for one second each, then participants were asked to recall the sequence. The sequences were the same for all participants.

Surprise recall test: participants were asked to write as many words from the word-rating task that they could remember. Words were accepted with simple spelling errors (e.g. 'truk' instead of 'truck') but not semantic errors (e.g. 'lorry' instead of 'truck'). Some participants spent longer trying to recall words. To control for the unequal time/effort that participants put in, the number of words accurately recalled was divided by the time spent on the recall page of the survey. This gave a words-recalled-per-minute variable, which was compared between groups.

Before being debriefed and completing the study, participants were shown a list of 14 tasks in the same arbitrary order. They were asked to select the tasks that they saw earlier in the briefing form. Accuracy of how many were correctly selected/correctly left unselected was out of 14.

Results and discussion of Part 2

Using a Kruskal–Wallis Test, there was no significant difference in word recall between groups ($\chi^2(2) = 0.229$, $p > .05$). This means that participants who were told of the word-recall test performed no differently than participants who were not told. This suggests that participants in each group paid little attention to the briefing and no group benefited as a result. This is consistent with the literature (Perrault and Keating, 2018; Knepp, 2014). An online study, therefore, is an inappropriate context to test the effectiveness of myriad-briefing because participants ignore the consent form, resulting in no observable effect.

In support of this claim, participants in the myriad-briefing group had an average accuracy of 4.8 out of 14 when recognising what procedures they were briefed with.

This means that, on average, participants failed to recognise, or falsely recognised, nine procedures that they saw minutes earlier during the briefing. Taken together, the lack of difference between groups in word recall and the poor recognition of the briefing suggests little attention was given to the briefing form. Investigations into the application of myriad-briefing should focus on in-person research.

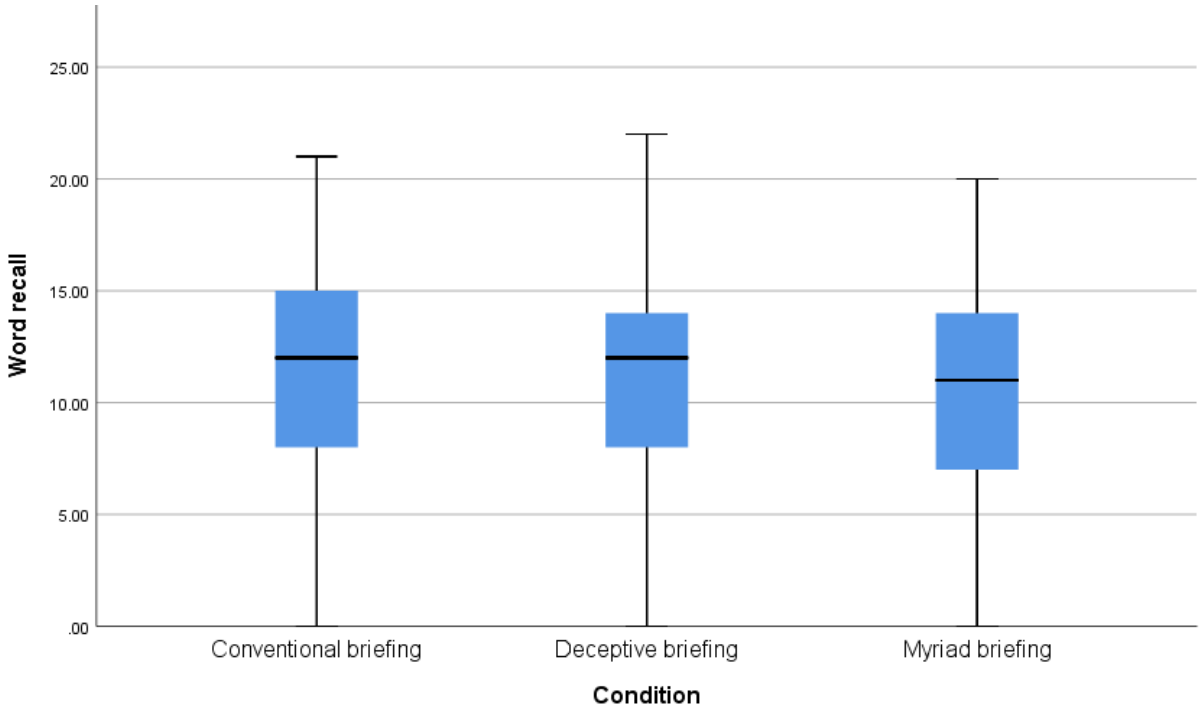

Figure 3: Word recall between groups – non-significant difference and large error bars suggest too little attention was given to the briefing form to influence attention during the task to increase recall.

There is the possibility that the measures were not sensitive enough. Perhaps briefing does influence implicit learning, but the experiment failed to detect it. It is worth noting that the data was not normally distributed and there was huge variation in performance, which creates a lot of 'noise'. To best evaluate myriad-briefing as a methodology in a future study, more controlled laboratory measures should be employed for clearer data. An open-ended recall may have been more appropriate as this avoids participants getting some right due to chance.

Conclusion

This paper introduces myriad-briefing as a concept technique of briefing participants without compromising ethics or methodology. To be employed in research, myriad-briefing must first be tested as an effective solution. The experiment described in this

paper has provided valuable insight into how myriad-briefing can be improved and the best way to test its effectiveness.

One preempted concern of myriad-briefing was that presenting more procedures may discourage participants. Part 1 found that a larger number of procedures did not influence the interest to participate in a hypothetical study, nor did the workload of the procedures. Although one negative finding cannot disprove there being an effect, the results encourage further testing of myriad-briefing. Additionally, the feedback will be used to enhance the phrasing of myriad-briefing to minimise ambiguity.

A second preempted concern was that evaluating myriad-briefing online may be a waste of resource because participants often ignore the online briefing (Perrault and Keating, 2018; Knepp, 2014). To confirm this, Part 2 found that there was no effect of briefing on a variable thought to be 'awareness-sensitive', and participants failed to accurately recognise what they were briefed with. This finding has two wider implications: firstly, it replicates and reiterates the issue that informed consent is rarely obtained in online research. Given the increasing number of studies conducted online, developing new ways to encourage paying attention to the briefing is increasingly important. Secondly, it suggests that myriad-briefing will be redundant for online research even if future research proves it effective for in-person research.

A common limitation of the two parts of this paper is that online research provides unreliable and noisy data, although this has been insightful; this paper prescribes that a future study evaluates myriad-briefing with more sensitive measures in a face-to-face experiment to motivate participants to engage. The author is currently collecting data for an experiment of this nature and writing a more in-depth review of the potential benefits of myriad-briefing.

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Glossary

Informed consent The consent given by a participant to take part in a study in full knowledge of the potential outcomes.

Kruskal-Wallis Test A statistical analysis for comparing two or more independent samples when distribution is not normal.

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Women's Representation in the Post-Soviet Space: Latvia and Lithuania

Avery Beam, Southwestern University, Texas

Abstract

Using a most-similar case design to compare Latvia and Lithuania, this study examines the role electoral systems play in affecting greater representation of women in post-Soviet democracies. After the country's most recent election, Latvia demonstrated a higher percentage of women in its parliament than Lithuania. Interestingly, despite having higher descriptive representation, Latvia has no quotas or women's organisations/caucuses while Lithuania implements voluntary quotas and has a prevalent women's caucus. This study advances an institutional argument, hypothesising that the Latvian parliament's higher percentage of women can be attributed to its proportional representation electoral system. Lithuania has a mixed system that has favoured a majoritarian pole. This, in turn, has adversely affected women's electoral success. In many ways, women's substantive representation in Latvia and Lithuania is only marginally different. However, regarding the sheer number of women in parliament, the difference between Lithuania and Latvia proves relatively marked. The Latvian and Lithuanian cases demonstrate that proportional representation electoral systems are more favourable to women candidates than mixed systems, even in the absence of quotas and a women's movement, and particularly in the context of post-Soviet democracies.

Keywords: Women's representation, descriptive representation, electoral systems, post-Soviet democracies, institutionalism, proportional representation system, Eastern European democratic development, post-communist democracies

Introduction

As post-communist countries with relatively new democratic systems of government, Latvia and Lithuania have struggled to overcome the legacy of Soviet ideological and political structures that have inhibited the success of minority candidates, specifically women candidates. After its 2018 parliamentary election, Latvia demonstrated a much higher percentage of women in its parliament (31 per cent) than Lithuania (21 per

cent, at the time). Following Lithuania's most recent parliamentary election in 2019, its parliament's percentage of women shifted to 24 per cent – still leaving a statistically significant margin between that of Latvia's. Interestingly, despite having higher descriptive representation, Latvia has no quotas or women's organisations while Lithuania implements voluntary quotas and has a prevalent women's caucus. This gender disparity between Latvia and Lithuania's respective parliaments begs the question: why does Latvia have higher descriptive representation for women than Lithuania? I argue that the Latvian parliament's higher percentage of women can be attributed to its proportional representation electoral system. Lithuania has a mixed system that has favoured a majoritarian tier that, in turn, has adversely affected women's electoral success. In many ways, women's substantive representation in Latvia and Lithuania is only marginally different. However, in regard to the sheer number of women in parliament, the difference between the countries proves relatively marked. The Latvian and Lithuanian cases demonstrate that proportional representation electoral systems are more favourable to women candidates than mixed systems, even in the absence of quotas and a women's movements, and particularly in the context of post-Soviet democracies. Relatively little research has been done regarding the effects of electoral systems on gender equality in post-Soviet democracies. The Latvian and Lithuanian cases prove especially significant because they confirm a strand of the women and politics literature that posits that electoral systems play a crucial role in advancing gender equality, specifically in post-Soviet, EU enlargement countries that have recently transitioned to democratic, parliamentary systems.

Most-similar cases: Latvia and Lithuania

This study employs a most-similar case design to compare Latvia and Lithuania and demonstrate that electoral systems are the most significant causal factor affecting the number of women in post-Soviet parliaments. As countries that have struggled to adequately accede to EU standards for equality and promote women candidates in the post-Soviet space, Latvia and Lithuania provide ideal cases to test the electoral systems explanation for women's representation. Latvia and Lithuania's substantial similarities provide analytical leverage so that a large number of historical, political, and ideological factors have less explanatory power when determining the factor that most influences descriptive representation in these countries.

Lithuania and Latvia are culturally similar and have closely linked historical experiences. Both countries gained independence from the Soviet Union in 1991 and

joined the European Union and NATO in 2004. Their shared communist history has influenced their current political, economic and social development in important ways. After the collapse of communism, these countries underwent a similar transition to democratic regimes and liberal market economies and experienced political and economic instability, raising rates of unemployment and a reform of socialist welfare state (Avdeyeva, 2010, 203). Most crucially, both countries went through a process of accession to the European Union, which established a single standard of policy across the countries (Avdeyeva, 2010, 203). Cowles, Caporaso and Risse argue that the capacity to accede to the EU, 'or countries' ability to adhere to the EU policy standards in different policy areas, depends on the fit between existing national policies and EU requirements' (cited in Avdeyeva, 2010, 207). In other words, countries where domestic policies are closer to EU standards typically have more streamlined, effective adoption and enforcement processes for democratic policies. In her large N study examining gender equality in EU enlargement countries, Avdeyeva finds that governments are more likely to adopt and implement international standards on gender equality in those countries that were initially better prepared for accession (Avdeyeva, 2010, 207). As the countries are former Soviet states that are deeply entrenched in the legacy of communism politically, economically and even culturally, EU experts accurately considered Latvia and Lithuania less prepared for accession than other states. This, in turn, affected the likelihood of the implementation of gender equality measures in these countries (Avdeyeva, 2010, 208). Effectively, Latvia and Lithuania inherited similar communist legacies and had to go through a major transition to embrace the norms, values and practices of democratic regimes. This is particularly important for capturing the political and social struggles that evolved in post-communist Latvia and Lithuania – specifically a divide around policies related to gender equality.

Latvia and Lithuania both operate under a unicameral parliamentary system and do not implement any compulsory gender quotas on the governmental level. Overall gender equality proves minimal in both countries, especially in terms of women's numbers in elite economic positions and policies that directly benefit women. However, in the workforce, gender equality proves relatively high for Latvia and Lithuania. Employing the Gender Equality Index published by the European Institute for Gender Equality, one can determine the similarities in gender equality across countries a part of the European Union. The Index measures the differences between women and men in key domains of the EU policy framework (e.g. workforce, healthcare), using a scale from 1 (full inequality) to 100 (full equality). In the Gender

Equality Index 2017, Latvia achieved a score of 57.0 out of 100 (European Institute for Gender Equality 2017, 1). Lithuania achieved a score of 56.8 out of 100 (European Institute for Gender Equality 2017, 1). Lithuania and Latvia rank relatively well in the domain of work, with participation for women scoring the fourth- and fifth-best positions in the EU-28, respectively (European Institute for Gender Equality 2017, 3). Both countries have almost reached the national target (73 per cent) of the Europe 2020 strategy (a ten-year strategy to advance the European Union's economy; EU2020) (European Institute for Gender Equality 2017, 1).

In terms of top economic and leadership positions, women remain largely deficient. Additionally, women in these countries are still expected to care for their families; women assume a double role within the workforce and at home, which complicates their position in the economic sphere (Tripp, 2013, 512). Although a number of women have been elected to powerful political positions – Lithuania's and Latvia's Speaker of the Parliament are both women – their representation is symbolic with no real political power to influence policy (Tripp, 2013, 512). Although Lithuania has proven compliant to EU standards of gender equality and demonstrates higher levels of compliance than most Eastern European states, gender equality policies still prove lacking in most issue areas (e.g. childcare, income; European Institute for Gender Equality, 2017, 3). Even though equal opportunity policy is realised in post-Soviet Lithuanian society, actual changes in society have proven slow (Jurėnienė, 2015 2). Similarly, while Latvia currently retains a relatively high level of women's representation in parliament, more pro-active gender equality policies will prove necessary to promote any meaningful forms of substantive representation (Rastringa, 2015).

Both Latvia and Lithuania have relatively weak, decentralised women's movements with limited points of access to influence state policy. In an evaluation of Latvia's women's movement, Picukane finds that the movement is not widespread nor very influential in terms of changes achieved, and the cooperation among organisations involved in the movement is weak (Picukane, 2003, 1). Since accession, gender studies and women's organisations in Lithuania have become more prominent. Yet, Jurėnienė finds 'Despite this advancement, it is not fashionable to be a feminist in Lithuania. Even women researchers interested in gender issues and involved in related studies usually do not identify themselves as feminists' (Jurėnienė, 2015, 2). Although gender equality has become more of a priority in Lithuania, the influence of the women's movement proves low when compared to other countries of the EU but markedly similar to the situation in Latvia. Because of the similarities outlined above, Latvia and

Lithuania's shared communist history, as well as their political systems, overall gender equality, economic women's representation, women's movements can be discounted as significant explanations for the number of women in their respective parliaments.

Literature review

There are various schools of thought that can explain women's descriptive representation in post-Soviet parliamentary democracies. Some scholars maintain that the prevalence of women's organisations is the most significant factor influencing women's descriptive representation. Others argue that the commitment of political parties to promoting gender equality has the highest impact on increasing the number of women in office. However, the cases of Latvia and Lithuania demonstrate that, in the absence of a proportional representation (PR) system or a strong proportional tier in a mixed system, these explanations prove insufficient, particularly in the case of post-Soviet democracies. The critical difference between Latvia and Lithuania lies in their electoral systems – and electoral systems present the most compelling explanation for the current number of women in their respective parliaments.

The number of women holding elective office across parliamentary democracies has increased considerably in recent decades, and many scholars attribute this increase to the influence of women's interest groups or organisations. These groups, which often champion certain issues related to gender equality generally and women specifically, provide a point of access for women to gain political experience and enter decision-making positions (Francia, 2010, 151). Conversely, organisations in most Eastern European countries have largely failed to develop a unified, coherent agenda, suggesting that the presence of women's groups do not fully explain instances of high women's representation in newly democratic, post-Soviet countries such as Latvia (Sloat, 2005, 437). Unlike Latvia, Lithuania has a number of women's organisations that focus largely on providing services to women such as psychological, financial and legal help (Stankevicius. 2012, 58). Lithuania's Women's Parliamentarian Group is an organisation within the parliament that advocates for women's civil rights. However, because Lithuania has substantially fewer women in parliament than Latvia, the presence of women's organisations (particularly in the absence of strong proportional tier) does not have a sufficient causal relation to the number of women in office.

One of the most prevalent explanations for enhanced women's descriptive representation is the commitment of political parties to promoting gender equality and supplying women candidates. Evidence has shown that potential women

candidates are subject to bias in recruitment that hinders the cause of electing more women to state legislatures and Congress because party chairs who are men consistently prefer candidates like themselves (Niven, 1998, 57). Effectively, party chairs who are men express a consistent preference for traits associated with themselves, 'a preference strong enough to affect their list of prospective legislative candidates', as Niven puts it (1998, 57). Therefore, political parties, to a large degree, determine who can and cannot succeed in the political arena. In Lithuania, some progressive political parties have demonstrated a trend toward greater gender parity in their recruitment processes by placing more women on party lists for seats in the proportional tier of the electoral system. The Farmers and Greens Union, which holds a plurality in parliament, successfully elected 11 women to parliament (the highest number of the parties with a seat share), and Lithuania's social democratic party has even adopted quotas. Nonetheless, although the Farmers and Greens Union, a progressive party that proved successful largely as a response to political corruption, contributed the highest number of women to parliament, only 20 per cent of the party's seat share is comprised of women (Lithuanian Republic Seimas, 2019). Moreover, the strategies that promote equality, specifically quotas, have proven ineffective due to 'a lack of solidarity among women parliamentarians…and disagreements among social democrats as the only party where gender quotas are laid down in its Statute' (Mejere, 2008, 54). Competition over seats in the favoured majoritarian tier of Lithuania's electoral system is largely what instigate these disagreements between social democrats seeking to maximise their party's vote (Mejere, 2008, 54). Conversely, women in Latvia have found significant electoral success in the absence of party quotas. The political parties' explanation for women's descriptive representation proves deficient in the cases of Latvia and Lithuania, and presumably, similar post-Soviet democracies.

Electoral systems play a decisive role in effecting the election of women to office and act as the most significant explanation for the number of women in Latvia and Lithuania's respective parliaments. Rule argues that electoral systems act as the most important factor in determining the success of women candidates, claiming that proportional representation (PR) systems are more beneficial to women running for office (Rule, 1994, 689). Studies have found that PR systems provide a substantial advantage over majoritarian/single-member district (SMD) systems because lists, and not specific candidates, are the focus of voting (Rule, 1994, 691). PR systems have higher rates of legislative turnover or higher district magnitude than majoritarian or

SMD systems, which makes it easier for women to run for and win office because they are not competing as newcomers against incumbents (Rule 1994, 691).

Mixed systems, which consist of one proportional tier and one majoritarian tier, are often viewed as the 'best of both worlds', combining the multi-party inclusivity of the PR system with the individual agency of the SMD system. However, Raabe and Linhart (2016) assert that mixed electoral systems adversely affect proportional representation in newer democracies, such as Latvia and Lithuania. The authors' large N study demonstrates that the general conjecture of mixed electoral systems providing the 'best of both worlds' is not confirmed by empirical data. In contrast, the performance of mixed systems is largely affected by technical details as well as country-specific contexts (namely consolidated vs developing democracies). Mixed systems in newer democracies tend to favour the majoritarian pole, which hinders proportional representation (Raabe and Linhart, 2016, 21). This finding has important implications for women's representation in Lithuania's mixed system and further demonstrates that women's electoral success in Latvia can be attributed to its pure PR system. In a significant 2001 study, Moser argues against the notion that electoral systems meaningfully influence the electoral success of women candidates, in the context of post-communist democracies (Moser, 2001, 367). In a large-scale examination of electoral systems across post-communist states, with a particular focus on Russia, Moser finds that that SMDs are actually slightly more beneficial to some women candidates and more women are elected to these districts. Moser attributes this finding to:

> Patriarchal attitudes and communist legacies [that] may make parties (and the centralization of nominations in party leadership under PR) a hindrance rather than an aid to women's representation in post-communist states. Conversely, the lack of institutionalization of party systems in post-communist states has meant that parties tend to play a less central role in nominating candidates and providing voting cues to the electorate.
> — (Moser, 2001, 367)

However, more recent data in places such as Poland, the Czech Republic, Latvia and Lithuania suggests that electoral systems do play an important role. Moser's study uses data from before 2001, a largely corrupt and transitionary time for post-Soviet governments seeking to democratise. Therefore, new studies are needed to evaluate the role of electoral systems in the success of women candidate in post-Soviet countries.

Case studies

As this study is concerned with the descriptive representation of women, I will be focusing on the 2018 and 2016 parliamentary elections results for Latvia and Lithuania. In order to prove the electoral systems explanation, I will begin by looking at the sheer number of women candidates and representatives elected in Latvia's proportional system and Lithuania's single-member and proportional tiers, focusing specifically on how the single-member tier undercuts the potential number of women in Lithuanian parliament. As a general point, the greater number of parties in PR systems provides an increased likelihood that one party will decide to promote women candidates (Matland and Studlar, 1996). Therefore, I will look at how political parties have structured their party lists, as well as the share of women parliamentarians in contrast to the number of women candidates nominated by parties Latvian and Lithuanian. The ideological makeup of these parties will also be considered. In terms of sources, I will primarily utilise databases, such as the Interparliamentary Union database, and official evaluations/reports on Latvian and Lithuanian political campaigns and election results. Moreover, because relatively little research has been done regarding the effects of electoral systems on equality in post-Soviet countries, in addition to the lack of publicly available election data, studies that examine such effects in similar cases will be applied to Latvia and Lithuania.

Latvia

Latvia's PR system has proven significantly conducive to the supply and election of women candidates. The percentage of women in the Latvian parliament has ebbed and flowed over the past decade (Interparliamentary Union, 2018). However, since the 2018 elections, women currently make up 31 per cent of Latvia's parliament, reaching the EU's standards for critical mass (Interparliamentary Union, 2018). This increase in women parliamentarians is rather remarkable considering that the Latvian government implements no quotas, Latvian women's organisations are virtually obsolete, and gender equality is relatively low on parties' agendas.

In the 2018 election, Latvia's dramatic shift from 19 per cent to 31 per cent of women parliamentarians, despite lacking institutional frameworks for promoting women candidates, indicates that the PR system plays a significant role in the election of women to parliament (Interparliamentary Union, 2018). To be sure, shifts in voter attitudes and dissatisfaction with current political leaders are possible factors

contributing to this significant 12 per cent jump. However, crucially, the infrastructure of a PR system is more receptive to these normative shifts and changes in voter preferences than an SMD system. In a PR system, parties are held more accountable to the changing preferences of their core supporters. Moreover, less competition for seats in office due to high district magnitude, a product of the PR system, makes it considerably easier for parties to promote women candidates and for these candidates to be successful.

Parties' willingness to put forth women candidates in the PR system has undoubtedly affected women's representation in Latvia. Scholars generally agree that the greater number of parties in PR systems provides an increased likelihood that one party will decide to promote women candidates (Matland and Studlar, 1996). Latvia has an open-list PR system, which many argue is less beneficial to women than closed-list PR because parties have less control over the elective success of the candidates on their party lists. Interestingly, the open-list system has appeared to be beneficial to some women candidates in the case of Latvia. Kunovich (2003) finds that, in an open-list PR system, voters have the opportunity to engage in intra-party preference voting. Parties can indicate their preference for particular candidates by their placement on electoral lists (p. 273). The voters can then comply with the party's preferences and vote for the candidates in the top positions, or they can reject the party's preferences by voting further down the electoral list (p. 273). Subsequently, voters can shift the position of particular candidates on electoral lists. Kunovich examines the effects of open-list PR systems on gender equality in Poland and the Czech Republic. Like Latvia, both Poland and the Czech Republic have open-list PR systems with multi-member districts. Her research suggests that, because major political parties in post-communist countries typically view female candidates as less desirable than male candidates, an open-list system can allow voters to deviate from party preferences and elect more women to office (Kunovich, 2003, 290; 2012, 174). In a later study, Kunovich (2012) confirms that:

> [there is no] systematic evidence that having an open-list system was an obstacle to women's election in Poland. In fact, I found that voters across the political spectrum positively shifted female candidates up the electoral list. Many parties often responded to positive shifts in the previous election by increasing the percentage of women in top positions on their subsequent lists. — (p. 174)

This implication proves especially important in the case of Latvia where women have been well-incorporated into the economic sphere and a large portion of voters is comprised of women.

Although Kunovich examines Poland and the Czech Republic in her studies, her findings – specifically in terms of the relationship between a post-communist open-list system and higher women's descriptive representation – can be applied to the Latvian case. Parties in Latvia have nominated significant numbers of women, not to push women's issues, but to emphasise these women as 'competent technocrats and as less corrupt than the average Latvian politician' (Matland and Lilliefeldt, 2014). It also appears that voters in Latvia are largely indifferent to candidate gender but, with a party hierarchy that tends to hold women back, preferential voting in the Latvian PR system has, in several cases, helped women, particularly in the most recent election where women candidates may have been seen as reflective of positive change (Matland and Lilliefeldt, 2014). Comparing the share of women candidates to the share of women in parliament, 31 per cent of Latvia's candidates were women, and 31 per cent of Latvia's current parliament is comprised of women – a largely unprecedented ratio of success for women's representation before and after an election. The electoral success of opposition parties, namely KPV and Harmony, indicates that the change in Latvians' voter preferences, which reflects an ideological shift away from the outgoing parliament's position, duly coincides with the election of more women candidates (Latvia Central Election Commission, 2018). Commenting on the Latvian election results, Ekmanis writes, 'the desire for fresh perspectives is in votes for newer parties and more female representation' (Ekmanis, 2018). Latvia's recent election saw a surge in success of women newcomers and, in some cases, women were even reranked by voters to be closer to the top of the party list (Latvia Central Election Commission, 2018). For instance, Janina Kursite was ranked tenth for the Latgale region on the KPV party's list but was moved to the first rank in order to successfully gain a seat in the new parliament (Latvia Central Election Commission 2018). In the Vidzeme region, Karina Sprude was originally ranked ninth but moved to the third rank, and Attīstībai/Par!'s Inese Ikstena was moved from tenth to third to comply with voters' preferences (Latvia Central Election Commission, 2018). According to the candidate lists of parties with a seat share in the current parliament, before and after preferential voting, approximately 38 per cent of elected women were reranked to be higher on the list. If women were not reranked to a higher spot, most retained the same rank they had prior to preferential voting.

Permitted by the multi-polarity distinctive to the PR system, opposition parties were able to make a significant mark in Latvia's most recent election. In their article, Matland and Studlar (1996) seek to explain gaps in women's representation across electorates, arguing that traditional parties will feel pressured to nominate more women if one of their political rivals starts to promote representation of women. Crucially, opposition or fringe parties consistently promote more women candidates on their party lists (Matland and Studlar, 1996). In terms of the Latvia case, a PR system has allowed for the electoral success of alternative parties. Although the electoral success of women was similar across parties, with each successful party supplying an average of four elected women, the opposition parties with a seat share in the current parliament, such as the KPV and Attīstībai/Par! tended to promote more women candidates than the major parties, specifically New Unity, which had been a leading party in Latvia since 2010 (Latvia Central Election Commission, 2018). New Unity now possesses eight seats in parliament, only one of which is held by a woman (Latvia Central Election Commission, 2018). Because opposition parties had women ranked higher on their lists, whether through preferential voting or an unchanged ranking, their electoral success evidently led to an increased number of women in parliament, enhancing women's descriptive representation.

Lithuania

Despite having a variety of women's organisations and quota adoption on the party-level, Lithuania's 2016 election results showed that women retained 21 per cent of seats in parliament, which is 2 per cent below the world average and nearly 10 per cent below EU standards (Interparliamentary Union, 2016). It is important to note that women's share of seats in the Lithuanian parliament shifted to 24 per cent in October 2019. However, due to a lack of available election data and the low statistical significance of the shift, this paper will focus on Lithuania's previous election. As more information on party-list configurations and voting patterns for the 2019 election become available, the validity of this thesis will require further evaluation. In Lithuania, with a fluctuation of 19–24 per cent women elected to parliament over the past four election cycles, party competition tends to focus on the SMD tier of the mixed system, suggesting that with a stronger proportional tier or pure PR system, the Lithuanian parliament would have a higher percentage of women in parliament (Jastramskis 2018, 1; Interparliamentary Union, 2018). This finding is consistent with the argument that SMDs are unfavourable for the representation of women and

explains why Lithuania has such a low number of female representatives, even with the presence of women's organisations.

Before further discussion of Lithuania's electoral system, it is necessary to note that Lithuania is a predominantly Catholic country while Latvia is not. In this vein, one could argue that religion is a more significant factor than the electoral system in contributing to voter and party preferences, which in turn affects the number of women elected to parliament. The stratification of religious messages across major parties is not widespread enough to support this claim. Lithuania's Christian Democratic party and the Electoral Action of Poles are strong advocates of Catholic values, although to different ends – the latter is pro-Kremlin while the former is not (Jurkynus, 2016, 47). However, in the 2016 election, Lithuanian Farmers and Green Union achieved a landslide victory (38 per cent seat share in parliament) on a largely secular platform that focused on environmental and agrarian issues (Jurkynus, 2016, 49). The party formed a coalition with the small faction of the Social Democrats, the party with the third-highest number of seat shares and the only party to implement quotas for women's representation (Jurkynus, 49, 2016). This suggests that, in the 2016 election, religion did not play a major role in dictating voter preferences and therefore did not necessarily contribute to the low total of women in Lithuania's parliament. More than half of the few women in the Lithuanian Farmers and Green Union were elected in multi-member districts (Central Electoral Commission of the Republic of Lithuania). Interestingly, in the 2019 elections, the Christian Democratic party assumed the majority in parliament and women's representation went up by 3 per cent, while the Lithuanian Farmers and Green Union still maintained a high seat share (Lithuanian Republic Seimas, 2019). This further demonstrates that underlying traditionalist attitudes and Catholic voter preferences do not have a substantial effect on the number of woman parliamentarians in Lithuania and subsequently highlights the structure of the country's PR-SMD electoral system as a distinctive factor.

The Lithuanian case demonstrates how the strength of the SMD tier considerably affects the success of women candidates. Mixed systems, combining the multi-party inclusivity of the PR system with the individual agency of the SMD system, are sometimes referred to as 'the best of both worlds'. The basic argument for mixed systems is that candidates allocate their campaign and legislative efforts between representing organised and unorganised interests (Kerevel, 2010, 2). The author writes:

> organized interests, or interest groups, provide resources that aid in a candidate's reelection, while unorganized interests, or ordinary citizens provide the votes needed to win an election. The reasoning is that the needed votes to win an election are primarily the result of the activities of SMD candidates, while PR candidates have little individual incentive to allocate their effort towards maximising the vote.
>
> — (Kerevel, 2010, 2)

As a result, parties tend to favour the majoritarian tier in order to obtain a plurality in parliament and promote popular incumbents, who are often men, rather than new women candidates (Kerevel, 2010, 3). As Kerevel and previous studies suggest, incumbents, which are usually men, are likely to be reelected in the SMD tier. Because SMDs only return a single officeholder to the legislature, elections in the SMD tier are significantly more competitive and, as a result, parties are less likely to risk losing votes by promoting women newcomers. In Lithuania's mixed system, 71 members are elected using majoritarian rules in the SMD tier and 70 members of parliament are elected using proportional representation (Jurkynus, 2016, 47). Although members of parliament elected through the SMD tier hold a slightly higher seat share, women only make up approximately 37 per cent of party nominees in this tier (Central Electoral Commission of the Republic of Lithuania).

The Christian Families Alliance and the Political Party 'List of Lithuania' fielded the highest numbers of women candidates, 51 per cent and 48 per cent respectively, and included the highest numbers of women candidates in winnable positions (Office for Democratic Institutions and Human Rights, 2017, 10). However, the 'List of Lithuania' elected no members and the Christian Families Alliance was only able to elect three women, two of whom were elected by party list (Lithuanian Republic Seimas, 2019). Of the women elected to Lithuania's parliament, approximately 61 per cent were elected from multi-member districts (Lithuanian Republic Seimas, 2019). In this vein, the mixed design of the electoral system and specifically its SMD tier undercuts the potential number of women in the Lithuanian parliament.

Lithuania's SMD tier has also largely restricted the influence of institutions designed to promote women candidates due to the low district magnitude that characterises majoritarian systems. In many Eastern European countries, high competition for a low number of seats between women politicians in a majoritarian system or tier has adversely affected the influence of women's organisations on increasing representation (Sloat, 2005, 437). For instance, the founder of Lithuania's Women's

Parliamentarian Group, Birute Vesaite, established the group to improve women's rights in Lithuania, but many other parliamentarians interpret this action as a competitive attempt to be reelected (Stankevicius, 2012, 59). Because the Lithuanian system favours the majoritarian tier over the proportional tier, women candidates are often positioned as divergent rivals competing for a limited number of seats, which has yielded negative consequences not only for women's substantive interests but also for the widespread promotion of women candidates. Importantly, in the Lithuanian political system, political organisations and interest groups cannot put forward candidates for election in the single-member or multi-member electoral districts (Taljunaite, 2004, 2). Effectively, Lithuania's mixed system limits the influence of institutional measures that seek to promote minority interests.

Conclusion

Latvia and Lithuania demonstrate that proportional representation electoral systems are overall more favourable to women candidates than mixed systems and provide evidence that electoral systems are a significant explanation for women's electoral success in the post-Soviet space. Latvia's PR system has proven conducive to the election of women candidates, even in the absence of women's groups and quotas. In this vein, if women's organisations and political parties in the Latvian parliament were to institutionalise gender equality, the success of women candidates in the country could prove monumental. Conversely, in the absence of a strong proportional tier, Lithuania's women's organisations and progressive parties have limited influence on women's representation in parliament, and the SMD tier's low district magnitude makes it harder for women to get elected. As post-Soviet countries deeply entrenched in the legacy of communism, Latvia and Lithuania have strived to adequately accede to EU standards of equality. As a result, overcoming gender inequity and promoting women representatives has proven especially difficult for these countries.

Based on the available data, the cases of Latvia and Lithuania strongly suggest that transitioning to a more inclusive electoral system with a higher district magnitude may be the first and most crucial step to increasing women's descriptive representation in post-Soviet democracies. However, a significant limitation of this project was the lack of publicly available election data, especially in terms of Lithuania's most recent election. The electoral commissions in both countries do not provide information on voting patterns and demographics that include factors such as age, profession, or religion. Widely used, reputable platforms, such as the World Bank and the Interparliamentary Union database, provide slightly conflicting election data

for these countries. If data becomes available and accessible, more research on this topic will need to be conducted to demonstrate the cogency of the electoral systems explanation for women's descriptive representation in Latvia and Lithuania. Although Latvia's PR system provides an explanation for the electoral success of women in response to changing voter preferences, more research into why these preferences changed and voting patterns shifted away from the established parties is needed.

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Glossary

Proportional representation electoral system In a proportional representation (PR) system, parties, rather than individual candidates, gain seats in proportion the number of votes cast for them. Parties will rank their candidates on a list and constituents will vote to elect the party list. PR systems tend to have a *high district magnitude,* which means there are more seats to be held.

Majoritarian or Single-Member District systems In a majoritarian electoral system, also referred to as single-member district (SMD) systems, constituents vote for an individual rather than the party and return a single officeholder to the legislature. Subsequently, elections in SMDs are often more competitive between candidates because there is only one seat to be held.

Mixed system A mixed system consists of both a *majoritarian/single-member district* tier and a *proportional representation* tier. The number of seats allocated for each tier varies across mixed systems.

Unicameral parliamentary system A unicameral parliamentary system is a parliament with one legislative chamber.

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The Impact of Sleeping Duration on the Risk of Breast Cancer: A systematic review and meta-analysis of population-based cohort studies

Amos Ochieng Okutse, College of Pure and Applied Sciences; Jomo Kenyatta University of Agriculture and Technology, Kenya

Abstract

The impact of different sleeping categories on the risk of breast cancer has remained debatable. This paper sought to systematically synthesise the available literature on this relationship from population-based cohort studies using meta-analytic procedures.

Studies about sleep duration and breast cancer were identified from the Cochrane Library database, EMBASE and PubMed databases for papers published up to February 2019.

Identified studies were analysed for quality using the Newcastle-Ottawa Scale. Effect sizes were visualised using funnel plots. Study heterogeneity was quantified using I^2 and visualised using Baujat plots. Publication prejudice was evaluated using Eggers regression model, with visualisations using funnel plots.

Eight cohort studies met the inclusion criteria. Random-effects model revealed non-statistically significant evidence of an association between short or long sleep and breast cancer Odds Ratio (OR) =0.90;(95% CI 0.79–1.02) and OR=0.95 (0.88–1.02) respectively. There was moderate to high heterogeneity I^2 (95% CI)=74.40% (48.20–87.40%) among studies examining short sleep and breast cancer, and low to moderate heterogeneity in studies for long sleep and breast cancer I^2 (95% CI)=3.0% (0.00–68.60%).

This study found non-substantial evidence of associations between sleeping periods and breast cancer in women. Studies employing novel sleep-measurement methodologies should be carried out to examine the underlying relationship.

Keywords: Breast cancer; sleep duration and breast cancer; systematic review; meta-analysis of breast cancer studies; population-based cohort studies.

Introduction

Globally, the burden of site-specific cancers has increased based on published global estimates (Bray *et al.*, 2018). While most countries have implemented measures to reduce the effects of cancer – such as the implementation of national policies like the National Cancer Control Strategy in Kenya (Topazian *et al.*, 2016) and the development of early detection and mammographic screening centres (Yip *et al.*, 2008) – the disease still remains a significant cause of death with its burden expected to increase due to ageing, population growths and changing life regimens such as cigarette smoking, alcohol drinking and general body dormancy (Sanchis-Gomar *et al.*, 2015; Jung *et al.*, 2016). Breast tumours have remained a domineering cause of demise in the female population. In the USA alone, the rate of invasive breast cancer is approximated at 232,340 cases, with one in every eight US women anticipated to develop breast cancer during the course of her life (Ma and Jemal, 2013). Belgium and Luxembourg had the highest age-standardised rates of breast cancer in 2018 (113.2 and 109.3 per 100, 000 respectively) based on estimates from the American Institute for Cancer Research.

The underlying relationship between sleeping patterns and all cancers has been examined in depth elsewhere in case-control studies (Wang *et al.*, 2015, 2016; Gu *et al.*, 2016). Whereas sufficient sleep is necessary for healthy development, insufficient sleep has been previously linked with an increased incidence of cancer of the breast as a result of possible suppression of melatonin production (Stevens, 2005).

Previous studies have linked insufficient sleep (<7h) to obesity, possible metabolic dysfunctions and chronic inflammations. (Gangwisch *et al.*, 2007; Irwin *et al.*, 2008). Sleeping patterns appear to be changing. In previous studies, the number of individuals who sleep for short durations of time has been reported to increase whereas the number of individuals who sleep for long durations of time (9+h of sleep per night) has been reported to decrease considerably (Jean-Louis *et al.*, 2014). Previous literature on the influence of sleep on cancer has found evidence ranging from positive (Jiao *et al.*, 2013; Luojus *et al.*, 2014) to inverse (Markt *et al.*, 2016; Heckman *et al.*, 2017) and null associations (Cohen *et al.*, 2015; Hurley *et al.*, 2015).

While there exists ample literature on these relationships, as presented above, there exist no records that explicitly and systematically review, synthesise and evaluate the available research on the effect of both long and short sleeping patterns on the risk of breast cancer in both pre- and post-menopausal women of different ethnicities, a factor that is important in understanding variations in incidence by race. Moreover, the fund of knowledge concerning dose-response relationships of the various studies using self-reported sleeping categories from population-based cohort studies is deficient. Also, relations between sleeping patterns and breast tumours from analyses previously conducted is obscure (Markt *et al.*, 2016; Heckman *et al.*, 2017).

This systematic review and meta-analysis aimed to systematically evaluate existing literature and update the fund of knowledge on the relationship between both long and short sleep patterns on the risk of breast cancer using multi-ethnic population-based cohort studies. We also aimed to explore the relationships performing sub-group analyses for publication biases and study heterogeneity.

Methodology

This systematic review and meta-analysis was conducted in accord with the 'Preferred Reporting Items for Systematic Reviews and Meta-Analyses' (PRISMA; Shamseer *et al.*, 2015).

Data sources

Studies were expansively and intensively identified through searches in the academic journal databases Cochrane Library database, PubMed and EMBASE, and they included studies up to February 2019 that evaluated the relationship between the duration of sleep and the risk of acquiring breast cancer. Study identification and extraction involved use of keywords including 'sleep' or 'sleep duration' and 'tumor' or 'cancer' or 'breast cancer'. Additional pertinent cohort studies were acquired through scanning the bibliographies of studies previously identified.

Study selection and eligibility criteria

Studies were initially screened for relevance using their abstracts and titles. Those studies that bore potential of inclusion into the review were identified and their full versions obtained. Inclusion of articles was based on their novelty, cohort studies, or because the paper explicitly provided estimates for calculation of Odds Ratio (OR) and

95% Confidence Intervals (CI). Studies were included that allowed calculation of these estimates through their literature, were published in English and were based on adult populations. On the other hand, review articles, case-control studies, studies with duplicated data, that did not provide estimates for OR and CI, were clinical trials, cell-related or did not mention breast tumours were excluded.

Data extraction

Spreadsheets which were designed in MS Excel specifically for this study. Where papers met the inclusion criteria, their details were checked and entered into the spreadsheet. For all included studies, details of the authors, year of publication, the country where the studies were conducted, types of cancers reported and the number of cancer cases reported at the end of the evaluation period were extracted (see Table 1). Also, the sample sizes and published estimates (Relative Risk (RR), Odds Ratio (OR), Hazard Ratio (HR) and 95% CI), including the author conclusions, were obtained. Unadjusted Odds Ratios were calculated using the published study estimates. The number of events in the experimental group (Ee), the total number of persons in the experimental group (Ne) and the number of events and total individuals in the reference group (Ec and Nc respectively) were extracted for analyses.

Author, year, Country/area	Study design	Types of cancers	No. of cases	Sample sizes (n)	Sleep Duration	Adjusted OR/RR/HR(95%CI)	Author Conclusions	NOS Score & Comments
Gu *et al*., 2016, USA	Cohort study	Breast cancer	5919	123858	<5 5–6 7–8 ≥9	0.84 (0.71–0.98) 1.00 (0.94–1.05) 1.00 0.89 (0.77–1.03)	'In conclusion, we observed potential increased risks of several cancer sites among men of short sleep duration, and changed risks of several cancer sites in women of both short and long sleep duration in older population. Only the association of stomach cancer achieved overall statistical significance and no association survives multiple comparison adjustment. Further studies are warranted to replicate these findings.'	7 • The sample was representative (2). • The study allowed ascertainment and comparability of exposure (2). • The study provided enough time for relevant outcomes to occur (3).

Hurley *et al*., 2015, USA	Cohort study	Breast cancer	4381	101609	3–6 7–9 ≥10	0.98 (0.92–1.05) 1.00 1.25 (0.93–1.68)	'These analyses suggest that longer sleep may be associated with increased risks of estrogen-mediated cancers. Further studies with more refined measures of sleep duration and quality are warranted.'	6 • The sample was representative (2). • The study allowed ascertainment and comparability of exposure (2) • The study provided enough time for relevant outcomes to occur (2).
Qian *et al*., 2015, USA	Cohort study	Breast cancer	1553	40013	<6 6–<7 7–<8 8–<9 ≥9	0.87 (0.64–1.18) 1.04 (0.90–1.20) 0.93 (0.82–1.05) 1.00 1.00 (0.84–1.19)	'Our finding does not support an association between sleep duration and overall breast cancer risk. However, the effect of sleep on different subtypes of breast cancer deserves further investigation.'	8 • The sample was representative (4). • The study allowed ascertainment and comparability of exposure (2). • The study allowed enough time for outcomes to occur (2).
Wu *et al*., 2008, Singapore	Cohort study	Breast cancer	525	33528	≤6 7 8 ≥9	1.00 1.03 (0.8–1.3) 0.90 (0.7–1.1) 0.81 (0.6–1.2)	'Sleep duration may influence breast cancer risk, possibly via its effect on melatonin levels.'	8 • The sample was representative (4). • The study allowed ascertainment and comparability of exposure (2). • The study provided relevant outcomes (2).
Vogtmann *et al*., 2013, USA	Cohort study	Breast cancer	5149	110011	≤5 6 7 8 ≥9	0.95 (0.85–1.07) 0.94 (0.87–1.00) 1.00 0.99 (0.92–1.06) 1.03 (0.90–1.18)	'In conclusion, this large study from the WHI does not provide support for an association between self-reported sleep duration, sleep quality, insomnia or sleep disturbance with the risk of breast	8 • The sample was representative (4). • The study allowed ascertainment and comparability of exposure (2). • The study

							cancer in postmenopausal women. The observed association between insomnia and the risk of breast cancer among women who do not use sleep aides warrants further investigation. Consideration of the association between sleep measures and different breast cancer subtypes could also be considered.'	allowed enough time for outcomes to occur (2).
Kakizaki *et al*., 2008, Japan	Cohort study	Breast cancer	143	28515	≤6 7 8 ≥9	1.67 (1.00–2.78) 1.00 0.99 (0.59–1.65) 0.29 (0.09–0.98)	'In conclusion, we have found a significant inverse association between sleep duration and breast cancer risk in Japanese women, those who slept 6 h or less having a significantly increased risk.'	8 • The sample was representative (4). • The study allowed ascertainment and comparability of exposure (2). • The study allowed enough time for outcomes to occur (2).
Pinheiro *et al*., 2006, USA	Cohort study	Breast cancer	4223	77418	≤5 6 7 8 ≥9	0.93 (0.79–1.09) 0.98 (0.91–1.06) 1.00 1.05 (0.97–1.13) 0.95 (0.82–1.11)	'In this prospective study, we found no convincing evidence for an association between sleep duration and the incidence of breast cancer.'	6 • The sample was representative (2). • The study allowed ascertainment and comparability of exposure (2). • The study allowed enough time for outcomes to occur (2).
Verkasalo *et al*., 2005, Finland	Cohort study	Breast cancer	242	12222	≤6 7–8 ≥9	0.85 (0.54–1.34) 1.00 0.69 (0.45–1.06)	'This study provides some support for a decreased risk of breast cancer in long sleepers.'	8 • The sample was representative(4). • The study allowed ascertainment and

comparability of exposure (2).
- The study provided allowed enough time for outcomes to occur (2).

Table 1: Characteristics of the included cohort studies

Study quality assessment

A quality assessment was carried out using the Newcastle-Ottawa Scale (NOS; Stang, 2010). The evaluation was based on (i) participant selection, (ii) comparability and (iii) outcomes, with studies being assigned scores 0–9. Studies with scores ≥7 were deemed to be of high quality (Table 2).

Study ID[#]	Study	Year	Ee	Ne	Ec	Nc	Sleep Duration	Study Type	Study Quality*
1	Verkasalo *et al.*	2015	23	1181	188	9053	short	cohort	8
2	Vogtmann *et al.*	2013	355	8686	2049	41970	short	cohort	8
3	Qian *et al.*	2015	45	1634	631	16032	short	cohort	8
4	Pinheiro *et al.*	2009	174	3553	1752	32041	short	cohort	6
5	Kakizaki *et al.*	2008	42	4549	40	7087	short	cohort	8
6	Wu *et al.*	2008	179	11370	131	8835	short	cohort	8
7	Hurley *et al.*	2015	1303	26440	3699	74211	short	cohort	6
8	Gu *et al.*	2016	162	4441	3648	74200	short	cohort	7
9	Verkasalo *et al.*,	2015	31	1988	188	9053	long	cohort	8
10	Vogtmann *et al.*,	2013	235	4693	2049	41970	long	cohort	8
11	Qian *et al.*,	2015	161	4104	631	16032	long	cohort	8
12	Pinheiro *et al.*,	2009	189	3657	1752	32041	long	cohort	6
13	Kakizaki *et al.*,	2008	11	3692	40	7087	long	cohort	8
14	Wu *et al.*,	2008	29	2284	131	8835	long	cohort	8
15	Hurley *et al.*,	2015	51	958	3699	74211	long	cohort	6
16	Gu *et al.*,	2016	189	4194	3648	74200	long	cohort	7

*study quality was assessed by the NOS Scale. [#]study ID 1 to 8 assess short sleep and breast cancer whereas study ID 8 to 16 assess the impact of long sleep duration on breast cancer.

Table 2: Meta-analyses data and study quality assessment

Statistical data analysis

Meta-analytical procedures were carried out using the inverse variance method and DerSimonian-Laird Estimator for tau^2. Both fixed- and random-effects models were used in pooling the risk estimates from individual studies. The extracted associations from each study were used in evaluating the relationship between the risk of breast cancer and the extent of sleep (RR, HR and OR 95% CI). These estimates were deemed equivalent to each other due to the rareness of breast cancer as an outcome (Shamseer *et al.*, 2015).

The assessment of the duration of sleep was carried out based on how each study reported their findings. Sleep durations were categorised as either short, medium or long. Each study denoted sleep categories as follows: short sleeping category <5h or ≤5h (Pinheiro *et al.*, 2006; Vogtmann *et al.*, 2013; Gu *et al.*, 2016), 3–6 h (Hurley *et al.*, 2015), <6h or ≤6h (Verkasalo *et al.*, 2005; Kakisaki *et al.*, 2008; Wu *et al.*, 2008; Qian *et al.*, 2015). Long sleeping durations were defined as ≥9h (Verkasalo *et al.*, 2005; Pinheiro *et al.*, 2006; Kakisaki *et al.*, 2008; Wu *et al.*, 2008; Vogtmann *et al.*, 2013; Qian *et al.*, 2015; Gu *et al.*, 2016) or ≥10h (Hurley *et al.*, 2015).

The OR for each included study were calculated and 95% CIs estimated for both short and long sleepers in comparison to the reference category. A standard reference category of 7h of sleep per night was employed to allow uniformity, comparability and to reduce biases.

Between study, heterogeneity was guesstimated using the Q test (conveyed with a p-value) and quantified using I^2 statistic. The Q-statistic was used to assess the null hypothesis that all the studies included in the analysis are investigating a similar effect. A statistically significant Q-statistic was suggestive of a non-similar effect size among the studies (Quintana, 2015). In quantifying heterogeneity, I^2 values from 25%, 50% and 75% were viewed as evidence of low, modest and high heterogeneity respectively (Quintana, 2015).

Sub-group analyses were performed by sleep duration as either short or long sleep duration against the developed standard reference category (7h). Funnel plots and Baujat plots were used to inspect the included studies for possibilities of publication bias and each studies contribution to overall heterogeneity respectively. Eggers regression was used to test for publication bias (Egger *et al.*, 1997). Forest plots were used to visually present the pooled effects of the studies end to end with the calculated summary effect sizes (Quintana, 2015). All analytical procedures used R programming environment, version 3.6.0, and employed the R Package 'Meta'

(Schwarzer *et al.*, 2015). P-values smaller than 0.05 were deemed statistically significant.

Results

Search results and selection

Database searches identified 5288 records with 3418 from EMBASE, 1321 from PubMed and 549 articles from the Cochrane Library (see Figure 1). Article screening excluded a total of 4236 articles from the analysis since they were either reviews, meta-analyses, reports or showed obvious irrelevance. From the remainder, 95 articles were then screened and 70 articles were subsequently excluded since they did not provide relevant data. The 25 remaining articles were further evaluated based on the inclusion and exclusion criteria to remain with eight population-based cohort studies after exclusion of ten articles with no mention of breast cancer and four case-control studies (excluded because they do not clearly indicate the temporal sequence between exposure and outcome).

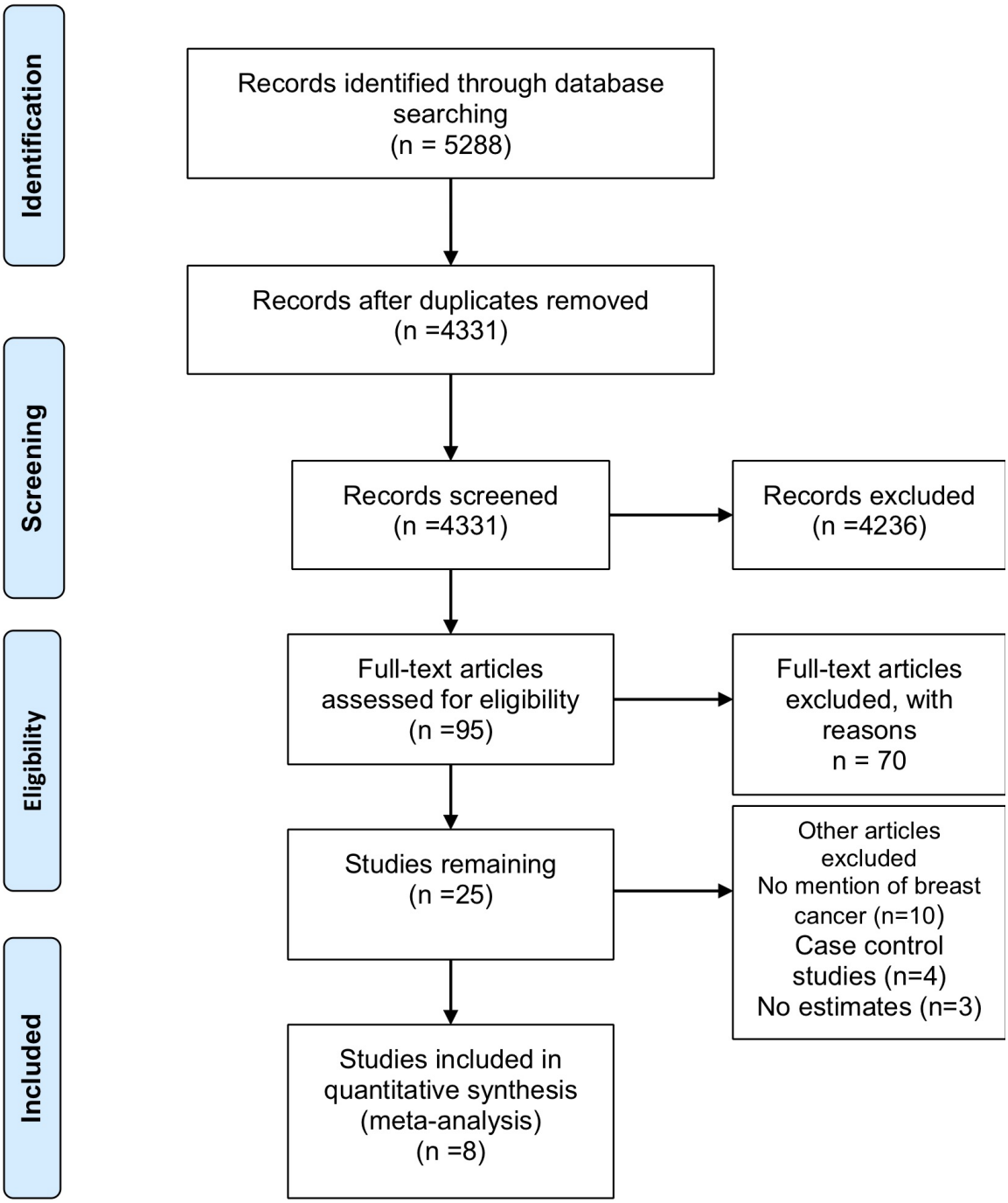

Figure 1: PRISMA Flow Diagram for the included studies. The flow diagram indicates the number of studies included in the meta-analysis at each stage. Adapted from: Moher *et al.*, 2009).

Description of the included studies

Verkasalo *et al.* (2005) sought to determine whether long sleep patterns are linked to decreases in the danger of developing breast cancer and relations of cancer with inadequate sleep or lack thereof coupled up with poor sleep quality. The authors hypothesised that there would be an indirect relationship between the risk of breast

cancer and the sleeping duration of the study population, possibly explained by the significant increases in the overall melatonin production in the long sleeping study participants. Using a self-administered questionnaire, the authors used the Finnish population-based cohort study of females born before the year 1958. Restricting the analysis to 7396 females with stable sleeping patterns in 1975 and 1981, the study showed there were 146 breast cancer cases with Hazard Ratios of 1.10 (95% CI 0.59–2.05), 1.0 and 0.28 (95% CI 0.09–0.88). The authors concluded that participants who slept for longer periods had a slightly reduced risk of acquiring breast cancer.

Vogtmann *et al.* (2013) sought to examine whether sleep duration, quality of sleep, sleep disturbances and insomnia had any significant association with breast cancer rate in the 'Women's Health Initiative(WHI)'. The study enrolled 110,011 women from the ages of 50 to 79 with no prior cancer history. The participants' sleep quality, duration and other individual-reported measures of sleeping were assessed over four weeks. After follow-up, 5149 breast-cancer incidents were recorded. Slightly adjusted sleep models for the three sleeping categories – using 7h sleep per night as the reference group, ≤5h (HR 0.89;95% CI:0.80–1.00) or 6h of sleep per night (HR 0.92; 95% CI:0.85–0.98) – revealed a substantial inverse relationship between breast-cancer and the sleeping categories (P_{trend}=0.00). Vogtmann *et al.* concluded that the study did not provide substantial evidence of an association between sleep and breast-cancer incidence among the study participants.

Qian *et al.* (2015) inspected the relationship between the duration of sleep and the risk of development of breast cancer based on estrogen receptor (ER) and progesterone receptor (PR) status. From the 40,013 females in the Breast Cancer Demonstration Project from which there were 1846 breast-cancer cases, the authors examined self-reported sleep patterns and duration during the week and on weekends in relation to breast-cancer incidence. Cox regression algorithms were utilised in guesstimating the RR and the corresponding confidence limits. While the authors found no significant statistical links between sleeping intervals and the inclusive risk of breast cancer, shorter sleeping patterns or behaviours were statistically significantly associated with decreased risk of breast cancer using 8–9h of sleep per night as the reference group and <6h of sleep per night as the short sleeping group RR (95% CI)=0.54 (0.31 to 0.93; P_{trend}=0.00). Qian *et al.* concluded that the study did not provide evidence of an association between breast cancer and the patterns and duration of sleep, suggesting further investigation of the overall effect of sleep on breast-cancer sub-types.

Pinheiro *et al.*, (2006) aimed to determine whether sleep duration might have an effect on the danger of acquiring breast cancer using the 'Nurses' Health Study', a cohort study in which individuals were followed prospectively. The authors explored the connotation between reported sleep duration patterns from the year 1986 and the succeeding risk of cancer of the breast after follow-up. Of the 77,418 females studied in the cohort, 4223 incident cases of breast cancer were reported. Using women who slept 7h per night as the reference group, covariate-adjusted Hazard Ratios obtained from cox regression models for the women sleeping 5, 6, 8 and 9 hours were HR =0.93; 95%CI (0.79 to 1.09), HR=0.98; (0.91–1.06), HR=1.05; (0.97 to 1.13) and HR=0.95; (0.82 to 1.11) correspondingly. The authors found no substantial suggestions of a relationship amid the duration of sleep and the risk of developing breast cancer.

Kakizaki *et al.* (2008) examined the connotation between the length of sleep and the risk of breast-cancer development in a female populace from the Miyagi Prefecture in north-eastern Japan. The study found reverse associations between breast cancer and the duration of sleep using women who slept for 7h per night as the reference group. HRs (95% CI) of women who slept for ≤6h, 8h, and ≥9h were 1.62 (1.05–2.50), 1.14 (0.36–1.43), and 0.72 (0.36–1.43) respectively (P_{trend}=0.03). Kakisaki *et al.* found no statistically important links between cancer of the breast and possible confounders.

Wu *et al.* (2008) investigated the relations of 'self-reported' measures of duration of sleep and the ensuing risk of breast cancer after follow-up using the Singapore Chinese Study (a cohort study). After an 11–year constant follow-up, 525 incident cases of breast cancer were identified from 33,528 women. Wu *et al.* found that sleep duration statistically significantly increased with decreasing risk of cancer of the breast among the post-menopausal females at baseline (P_{trend}=0.05). Of the participants who reported 9+h of sleep per night, the reported RR was 0.67 (95% CI:0.40–1.10) in comparison to the women who slept for 6h per night. Inverse associations were reported predominantly in lean women. Conclusively, sleeping duration had a considerable influence on the development of breast cancer, mostly based on its effect on body melatonin levels.

Hurley *et al.* (2015) analysed sleep duration and the risk of specifically selected cancers in a group of women from California in a prospective cohort: the California Teachers Study. Cancer analyses focused on specific cancers, including colorectal, breast, lung, melanoma and endometrial cancers. Using average sleepers (7–9h per night) as the reference group, Hurley *et al.* found that long sleepers registered a statistically significant rise in the risk of all estrogen-intermediated malignancies

HR(95% CI)=1.22 (0.97 to 1.54), (P_{trend}=0.04). The authors concluded that longer sleeping durations among participants might be linked to increased risk of estrogen-arbitrated types of cancers.

Gu *et al.* (2016) explored the connotations between sleeping durations and the risk of 18 location-specific types of malignancies using self-reported sleeping patterns of study participants from a Health and Diet Cohort Study. Females reported a reduction in the risk of developing breast cancer in participants who slept for <5h per night in comparison to participants in the reference group (7–8h/night) HR (95% CI)=0.84; (0.71–0.98).

Short sleep duration and risk of breast cancer

A standard reference category of people who slept for 7 hours per night was used to calculate the odds of a short sleeper developing breast cancer. The pooled-effect OR was obtained as OR=0.92 (0.88-0.96) based on the fixed-effects model. For studies that reported or used a different reference category, the standard reference category of 7 hours of sleep per night was used instead for uniformity, consistency and to allow comparability of the findings. The probability that a short sleeper develops breast cancer was 0.92 times higher than for the reference group. The influence of short sleep on the risk of breast cancer was statistically significant (Figure 2).

The amount of heterogeneity was I^2=74.40% (95% CI 48.20–87.40), suggestive of moderate to high heterogeneity among the included studies. The Q-statistic was Q=27.36 (p=0.00). Eggers regression revealed non-statistically significant evidence for funnel plot asymmetry (p=0.74). This was supported by the funnel plot for the assessment of publication bias, which also illustrated symmetry (Figure 3). Study 7 (Hurley *et al.*, 2015) accounted the most towards overall heterogeneity as illustrated by Figure 5.

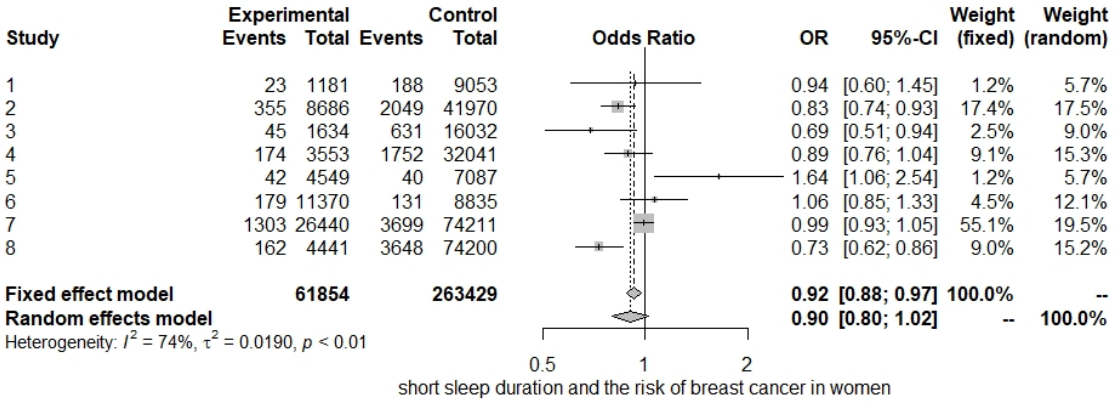

Figure 2: A Forest Plot. Point estimates and 95% CI represent all the studies encompassed in the meta-analysis. The size of the boxes mirrors the weight of the study.

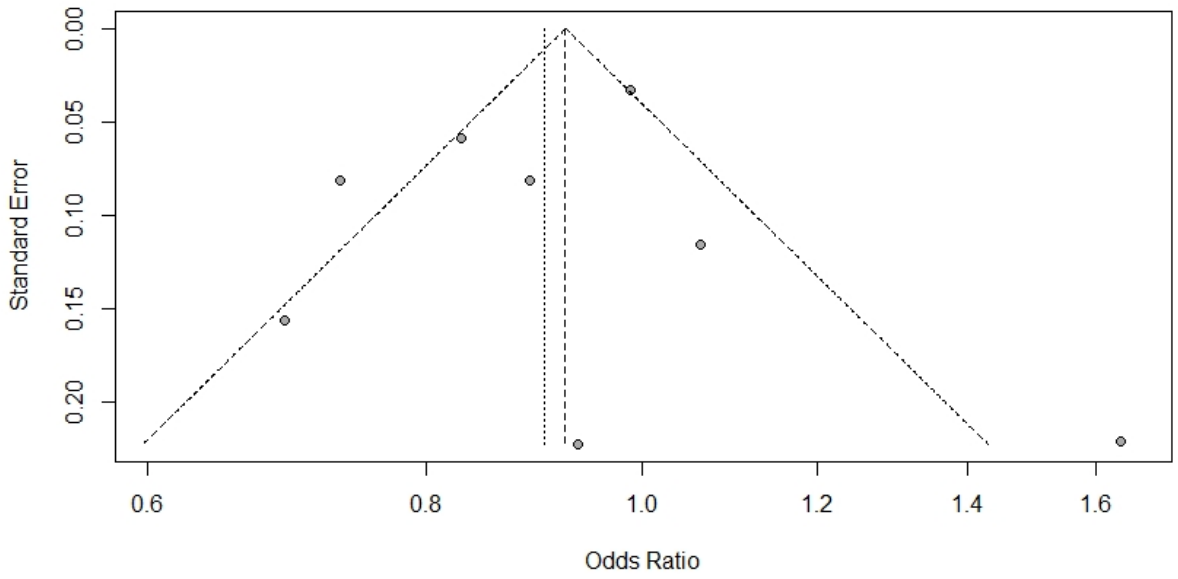

Figure 3: A Funnel Plot. This plot is symmetric where points fall on both sides of the summary effect size. These results are consistent with Eggers regression

Long sleep duration and risk of breast cancer

The pooled-effect OR (95% CI) for the included studies was OR=0.95 (0.89–1.02) for the cohort studies included in the analysis based on the fixed-effects model. The probability that a long sleeper (≥8h) develops breast cancer was 0.95 times higher than the probability that a person in the reference group (7h) develops breast cancer. The

influence of extended sleep on the risk of breast cancer was statistically insignificant (p=0.21) (Figure 4).

The amount of heterogeneity was I^2=3.00% (95% CI 0.00–68.60), suggestive of a low to moderate heterogeneity among the included studies. The Q-statistic was Q=7.22 (p=0.40). Eggers regression revealed non-statistically significant evidence for funnel plot asymmetry (p=0.07) as the funnel plot was symmetric (Figure 6). Study 10 (Vogtmann *et al.,* 2013) accounted the most towards overall heterogeneity (Figure 5).

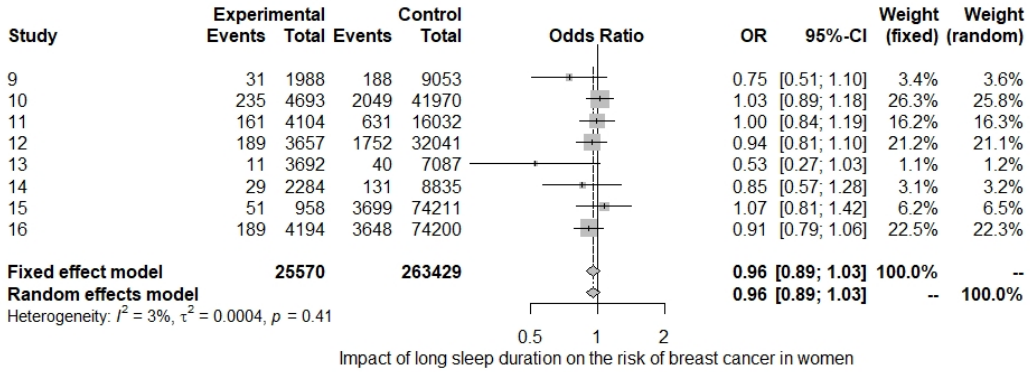

Figure 4: A Forest Plot. Summary of the effect of long sleeping duration on the risk of cancer of the breast.

Heterogeneity assessment

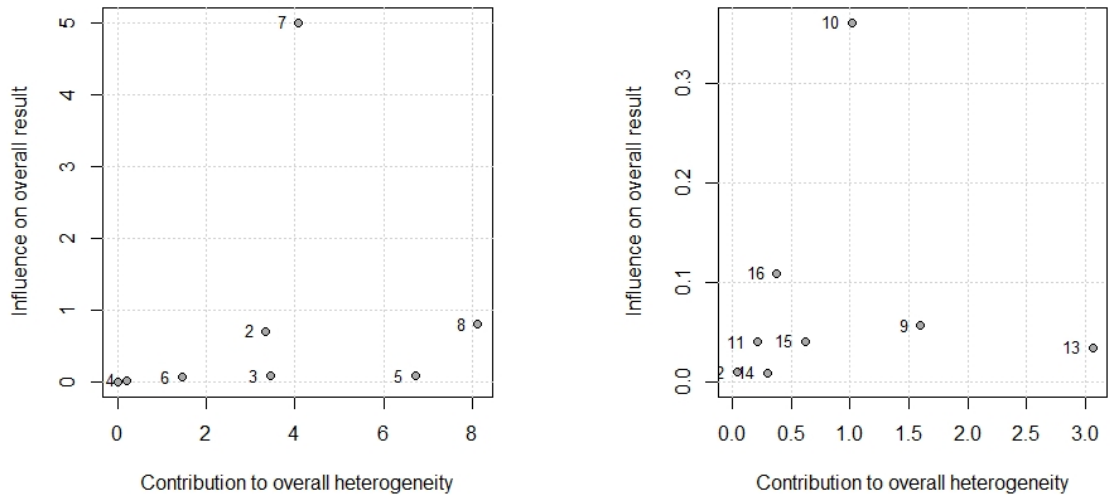

Figure 5: A Baujat Plot for the estimation of overall study heterogeneity. The plot on the left examines the heterogeneity in studies of short sleep and breast cancer, whereas the plot on the right examines the effect of extended sleep. Studies on the upper quadrant have a strong influence on heterogeneity.

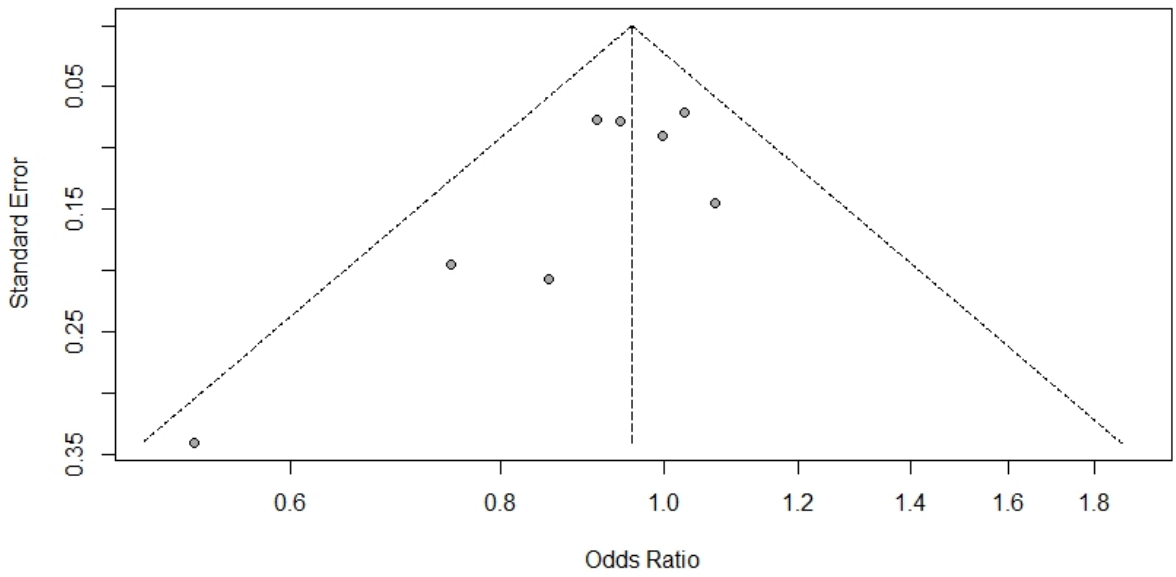

Figure 6: A Funnel Plot illustrating symmetry of studies examining the impact of long sleeping patterns on the risk of breast cancer.

Discussion

This study comprehensively reviewed literature related to the impact of both long and short categories of sleeping on the risk of developing breast cancer in females using population-based cohort studies that met the inclusion criteria. Whereas this analysis found no statistically significant links between long sleeping duration and the risk of

breast cancer based on both fixed- and random-effects models, the study did find statistically significant evidence of influence of short sleeping patterns on the risk of breast cancer based on the fixed-effects model. However, on the other hand, the random-effects model revealed non-statistically significant evidence of an association between short sleep and cancer of the breast.

Comparing these findings (random-effects model results) to previously conducted individual researches on the same topic, consistencies were with a study that reported that sleeping durations (both short and long) had a non-significant statistical impact or association with an increase in cancer risk (Zhao *et al.*, 2013). Besides, an analysis of prospective cohort studies by Lu *et al.* (2013) did not find substantial evidence of an association between the duration of sleep and an increased risk of all cancers (Lu *et al.*, 2013).

Possible explanations of associations between breast cancer and sleep

While cancer as a disease has a multi-faceted etiology, different studies have tried to explain the link or pathways behind the relationship between breast cancer (and all cancers) and the duration of sleep. In previous studies, decreased melatonin levels have been linked to short sleeping durations; in addition, melatonin has been proposed as a suppressor of the initial phase in tumour generation, a process that inhibits propagation of cancer cells in humans (Blask, 2009; Hill *et al.*, 2015).

Moreover, studies have also tried to explain the association between breast cancer using sex hormones (Germain, 2011). Melatonin might have a modulating effect on the production of sex hormones through its interactions with estrogen-signalling pathways using a variety of mechanisms (Alvarez-García *et al.*, 2013).

Bovbjerg (2003) linked impairments in immune functioning in his explanation of sleep and regulation of the immune system. Sleep deficiency studies have found that changes in duration of sleep might suppress the functioning of the immune system, resulting in shifts in the production of cytokine (Chen *et al.*, 2018). Also, circadian physiology disruptions have also been used in explaining sleep disturbances with respect to all cancers (Hill *et al.*, 2015).

Study strengths and limitations

This study has comprehensively used up-to-date literature on sleep and breast cancer, predominantly cohort studies to explain whether there exist associations between long and short categories of sleep and risk of breast cancer in women. The studies synthesised had considerably large sample sizes, which improved the statistical power. Moreover, the pooled effects of the studies included in the analysis were analysed using both fixed- and random-effects models, allowing comparison of the findings.

Sub-group analysis was performed separately using both short and long durations of sleep, a situation that allowed an analysis of the effect of each paying attention to breast cancer. Besides, data for the pooled effect was obtained from the primary cohort studies in which individuals were followed prospectively. The methodology employed in the evaluation of the eminence of the cohort studies encompassed in this analysis strengthens the validity of the findings of this paper.

On the other hand, this meta-analysis did not use adjusted estimates from the previously conducted studies, a situation that might have allowed effects of confounding variables, which might obscure the true associations between variables. Studies synthesised in this paper had different classifications of sleeping categories in addition to the measures of sleep being self-reported. Studies reported different measures of association (RR, OR and HRs); we, however, used the OR calculated from the estimates obtained from various studies (see Script).

Conclusions

While individuals continue to sleep less due to stress, anxiety, depression and change in lifestyle behaviours, findings from this analysis suggest non-statistically significant relations between durations of sleep and breast cancer. Future research studies should be focused on establishing the links and mechanisms suggesting relationships between sleep and breast cancer using more reliable measures of sleep durations to enhance the quality of the sleep measures obtained.

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The role of the autophagy-inducer spermidine in cardiovascular ageing

Isa Hassan and Leda Mirbahai, University of Warwick, Coventry.

Abstract

Due to progressive degeneration of tissues with age, ageing has been recognised as a significant risk factor for the development of most chronic diseases, including cardiovascular diseases. Interventions – such as the addition of the polyamine spermidine to the diet – have been suggested to extend lifespan, as seen in a mouse model. This has partly been attributed to slowing down the negative effects of the ageing process on the cardiovascular system. Spermidine acts as a calorie restriction mimetic (CRM), which is naturally abundant in eukaryotic cells; however, the concentration of spermidine declines in cells with age. As spermidine is naturally found in several food sources, such as aged cheeses, fermented soybeans and wheatgerm, it is plausible to investigate the impact of dietary interventions on reducing the risk of age-related cardiovascular diseases. The data summarised in this paper indicates that the cardioprotective properties of spermidine can be partly attributed to its ability to promote autophagy in cardiac muscle, a vital process for the recycling of dysfunctional and potentially harmful cellular components, thus, preventing cardiomyopathies. Overall, the evidence presented in this review paper supports the use of spermidine as a promising candidate for delaying some of the age-related changes to the structure and function of the cardiovascular system.

Keywords: Spermidine, cardiac autophagy, increasing lifespan, slowing cardiovascular ageing, calorie restriction mimetic, spermidine and longevity, spermidine and autophagy induction

Introduction

The world's population is ageing, resulting in older persons making up a larger proportion of the population (United Nations, 2017). This has societal implications across a number of sectors including – but not limited to – goods and services, labour and healthcare (United Nations, 2017). The health challenges inherent in an ageing population will undoubtedly give rise to an increase in the rates of chronic diseases,

and thus the need to address this. Ageing is the main risk factor for the development of cardiovascular diseases (Niccoli and Partridge, 2012), equating to an increased risk in potential cases of myocardial infarction, stroke, heart failure and subsequent deaths (Niccoli and Partridge, 2012). The latest projections detailing the challenges of an ageing population within the United Kingdom show that there will be an additional 8.6 million people aged 65 and over by 2060 (Storey, 2018). This serves to place further strain on the publicly funded National Health Service (NHS; Storey, 2018), with cardiovascular diseases being the dominant cause of death (Majeed and Aylin, 2005)

A promising pharmacological candidate in addressing some of the problems associated with increased prevalence of cardiovascular diseases is the polyamine spermidine (Eisenberg *et al.*, 2016; Wang *et al.*, 2020). It has been suggested that decline in the levels of spermidine in cells is associated with an increased risk of the development of age-related cardiovascular diseases (Eisenberg *et al.*, 2009). Therefore, we aim to highlight some of the key physiological changes that occur as a result of ageing in the cardiovascular system and, more importantly, to collate the current research on the role and mechanism of the action of spermidine in delaying some of the observed age-associated cardiovascular diseases. We will also consider the potential of spermidine as a treatment and as a preventative tool for these challenges found in the ageing population.

Spermidine and autophagy

Spermidine is a member of the polyamine family and is naturally found in certain foods such as wheatgerm, fermented soybeans and aged cheeses (Madeo *et al.*, 2018a) Polyamines, such as spermidine, possess cations that interact with molecules such as lipids, proteins, DNA and RNA. These can have a negative charge, serving to stabilise them (Minois *et al.*, 2011). They therefore play various roles in cell proliferation, survival and growth by helping to mitigate DNA mutations and degradation along with delaying cell senescence and necrosis. This has implications for increasing longevity and reducing the incidence of age-related disease (Minois *et al.*, 2011).

Autophagy has been recognised as a vital process for lifespan extension and longevity (Rubinsztein *et al.*, 2011). Supplementation with spermidine has upregulated autophagy in yeast, worms, flies, human immune cells and mice, which subsequently led to lifespan extension (Eisenberg *et al.*, 2009). The same concept has been shown to hold true for cardiomyocytes, where spermidine promoted cardioprotective autophagy (Madeo *et al.*, 2018a; Eisenberg *et al.*, 2016). Autophagy plays a pivotal role in

maintaining optimal cellular environments by removing damaged organelles and toxic protein aggregates (Rubinsztein *et al.*, 2011). During ageing, damaged, misfolded and dysfunctional proteins accumulate, disrupting cellular environments and increasing risk of apoptosis induction (Escobar *et al.*, 2019). Therefore, discovering easily implementable methods of upregulating autophagy is of vital importance in tackling developments of cardiac pathophysiology.

Ageing and the increased risk of cardiovascular dysfunction

There are a number of molecular mechanisms contributing to the development of cardiac pathology during the ageing process (Chiao and Rabinovitch, 2015). These include mitochondrial reactive oxygen species (ROS) production and dysfunction, calcium homeostasis impairment, extracellular matrix (ECM) remodelling, neurohormonal signalling, stem cell ageing, miRNA deregulation and altered nutrient and growth signalling (Chiao and Rabinovitch, 2015). The physiological processes responsible for the development of cardiovascular dysfunction are numerous, including altered left-ventricular diastolic filling, left-ventricular hypertrophy and increased aortic root diameter (Gerstenblith *et al.*, 1977) To compound this further, there are reductions in maximum heart rate and contractility along with a decline in cardioprotective and repair processes (Strait and Lakatta, 2012). Such repair processes are vital for protection against oxidative stress, the loss of proteostasis and mitochondrial dysfunction, which eventually culminate in cardiomyopathies (Strait and Lakatta, 2012). Spermidine has the potential to mitigate pathophysiological developments through inducing a number of cardiovascular changes (Figure 1). Autophagy is the principle mechanism by which benefits are conferred due to the upregulation of oxidative stress protection, recycling of dysfunctional proteins and mitochondrial biogenesis (LaRocca *et al.*, 2013; Minois *et al.*, 2011; Wang *et al.*, 2020).

Cardiac hypertrophy predominantly occurs due to the dysfunction of nutrient and growth signalling pathways, particularly involving mammalian target of rapamycin (mTOR) and insulin-like growth factor-1 (IGF-1) (Chiao and Rabinovitch, 2015). Studies in both *Drosophila* and mice have shown the importance of mTOR in cardiac-hypertrophy development with downregulation of mTOR signalling increasing resistance to cardiac ageing and upregulation impairing resistance to cardiac ageing (Chiao and Rabinovitch, 2015). Moreover, the insulin/IGF-1 pathway has been implicated in the development of cardiac disease with reduced activation of this pathway slowing cardiomyocyte dysfunction in mice and *Drosophila* (Li *et al.*, 2008; Wessels *et al.*, 2004). Spermidine works independently of the mTOR pathway to elicit

an anti-ageing effect via gene hypoacetylation as opposed to altering the phosphorylation status of mTOR (Minois, 2014). With regard to Insulin/IGF signalling, it has been demonstrated that reducing such signalling leads to glycine-N-methytransferase (Gnmt)-dependent spermidine level increase in *Drosophila,* resulting in increased lifespan (Tain *et al.*, 2020).

Additionally, mice over-expressing catalase in the mitochondria (mCAT) have shown slowed cardiac ageing, decreased hypertrophy and improved diastolic function (Dai *et al.*, 2009), whereas mice over-expressing mitochondrial polymerase – and hence increased mitochondrial mutation – have shortened lifespan and earlier onset of cardiac disease (Dai *et al.*, 2010). Subsequent mCAT mutations in these mice demonstrated reduced mitochondrial damage and cardiomyopathy (Trifunovic *et al.*, 2004; Dai *et al.*, 2010). Defective mitochondria play a pivotal role in age-related decline and cardiac dysfunction but can be targeted by spermidine through mitophagy induction (Madeo *et al.*, 2018a)

Changes in the ECM of cardiomyocytes as ageing progresses is also implicated in cardiac function decline. The cardiac ECM environment is comprised of collagen types I through to VI, elastin, laminin, fibrinogen and fibronectin, all generated by cardiac fibroblasts (DeQuach *et al.*, 2010). The ECM is responsible for aligning the cardiac myocytes and structurally supporting the heart. However, ECM components such as metalloproteinases, along with the quantity and quality of collagen deposition, can also contribute to diastolic heart failure depending on the individual's phenotype (Ouzounian *et al.*, 2008). While spermidine does not appear to impact the degree of collagen deposition in the ECM of cardiomyocytes in aged mice, it directly impacts cardiomyocytes through increased mitochondrial volumes and decreased sarcoplasmic volume. These changes were shown to increase myocardial compliance (Eisenberg *et al.*, 2016).

Although interventions in treating heart disease are relatively effective – mainly targeting cholesterol levels and blood pressure – they do not target the underlying mechanisms of cardiovascular disease development (Cabo and Navas, 2016). Spermidine, however, has demonstrated the potential to target these mechanisms in mouse models (Cabo and Navas, 2016). This is where the calorie restriction mimetic (CRM) spermidine may be extremely valuable in mitigating age-related cardiac pathologies.

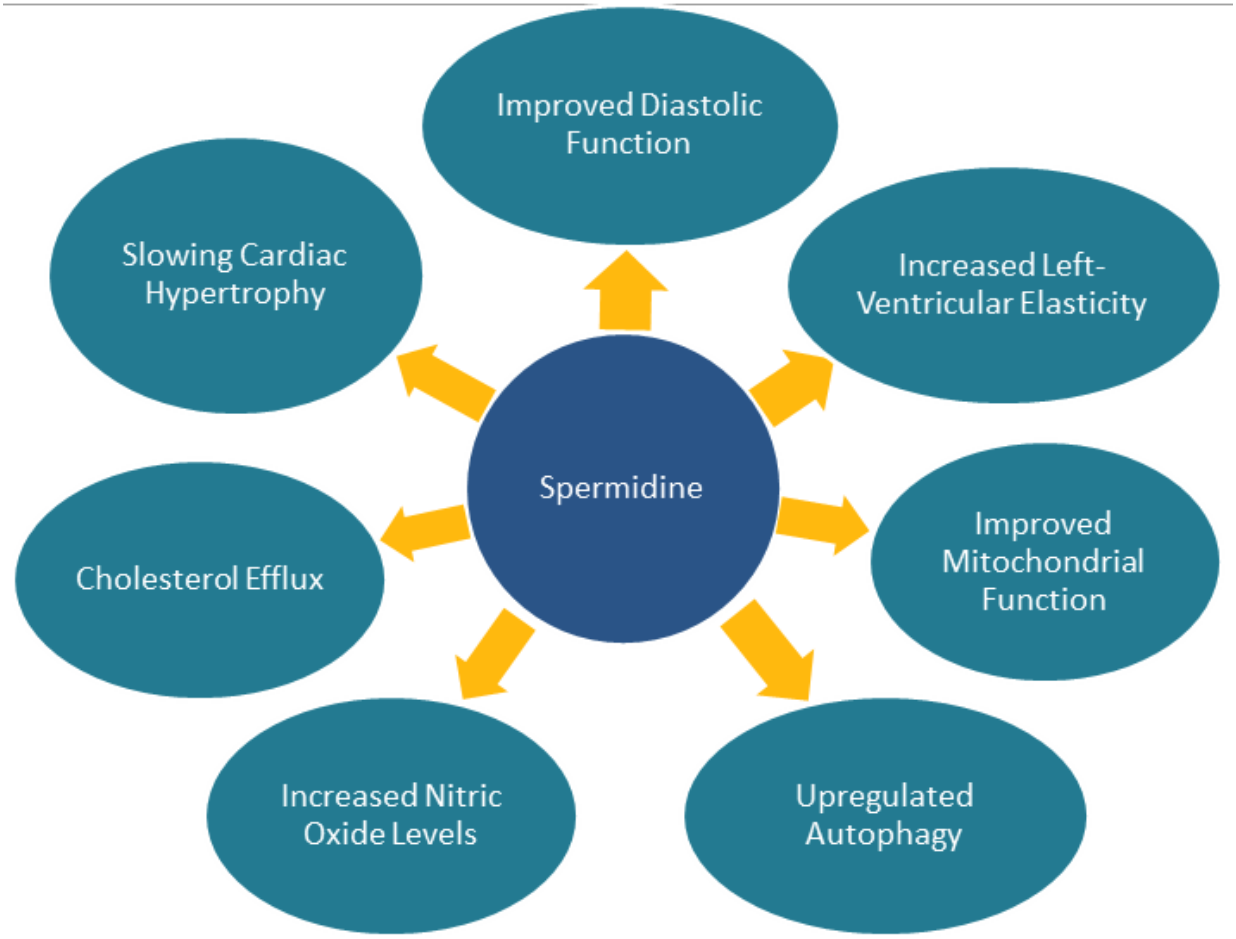

Figure 1: Cardioprotective effects of spermidine

Mechanism of spermidine in inducing autophagy

It has been shown that the beneficial effects of spermidine are due to its ability to induce autophagy (Eisenberg *et al.*, 2009). Model organisms such as yeast, worms and flies, with deficient machinery to induce autophagy, acquired no life-extension benefits from the introduction of spermidine. Such studies suggest that effective machinery to induce autophagy is necessary for spermidine to be effective (Eisenberg *et al.*, 2009). It has also been demonstrated that spermidine-induced paraquat resistance is markedly reduced in *Drosophila* that have defective machinery for autophagy compared to those without deficits (Minois *et al.*, 2012). Spermidine inhibits the activity of certain histone acetyltransferases (HATs) resulting in H3 hypoacetylation (Eisenberg *et al.*, 2009). This confers gene transcription regulation favouring the induction of autophagy and apoptosis as opposed to inflammatory necrotic cell death (Eisenberg *et al.*, 2009).

Hypoacetylation of histones has been shown to promote longevity in yeast cells also, particularly through the activation of Sir2 and NAD+-dependent histone deacetylases

and is therefore considered a potential key event in healthy ageing (Imai *et al.*, 2000) This provides further evidence that hypoacetylation may be key in promoting longevity, which is a key mechanism of spermidine.

Additionally, spermidine acts as an acetyltransferase inhibitor in E1A-associated protein p300 (EP300) through competitive inhibition of the EP300 protein with Acetyl-CoA (Pietrocola *et al.*, 2015). It has been demonstrated that when Acetyl-CoA levels are depleted in human and murine cell lines, deacetylation of cytoplasmic proteins occurs stimulating autophagy in heart and muscle cells (Mariño *et al.*, 2014). However, when Acetyl-CoA levels are maintained during starvation, autophagy induction is inhibited (Mariño *et al.*, 2014).

Another pathway in which the action of spermidine is critical involves the polyamine-eIF5A-hypusine axis (Puleston, Buck and Pearce, 2019). Spermidine promotes autophagy in B cells and macrophage activation through the hypusination of a conserved lysine residue in the eIF5A protein (Zhang, Alsaleh, Feltham and Sun, 2019) (Puleston *et al.*, 2019). Activation of eIF5A subsequently triggers the expression of mitochondrial proteins involved in the tricarboxylic acid (TCA) cycle and oxidative phosphorylation (Puleston *et al.*, 2019). In B cells, post-translational modification of the eIF5A protein stimulates the production of autophagy transcription factor TFEB, which has the potential to reverse immune cell senescence (Zhang *et al.*, 2019).

Induction of autophagy for cardiac protection by spermidine

Spermidine is synthesised *in vivo* via the conversion of arginine to ornithine, which is then converted to polyamines putrescine, spermidine and spermine mediated by ornithine decarboxylase (Figure 2) (Minois, 2014).

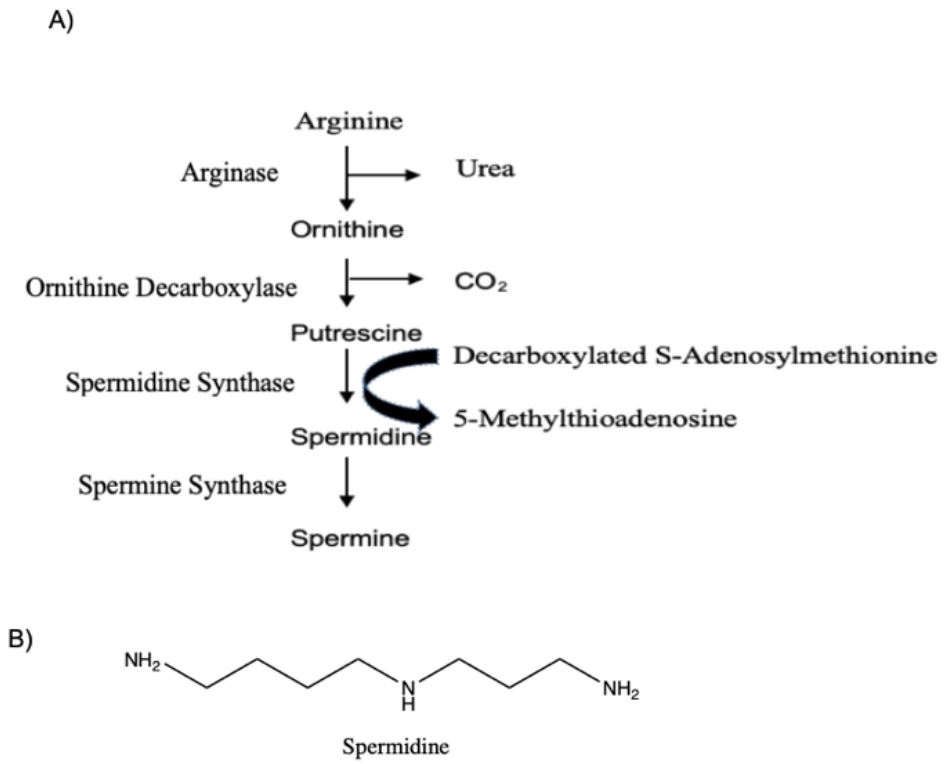

Figure 2: A) Biosynthetic pathway of polyamine spermidine via ornithine decarboxylase; B) Chemical structure of spermidine

Spermidine is acquired in a number of ways including cellular biosynthesis, microbiota generation and through oral uptake (Madeo *et al.*, 2018a). It is well established that spermidine levels decline in humans as we age with concentrations of cellular spermidine being determined by dietary intake, cellular biosynthesis, rates of catabolism and urinary excretion (Madeo *et al.*, 2018a). However, increased dietary intake of polyamines has been shown to increase the blood concentration of polyamines in both mice and humans (Soda *et al.*, 2009). Polyamine levels in this study were determined through centrifugation of blood samples and subsequent high-performance liquid chromatography analysis, which showed statistically significant blood concentration increases (Soda *et al.*, 2009). The transport mechanism of polyamines into the intracellular environment is currently poorly understood with only three competing models, none of which fully explain the transport process (Nowotarski *et al.*, 2013).

Recently discovered is the ability of spermidine to improve cardiac function in rats through activation of the AMPK/mTOR pathway and through slowing cardiac hypertrophy (Yan *et al.*, 2019). Investigations in rat models fed a high salt diet with simultaneous spermidine administration show similar results (Eisenberg *et al.*, 2016).

Delayed hypertension onset, decreased cardiac hypertrophy and increased diastolic functioning were shown while renal injury due to increases in blood pressure was reduced (Eisenberg *et al.*, 2016). This has been demonstrated in both rats and mice with spermidine significantly improving markers of cardiac ageing such as left-ventricular hypertrophy and stiffness while mitigating diastolic dysfunction (Eisenberg *et al.*, 2016). Expression of LC3-II – an autophagy marker – was reduced in aortas of older mice, whereas p62 – an autophagy substrate marker – was increased relative to younger mice (LaRocca *et al.*, 2013). Addition of spermidine restored the LC3-II expression and reduced p62 in older mice, but did not have an effect in younger mice. Moreover, H3 histone acetylation was decreased and Atg3 – an autophagy protein – was upregulated in both old and young mice (LaRocca *et al.*, 2013). It has been shown that the induction of autophagy in mice through exogenous supplementation with spermidine stimulates cholesterol efflux (Michiels *et al.*, 2016). This inhibits lipid accumulation and necrotic core formation in vascular smooth muscle cells, hinting at a potential to prevent vascular disease (Michiels *et al.*, 2016).

Expression of the Atg5 protein has also been observed and is vital for the induction of autophagy in cardiomyocytes as demonstrated in Atg5-deficient mice (Nakai *et al.*, 2007). Loss of this protein was shown to induce cardiomyopathy in mice, producing hypertrophy, left-ventricular dilatation, contractile dysfunction and increased ubiquitination (Nakai *et al.*, 2007). In addition, it was seen that contractile tissue was preserved, an improvement in mitochondrial function was noted along with improved inflammation suppression mechanisms (Nakai *et al.*, 2007). The most likely explanation for this effect is the increased bioavailability of nitric oxide (NO) acting as a vasodilator, reducing arterial blood pressure (Van Faassen *et al.*, 2009). In old mice, endothelial dilation functions are approximately 25 per cent lower compared to young mice and also approximately 20 per cent increase in arterial stiffness in old mice hypothesises to be due to decreased NO bioavailability (LaRocca *et al.*, 2013). This poses the question of whether the NO pathways and autophagy are independent mechanisms or can only work in conjunction with each other (Madeo *et al.*, 2018a).

Conclusion

Spermidine has demonstrated promising results for promoting longevity and improving health span in various research models, particularly through the polyamine's ability to induce autophagy (Madeo *et al.*, 2018a). Cardioprotective effects are also apparent through the induction of nitric-oxide synthesis by spermidine; however, this mechanism needs to be elucidated further to identify therapeutic

molecular targets (Madeo *et al.*, 2018a). Although one survey-based study linked increased consumption of spermidine rich foods to lower rates of cardiovascular disease in humans (Kiechl *et al.*, 2018), more research is needed to ascertain whether the effects seen in mice are translatable to humans with respect to longevity and the extent of benefits to cardiac health. For example, levels of blood spermidine concentrations needed to maintain optimal cardiovascular health in humans are not known. Nonetheless, noting that spermidine levels reduce in ageing individuals (Madeo *et al.*, 2018a) and blood concentrations of the polyamine can be increased through dietary intake (Soda *et al.*, 2009) provides a promising basis for the potential use of spermidine as a supplement.

These findings represent an important step in establishing treatment targets and discovering precise molecular pathways implementable in preventing age-related disease. However, minimum dosages will need to be determined that could be potentially therapeutic. It will also need to be determined whether the potential effects are translatable to the majority of the population (Madeo *et al.*, 2018b). There have been conflicting results with respect to how supplementation of spermidine impacts blood levels of the compound, with some studies demonstrating an increase and others having no impact (Brodal *et al.*, 1999. Soda *et al.*, 2009; Schwarz *et al.*, 2018). However, the differences observed in these studies are likely to be associated with the concentrations of spermidine administered. Spermidine is also being investigated for treatment surrounding intrauterine growth restriction in newborns and reducing the impact of oxidative stress caused by hypoxia on the heart (Chai *et al.*, 2019).

Future research with spermidine is currently being centred around safety and tolerability of the compound with one study demonstrating this it is safe and well tolerated in mice and older adults with subjective cognitive decline (Schwarz *et al.*, 2018) leading the way for longer exposure studies to be conducted. That being said, spermidine is naturally abundant in all eukaryotic cells so is unlikely to be poorly tolerated if acquired from exogenous food sources.

A larger number of studies will need to be completed to determine any possible side effects and utility of spermidine in human populations with more epidemiological studies taking into consideration any confounding factors. If successful, the compound has the potential clinical application of targeting specific mechanisms responsible for the onset of cardiovascular diseases.

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Glossary

Acetylation Introduction of an acetyl (O=C-R) functional group into a chemical compound

Acetyl CoA A molecule involved in many biochemical reactions, mainly the tricarboxylic acid cycle for energy production

Ageing The occurrence of structural and functional changes that occur over time

Apoptosis Controlled cell death as part of an organism's normal growth process

Autophagy Cell regulatory mechanism that removes dysfunctional or unnecessary components

Biogenesis Synthesis of substances by a microorganism

Calorie restriction mimetic Molecule mimicking the anti-ageing effects of calorie restriction

Cardiovascular Relating to the heart and blood vessels

Cardiomyocytes Cells comprising heart muscle

Cardiomyopathy Disease of the heart muscle

Catabolism The break-down of molecules through metabolic pathways

Cations Positively charged ions

Cell necrosis Death of cells due to injury, disease or lack of blood supply

Chronic disease A health condition lasting for longer than three months

Compound A substance formed when two or more chemical elements are combined

Diastolic Relaxation phase of the heart

Eukaryotic cell Cells found in animals, plants and fungi

Exogenous From an outside source

Extracellular matrix Network of proteoglycans, water, minerals and fibrous proteins that form structural and biochemical support to surrounding cells

Fibroblasts Principle active cell in connective tissue that synthesises the extracellular matrix and collagen

Glycine-N-methyltransferase Catalyses the methylation of glycine from S-adenosylmethionine

Histone Proteins in eukaryotic cell nuclei that package and order the DNA into structural units called nucleosomes

Histone acetyltransferases Enzymes that transfer acetyl groups to acetylate lysine amino acids on histone proteins

Homeostasis Maintenance of an equilibrium

Hypertension Persistently raised arterial blood pressure not within healthy limits

Hypertrophy Enlargement of an organ or tissue due to increase in cellular size

Hypoacetylation Insufficient acetylation causing gene inactivation

Hypoxia A lack of oxygen supply

Hypusination Addition of the amino acid hypusine, which is only found in eukaryotic translation initiation factor 5A (eIF5A) and archaebacteria

In Vivo Within a living organism

Metalloproteinase Any protease enzyme with a metal involved in its catalytic mechanism

Microbiota Communities of microorganisms

MiRNA Micro RNA functioning in RNA silencing and post-transcriptional regulation

Mitochondria An organelle responsible for respiration and energy production

Mitochondrial Polymerase Mitochondrial replication machinery

Mitophagy Degradation of mitochondria by autophagy

mTOR Mammalian Target of Rapamycin is a protein kinase involved in a number of cellular processes (ageing in this case).

Oxidative phosphorylation The process of ATP formation through the transfer of electrons from NADH or $FADH_2$ to Oxygen forming H_2O

Paraquat A chemical herbicide that is highly toxic

Pathophysiology Abnormal functioning associated with disease or injury

Polyamine A carbon containing compound comprising of more than two amino ($-NH_2$) groups

Pharmacological Uses, effects and modes of action of drugs

Proteostasis Biological pathways in cells that regulate biogenesis, folding, trafficking and protein degradation

Sarcoplasmic volume Amount of cytoplasm of striated muscle cells

Senescence Deterioration with age

Systolic Contraction phase of the heart

Tricarboxylic acid cycle The second stage of cellular respiration occurring in the mitochondria, involved in energy production.

Ubiquitination The process of adding a ubiquitin protein to a protein tagging the protein for degradation

Vasodilator Increasing the diameter of a blood vessel

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Discounting Beyond Death: An exploration of intergenerational distribution preferences

Lieke Voorintholt, University of Groningen, The Netherlands

Abstract

How do people value the welfare of future generations? This question is of special importance now that the welfare of future generations is at stake because of expected climate change problems. This paper investigates people's preferences regarding intergenerational distribution of welfare. It discusses research on the time discounting of life saving and uses a new question that aims to measure the valuation of future generations' standard of life. Data is obtained from an online questionnaire (n = 138) and indicates decreasing valuation of future welfare. Heterogeneity is observed between distributions among one's descendants and among future generations in general. This might be explained by the superiority of either kinship-related or ethical motives that would differ for both sorts. Obtained distributions possibly reflect decreasing connectedness to generations over time until the point where such generations are considered strangers and no further discounting takes place. The effect of major life events such as grandparenthood also fit this explanatory framework. Changes in demographic factors could therefore translate to changes in intergenerational discounting. Exact predictions of these and other relationships should be confirmed by further research.

Keywords: Intergenerational discounting, societal preferences, kinship, ethics, economics of climate change.

Introduction

Discounting is an economic subject serving many applications. The economic theory of cost–benefit analysis, for example, implies that decisions with delayed costs and benefits should be judged based on their net present value. This value is not only dependent upon present and future costs and benefits, but also on the unobservable social discount factor, which reflects society's valuation of some outcome taking place in the future relative to the present. Less explicit intergenerational discounting takes place continuously because both private and public consumption have implications for

the very long run. An example of such an implication is climate change as a result of the emission of greenhouse gases. Since the climate tends to behave as a public good, climate change becomes a public policy issue for which the intergenerational discount factor is an important policy parameter.

Lower levels of discounting, exemplified by higher discount factors, imply a higher willingness to make sacrifices now in order to sustain the welfare level of future generations. Under the economic assumption that a benevolent social planner ideally uses policy parameters that reflect the values of citizens, it is crucial for governments to become familiar with the values of citizens regarding the topic of discounting. [i] *The Economist* thus states that decisions on the use of resources will ultimately be based on moral assumptions about how much less one values their *descendants'* lives than their own (The Economist, 2018). The reference to descendants rather than to future generations in general seems to correspond with widely expressed societal sentiments about how we will leave the earth to our *children and grandchildren*. Within-family intergenerational distribution preferences might, however, be based on very different motives than preferences for distribution among generations in general.

This paper compares 'private' discounting based on distribution preferences for one's own descendants to 'public' discounting based on such preferences for upcoming generations in general to obtain an indication whether separation of the two concepts is associated with different values and determinants. Data is collected to determine values for the two sorts of discounting based on a newly designed question. Moreover, this paper focuses not only on the factors associated with the two different sorts of intergenerational discounting, but also on the manner in which differences in respondents' background variables correlate with differences between their distribution preferences. This can potentially shed light on how intergenerational discounting is associated with major life events.

As mentioned before, the intergenerational discount factor is a crucial determinant of models that calculate how much consumption to forego now in order to limit future climate change. As a result, societal approval of an intergenerational discount factor that resembles the normative value of 1 would greatly contribute to preventing climate catastrophe. It would therefore be useful to obtain information about which background variables, if any, serve to explain the value of someone's intergenerational discount factor and whether private discounting differs from public discounting. The lack of empirical research still leaves many blanks in the understanding of intergenerational discounting. This paper finds that heterogeneity between discount

factor values can be partially explained by the interplay between ethical and kinship-related motives that are triggered for certain distribution decisions.

Conceptual framework

Discounting of personal consumption has been subject to research for a long time, starting with the work of Fisher (1930). It should, however, be clarified that intergenerational discounting is distinct from the concept of consumer impatience, which forms the basis of such regular discounting within one's lifespan, especially the simple form of monetary discounting. The following critique by Schelling supports this idea:

> The alleged inborn preference for earlier rather than later consumption is exclusively concerned with the consumer's impatience with respect to his or her *own* consumption. [...] But greenhouse policy is not about saving for later consumption. It is about foregoing consumption in order that *somebody* else at a later time enjoys more consumption than would otherwise be available.
> — (Schelling, 1995: 396)

Intergenerational distribution where trade-offs are made between the welfare of future generations independent of personal welfare level can formally be captured in a theoretical model (Appendix A). This model can, in turn, be used for the interpretation of empirical findings of this paper.

Based on the literature, ethics and kinship appear to be the main motives that determine whether someone has a high or low discount factor. Before discussing these motives, this section will first reflect on the literature about time discounting life saving, which until now has most closely approached empirical measurement of intergenerational discounting.

Life-saving discounting

Cropper *et al.* (1994) dominate research on long-term discounting derived empirically from measured individual choice. Using various participant pools, they repeated a 12–15-minute telephone survey in which respondents were asked whether they prefer a programme that saves a fixed number of lives now over a programme that saves a higher fixed number of lives in t years from now, where t varies from t = 5 to t = 100. They found that the constant exponential annual discount factor clearly increases with the length of the time horizon. Their general results are not always supported by

outcomes of other studies of the same sort (Johannesson and Johansson, 1997; Frederick, 2003). Most other papers pose the critique that the manner in which the life-saving question is framed leads to highly varying results.

However insightful, the empirical research on life-saving discounting provides inadequate basis to draw valid conclusions about intergenerational discounting of welfare. Saving a number of lives is of a very different order than the broad and much less concrete consequences of current consumption and investment on future welfare. This paper therefore uses a different methodology for its results.

Ethics

Various publications on intergenerational discounting – of which Stern's (2006) is most well-known – present a normative discount factor that is based on welfare economics' ethical framework of total utilitarianism. This sort of utilitarianism implies zero pure discounting, since equal weight should be given to the welfare of current and future people. When focusing on positive rather than normative economics, aggregated discount factors that are based on this view cannot simply be used as a representation of societal discounting preferences. What can be studied instead are the individuals who apply this sort of reasoning in their distribution decision, which is also what this paper attempts to do.

Kinship

Following the quotation at the start of this section, Schelling makes the claim that he would have no preference for an increment of consumption to accrue in the year 2150 to strangers not yet existing compared to such an increment accruing in the year 2100 also to strangers not yet existing. Directly after, he admits that this might be different for preferences in the short term:

> I can imagine reasons – some of them may even appeal to me – for preferring a boost to consumption in 2025 to the same boost of consumption in 2075 [...] In 2025, my oldest son will be the age I am today and his brothers a little younger; with a little luck they will be alive and healthy and my grandchildren will be the ages that my children are today, and my great-grandchildren (whom I do not yet know) will have most of their lives ahead of them. Seventy-five years later they will all be strangers to me. My genes may be as plentiful in the population at the later date but they will be spread thinner.

— (Schelling, 1995: 396)

Schelling uses the strength of a genetical connection to explain his potential time preference. Certain anthropologists have also defined kinship in American culture as biogenetic:

> Because blood is a 'thing' and because it is subdivided with each reproductive step away from a given ancestor, the precise degree to which two persons share a common heredity can be calculated, and 'distance' can thus be stated in specific quantitative terms.
> — (Schneider, 1968: 25)

For descendants, genetic relatedness exponentially decreases with factor 0.5 per generation. Since low levels of relatedness stretch over infinitely many generations, Schneider suggests that in American society, the level of relatedness that is still associated with kinship is a personal decision. Data on actual distribution decisions among multiple generations of descendants could provide insight on such 'cut-off points'. A first indication of such a point might be the focus on the futures of one's children and grandchildren, which is more common in the public conversation on climate change, than the focus on the future of one's complete set of future offspring.

Kinship can obviously also occur in other forms than the one based on Schneider's model that relates it to genetical connections. As a result, the people who fully base their discount factors on kinship-related motives might not necessarily value their grandchild's welfare factor 0.5 of the welfare of their child. Naturally, ethical and kinship-related motives can also be mixed, leading to less extreme outcomes.

Hypotheses

A first hypothesis is that the influence of total utilitarian motives that speak for an equal distribution of welfare will be most prevalent in the broader societal context of distribution between generations in general. This implies that, on average, public discounting will be lower than private discounting. Additional regression results that would fit this explanatory framework imply that non-societal individual characteristics of respondents have less of an effect on the public than on the private discount factors. The climate impact proxies *number of new clothes* and *number of new flights* are hypothesised to lower the average public discount factor π.

Second, along the same line of reasoning, kinship-related motives will be stronger when distribution only takes place among one's own descendants. Moreover, the kinship-related motives might be more influential for those generations of descendants with whom a social connection is experienced strongest and before the cut-off point that was mentioned before. In terms of regression results, this framework predicts that grandparents will have a higher value of the proxy used for valuation of one's grandchild's welfare than non-grandparents do of potential grandchildren's. In addition, people who might have known more members further up their family tree such as great-grandparents will also feel a stronger connection to a (potential) descendant that is similarly distant (one's great-grandchild in this case).

Methodology

Since there exists no suitable dataset to answer the research questions of this paper, own data was collected. This was done with the use of a questionnaire study, which allows for the possibility to research the relationships between a large number of variables.

Participants

Research participants are Dutch adults of ages 18 to 78 (*M* 43.0, *Mdn* 44.5). However, as can be observed in Figure 1, the sample shows a clear peak for 20-year-olds (*Mode* 22) and a relatively small number of participants between the ages 30 to 50. This might be caused by the use of a convenience rather than a random sample. The total number of respondents is 138, of which 65 are females and 73 are males. Their median income interval is €2000–€2999 net per month. Of the total respondents, 63 are parents, of whom 48 have children over 19 years of age, and 34 of these respondents are grandparents.

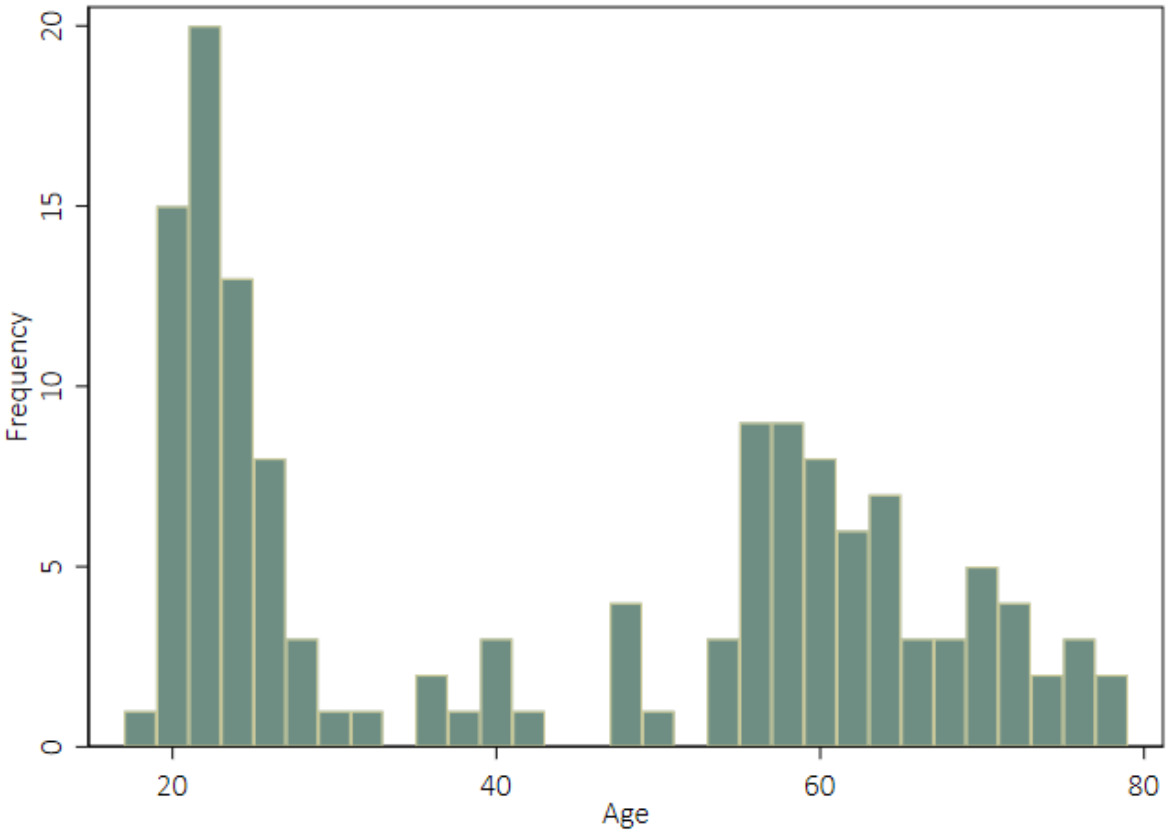

Figure 1: Histogram for respondent age.

The 138 responses were collected between 26 March to 15 April 2019. During this period, an online questionnaire was distributed to acquaintances of the author through Facebook, e-mail and by individual requests. Awareness exists that both the relatively small sample size and the manner in which respondents were selected can lead to biased outcomes. The conclusion of this paper further addresses this issue.

Questionnaire

An online questionnaire was created with a total of 33 questions in Dutch. The questionnaire contained many questions that aim to measure relevant background variables to include in the regression – from basic demographics to numbers of family members of various categories. In the cases of parents,[ii] grandparents and great-parents, respondents were asked for the number of these family members that they have memories of (not just on the basis of pictures). The questionnaire ended with questions on relevant behavioural variables such as smoking,[iii] new clothing consumption, plane travelling and volunteering. Furthermore, respondents' life-saving discount factors were measured with a question in line with previous research. The results of this will not be discussed in this paper.

Intergenerational distribution preferences were measured with the use of a self-designed question (Appendix B), which is the most important section of the questionnaire. This question asks for the distribution of 100 lottery tickets over five future generations. Each lottery ticket represents a per cent chance on an equal or higher standard of life than one's own. The lottery ticket distribution over generations of one's descendants (private discounting) can be compared to the distribution over generations in general (public discounting). It needs to be mentioned that the use of a lottery in the hypothetic situation potentially influences results because it introduces risk preferences that can impact time preferences in some cases (Andreoni and Sprenger, 2012).[iv]

Respondents were asked to distribute standard of life rather than utility or broad consumption (including non-monetary goods and services), because those concepts might be difficult to understand for non-economists. The standard of life is suitable because it does not end up on top of a certain standard that the future generation is already expected to have, but fully determines that standard. The level of the standard of life that respondents could distribute is their own, such that no value had to be specified.

The standard of life is defined in the questionnaire as a combination of multiple definitions found on the internet (Statistics Netherlands, 2014; Fontinelle, 2019) in the following manner:

> The **standard of life** gives an indication of the level of human welfare on economic, social and cultural dimensions. Various indicators are used to measure the level of the standard of life. Think of material resources, the structure of society (housing, education and health care, etc.) and the (natural) environment, for example.

Discount factors

Discount factors can be calculated based on the outcomes of the private and public intergenerational distribution question using the following expression:

$$\left(\frac{\text{lottery tickets}_{g+1}}{\text{lottery tickets}_{g}}\right)^{\frac{1}{25}}.$$

The number of lottery tickets distributed to Generation g+1 as a share of the lottery tickets distributed to Generation g captures a respondent's implicit valuation of the

standard of life of a generation in terms of the standard of life of the previous generation. To convert this to a yearly discount factor, the shares simply have to be raised to the power $\frac{1}{25}$, where 25 indicates the number of years between two generations according to the question that respondents faced. Applying this calculation to the five answers on the two questions corresponding to both cases results in a total of eight discount factors. δ_i corresponds to the generation intervals between descendants and π_i corresponds to the generation intervals between future generations in general (i = 1, 2, 3, 4). Both sets of factors have their own 'time-invariant' discount factor δ and π, which is the average of the four factors that are each specific to a combination of two subsequent generations.

Figure 2 represents a visualisation of intergenerational distribution that is based on lottery ticket distribution (among future generations in general). The number of tickets of the generation in each box equals that of the generation above multiplied with the yearly discount factor raised to the power *number of years between the two generations* (see arrows).

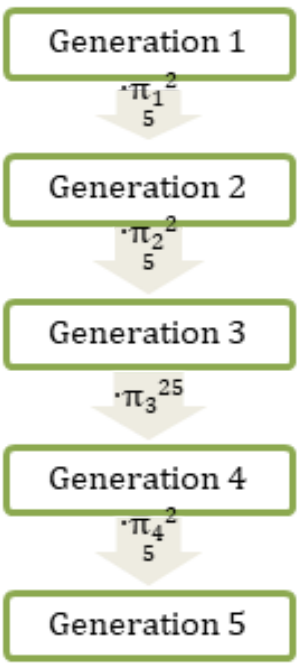

Figure 2: A model of intergenerational distribution.

Econometric techniques

The normal distribution of most variables was tested with the Skewness-Kurtosis test. The outcome of non-normality implies the use of median rather than mean comparison. Therefore, the Wilcoxon Signed-Rank test was used to compare medians

of two measures with one sample.[v] To test hypotheses about regression coefficients, a multivariable regression with several of the discount factors δ and π as dependent variables was performed on the data using robust standard errors. Significance of the regression coefficients was determined using t-tests.

Results and discussion

Median values

Figure 3 gives a first impression of empirical results. The line graph clearly shows a wider range of median lots distributed to descendants than to generations in general, with the final two median values of the former even equalling zero. Median comparisons indicate that a higher number of lottery tickets was given away to the first two generations of descendants than the first two generations in general (p = 0.000). Another main difference between the two distributions is the discounting that takes place between Generations 2 and 3. The discount factor appears to be much lower for private than for public distribution: $\delta_2 < \pi_2$. Clearly, this had to happen at some point because the two distribution graphs cross at least once by construction.

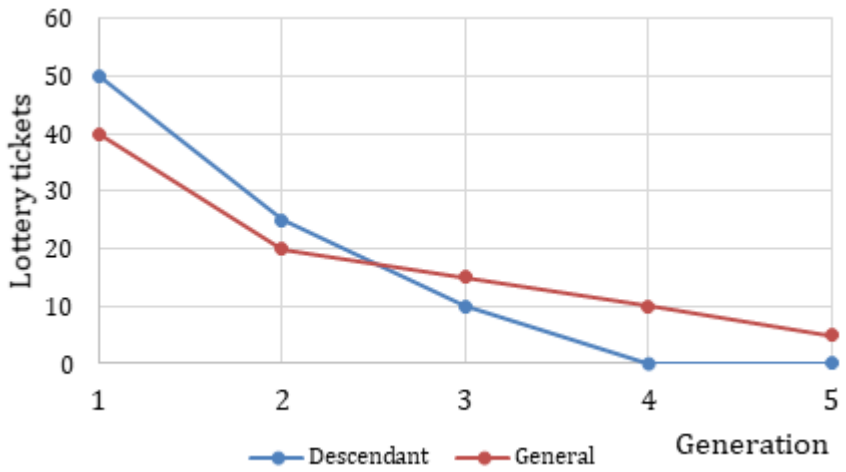

Figure 3: Median values of lottery tickets distributed

Summary statistics of the discount factors are presented in Tables 1 and 2. No factors could be calculated for a combination of Generations g+1 and g if the number of lottery tickets distributed to Generation g is zero. The lower variable count of the δ_i's than π_i's indicates that this turns out to be the case more often for private than public discounting.

The median overall private discount factor $\delta = 0.66$ is lower than the median public discount factor $\pi = 0.98$ ($p = 0.000$). In fact, this holds for all δ_i and π_i except for $i = 4$, which shows that higher private than public discounting is present but not limited to the earlier generations where close descendant ties still distinguish the two sorts of distribution. The pattern does not hold anymore for δ_4 and π_4. The median value of 1 for both factors indicates a halt to discounting after four generations ($\approx$ 100 years). The median discount factor π_3 is also 1, which indicates a halt to discounting already at an earlier stage than in the case of distribution among descendants. The self-designed question should have included a sixth generation to distribute lottery tickets to in order to find stronger evidence of a halt to discounting.

The pure kinship effect of a genetical connection with a descendant is associated with a value loss of factor 0.5 per generation. As the self-designed question assumed a 25 year time period between each generation, the annual discount factor corresponding to the factor 0.5 is approximately 0.9727.[vi] This is exactly the median value of δ_2. This value is significantly smaller than δ_1, δ_3 and δ_4, which means that the level of (constant exponential) discounting is thus the highest between one's grandchild and great-grandchild. However, a similar pattern holds for public discounting as indicated by the factors π_i. Apparently, relatively most value is lost after two generations. This is exactly in line with the all-too-common reference to 'the future of our children and grandchildren' used in the public conversation on climate change. The increase in discounting of the welfare of Generation 3 corresponds to using the generation of one's great-grandchildren as a 'cut-off point'.

	δ_1	δ_2	δ_3	δ_4	δ
median	0.9839	0.9727	0.9862	1	0.6576
mean	0.8382	0.7214	0.7705	0.9217	0.6717
sd	0.3513	0.4354	0.4131	0.2640	0.3521
N	135	117	86	67	137

Table 1: Summary statistics of the private discount factors

	π_1	π_2	π_3	π_4	π
median	0.9886	0.9839	1	1	0.9762
mean	0.8626	0.7964	0.8253	0.8859	0.7226
sd	0.3291	0.3918	0.3714	0.3183	0.3438
N	135	119	96	80	136

Table 2: Summary statistics of the public discount factors

As a robustness check, discount factors based on a different number of years between two generations are calculated and compared to the default of 25 years. For all factors except δ_2, the differences for t = 20 and t = 30 are less than 0.01. Although no reason for immediate concern, a difference of 0.01 should still be regarded as important if the factors would be used for (policy) implementations. To illustrate, the half-life corresponding to $\pi = 0.97$ is 23 years, whereas it is 34 years for $\pi = 0.98$.

Regression results

Table 3 presents a total of five regressions: three for private discount factors and two for public discount factors as dependent variables. All regression models for the other discount factors turned out to be insignificant as a whole based on their F-statistics. Right-hand sides of the regression equations contain several background variables that were measured in the questionnaire, some of which were transformed to dummies. The following paragraphs will point out the most remarkable results and reflect on ideas posed in the conceptual framework. A first remark is that only a

minority of independent variables turns out to significantly explain the dependent variables.

Both the private and public discounting models show a negative effect of the male gender on the discount factor. This effect is significant for δ_2, where the discount factor of males is on average 0.22 lower than of females. This means that males discount the welfare of their great-grandchildren relative to the welfare of their grandchildren much more than females do, *ceteris paribus*. The number of siblings shows a significant negative effect on δ_2 for which no immediate explanation can be given as well.

Significance of $\beta_{Grandchildren} > 0$ for δ_1 means that a person who has grandchildren discounts their grandchild's welfare relative to their child's much less than a person without grandchildren, *ceteris paribus*. No such effect is found for the factor δ_2 that indicates the same relationship for the jump from one's grandchild to great-grandchild. In contrast, its beta-coefficient has a negative sign and even larger absolute value (but is insignificant). This does not necessarily indicate that grandparents care less about their great-grandchildren than do non-grandparents, but rather that they have given away a higher number of lottery tickets to their grandchildren in comparison and therefore have to decrease that number with a higher percentage. This might also serve as an explanation for δ_2 as minimum discount factor. The grandchildren effect is not significant in the case of public discounting, which confirms the idea that kinship-related effects are less prevalent for this more societal sort of discounting.

The number of grandparents that one has known does not significantly explain either the private or the public discount factors, although this variable was expected to positively correlate with the discount factor δ_1. A similar conclusion can be drawn about great-grandparents and the expected positive relationship with δ_2.

With regard to behavioural variables, the expected negative effect on π is significant for Flights, but not for New clothes. Both variables have a negative impact on the discount factor for all cases, which is in line with the idea that high consumption of goods or services that are associated with negative externalities is related to a lower reflection of ethical motives in one's discount factor. Volunteering, which is instead associated with positive rather than negative externalities, has a positive sign and is significant for some of the models instead.

Finally, income shows a negative effect on the discount factor in all cases, indicating higher discounting. A higher income, therefore, points to 'short-sightedness' in the case of intergenerational distribution. Significance, however, only holds for δ_2 (using $\alpha = 0.05$).

Dependent variable	δ_1	δ_2	δ	π_1	π
Male	-0.0840	-0.2153*	-0.1132	-0.0920	-0.1188~
	(0.185)	(0.027)	(0.101)	(0.150)	(0.084)
Age	-0.0102	0.0050	-0.0075	0.0135	0.0039
	(0.550)	(0.829)	(0.660)	(0.438)	(0.812)
Age Squared	0.0000	0.0000	0.0000	-0.0002	-0.0001
	(0.950)	(0.868)	(0.878)	(0.264)	(0.672)
Income	-0.0193	-0.1257**	-0.0499	-0.0307	-0.0483
	(0.558)	(0.003)	(0.103)	(0.341)	(0.130)
Siblings	-0.0058	-0.0561*	-0.0218	-0.0050	-0.0137
	(0.725)	(0.041)	(0.112)	(0.752)	(0.356)
Children[a]	0.0763	0.0535	0.0645	-0.0907	-0.0802
	(0.668)	(0.763)	(0.681)	(0.538)	(0.602)
Grandchildren[a]	0.3511*	-0.2196	0.1535	0.1937	0.0605
	(0.027)	(0.280)	(0.236)	(0.239)	(0.641)
Grandparents known	-0.0042	0.0409	0.0070	0.0083	0.0179
	(0.877)	(0.391)	(0.786)	(0.772)	(0.486)
Great- grandparents known	0.0434	-0.0619	-0.0091	-0.0507	-0.0676
	(0.243)	(0.272)	(0.829)	(0.307)	(0.156)
Volunteering hours[b]	0.0014~	-0.0011	0.0011	0.0021*	0.0018~

	(0.052)	(0.638)	(0.384)	(0.028)	(0.057)
New clothes[b]	-0.0252	-0.0031	-0.0215	-0.0230	-0.0151
	(0.105)	(0.799)	(0.119)	(0.114)	(0.274)
Flights[c]	-0.0099*	-0.0016	-0.0074	-0.0124**	-0.0107*
	(0.044)	(0.879)	(0.110)	(0.010)	(0.017)
Constant	1.3172**	0.9912**	1.1715**	0.9290**	0.9885**
	(0.000)	(0.008)	(0.000)	(0.000)	(0.000)
N	120	102	122	120	121
R^2	0.286	0.292	0.288	0.251	0.297

Two-tailed *p*-values in parentheses
$^{\sim}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$
a: the variables Children and Grandchildren are dummy's for having at least one family member in this category
b: the variables Volunteering hours and New clothes are measured per month
c: the variable Flights measures the number of plane flights over the past two years

Table 3: Regression models for private and public discount factors

Summary

Intergenerational discounting shows much heterogeneity. For some respondents, a cut-off point after which they distribute 0 tickets can be observed after one or two generations, whereas some others perfectly equally distribute all tickets over the five generations. Overall statistics show that private distribution among one's descendants is associated with higher discounting than public distribution among generations in general. Both distributions show a clear decreasing trend and discount factors still lie within a narrow range. Small differences in the exact height of a discount factor can however lead to very different outcomes.

Kinship effects, assuming they generally lead to higher discounting, thus seem to be triggered by the reference to descendants. A more explicit trigger of kinship effects, specifically on discount levels surrounding the generation of one's grandchild, is whether one has grandchildren. Grandparents probably experience a higher perception of social connectedness to this generation. However, something that is not

in line with the hypotheses of this paper is the very insignificant effect of number of grandparents and great-grandparents that one has known on discounting. This indicates that relational ties with ancestors have no significant impact on distribution and discounting choices. The experience with family members of distant generations apparently only affects the strength of kinship-related motives future generations of similar distance if those family members are or were descendants rather than ancestors.

Instead of a clear cut-off point where the number of distributed lottery tickets falls to zero, median values seem to indicate that when two generations are considered similarly distant the discount factor will take on the value 1. As specified by the theoretical model, this implies that both Generations g and g + 1 are valued equally by the individual in Generation 0.

Consumption of clothing garments and plane flights that are associated with negative externalities are also indicative of lower discount factors. The opposite holds for volunteering. Assuming that imposing positive or negative externalities on society is related to relative importance of ethical motives that speak for equal distribution, this result fits the hypothesised framework in which the relative importance of motives is based on certain triggers that can be proxied by basic background variables.

Conclusion

This paper has presented a very explorative sort of research. The new empirical measurement of discount factors might, however, be a welcome addition to the discipline of climate economics in which discount factors presented are – most of the time – either normative or based on concepts that do not appear representative of intergenerational distribution preferences. The interplay between ethical and kinship-related motives can serve as an explanation of heterogeneity in discount factors. The results of this paper, therefore, seem meaningful and worth further research.

Limitations

Awareness exists of the fact that the methodology has several limitations. Trade-off between own and future welfare was not perfectly mirrored in the question on lottery ticket distribution, which did not require respondents to include themselves in the distribution decisions. In the extreme case where the valuation of a future beyond one's death is zero, intergenerational discounting preferences beyond one's death are

not even relevant. This limitation is however also applicable to life-saving questions, where lives saved are most likely those of distant strangers and do not have anything to with foregoing own consumption of either healthcare or material goods. In the case of lottery ticket distribution, these very short-sighted people might distribute all of their 100 tickets to Generation 1. In that case their high discounting preferences are still revealed.

Another important and more practical limitation has been the use of a convenience sample rather than a randomised sample. This might have especially limited the outcomes of the regression models that would have moreover profited from both a higher sample size and a more heterogeneous sample. The perceived difficulty of the questionnaire increased the difficulty of finding respondents. From the 138 respondents there were still many who, based on their illogical answers, misinterpreted the life-saving and monetary discounting questions.

Further research

In line with the final limitation raised, the most important step forward is optimisation of the intergenerational distribution question. The question should be further simplified to stimulate response rates and additional generations could be added to investigate the potential halt to discounting. Finally, it needs to be presented to a larger and randomised sample, for instance the LISS panel (Longitudinal Internet Studies for the Social sciences). This is a representative sample of true probability of Dutch households drawn from the population register (Scherpenzeel and Das, 2010).

New variables could be used to investigate 'triggers' of kinship. For example, instead of using a dummy for having (had) grandchildren, the number of grandchildren or the perceived quality of the relationship could be used as variables. In addition to grandparenthood, the effect of great-grandparenthood can be tested with a representative sample that includes great-grandparents. Similarly, new variables that capture the strength of the ethical motive could be included.

Finally, follow-up research would profit from a new set of analysis procedures that might make interpretation of results somewhat more straightforward. Although it would disregard variation between discount factors corresponding to different combinations of generations, a single time-invariant discount factor would be a great addition to other statistics. The fit of other discount functions than a constant exponential function, such as a quadratic or linear function should in that case also be

tested. Especially with the apparent halt to discounting after 3 or 4 generations, it seems suitable to use a different sort of function than the default of constant exponential discounting used in the neoclassical theory of project evaluation (Arrow and Kurz, 1970).

Policies

Further confirmation of high discount factors would show the need of governments to act upon this valuation in such a manner that desired future welfare levels can still be attained. An example is implementing model outcomes based on the factors, for instance a carbon tax (Pindyck, 2013; Poelhekke, 2017).

Deciding on the right discount factor 'requires a fundamental decision about how much we care about future generations' (Partnoy, 2012: 240). Slowly but certainly more researchers, journalists and politicians seem to become aware of this importance. Because of the involved irreversibility it is crucial that citizens will take over this awareness and continue, or start, to think about discounting beyond death.

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Appendices

Appendix A: Theoretical model

A formal theoretical model can be constructed to provide economic intuition for the results that will be presented later in this paper. Consider an individual in Generation 0 who values the utility of the two generations following his own: Generations 1 and 2. His own utility U_0 is then a function of the utility levels of Generation 1 and Generation 2. Assume that U_1 does not enter U_2 and vice versa. The expected utility of these two generations is, however, determined by the number of lottery tickets they receive, which indicates each generation's chance on a high standard of life. The methodology section provides a full explanation of this hypothetical situation. For Generation 1 the number of lottery tickets is L, and for Generation 2 it is 100 - L, where 100 indicates the total number of lottery tickets available:

$$U_0(L) = U_1(L) + \psi U_2(100 - L)$$

This individual therefore maximises his utility by allocating the 100 tickets such that the additional utility he would receive from giving an additional ticket to Generation 1 is identical to the additional utility he would receive if he would give it to Generation 2 instead. That is, we have the following first-order-condition that needs to hold in equilibrium:

$$\frac{dU_0(L)}{dL} = \frac{dU_1(L)}{dL} + \psi \frac{dU_2(100 - L)}{dL} = 0$$

From which it follows that:

$$\frac{dU_1(L)}{dL} = -\psi \frac{dU_2(100 - L)}{dL}$$

and:

$$\psi = -\frac{dU_1(L)/dL}{dU_2(100 - L)/dL}$$

Where Ψ indicates the valuation of the utility of Generation 2 as a factor of the utility of Generation 1.

The assumption is made that Generation 1 and Generation 2 will equally enjoy chance on a high standard of life measured by lottery tickets: $U_1(L) = U_2(100 - L)$. In this case, an unequal distribution of lottery tickets points out that $\Psi \neq 1$. If $\Psi < 1$, the individual from Generation 0 has a preference to distribute a majority of lottery tickets to Generation 1. If instead $\Psi > 1$, distributing a majority of lottery tickets to Generation 2 is preferred. This is called 'negative discounting'.

This model can be extended to more than two future generations, but the intuition remains the same.

Appendix B: Self-designed question on intergenerational distribution

This question is about how important you deem it that (**your potential own descendants/upcoming generations in general**) will have the same standard of life as you have or expect to have during the rest of your life.

Imagine that each (of your descendants/generation) participates in their own 'standard of life lottery'. Each lottery has 100 participating lottery tickets and the different lotteries operate independently of one another. Each lottery will draw one winning lottery ticket. The prize for the winning ticket in each lottery is the **same or a higher standard of** life than (your own/that of your own generation). Thus, for each (descendant/generation) every additional lottery ticket equals an extra per cent change on winning this price

You can decide the number of lottery tickets that each (descendant/generation) will receive to participate in his or her own lottery. You have a total of 100 lottery tickets to divide over (your (potential) descendants/the five generations following yours). Assume that each (descendant/generation) will get one child at age 25 and that everyone's life expectancy at birth is 85 years.

Example: *Assigning 100 lottery tickets to a descendant (generation) means that the winning lottery ticket will always be in the possession of this descendant (generation) and he/she will thus always have the same or a higher standard of life than yourself. Assigning 0 lottery tickets to a descendant (generation) means that the winning lottery ticket will in no occasion be in the possession of this descendant (generation) and he/she will thus always have a lower standard of life than yourself. Each number of lottery tickets in-between these two extremes will not provide complete security about the standard of life of the descendant (generation.) With 30 lottery tickets, the descendant (generation) has 30 per cent chance of the same or a higher standard of life than yours.*

Indicate your desired distribution below:

(Child/1 generation following yours): _____

(Grandchild/2 generations following yours): _____

(Great-grandchild/3 generations following yours): _____

(Great-great-grandchild/4 generations following yours): _____

(Great-great-great-grandchild/5 generations following yours): _____

Endnotes

[i] This is an extensive discussion point in the work of Dasgupta (2001).

[ii] In a later stage, the variable Parents was excluded from the regression completely. Many people filled in a value that was higher than two, which probably referred to their stepparents as well. However, the idea of this question was not to compare the impact of having stepparents on discount factors. It was merely meant as a control and for completeness, but no effect was expected. Due to the expected misinterpretation, it was decided to simply exclude the variable.

[iii] In a similar manner, the independent variable Smoker was dropped due to a very small percentage of smokers (of which some also only light smokers). It was originally included to check whether the same significant negative relationship between cigarette consumption and the life-saving discount factor was found as by Cairns (1994).

[iv] However, these authors also state that the influence appears to be limited in the case when uncertainty is equal for the complete choice set. The lottery still appears a suitable instrument for the questionnaire, because it allows for the incorporation of the binary outcome 'same or higher/lower standard of life' rather than the 'share' of one's own standard of life. With the current method used there is no need to specify how much lower a lower standard of life is, so that distribution decisions are less extreme and more realistic.

[v] This test considers the relative magnitude as well as the direction of differences between the two measures (Siegel, 1956).

[vi] $\text{vi } x^{25} = 0.5 \text{ so } x = \sqrt[25]{0.5} \approx 0.97265$.

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Glossary

Benevolent social planner Hypothetical agent in full charge of society who executes exactly what its citizens (aggregately) request.

Cost–benefit analysis An investigation of costs and benefits of a potential project, often throughout several time periods. In this case, the discount factor becomes part of the analysis.

Constant exponential (discounting) Functional form of discounting that implies that the value of each delayed year relative to the previous year is the same, and equals the annual discount factor. The value of a multiple-period delay therefore shrinks exponentially. Examples of alternative forms are linear and hyperbolic discounting.

Discount factor Determines the valuation of something that is delayed to a future time period relative to its occurrence in the present.

Annual (discount factor) Discount factor for which the future time period is set one year from the present. Default term used in the discussion of discount factor values.

Discounting Valuing something that is delayed to a future time period relative to its occurrence in the present. If the value is less, then the future occurrence is ‘discounted’.

Intergenerational discounting *See discounting.* Distinct from both personal and social discounting because the unit that is delayed is carried over to another generation. Costs and benefits of a certain project might therefore not be borne by the same generation, thus complicating analysis.

Kinship In the natural sciences defined as ties to those with a genetical connection. This definition, rather than the non-genetical interpretation that is used in most social sciences, is the one of interest for this paper.

Monetary discounting *See discounting.* Special case of discounting for which the unit is money and the delay in principle only affects the agent who does the discounting.

Normative economics Discusses questions related to 'what ought to be'.

Positive economics Discusses questions related to 'what is'.

Public good In the pure form, this is any good from which no one can be excluded from consumption and consumption is non-rival, which means that the costs or scope of provision do not depend on the number of users. A public good is therefore well-suited to be provided by the public sector. Examples of such goods are streetlights, clean air and a healthy climate. Public goods can also be impure in which case they are still excludable or rival to some extent.

Risk preferences Human behaviour with respect to risk. In economics, three different risk preferences can be distinguished: risk-loving, risk-neutral and risk-averse types of people.

Social discounting *See discounting.* The valuation of the delayed (mostly public) unit is societal rather than individual.

Standard of life Measurement of well-being based on various indicators such as a person's material resources, the structure of society and the (natural) environment.

Time discounting of life saving Valuing a number of lives saved in the future relative to a number of lives saved in the present. If these numbers are not equivalent, there exists time preference for saving lives.

Time preference Different term for (time) discounting.

Total utilitarianism Variant of utilitarianism in which the sum of all separate individual utilities needs to be maximised. This interpretation can be used to defend

the importance of the utilities of those individuals not yet alive, since they similarly enter the total sum that needs to be maximised.

Welfare Measurement of well-being that classically focuses on material consumption. However, welfare is often used in a general comparison of well-being between different (groups of) people.

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The New Silk Roads

Peter Frankopan (2018), *The New Silk Roads*, London: Bloomsbury Publishing, 253pp
ISBN: 9781526607423 (hardback)

Katja Laug, The University of Warwick, Coventry

Peter Frankopan follows his 2015 Bloomsbury publication *The Silk Roads: A New History of the World* with an illuminating account of the present and projected future of global economic and power structures that shifts the centre of attention away from the Western-centric narrative and towards the East and the re-emergence of economic power structures, particularly in Asia.

The New Silk Roads sets out to demonstrate that 'the decisions being made in today's world that really matter are not being made in Paris, London, Berlin or Rome (…) but in Beijing and Moscow, in Tehran and Riyadh, in Delhi and Islamabad, in Kabul and in Taliban-controlled areas of Afghanistan, in Ankara, Damascus and Jerusalem' (p. 7). What follows Frankopan's declaration is an insightful and wide-ranging analysis of global power structures and economics that is decidedly missing from mainstream Western discourses and media landscapes. The book traces the rising power in the East as a consequence of the 'demands and needs for resources, goods, services and skills' in the developed economies of the Global North, which has led to a 'crisis of confidence' in Europe and the US. Yet, Frankopan argues, the 'sun rising in the east does not mean that it is setting on the west. Not yet, at least' (p. 43).

Frankopan traces how Europe appears unable to cope with tensions arising from migration and the arrival of displaced peoples from Africa and the Middle East, from member states' inherent inability to see eye to eye, from Britain's tendency to sentimentalise the Empire, and from a lack of coherent strategies for international cooperation and to secure a place at the future tables of power. On the other , countries along the Silk Roads, Frankopan suggests, seek common interests and denominators and foster mutually beneficial investment and collaboration practices – and China is leading the way. 'The Silk Roads are an integral part not only of China's economic and foreign policy,' Frankopan argues, 'they are an integral part of how China sees the world – and how it is preparing for the future' (p. 148).

Like other critics, philosophers and thinkers, such as Pankaj Mishra or Noam Chomsky, Frankopan views the rise of the far-right and fascism across the global North as a symptom of a dying Empire and shifting powers from West to East, and considers the 'triumph of liberal democracy (…) on hold, if not over' (p. 243). Frankopan is not blind to the inherent flaws of 'liberal western democracy', and his often-scathing criticism of particularly US foreign and domestic policies are justified both by the present and by historic records. Yet, where Frankopan is clear-sighted in the failings of the Western powerhouses on these matters, *The New Silk Roads* is less so on other issues, particularly on the human cost of the current and projected shifting economic and political power structures. The analysis of the recent bilateral relationships between China and several African countries mentions, but fails to examine, the inherently problematic nature of Chinese investments across Africa. Nor does his mention of record numbers of African students studying in China consider the rampant anti-African racism there that has recently received international attention and continues to play a role in how business is conducted between African nations and China. The mention of the tentative changes in the relationship between Saudi Arabia and Israel does not account for potential repercussions for or from Palestine, and the mention of the human rights crisis suffered by the Uighurs in western China, while not absent, does not factor into Frankopan's perspective on China's return to global power.

In his discussion on India's economic developments and future in the Belt and Road Initiative, Frankopan succinctly points out the growing middle class in the country, highlighting a growing number of households 'with disposable incomes of more than $10,000 a year' (p. 32) rising from 2 million to 50 million in less than 25 years. While this data is significant, it does not account for the rise in overall population in the same time, nor does it consider the persistently high rates of abject poverty that ravages especially rural communities across the nation and has recently been compounded by droughts. Wealth in India, as elsewhere, is concentrated in urban areas, and these urban areas are over-populated, unequal and unsustainable. Frankopan also fails to address the rise of Hindu-fascism that is currently descending with a vengeance on Muslim communities and liberation movements across the country. This has recently sparked a resistance movement that has been absent from Indian politics for decades and has generated international support as well as repressive violence in India itself. Kashmir, another region implicated in the power struggles in the region, barely makes an appearance in *The New Silk Roads*, despite the vital role it plays in securing access to water for both India and Pakistan – the

Kashmiris being another people relegated to the side-lines of the analysis of global and regional politics.

'A new world is emerging in Asia,' Frankopan predicts, 'but it is not a free one' (p. 81). Throughout *The New Silk Roads*, the author hints at the potential for unfreedom and human rights violations in those nations collaborating to establish the new Silk Roads, but fails to factor into his analysis the human cost or the potential for peoples to resist and change the paths of politics. Where Silk Road nations such as China, India, Iran, Russia, Turkey and many others utilise increasingly repressive measures to control their populations, these measures are a reaction to increasing resistance against the political elites that place growth before life. Omitting these resistance movements from an analysis of shifting power structures appears at times myopic, at times fatalistic.

Scientists and economists agree that exponential growth is not a sustainable economic model, neither for the environment nor for human life. Western liberal democracy and economic dominance has wreaked havoc on the planet and on its peoples, especially in the Global South. To date, any redress for the ecological damage proposed in a series of 'Green New Deals' is contingent on the continued exploitation of the peoples, minerals, natural resources and cheap and precarious labour of the Global South. Frankopan's projections see a linear shift in global power based on the continued extraction of wealth and labour from countries rich in natural and human resources. This shift may come about through investments and uneasy political alliances, rather than military might and force, yet who will be the beneficiaries of these new trade deals and who will pay the price for the economic growth required to complete this shift?

The New Silk Roads is an important book that seeks to provide a more complete understanding of economic patterns and resulting political power on a truly global scale. It may not be possible to predict the human aspect of politics, the potential for resistance and effecting change for the wider population, but it is something to keep in mind when reading Frankopan's exceptionally insightful book on global economics and politics.

Shayla Rance, Monash University, Australia

Peter Frankopan's *The New Silk Roads* builds upon his earlier publication, *Silk Roads* (2015). This later volume provides a concise, reader-friendly insight into the shift of

the centre of the political and economic spheres of the world. In *Silk Roads,* Frankopan likens the global order as parallel to the silk roads that were historically at the centre of trade and culture centuries ago. The original publication (2015) talked about the international political economy at that specific point in time, which is of interest as it encapsulates the complexities of a juncture in history. However, in *The New Silk Roads*, Frankopan talks about a different juncture, looking at current issues, and the volumes, when read together, illustrate exactly how rapidly the world has changed between the two publications. Although the overarching claims between the works generally remain the same, in *The New Silk Roads*, Frankopan makes an important distinction: that all roads lead to Beijing, and this would not have happened without increasing Chinese bilateral investment in the region. Frankopan centres his take on the current international political economy as one that could not function in the same without Chinese policy. As a result of this, much of the book rightly focuses on President Xi's 'One Belt, One Road' initiative and the development it has meant for nations along the Silk Road and further afield in peripheral regions such as Africa or South Asia.

Can 'One Belt, One Road' be considered sustainable?

What Frankopan touches upon in his discussion is the fact that China's offshore investment is largely unprecedented. The sheer amount of bilateral investment between China and developing nations has previously been unheard of, and the potential complications that have arisen from this new venture are not lost on Frankopan. The author quotes Xi Jinping in his discussion of the Northern Powerhouse project, which proposed a boost to the economy of Northern England, as demonstrative of the philanthropic interest of nations in new, large-scale infrastructure projects. However, President Xi's argument that this sort of extensive investment is commonplace internationally is absurd. Frankopan points out how the Northern Powerhouse project is insignificantly sized in comparison. The lack of accurate statements from political leaders, not only Xi Jinping, sets the tone for Frankopan's outlook on the topic 'is Xi's “One Belt, One Road” and ensuing investment sustainable?' Will developing nations be able to pay back loans made, or – as we have already started to see – will countries be forced to forfeit assets under economic duress to Chinese investors at bargain rates? *The New Silk Roads* takes a somewhat realist outlook on the current political landscape and does not shy away from pointing out some of the hypocrisies that continue to plague not only investment in developing countries, but also a melting pot of policy issues and current affairs. The book does a

fantastic job of simplifying the complexities of the international political economy into something more accessible, and ultimately more concerning, for the non-specialist reader.

What does this mean for the current international political economy?

Politically, Frankopan is pragmatic in his belief that 'the ability to prepare for the future looks questionable'. He says this while arguing that a true neoliberal world order does not exist and that regionalism (especially Eurocentrism) remains. Frankopan argues that many developed nations are unwilling to fully commit to a truly interconnected global order (if in doubt, think of Brexit, or Trump's anti-immigration policies), which has forced many crucial negotiations to exist outside of traditional neoliberal institutions, causing huge problems for their legitimacy. Having bilateral discussions means that international cooperation, at least in the author's eyes, is at an all-time low. Thus, it should not be a surprise that the investment in the developing world is now coming from the East instead of the West, or, as other academics in the field describe it, the shift as unipolar to bipolar global order. This shift, however accurate it may be, does not address the impact of what the global climate crisis will have on nations that are more densely populated without the mature urban planning and infrastructure of core nations. What does it mean in the long term if the centre of the economic and political world is Beijing, if air and water pollutants make it an undesirable, or uninhabitable place to live? What impact will this have on the ongoing infrastructural development plans of Chinese developers, when global temperatures are rising? If these are some of the more pressing questions you hold as a reader, then *The New Silk Roads* may not be the book for you.

Frankopan's notes are extensive, spanning 45 pages of in-depth and varied sources. Many of the sources mentioned in these notes are translated from other languages or come left-field to what many other academics in the field are basing their research on. This is interesting as it allows *The New Silk Roads* to have a slightly different take on the topic, but it makes it difficult to track the authors' thought process.

The crux of my issue with the publication is that it is not comprehensive of the impact of the climate crisis on the international political economy. While being a captivatingly fresh take on the current global order, it is not a substitute for more thoroughly researched academic texts. However, it does make for an enjoyable read and is perfect for anyone wanting to get acquainted with the topic, or as an addition to more scholarly research.

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Invisible Women (Exposing data bias in a world designed for men)

Caroline Criado Perez (2019), *Invisible Women (Exposing data bias in a world designed for men)*, London: Chatto & Windus,
432pp
ISBN-13: 978-1784741723 (Hardback)
ISBN-13: 978-1784706289 (Paperback)

Ridmi Dolamulla, Monash University Australia

In a world designed by men for men, *Invisible Women* challenges the patriarchy. From policymakers to teenagers, this is a must-read for everyone. It is a real exposé to a world of inequalities that is beyond systematic differences between genders in the labour market.

Caroline Perez opens your eyes into all of the small, long-forgotten forms of discrimination that women face in various aspects of life, including daily life, workplace, transportation, public services and so forth. My initial reactions of thinking the book was esoteric and one-dimensional were soon proven wrong by the countless case-studies and Perez's deep understanding of each and every issue she describes. She uses journal articles, studies, books and broadcast media sources to support her arguments. Her unique perspective on gender equality, feminism and the gender data gap makes this book a masterpiece.

I was most surprised by the inequality of the transportation system towards women, for example the description of roads being suited to the journeys of men, who only to go work and come home, compared to being suited for the needs of women – who have many errands to run. As we grow up, we are not taught to notice these small injustices, and it is absolutely eye-opening to read studies and evidence of how these are such things that one should pay attention to. Personally, one of the statements that resonates is the fact that 'as little as a single point rise in female legislators' increased 'the ratio of educational expenditure'. This particularly struck me as it shows the importance of Perez's work of educating the wider population about the importance of female representation in politics and government.

Perez maintains a strong voice throughout the book as she feeds the readers information about a world created both intentionally and unintentionally against women. The extensive use of credited robust evidence elevates her book to a completely new standard. The extremely detailed bibliography and references that were included in the book helped readers such as myself to further explore her points. However, she did not present both perspectives of each of her arguments. Rather than looking at some of the issues from the male perspective, Perez maintained a strong feminist voice the entire book. Although this can be impactful, it can be difficult for male readers to understand her reasoning. This is a book that should be read by everyone, regardless of their gender, and if there were other perspectives besides a headstrong feminist view, she may be able to reach a much larger diverse audience.

Invisible Women is a thought-provoking, revelatory snapshot of a world that continues to bypass the needs of women in all areas of life. The structure of the book was cleverly designed, with each of the six chapters examining different areas in the world where women face injustice and considering how this can be fixed. Perez's encouraging words about the various ways to end this injustice and create hope for the future give hope to young policymakers and feminists such as myself to work towards making the world a place without a gender gap.

Nese Ceren Tosun, Institute for Advanced Teaching & Learning (IATL), University of Warwick.

It is with gratitude, anger, pleasure and hope that I am writing these lines. Perez's now award-winning book convincingly accounts for the pervasive gender data gap affecting our lives, ranging from little everyday annoyances (!) to life-threatening conditions. We live in a world where the male (size, body, aesthetics, preferences, etc.) is rendered universal, and female as niche (p. 12) – and is hence systematically excluded from all sorts of data. Past and present stories, histories, scientific measurements, artistic, socio-cultural productions are 'all marked – disfigured – by a female shaped "absent presence"' (p.xi) and 'the male-unless-otherwise-indicated approach to research' (p. 4).

This may not come as a shock to the female reader, who *lives* the book and who is continuously declared difficult in moments when it is the structure that does not fit her body, mode and natural or cultural dispositions. What may be shocking for both male and female readers, though, are the deadly consequences of holding onto series of disrupted representations and measurements. The extent of our disciplinary,

professional, everyday complicities in sustaining the gap – willingly or unintentionally – between men and women is rather distressing.

Perez manages to convince us, leaving no room for escaping her argument, via a compilation of in-depth research across fields and countries. Her comparative and intersectional approach shows that even the most 'developed' parts of the world or the members of the most affluent-elite-well-educated groups are not immune to the biases maintained by conventions of the gender data gap.

The strength of the book relies equally on HOW it is written, as much as WHAT it is about. Perez does not play a blame-game; she just depicts a brutal image that affects us all. She masterfully weaves in individual stories that allow for empathy and affective engagement while sharing the macro-picture through local and global statistics to the effect of exploring the consequences of the data gap in its genuine vertical depth and horizontal spread. The book's reliance on the *assumed universals* of standards of writing, in a way, empowers the male-dominated conventions of generating and disseminating data. The linear, rational flow of thought that bases itself on assumed to be objective quantitative data raises the voice of the scientific truth. The paradox is that, as the book itself shows, what we perceive to be scientific, objective or as a convincing argumentation heavily veils female ways of doing, knowing and being. The underlying style claim to objectivity makes the book very easy to read as it complies with the expectations, but it is also very compliant with the *universal (male?) standard.* One can argue that this style may be partially responsible for the book's popularity: by actually using a language and a mode of argumentation that is so typical, loyal to conventional non-fiction writing, Perez renders herself legible to the exact audience who might 'accuse' her of subjectivity, the audience who on the same grounds might not access the core of her argument. While my soul craved for that genre-bending, truly feminine voice – a more fluid one – to her credit, this book appeals to a larger audience without expecting to have given the issue a thought from her reader. Perez curates and gives voice to the bare data that is out there, but just invisible.

Another point of unease is that the author relies heavily on a discourse of efficiency and the value for the economy to justify the significance of women data. In an ideal world, the body that one was born with should make itself significant to the data regardless of the birth genitals. This is a matter of justice and freedom. The women should not carry the burden of proving that the damage caused to their body has also a cost for men (AKA the overall economy) to be taken seriously, to be seen. In this less-

than-ideal world, Perez needs to argue for public spaces because otherwise there is a mental health cost, which then costs to the overall economy (Chapter 2). Like her style, I feel her compliance with the dominant neoliberal paradigm of justifying the value (of a person, action or a policy) based on its economic cost/benefit sustains the point that the women matter only if/when they are a cost to men and are visible only in male terms instead of taking women as an aim in themselves, but surely makes her argument easier to swallow for more.

To the fellow female reader, I hope you take on board the invitation extended by the author to be more demanding and visible in the way you are, because it is legitimate and you are not being difficult – you are not the deviation from the standard humanity (p. 25) from the norm or atypical; it is just that the norms and types are deviations from you. To the male reader, I hope you buy this book, unlike previous data's suggestion that 'women will buy books by and about men, but men won't buy books by and about women (or at least not many)' (p. 14–15). I hope you and I, we all, can rewrite the data, lift the biases and shift the boundaries. After all, as Perez reminds us, we are in this together. Tackling and correcting gender bias is not 'just' a feminist or *for women* agenda; it is about correcting ways of being that are 'inefficient' and, more importantly, deeply inhuman. Thanks to Perez's detailed account, we know where to start *seeing* and stop being complicit within our respective professional and everyday life-fields.

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Dining and Dying at Pompeii: Last Supper at Pompeii Exhibition Review

Isabelle Green, Shayni Solanki, Archie Green, Stephanie Young, Megan Woodberry, Oscar Fanti, Rhianna Pike and Georgia-May Brown, University of Warwick, Coventry

'This major exhibition will tell the story of the ancient Roman city of Pompeii's love affair with food and wine.' [https://www.ashmolean.org/pompeii]

When we think of Pompeii, our thoughts turn to the eruption of Vesuvius, but this exhibition showed that there was more to Pompeii than its destruction.

The first sight to confront a visitor to the exhibition was a statue of Bacchus, an expressive statue of the god of wine that created a striking first impression. It was presented in an eye-catching way, standing alone in the middle of a room, highlighted by the lighting, along with the painting of a banquet from the House of the Triclinium.

Figure 1: Fish Mosaic, Naples Museum, Inv. 120177

Fish and seafood were a common food source, as shown by the realism of this mosaic – one of many that can be found on sites like Pompeii – on which even individual species can be identified. It displays some of the foodstuffs in which the Romans, particularly the wealthy, would indulge. In fact, the mosaic itself is a display of wealth

– not only because it is fantastically designed but also because the display of sea produce shows that the owner of this mosaic clearly had money to spare.

Another interesting feature of the exhibition was the examples of carbonised food, including bread and pomegranate seeds, showing us what their diet may have been in the last few weeks of Pompeii. The display also indicated which foods were imported from other provinces or countries. The nearby display of pottery, glass and silverware showed the tools that families were using to cook and prepare their food, including a 'non-stick' frying pan. These everyday items made the people living in Pompeii feel more real, rather than something that is almost like a myth.

The interactive elements throughout the exhibition were rather effective, notably the 'Roman Master Chef' competition, where visitors were invited to write down a menu inspired by the exhibition. There was also an area dedicated to dining outside in a Roman garden, with typical sounds of a summer's day playing. This made the exhibition more immersive, helping create an impression of daily life as opposed to the usual view of Roman culture, which too often focuses upon political history alone.

The final element of the exhibition was the resin cast of the Lady of Oplontis, linking the theme of death with that of dining. This was a sombre ending; the nature of the figure made all the more striking by the dim, focused lighting. While it was impressive that the Lady of Oplontis was on display, she felt under-represented, as she was alone at the back of the exhibition and didn't seem relevant to the other items. Her jewellery was presented separately in a cabinet. This was emotionally provoking; in this cabinet was a string of beads historians think was given to her by a child, further highlighting that these people were ordinary citizens, just like us.

These remnants of Pompeii truly give a sense of being close to history, and bring us closer to comprehending and understanding the ancient world.

List of Figures

Figure 1: Fish Mosaic, Naples Museum, Inv. 120177
https://commons.wikimedia.org/wiki/File:Fish_Catalogue_MAN_Napoli_Inv120177_n02.jpg, accessed 28 November 2019

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Exhibition Review: *Last Supper in Pompeii* – Too much death, not enough food

Edward Summers, Sabah Nawaz, Elysia Dale, George Seager, Peter Novis, Millie Coster, Matthew Jenkins, Cameron Hill and Daisy Sutherland, University of Warwick, Coventry

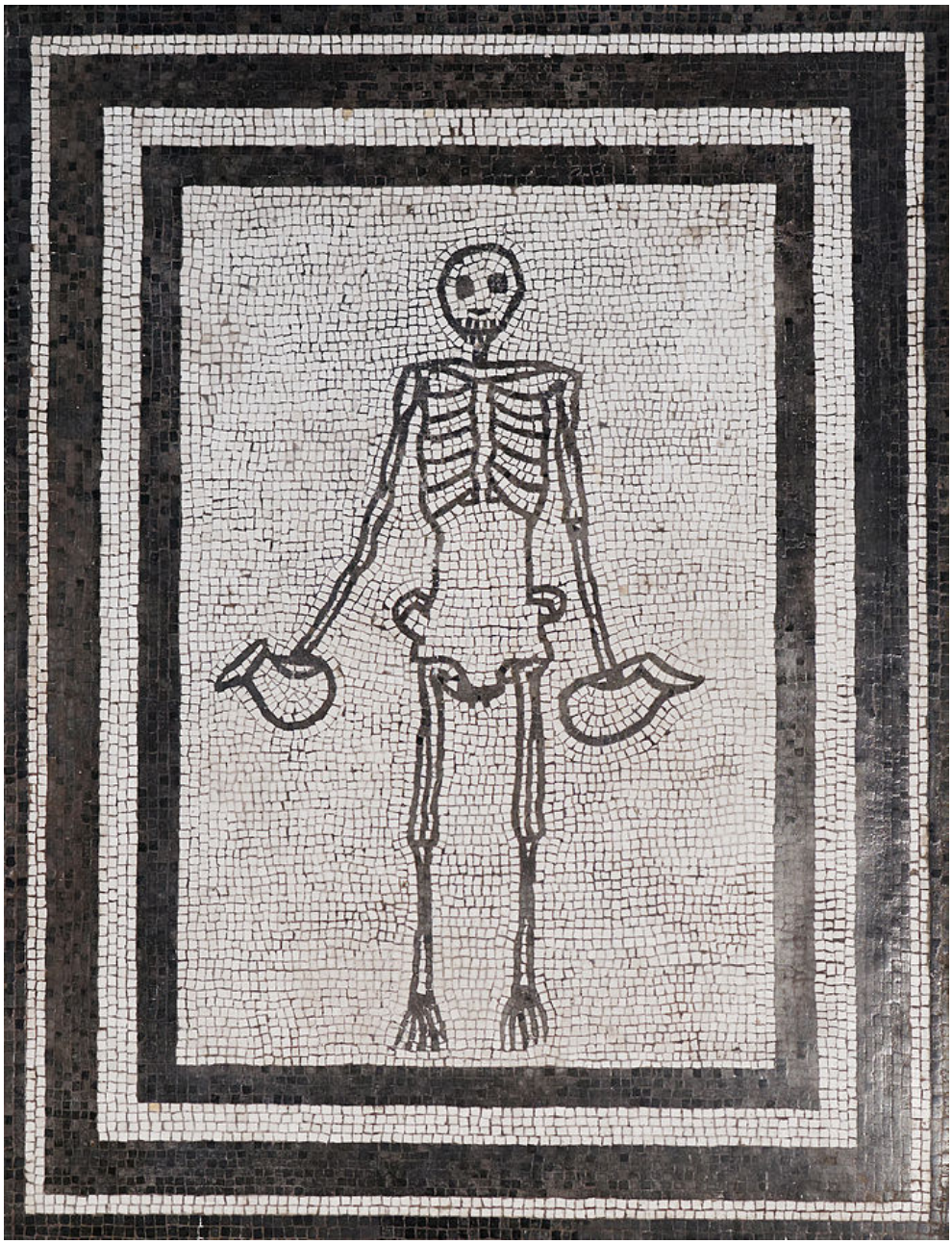

Figure 1: Mosaic of skeleton carrying wine jugs, Naples Museum inv. 9978, from Pompeii

The Ashmolean's *Last Supper in Pompeii* exhibition is a satisfying dish, but could have done with the cutting of a little fat. The exhibition presents, with the tragic end of the city hanging over it, a broad image of diets, dining, the production and selling of food and the links between death and consumption in ancient Pompeii. It is a topic that is

under-represented in popular perceptions of the ancient world, but the exhibition does an admirable job of ensuring that what could be a dry presentation is consistently thought-provoking and fun. Varied forms of evidence (such as carbonised food remains, mosaics, frescos and eating utensils) keep the exhibition engaging, making each room distinct to the palate as you move through them. It gives the feeling of travelling through streets where you pass by new aspects of the Roman diet as you travel. As a whole, the ideas presented seem fully realised.

But herein lies the problem with the *Last Supper in Pompeii*; while the menu has a great deal to offer, there were some items on display that stood out as unnecessary to the exhibit's stated goal. A prime example was the resin cast (filled from a mould of a woman in her dying moments) – something that would turn anyone off their food. It is a fair assessment to say that when one speaks of Pompeii, one thinks of bodies; yet in this exhibition such a thing felt unnecessary and detracted from the exhibition's aims. That's not to say that the cast did not help the viewer to understand how real the disaster of Pompeii was – but does such a thing really help a visitor appreciate the city's food and drink, or is it merely a shocking distraction?

The exhibits that focused on Roman Britain provided a satisfying contrast with those from Pompeii. Not everywhere across the Roman Empire had such opulence, and the section on Roman Britain showed a more humble approach to the themes presented earlier. The walls were black and small lights were the only source of illumination throughout this area, creating a distinct sense of otherness and separation from the liveliness of Pompeii. The first sight was a tombstone, a humble soldier's memorial, whereby the visitor was led towards death as a theme in the Roman world. The rooms were structured in such a way as to narrow vision; ultimately, it becomes quite easy to stumble upon the wretched Lady of Oplontis cast, presented in total isolation, left only to speak for the pathos of itself. The cast itself as the final piece can be seen in this light as powerful – a final statement on the tragedy at Pompeii that is certain to stick in the viewer's mind long after. To contrast such grotesque imagery with the liveliness of dining, ties together the recurring words seen throughout the exhibition: *Carpe Diem*, enjoy life while you can, as it can come to a sudden end.

The exhibition recreated the feel of Pompeii, including the recreation of a fountain with sound effects, which enhanced the experience and engrossed the audience. The flow of the exhibition was smooth and easy to follow, but the lighting was quite dim, meaning that, on occasion, it was difficult to engage with some of the displays. Another slight flaw with the layout was that when there was an interesting piece on

display, such as the Phoenix Tavern sign, it would attract a large agglomeration of people.

Ultimately, while this exhibition does cover the necessary aspects of food and drink in Pompeii, it consistently oversteps its boundaries, drawing attention to areas outside of what this exhibition is meant to cover and more towards the horror of the eruption of Vesuvius and the wider Roman world. In effect, while the resin cast and theme of death are entertaining, this gory spectacle is something the Romans would have gone to the amphitheatre to view – not the dining room!

List of illustrations

Figure 1: Mosaic of skeleton carrying wine jugs, Naples Museum inv. 9978, from Pompeii
https://commons.wikimedia.org/wiki/File:Carpe_Diem_MAN_Napoli_Inv9978.jpg
accessed 23 March 2020

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