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Cover by Victor Grech

Science Journal of the Malta Chamber of Scientists

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Chronological List of Past and Present Editors of Xjenza The Journal of the Malta Chamber of Scientists

2018 –

Editor: Cristiana Sebu

Senior Editors: *Sebastiano D'Amico, David Magri*

Associate Editors: *Sandro Lanfranco, Ian Thornton, Gianluca Valentino, Ian Cassar, Alexandra Bonnici, Joseph Galea, Pierre Vella, Lourdes Farrugia, Godfrey Baldacchino, Liberato Camilleri*

Xjenza Online Vol. 9 Special Iss. (2021)

Xjenza Online Vol. 9 Iss. 2 (2021)

Xjenza Online Vol. 9 Iss. 1 (2021)

Xjenza Online Vol. 8 Iss. 2 (2020)

Xjenza Online Vol. 8 Iss. 1 (2020)

Xjenza Online Vol. 7 Iss. 2 (2019)

Xjenza Online Vol. 7 Iss. 1 (2019)

Xjenza Online Vol. 6 Iss. 2 (2018)

Xjenza Online Vol. 6 Iss. 1 (2018)

2013 – 2017

Editor: Giuseppe Di Giovanni

Associate Editors: *David Magri, Ian Thornton, Ian Cassar, Philip Farrugia, Sebastiano D'Amico, Nicholas Sammut, David Mifsud, Godfrey Baldacchino, Liberato Camilleri, Carmel Cefai*

Xjenza Online Vol. 5 Iss. 2 (2017)

Xjenza Online Vol. 5 SI MNS Proceedings (2017)

Xjenza Online Vol. 5 Iss. 1 (2017)

Xjenza Online Vol. 5 Virtual Issue COST (2017)

Xjenza Online Vol. 4 Iss. 2 (2016)

Xjenza Online Vol. 4 Iss. 1 (2016)

Xjenza Online Vol. 3 Iss. 2 (2015)

Associate Editors: *David Magri, Ian Thornton, Ian Cassar, Philip Farrugia, Sebastiano D'Amico, Nicholas Sammut, Joseph Galea, David Mifsud, Sandro Lanfranco, Mario Valentino, Godfrey Baldacchino, Liberato Camilleri*

Xjenza Online Vol. 3 Iss. 1 (2015)

Xjenza Online Vol. 2 Iss. 2 (2014)

Xjenza Online Vol. 2 Iss. 1 (2014)

Xjenza Online Vol. 1 Iss. 2 (2013)

Xjenza Online Vol. 1 Iss. 1 (2013)

2003 – 2007

Editors: Joseph N. Grima and Richard Muscat

Xjenza Vol. 12 (2007)

Xjenza Vol. 11 (2006)

Xjenza Vol. 10 (2005)

Xjenza Vol. 9 (2004)

Xjenza Vol. 8 (2003)

1996 – 2002

Editor: Angela Xuereb

Associate Editor: *Richard Muscat*

Xjenza Vol. 7 (2002)

Xjenza Vol. 6 (2001)

Associate Editors: *Martin Ebejer and Richard Muscat*

Xjenza Vol. 5 (2000)

Xjenza Vol. 4 Iss. 2 (1999)

Xjenza Vol. 4 Iss. 1 (1999)

Associate Editors: *Martin Ebejer, Richard Muscat, and Christian A. Scerri*

Xjenza Vol. 3 Iss. 2 (1998)

Xjenza Vol. 3 Iss. 1 (1998)

Associate Editors: *Martin Ebejer, Richard Muscat, Christian A. Scerri and Emmanuel Sinagra*

Xjenza Vol. 2 Iss. 2 (1997)

Xjenza Vol. 2 Iss. 1 (1997)

Xjenza Vol. 1 Iss. 2 (1996)

Xjenza Vol. 1 Iss. 1 (1996)

Scope of Journal

Xjenza Online is the Science Journal of the Malta Chamber of Scientists and is published in an electronic format. Xjenza Online is a peer-reviewed, open access international journal. The scope of the journal encompasses research articles, original research reports, reviews, short communications and scientific commentaries in the fields of: mathematics, statistics, geology, engineering, computer science, social sciences, natural and earth sciences, technological sciences, linguistics, industrial, nanotechnology, biology, chemistry, physics, zoology, medical studies, electronics and all other applied and theoretical aspect of science.

The first printed issue of the journal was published in 1996 and the last (Vol. 12) in 2007. The publication of Xjenza was then ceased until 2013 when a new editorial board was formed with internationally recognised scientists, and Xjenza was relaunched as an online journal, with two issues being produced every year. One of the aims of Xjenza, besides highlighting the exciting research being performed nationally and internationally by Maltese scholars, is to provide a launching platform into scientific publishing for a wide scope of potential authors, including students and young researchers, into scientific publishing in a peer-reviewed environment.

Instructions for Authors

Xjenza is the Science Journal of the Malta Chamber of Scientists and is published by the Chamber in electronic format on the website: <http://www.mcs.org.mt/index.php/xjenza>. Xjenza will consider manuscripts for publication on a wide variety of scientific topics in the following categories

1. Research Articles
2. Communications
3. Review Articles
4. Notes
5. Research Reports
6. Commentaries
7. News and Views
8. Invited Articles and Special Issues
9. Errata

Research Articles form the main category of scientific papers submitted to Xjenza. The same standards of scientific content and quality that applies to Communications also apply to Research Articles.

Communications are short peer-reviewed research articles (limited to three journal pages) that describe new important results meriting urgent publication. These are often followed by a full Research Article.

Review Articles describe work of interest to the wide community of readers of Xjenza. They should provide an in-depth understanding of significant topics in the sciences and a critical discussion of the existing state of knowledge on a topic based on primary literature sources. Review Articles should not normally exceed 6000 words. Authors are strongly advised to contact the Editorial Board before writing a Review.

Notes are fully referenced, peer-reviewed short articles limited to three journal pages that describe new theories, concepts and developments made by the authors in any branch of science and technology. Notes need not contain results from experimental or simulation work.

Research Reports are extended reports describing research of interest to a wide scientific audience characteristic of Xjenza. Please contact the editor to discuss the suitability of topics for Research Reports.

Commentaries Upon Editor's invitation, commentaries discuss a paper published in a specific issue and should set the problems addressed by the paper in the wider context of the field. Proposals for Commentaries may be submitted; however, in this case authors should only send an outline of the proposed paper for initial consideration. The contents of the commentaries should follow the following set of rules: 3000 words maximum, title 20 words maximum, references 10 maximum (including the article discussed) and figures/tables 2 maximum.

News and Views The News section provides a space for articles up to three journal pages in length describing leading developments in any field of science and technology or for reporting items such as conference reports. The Editor reserves the right to modify or reject articles for consideration as News.

Invited Articles and Special Issues Xjenza regularly publishes Invited Articles and Special Issues that consist of articles written at the invitation of the Editor or another member of the editorial board.

Errata Xjenza also publishes errata, in which authors correct significant errors of substance in their published manuscripts. The title should read: Erratum: "Original title" by ***, Xjenza, vol. *** (year). Errata should be short and consistent for clarity.

Submission of Manuscripts

Manuscripts should be sent according to the guidelines given hereafter to xjenza@mcs.org.mt.

Referees All manuscripts submitted to Xjenza are peer reviewed. Authors are requested to submit with their manuscript the names and addresses of three referees, preferably from overseas. Every effort will be made to use the recommended reviewers; however the editor reserves the right to also consult other competent reviewers.

Conflict of Interest Authors are expected to disclose any commercial or other types of associations that may pose a conflict of interest in connection to with the submitted manuscript. All funding sources supporting the work, and institutional or corporate affiliations of the authors, should be acknowledged on the title page or at the end of the article.

Policy and Ethics The work presented in the submitted manuscript must have been carried out in compliance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans (<http://www.wma.net/en/30publications/10policies/b3/index.html>); EU Directive 2010/63/EU for animal experiments (http://ec.europa.eu/environment/chemicals/lab_animals/legislation_en.htm); Uniform Requirements for manuscripts submitted to Biomedical journals (<http://www.icmje.org>). This must be stated at an appropriate point in the article.

Submission, Declaration and Verification Author(s) must only submit work that has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis), that is not under consideration for publication elsewhere, that has been approved for publication by all authors, and tacitly or explicitly, by the responsible authorities where the work was carried out, and that, if accepted, will not be published elsewhere in the same form, in English or in any other language, including electronically, without the written consent of the copyright-holder.

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Manuscripts in press, unpublished data and personal communications are discouraged; however, corresponding authors are expected to obtain permission in writing from at least one author of such materials.

Preparation of Manuscripts

Xjenza accepts submissions in MS Word, Libre Office Writer and L^AT_EX, the latter being the preferred option. Anyone submitting in L^AT_EX should use the journal template, the latest version of which can be found at <http://github.com/hicklin/Xjenza-Journal-Template>. All the necessary files to run the L^AT_EX document should be supplied together with the rendered PDF.

If a word processor is used the styling should be kept to a minimum. Bold face and italic fonts, as well as subscript and superscript text may be used as required by the context. Text should be in single-column format and the word processor options should not be used in order to justify text or hyphenate words. Alongside the native format of the word processor, a PDF file, generated by the word processor, must be provided. Furthermore, artwork should be in accordance with the artwork guidelines given below and must be submitted separately from the word processor file. Similarly, the bibliographic data of the cited material should be submitted separately as an Endnote (*.xml), Research Information Systems (*.ris), Zotero Library (zotero.sqlite) or a BibT_EX (*.bib) file.

Article Structure

A manuscript for publication in Xjenza will typically have the following components: Title page, Abstract, Keywords, Abbreviations, Introduction, Materials and Methods, Results, Discussion, Conclusions, Appendices and References.

The manuscript will be divided into clearly defined and numbered sections. Each numbered subsection should have a brief heading. Each heading should appear on its own separate line. Subsections should be used as much as possible when cross-referencing text, i.e. refer to the subsection by the section number.

Title page

- The title should be concise yet informative. Titles are often used in information-retrieval systems. Avoid abbreviations and formulae where possible.
- Author names and affiliations. Indicate the authors' affiliation addresses (where the actual work was done) below the names. Indicate all affiliations with a lower-case superscript number immediately after each author's name and in front of the appropriate address. Provide the full postal address of each affiliation, including the country name and, if available, the e-mail address.
- Corresponding author. Clearly indicate who will handle correspondence at all stages of refereeing and publication, including post-publication. Ensure that telephone and fax numbers (with country and area code) are provided in addition to the e-mail address and complete postal address. Contact details must be kept up to date by the corresponding author.
- Present/permanent address. If an author has changed the address since the work described, this can be indicated as a footnote to the author's name. The address at which the author actually did the work must be retained as the main, affiliation address. Superscript Arabic numerals are used for such footnotes.

Abstract A concise and factual abstract is required of up to about 250 words. The abstract should state briefly the background and purpose of the research, the principal results and major conclusions. An abstract is often presented separately from the article, so

it must be able to stand alone. For this reason, references and non-standard abbreviations should be avoided. If essential, these must be defined at first mention in the abstract itself.

Abbreviations Define abbreviations that are not standard in this field in a footnote to be placed on the first page of the article. Such abbreviations that are unavoidable in the abstract must be defined at their first mention as well as in the footnote and should be used consistently throughout the text.

Introduction State the objectives of the work and provide an adequate background, avoid a detailed literature survey or a summary of the results.

Materials and Methods Provide sufficient detail to allow the work to be reproduced. Methods already published should be indicated by a reference: only relevant modifications should be described.

Results Results should be clear and concise. Numbered/tabulated information and/or figures should also be included.

Discussion This should explore the significance of the results of the work, yet not repeat them. Avoid extensive citations and discussion of published literature. A combined section of Results and Discussion is often appropriate.

Conclusions The main conclusions based on results of the study may be presented in a short Conclusions section. This may stand alone or form a subsection of a Discussion or Results and Discussion section.

Appendices Formulae and equations in appendices should be given separate numbering: Eq. (A.1), Eq. (A.2), etc.; in a subsequent appendix, Eq. (B.1) and so on. Similarly for tables and figures: Table A.1; Fig. A.1, etc.

Acknowledgements Collate acknowledgements in a separate section at the end of the article before the references. Do not include them on the title page, as a footnote to the title or otherwise. List here those individuals who provided assistance during the research (e.g., providing language help, writing assistance or proof reading the article, etc.).

Units Follow internationally accepted rules and conventions: use the international system of units (SI). If other units are mentioned, please give their equivalent in SI. Anyone using L^AT_EX should use the package `siunitx` in all cases.

Footnotes Footnotes should be used sparingly. Number them consecutively throughout the article, using superscript Arabic numbers. Many word processors build footnotes into the text, and this feature may be used. Should this not be the case, indicate the position of footnotes by a superscript number in the text and list the footnotes separately at the end of the article. Do not include footnotes in the Reference list.

Table Footnotes Indicate each footnote in a table with a superscript lower case letter.

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- Make sure you use uniform lettering and sizing of your original artwork.
- Save text in illustrations as 'graphics' or enclose the font.
- Only use the following fonts in your illustrations: Arial, Courier, Times, Symbol or Computer Modern Roman, the latter is preferred.
- Number the illustrations according to their sequence in the text.
- Name your artwork files as 'figx' or 'tabx' where x corresponds to the sequence number in your document.

- Provide captions to illustrations separately.
- Produce images near to the desired size of the printed version or grater.
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- Submit each figure as a separate file.

Formats Regardless of the application used, when your electronic artwork is finalised its file format should be one of the following (note the resolution requirements for line drawings, halftones, and line/halftone combinations given below):

- PDF or SVG: Vector drawings. Embed the font or save the text as 'graphics'.
- JPEG or PNG: Color or grayscale photographs (halftones): always use a minimum of 300 dpi.
- JPEG or PNG: Bitmapped line drawings: use a minimum of 1000 dpi.
- JPEG or PNG: Combinations bitmapped line/half-tone (color or grayscale): a minimum of 500 dpi is required.

Where possible use a vector format for your artwork (PDF or SVG). If this is not possible, supply files that have an adequate resolution.

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Figure Captions Ensure that each illustration has a caption. Supply captions separately, not attached to the figure. A caption should comprise a brief title (not on the figure itself) and a description of the illustration. Keep text in the illustrations themselves to a minimum, but explain all symbols and abbreviations used.

Tables Number tables consecutively in accordance with their appearance in the text. Place footnotes to tables below the table body and indicate them with superscript lowercase letters. Avoid vertical rules. Be moderate with the use of tables and ensure that the data presented in tables do not duplicate results described elsewhere in the article. Large tables should be submitted in CSV format.

Citations and References Reference and citation styles for manuscripts submitted to Xjenja should be in accordance to the [APA v6](#) style.

Citation in text References to cited literature in the text should be given in the form of an author's surname and the year of publication of the paper with the addition of a letter for references to several publications of the author in the same year. For further information regarding multiple authors consult the [APA v6](#) guidelines. Citations may be made directly

Kramer et al. (2010) have recently shown ...
or parenthetically

as demonstrated (Allan, 2000a, 2000b, 1999; Allan and Jones, 1999).

Groups of references should be listed first alphabetically, then chronologically. When writing in \LaTeX use `\textcite{}` and `\parencite{}` for the respective cases mentioned.

The reference section Every reference cited in the text should also be present in the reference list (and vice versa). The reference list should also be supplied as an Endnote (*.xml), Research Information Systems (*.ris), Zotero Library (zotero.sqlite) or a BiBTeX (*.bib) file. Unpublished results and personal communications are not recommended in the reference list, but may be mentioned in the text. If these references are included in the reference list they should follow the standard reference style of the journal and should include a substitution of the publication date with either 'Unpublished results' or 'Personal communication'. Citation of a reference as 'in press' implies that the item has been accepted for publication.

References should be arranged first alphabetically and then further sorted chronologically if necessary. More than one reference from the same author(s) in the same year must be identified by the letters 'a', 'b', 'c', etc., placed after the year of publication. Consult the [APA v6](#) guidelines for multiple authors. Below are some examples of referencing different bibliographic material.

Reference to a Journal Publication

Agree, E. M. and Freedman, V. A. (2011). A Quality-of-Life Scale for Assistive Technology: Results of a Pilot Study of Aging and Technology. *Phys. Ther.*, 91(12):1780–1788.

McCreadie, C. and Tinker, A. (2005). The acceptability of assistive technology to older people. *Ageing Soc.*, 25(1):91–110.

Reference to a Book

Brownsell, B. (2003). *Assistive Technology and Telecare: Forging Solutions for Independent Living*. Policy Press, Bristol.

Fisk, M. J. (2003). *Social Alarms to Telecare: Older People's Services in Transition*. Policy Press, Bristol, 1st edition.

Reference to a Chapter in an Edited Book

Brownsell, S. and Bradley, D. (2003). New Generations of Telecare Equipment. In *Assist. Technol. Telecare Forg. Solut. Indep. Living*, pages 39–50.

Web references The full URL should be given together with the date the reference was last accessed. Any further information, if known (DOI, author names, dates, reference to a source publication, etc.), should also be given. Web references can be listed separately or can be included in the reference list.

References in a Special Issue Please ensure that the words 'this issue' are added to any references in the list (and any citations in the text) to other articles in the same Special Issue.

Journal Abbreviations Journal names should be abbreviated according to:

-Index Medicus journal abbreviations: <http://www.nlm.nih.gov/tsd/serials/lji.html>;

-List of title word abbreviations: <http://www.issn.org/2-22661-LTWA-online.php>;

-CAS (Chemical Abstracts Service): <http://www.cas.org/sent.html>.

Video data Xjenja accepts video material and animation sequences to support and enhance the presentation of the scientific research. Authors who have video or animation files that they wish to submit with their article should send them as a separate file. Reference to the video material should be clearly made in text. This will be modified into a linked to the paper's supplementary information page. All submitted files should be properly labelled so that they directly relate to the video files content. This should be within a maximum size of 50 MB.

Submission check list

The following list will be useful during the final checking of a manuscript prior to sending it to the journal for review. Please consult the Author Guidelines for further details of any item.

- One author has been designated as the corresponding author with contact details:
 - E-mail address.
 - Full postal address.
 - Telephone and fax numbers.
- All necessary files have been sent, and contain:
 - All figures are given separately in PDF, SVG, JPEG or PNG format.
 - Caption for figures is included at the end of the text.

- All tables (including title, description, footnotes) are included in the text and large tables have been given separately as CSV.
- The reference list has been given in XML, RIS, zotero.split or BIB file format.
- Further considerations
 - Abstract does not exceed about 250 words.
 - Manuscript has been 'spell-checked' and 'grammar-checked'.
 - References are in the required format.
 - All references mentioned in the reference list are cited in the text, and vice versa.
 - Bibliographic data for all cited material has been provided.
 - Permission has been obtained for use of copyrighted material from other sources (including the Web).
 - A PDF document generated from the word processor used is submitted.

After Acceptance

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Special Editorial

Top Research in Malta 2019

Giuseppe Di Giovanni^{*1}

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Dear Xjenza Online readers,

Four years have passed since my last Editorial of Xjenza Online in 2017 and with which I concluded my leadership as Editor-in-Chief. It is wonderful to see that Xjenza Online has continued to grow with the new editor Prof Cristiana Sebu and her fantastic editorial board.

The idea of editing a Special Issue of Xjenza Online came to my mind at the beginning of 2021 when I was contacted by the editors of Think, the University of Malta Magazine, with the good news of my having been listed among the top 2% of scientists in the world for Neuroscience, Neurology & Neurosurgery. Seven University of Malta researchers were listed as being at the top of their fields in 2019, and Think highlighted our work in an article entitled “Big Science in Little Malta” (Schellekens, 2021) a piece of news that also reached the local media (Carabott, 2021).

In fact, eleven scientists based in Malta—seven of whom are University of Malta academics—were listed among the top 2% most cited, according to a Stanford University study. These were, Joseph N Grima, Georgios N Yannakakis, Godfrey Baldacchino, Albert Caruana, Michael A Borg, Giuseppe Di Giovanni and Ruben Gatt from the University of Malta; Carmelo Scarpignato from the Birkirkara United Campus of Malta, Victor Grech and David Pace from Mater Dei Hospital and MCAST's Mario Balzan.

This list of the most widely cited researchers in their fields was compiled by Prof John Ioannidis and his team at Stanford University. They analysed data from 1965 to 2019, covering around 7 million scientists in 22 major fields. The list identifies the top 100,000 scientists across all fields and was published in Plos Biology in 2019 (Ioannidis et al., 2019).

The idea to produce this Special Issue of Xjenza Online which showcases manuscripts by these Top Researchers and others was driven by the desire to acknowledge their contribution to the scientific development of Malta and

make their work and contribution known to the readers of Xjenza. My proposal was warmly welcomed by the Editor-in-Chief Prof Sebu and the President of Malta Chamber of Scientists Dr Gianluca Valentino and also from the authors.

In order to obtain a wider snapshot of the best science in Malta, I decided to invite not only the 11 researchers included in Ioannidis list (Ioannidis et al., 2019) but also the researchers listed among the top ones in Google Scholar User Profile rankings when you search for University of Malta (Google Scholar, 2021) where the scholars are listed according to the number of their citations.

Readers will find the first 10 invited articles in this first part of the Special Issue and the others will be part of the second issue of the Top Research in Malta.

The special issue opens with the contribution by Victor Grech (one of the Top 2% scientists, 4465 citations and an H-index of 30 in Google Scholar UM list) who summarised his work on the factors that influence sex ratio at birth with the most important being stress and sex-selective termination; gendercide, which has resulted in circa 130,000,000 missing women in the world. Additional factors include geographical trends, coital rates, radiation, secular trends and seasonality.

Ronald Sultana (Cited by 4514, H index 34) details his long (thirty years) and successful career outlining some of the key milestones of his academic journey in the three inter-related strands that mark his scholarship, namely the links between education, work and employment, teacher education, and international and comparative education. Sultana suggests that while steadfast work is the key ingredient to attaining international recognition in one's field, luck, being in the right place at the right time, and the enabling influence of mentors are also important, as is the capacity of making the best of opportunities that arise. In his view, however, the litmus test of a successful career is the extent to which intellectual labour promotes the common good. I agree with his words and I am sure

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young researchers will find this article inspirational.

Godfrey Baldacchino (one of the Top 2% scientists, 6752 citations and an H-index of 42 in Google Scholar) contributed to the Special Issue with a reprint of his recent article (Baldacchino, 2021) "Origins and destinations: career paths of male and female academics at the University of Malta". There is still a glaring 'gender gap' amongst full-time academic staff at the University of Malta, with female Professors making up less than 20%. Men and women in Malta can today achieve similar career destinations in academia; and existing gender gaps are therefore likely to close with time (although it requires some decades), based on existing policies.

Lino Briguglio (Cited by 7425, H index 31) presents an overview of his work, mostly related to the Maltese economy, since the early 1970s. Interestingly, Briguglio ends his contribution with some considerations on the outcomes of research paper citations. According to Briguglio a paper should be 1) international dimension, 2) easily accessible online free of charge, and 3) seminal. Having one's work cited in the literature does not only carry prestige for the cited author but can also lead to material gains including securing a university position and getting promoted.

Peter Mayo (Cited by 5039, H index 31) defines himself as, an "engaged sociologist—a value committed one". During thirty or so years of career at the University of Malta, his has research focused mainly in sociological research, and specifically sociology of education research. The major influences of his work are Antonio Gramsci, Paulo Freire, some classical sociologists, Henry A. Giroux, Antonia Darder and many others within critical social and political thought.

Caruana Albert (Cited by 12609, H index 40) and Jirka Konietzny presents a study on the relationship between subjective norms and gambling intention and the possible mediation effect of spitefulness as an overlooked social behaviour. The study also investigates whether gender plays a moderating role. Caruana and Konietzny conclude that moderated-mediated regression supports the role of gender and the partially mediated effect of spitefulness in the relationship between subjective norms and recreational gambling intention.

Isabel Stabile (Cited by 2359, H index 20) with Alexia Grech and Sophie Hackenbruch present a research paper entitled "Students' Attitude towards Academic Misconduct Scenarios: A Review and Pilot Study". The study shows that medical students at UM behave similarly to those elsewhere in terms of academic dishonesty. Stabile and colleagues conclude by saying that utilizing only assessment of knowledge to determine academic progression may not adequately equip students with those char-

acteristics that would be expected of them as junior doctors. Jean Calleja Agius (Cited by 2939, H index 26) with Owen Galea and Nicoletta Riva authored a review on menstrual-derived stem cells (MenSC) particularly in premature ovarian failure and Asherman's syndrome. MenSC are cyclically available in large numbers and can be obtained non-invasively and cheaply. Furthermore, MenSC are not limited by ethical dilemmas since they are obtained from menstrual blood which is considered a clinical waste. These attributes make MenSC an attractive alternative to other conventionally used adult stem cells and consequently have attracted substantial interest in the field of gynaecology and regenerative medicine.

Mitterer Holger (Cited by 4187, H index 36) presents a research work on the acquisition of a second language (L2), in particular of its phonology, that seems influenced by orthography. Holger tested whether this pattern is due to a focus on orthography in most formal L2 education by testing Maltese learners of English. Holger observed that Maltese learners do not make a quantity distinction in English words with single versus double letters. This indicates that earlier results are due to the focus on orthography in formal education rather than an automatic use of orthography in speech processing.

The collection ends with the contribution of Giovanna Bosica, the most cited female scientist among the UM academics (Cited by 3814, H index 30) with a review on the Green Chemistry movement that has helped the industry become much cleaner. Green chemistry efficiently utilises (preferably renewable) raw materials, eliminates waste, and avoids the use of toxic and/or hazardous reagents and solvents in the manufacture and application of chemical products.

I would like to thank all the contributors that have made this volume exceptional, showcasing 10 of the most important acclaimed UM academics. I am grateful to these authors for their high standard of work and to the reviewers for their crucial help in the peer-review process.

I look forward to the second part of this Special Issue of Xjenza Online on Top Research in Malta and I wish all the best to all Maltese academics.

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Research Article

The sex ratio at birth

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Abstract. The sex ratio at birth (male/total:M/T) is remarkably constant but may be influenced by many factors. Even small changes may result in highly statistically significant variations. The most important factors that impinge on M/T are stress and sex-selective termination. Additional factors include geographical trends, coital rates, radiation, secular trends and seasonality. This paper will summarise these factors but the most important is gendercide, which has resulted in circa 130,000,000 missing women in the world.

Keywords: Birth Rate/*trends, Humans, Nuclear Weapons, Radiation, Radiation Exposure, Sex Ratio

1 Introduction

The human sex ratio at birth is often referred to as M/T (male divided by total births). In humans, male live births such that 515 males are born for every 485 female births (M/T of 0.515) (Grech et al., 2019b). M/T varies and the causes may be classified into two categories: proximate and ultimate. The former refers to events that cause acute changes while it is postulated that the latter have had evolutionary drivers that have adapted the species to its surroundings. The influences that have been shown to affect M/T are legion and this paper will provide a brief outline (James et al., 2017).

2 Historical Notes

Studies and speculation on what influences M/T date to ancient Greek times, and these include allusions to the four elements that were thought to comprise nature: earth, air, fire, and water. For instance, some theories held that an infant's sex was determined by the degree of heat that a man's ejaculate was exposed to during insemination. Theories abounded with no actual scientific basis until the post-Enlightenment world of the 18th century. Those who were intrigued by this conundrum in-

cluded investigative theologians such as John Arbuthnot and Johann Peter Süssmilch, mathematicians such as Nicolas de Condorcet, Pierre-Simon Laplace and Denis Poisson, physiologists such as Johann Daniel Hofacker and organizers of statistical observations such as Joseph Fourier and Adolphe Quetelet (Brian et al., 2007).

Solid statistical analysis was first performed in London by John Graunt (1620-1674) who had access to birth data and published the first ever descriptive analysis of M/T data. John Arbuthnot (1667-1735) extended this data collection to publish the ever first statistical test based on the symmetric binomial distribution, demonstrating that the male excess was statistically significant and not due to chance alone (Brian et al., 2007; Grech, 2019).

A systematic search showed that circa ten factors may have an influence on M/T, with stress and sex-selective termination being the most predominant. Additional factors included geographical trends, coital rates, radiation, secular trends and seasonality (West et al., 2019).

3 Gendercide and Femineglect

Gendercide (the selective abortion of fetuses of one particular gender) and femineglect (the deliberate infliction of lower standards of care of all sorts, especially of health, to female neonates, infants and children, simply because of their gender) is rampant, especially in Asia. This has resulted in severe demographic sex imbalances in many countries (Diamantopoulou, 2000; Grech, 2018b).

This cultural attitude is impelled by the tendency for patrilineal inheritance in patriarchal societies, coupled with a reliance on male children to provide economic support indefinitely. For this reason, due to the patriarchal nature of most societies, male offspring preference is far more common than female preference. In Asia, this attitude is greatly reinforced by the Confucian tradition of strong son preference and female subordination (Diamantopoulou, 2000).

This attitude persists even in Asian communities in

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developed countries and antenatal sexing and gender-selective abortion is the likeliest explanation for the high M/F noted in Asian or Pacific Islander births in the United States when compared with the other races in the same country (Grech, 2017a). The sex ratio at birth decreases with increasing birth order (James, 1980). The theory that sex-selective termination is prevalent in the United States is further reinforced by a birth order analysis by race which showed that M/T decreased with increasing sibling order for all races, as is the norm, except for Asian or Pacific Islander births, where M/T rose progressively to 3rd order births then fell (Grech, 2017b). The implication is that this group may be systematically implementing gendercide. Indeed, the known effects of increasing maternal age and/or decreasing coital rates with time associated with a decrease in M/T are not only excluded in this race, but go contrary to this study's findings as Asian or Pacific Islander births also had the oldest mean maternal ages for all birth orders. The Asian or Pacific Islander strategy is equivalent to a constant loss of 3.5 females fetuses per 1000 live births when compared to White births (Grech, 2017b).

The United Nations divides regions into More Developed, Less Developed and Least Developed countries (as defined by the UN General Assembly). In Less Developed countries (and this group includes Asia), M/T was initially stable at 0.53, then rose after 1984 to 0.545, coinciding with the introduction of ultrasonography and access other antenatal sex determining technologies that could, potentially, support the practice of selective femicide (Grech, 2015c).

The likelihood that gendercide is routinely used in these cultures is reinforced by the observation that in Asian countries where education levels rise, M/T drops to values found in other races. This was observed in South Korea where M/T had peaked at 0.538 in 1990, but dropped to 0.513 by 2013 due to education campaigns and this was the first Asian country to reverse this high and artificial M/T trend (Chung et al., 2007).

It has been estimated that that the number of missing females reached 126 million in 2010 and is expected to peak at 150 million in 2035. The annual number of newly missing females is expected to exceed 3 million every year until 2050 (Bongaarts et al., 2015).

Femineglect also kills antenatally and/or perinatally. For example, in some cultures, when it is known that the fetus is female, failure to attend antenatal clinics and take the tetanus vaccine leads to an excess female neonatal mortality (Bharadwaj et al., 2013). In these cultures, female children may also have poorer vaccine uptake and poorer hospital attendances for acute illnesses, with increased morbidity and mortality such that in South and

East Asia, there is higher female under-5 mortality compared to males, in stark contrast to the rest of the world where the opposite occurs. Women in such countries may experience significant social pressure to produce sons, becoming repeatedly pregnant until they do so, as failure may lead them to experience violence, rejection or even death (Grech, 2015d).

4 Acute Stress

Human biological sex is fixed at conception and M/T thus depends on two factors: the gender ratio at conception and its alteration by natural causes of sex-selective embryonic and/or fetal death (miscarriage and/or stillbirth) (James et al., 2019). For example, ambient temperature is a simple and easily measured stressor to test and it has been shown that a 1°C increase in annual temperature (resulting in a milder winters) predicts one more male than expected for every thousand females born in a given year. Interestingly, males from cold-stressed cohorts who have experienced cold weather in-utero culling have, on average, longer life expectancies. This has been calculated as an average decrease in male life-span by 14 days per 1°C increase from one year to the next among those who survived to one year of age (Catalano et al., 2008).

A stress-related acute decline in M/T was demonstrated following the September 11 attacks on the United States with a decrease in M/T four months later (Catalano et al., 2006). This was shown to be due to an excess of male fetal loss during pregnancy (Bruckner et al., 2010). Several terrorist attacks were linked to a transient drop in M/T including during The Troubles in Northern Ireland (late 1960s to late 1990s), the Rodney King riots in Los Angeles in 1992, the Breivik shootings in Oslo in 2011 and the Sandy Hook school shootings in Connecticut in 2012 (Grech, 2015h). A meta-analysis of terrorist attacks further confirmed this phenomenon, (Masukume et al., 2017) even after seasonal correction (Grech et al., 2017a).

A very wide spectrum of stressors has been associated with a decline in M/T and these included the assassination of prominent journalists (Calleja, 2020), the sovereignty referendums in Canada (Grech, 2015i), warfare (Grech, 2013, 2014b), riots in France and terrorist attacks in Japan (Grech et al., 2017b), parliamentary elections in Malta (Grech, 2014c), mass layoffs (Catalano et al., 2010), the assassination of President J. F. Kennedy (Grech, 2015b) and the 2007 recession in the United States (Grech, 2015e). Even natural or relatively insignificant events may transiently lower M/T, and these have included the death of Princess Diana in 1997 in the UK (Grech, 2015f), the Eyjafjallajökull volcanic eruption in Iceland in 2010 (Grech et al., 2016b), earthquakes

(Catalano et al., 2013) and American legislation facilitating immigration from Cuba to the United States so as to allow Cuban citizens to escape from their country (Grech, 2014f). Even stressful metabolic conditions, such as type 1 diabetes, have been shown to reduce the sex ratio at birth (García-Patterson et al., 2016).

A common finding is that with all acute events, the M/T dip witnessed is transient, occurring approximately 4-5 months after the exogenous stressor event (Catalano et al., 2006).

These M/T dips are not only sharp and transient but also dramatic and relatively severe. The perinatal mortality rate (number of stillbirths and deaths in the first week of life/1000 live births) is considered an important metric in the assessment of the quality of health care delivery and is expected to be $< 7/1,000$ in developed countries. The very transient M/T dips observed not only match but sometimes transiently dip to even double or triple this value, making this not only a Public Health issue and inexpensive metric to objectively assess the effects of population stressors (Grech, 2018c).

China's Great Leap Forward (11/1957-1/1961) is an interesting case study in this regard, an event that had tragic consequences with a catastrophic national famine that lasted between 1959 and 1961. This not only resulted in a reduction in births but an additional male birth deficit (Song, 2012). It was estimated that there were 18,286,000 less births in 1959-61 than anticipated with an additional deficit of 196,221 male births. The total birth deficit was circa 301.7 per 1000 with an additional male deficit of 3.2 per 1,000, figures that greatly exceed the $\approx 6/1,000$ for a reasonable value of perinatal mortality. Clearly, extreme political decisions should be taken with caution since they can effect enormous impacts on history and on human biology, including massive effects on births and M/T (Grech, 2018a).

These dips conform with the Trivers-Willard hypothesis (TWH) which supports the notion that evolution should have selected parents with the ability to influence M/T according to conditions in pregnancy. This is because in polygamous species (wherein males have multiple mating opportunities), a robust son who is conceived under favorable conditions therefore has greater reproductive opportunities than an equivalent daughter who is constrained by pregnancy and lactation. However, under adverse conditions, a male fetus requires greater resources (on average 8% more protein, 9.2% more carbohydrates, 10.9% lipids of animal origin and 14.9% lipids of vegetable origin) in order to be carried to term (as males are, on average, larger babies) and will be less likely to survive pregnancy (Tamimi et al., 2003). Should he do so, a frail male may not survive to reproductive age, and if so, will compete

poorly with more robust males for mating rights. However, under poor conditions, a frail female is more likely to survive and reproduce. Hence, in unfavorable conditions, the parental passage of genes is more likely if fewer males are produced through the culling of weaker males (Trivers et al., 1973). This theory is supported by many studies (Cronk, 2007; Douhard, 2017).

5 Chronic Stress and Socio-economic Status

Different races have different M/T. This may be due to innate physiological differences or to other factors. In the US, M/T was shown to demonstrate a decreasing trend along the subpopulations Asian or Pacific Islander > White > American Indian or Alaska Native > Black or African American (Grech, 2017b). M/T falls with declines in surrogates of socioeconomic status, presumably due to chronic higher stress levels. The lower baseline M/T of Indian or Alaska Native and Black and African American is equivalent to a constant loss of 3.5-4/1,000 male births when compared to White M/T. Race is the most significant variable associated with wealth inequality in the United States and may be partially responsible for the observed differences (Grech, 2018c). A temporal M/T review showed that in More Developed countries, M/T was stable at 0.53 up to 1979, then fell to 0.525. The reason/s for this decline are uncertain but it has been speculated that this may be due to the trend for delayed pregnancies in educated women with increasing maternal age and possibly decreased coital rates. The Least Developed countries exhibited a stable and lowest M/T of 0.52 and this may be due to chronic stress (Grech, 2018c). A few localised studies, for example in Sub-Saharan Africa, have confirmed the chronic stress effect (Morse et al., 2021).

Several metrics indicate individual countries' health and socioeconomic status and for all available countries M/T and these indicators were compared in order to ascertain whether 'better' levels of these indicators were associated with higher M/T. These metrics included infant mortality rate, under 5 years mortality rate, fertility rate, Human Development Index, gross domestic product per capita, life expectancy for both sexes, females, males, as well as both sexes Health Adjusted Life Expectancy (HALE). All except for the Human Development Index (HDI) correlated with M/T at statistically significant levels (Grech et al., 2019a).

M/T may, therefore, serve as a surrogate, sentinel health indicator (James et al., 2018a).

6 Radiation

Radiation is the only known stressor/toxin which elevates M/T by destroying female in excess of male fetuses, and this is thus far unexplained. Indeed, M/T increases by 0.0036 (over the approximately 0.515 baseline value) when the normal average background radiation dose rate of 0.1141 $\mu\text{Sv}/\text{hour}$ is doubled to 0.2282 $\mu\text{Sv}/\text{hour}$ (Scherb et al., 2007). A radiation-related rise in M/T has been shown to occur in proximity to nuclear reactors (Scherb et al., 2019) after the meltdown of the Windscale (Sellafield) and Chernobyl reactors in 1957 and 1986, respectively (Grech, 2014a, 2014e). Even heavy rainfall (which precipitates and concentrates ambient natural radioactivity) after Hurricane Katrina revealed a dose-response relation between the amount of rainfall and monthly M/T in the states of Alabama, Louisiana and Mississippi 8-10 months later (Grech et al., 2015).

On a global level, extensive atomic bomb testing was carried out by several countries leading up to the Partial Test Ban Treaty of 1963 which prohibited atmospheric test explosions. 94.5% of births studied showed a uniform reduction in M/T prior to the Treaty, followed by an increase in M/T to the mid-1970s, with a subsequent decline. A negative correlation of M/T with total births was found in 66% of births studied, and these were the regions which exhibited the rising M/T pattern in the 1970s. The birth deficit for countries which displayed significant correlations of total births with M/T (i.e. North America, Europe and Asia) was estimated at 10,090,701 (Grech, 2015a).

7 Excess Coital Activity

The regression of M/T on time of conception within the human menstrual cycle is U-shaped. Due to hormonal activity, females are generally more receptive to coitus mid-cycle, peri-ovulation. Increased coital activity (for reasons uncertain) increases the odds of conception early in the menstrual cycle, thereby skewing the odds toward males, elevating M/T. This explains the finding that during the Great Wars, M/T rose in countries actively at war only (James, 2009). This is probably because in times of war, an adult sex ratio imbalance is manifest, with more males being away from their homes, and soldiers only granted short periods of leave in order to return home (James, 2009). This has been claimed to result in sexual excesses, 'actions [that] were viewed as understandable responses to the Frauenuberschuss,' the excess supply of women (Michel, 1993). The related increased coital activity may have caused the M/T elevations and this has been confirmed by a meta-analysis of births (James, 2008).

A rise in M/T nine months after occasions of public ela-

tion has also been reported for example in South Africa nine months after the 2010 World Cup there (Grech et al., 2016c; Masukume et al., 2015), and the high M/T in the UK following the birth of Prince William in 1982 (Grech, 2015f). High coital rates might also explain the reported spike in births and M/T in Hong Kong in the auspicious (to the adherents of the Chinese Zodiac) Dragon years of 1976, 1988 and 2000 (Grech, 2015g), and to misrepresentation of birth year reporting for female babies in Japan in the Fire-Horse year 1966 such that babies born at the beginning or end of this "unlucky" year had their birth years misreported as having occurred in adjacent years (Grech, 2016). The steady decline in coital rates with duration of marriage also explains the decline in M/T of first births with the duration of time between marriage and birth (James et al., 2017, 2018b).

8 Secular and Geographical Variation

M/T may exhibit seasonal variation, peaking as summer approaches and this was demonstrated for the United States with a significant peak in June (Grech et al., 2016a). Global datasets have shown an overall decreasing trend in M/T in Europe and North America (Grech, 2014d). A latitude gradient in M/T is also present, with more males being born in southern, warmer latitudes in Europe. The converse occurs in North America, with more males born in northern latitudes and the reason for this is unknown (Grech et al., 2002; Grech et al., 2000, 2003).

9 Conclusion

While acute events may transiently decrease M/T, or chronically depress M/T in situations of prolonged stress, M/T may also occasionally rise sharply in relation to events that lead to elation possibly due to increased coital activity.

However, these effects simply pale into insignificance when compared to two man-made effects: radiation exposure, and gendercide (with attendant femineglect). These influences have hugely increased M/T, with the potential for demographic havoc in affected countries, notably Asia (Grech, 2015d).

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Review Article

Being an academic: a process of becoming

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Abstract. This paper presents an autobiographical narrative outlining some of the key milestones of the author's academic journey as evident in his publications in the three inter-related strands that mark his scholarship, namely the links between education, work and employment, teacher education, and international and comparative education. The author draws on over thirty years of experience in research with a view to sharing hard-won insights with early-stage researchers and scholars embarking on an academic career. He notes that while steadfast work is the key ingredient of attaining international recognition in one's field, luck, being in the right place at the right time, and the enabling influence of mentors are also important, as is the capacity of making the best of opportunities that arise. In his view, however, the litmus test of a successful career is the extent to which intellectual labour promotes the common good.

Keywords: educational research, career development, career planning, academia

1 Introduction

It is indeed a privilege and an honour to be invited by *Xjenza* to feature in this special issue, where senior academics have been asked to showcase their research in their particular field of expertise. There are, of course, many ways of responding to such an invitation, and much depends on the kind of audience one has in mind when one writes. In my case, it is the early-stage researcher/beginning academic that I imagined as the reader of this narrative. Those with a background in the social sciences generally, and education in particular, are more likely to find what I have to say directly relevant. Nevertheless, others might find this series of reflections of interest as they strive to craft an academic career for themselves.

I have adopted an autobiographical approach, not only

because this is an engaging style, but also because of my firm conviction that the personal and the professional are difficult if not impossible to keep apart (Sultana, 2011a). The choice of research area, the theoretical lenses we are attracted to, the motivation that keeps us going through the hard times – one and all are rooted in our life experiences, as other colleagues have noted (Darmanin, 2011; Mayo, 2013). Being aware of this and acknowledging the influence of our background – including such ascriptions as social class, gender, and ethnicity – on our way of thinking, being, and feeling is crucial. In the social sciences in particular, the dominant approach to knowledge building is that there is no view from nowhere. Being aware of one's 'positionality' (Rowe, 2014) goes some way in bracketing prejudice and bias, and problematising that which we think of as 'natural' and 'normal'.

Autobiographic writing is also 'performative' (Holmes, 2009), a social and literary artefact (Shands et al., 2015): an author's claims to "tell it the way it is" need to be considered in the light of the power relations that are inevitably wielded for effect, including what is said and what is left unsaid, what is foregrounded and what is relegated to the background, and how style and rhetorical devices are used to create a desired effect. Autobiographical writing is also infused by tropes or motifs that tend to recur in this genre, such as the protagonist "making it against all odds", or "being driven by destiny", or "it all makes sense now", among others (Convery, 1999). This is not to say that autobiography is fiction. Rather, it is to stress that there are many ways of narrating the same life, with autobiography being just one of them.

2 Who am I?

I am now 63 years old. It is a dangerous age, when one starts looking back at one's achievements, wondering whether one has peaked, and when perhaps one does not dare look to the future and its halls of shadows. The fire in the belly has become embers: less dramatic perhaps,

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but still able to cook the food slowly, possibly bringing out the flavours better. Questions arise as to what one could have done more, or perhaps less and better, whether one has been driven by personal career ambitions rather more than by the common good, and whether choices made were the right ones. It is also a time to try to find meaning and patterns and compass points that lead to where one is now. As the philosopher Kierkegaard famously said: “Life can only be understood backwards. . . even if it must be lived forwards”.

The bare facts of my life are that I grew up in an upwardly mobile middle-class family, in a place and at a time when people were known by their kinfolk’s nicknames, where life often spilled into the streets, and where the church and politics structured lives as much as convictions. I did well at school, even if, as a scholarship boy at an élite school, whole areas of knowledge seemed to slip away given that they were taught in English, a language I knew from books, but not from everyday interaction at home. Family life provided a shelter, but was also stifling at times, and I was lucky enough to expand my horizons in my teens when I joined a community-based organisation (Sultana, 1996), led by inspirational educators who helped me develop qualities that I did not even know I had, and which formal schooling generally failed to recognise. This is when, at the age of 15, I fell in love with teaching, and with the sheer magical experience of using words to enthrall a group of youngsters, of organising events that brought out the best in learners, and of establishing mentoring relationships that opened up a universe of deeply meaningful conversations.

My parents’ ‘capacity to aspire’ (Appadurai, 2004) and what they considered the ‘horizons of possibility’ (Hodkinson et al., 1996) for their children were limited, and despite good results they encouraged me to sit for a competitive exam to become a bank clerk. . . an exam that I (luckily?) failed. As a default I followed my elder sister into university where, like her, I graduated with a first-class honours. A stint as a teacher was followed by a Commonwealth Scholarship at Reading University, where I trained as a career guidance and counsellor. The Distinction I was awarded there set me up for another grant, which this time took me to New Zealand, where I obtained my PhD in educational sociology with a thesis that focused on transition from school to work. Doctorates were still a rarity in Malta those days, and having one almost automatically opened doors to a university post. I joined the Faculty of Education, and am still a member 33 years later, besides also being the founding Director of the *Euro-Mediterranean Centre for Educational Research*. Grants took me to Stanford University in 1990, (where I was a Fulbright Fellow for four months), and to Paris in

the summer of 1992 (where I embarked on a post-doctoral research project on education and the European Union), with the latest award being an Honorary Doctorate granted in 2020 by Université Laval (Quebec) in acknowledgement of what that institution generously considered to be “exemplary and outstanding achievement and influence”.

Such recognition should not obscure the feelings of self-doubt, the lows that came with the highs, the homesickness that was the other side of the excitement of being away, the pre-internet/pre-EU membership sense of isolation when Malta felt a prison as much as a haven, the constant stress of trying to keep up with the latest research, the drubbing by reviewers of papers that one proudly submits, the stomach-churning anxiety (which never really goes away) of facing a crowd when presenting at a conference (or the dejection felt when only a handful turn up to one’s session) . . . not to mention the difficulties of finding a balance between the demands of parenthood and of academia. And yet, here we are, thanks to hard work, for sure, but also thanks to the sheer luck of being at the right place at the right time, and to the helping hand of mentors who opened doors – and sometimes wallets – to see me through.

3 Research strands

Taking the cue from Kierkegaard by looking back in an effort to join the dots that mark my past, I see three main strands in my research output, a reflection of the multiple demands that are typically made on scholars in small states. Such multi-functionality (Farrugia et al., 1989) was initially a source of intense frustration, and that for two reasons. First, breadth often comes at the expense of depth. Second, it is difficult to establish oneself internationally unless one’s name and work are associated with a specific field. This is not just a function of the quality of work produced: it also has to do with the way knowledge networks operate, and the difficulties in keeping up with the dynamics inherent to the field, including attending key events, being part of an executive committee of the field’s association, contributing to projects and Special Interest Groups, and so on. With time, however, I came to realise that there is quite a robust demand for ‘gifted generalists’ whose ‘flexible specialisation’ (Baldacchino, 2019) leads them to ‘speak’ different technical languages, affording a better grasp of how the different parts fit in and contribute to the whole. This of course entails more work as one has to keep up with developments in more than one distinct area of knowledge. It also became increasingly obvious to me that depth can be achieved in more ways than one: the rhizomatic nature of knowledge is such that planting one’s academic roots in diverse places can lead to making connections that were previously not imagined,

potentially leading to new insights.

The field in which I flourished as an academic is education, a broad enough area that allowed me to 'husband' three related garden patches, namely [1] the links between education, work and employment [2] teacher education, and [3] comparative education. All my work in these three areas is informed by an engagement with sociology (and in particular critical social theory), and to some extent with philosophy, economics, history, and psychology, an interest that flows naturally from attempts to understand the interactions between individuals and society, and between agency and structure in particular historical conjunctures. At one level, therefore, I am fully committed to multidisciplinary, recognising that disciplinary boundaries have been historically constructed and often have to do more with the power of 'academic tribes' (Trowler, 2014) in delineating and claiming exclusive expertise than with anything else. I do recognise, however, that different fields of knowledge have developed their own disciplinary cultures (Becher, 1981), which include competing epistemological and methodological orientations that can give rise to a diversity of insights. For this reason, interdisciplinarity is a bit trickier, as one might find oneself operating with different, even contradictory assumptions.

The primary value of each of the disciplines mentioned above – over and above their intrinsic worth – is the lenses they provide in order to see and interpret the phenomena around us, and to act on the basis of those insights. In my case, the gravitational pull that weaves the different disciplinary strands together is social justice (Hooley et al., 2018, 2019; Sultana, 2014)¹ broadly defined. This entails looking at society as a human accomplishment, where different and conflicting interests are inevitably present, and where intellectual and practical work, dialectically conceived, can help us understand the world and render it more just. Critical social theory, no less than critical psychology and critical economics provide us with penetrating insights about the human condition, about the way wealth and life chances are produced and distributed, and how subjectivities are shaped by, among others, formal education. The value of both history and comparative studies – i.e., comparison across space and time (Sultana, 2017b) – is that they alert us to the crucial fact that "another world is possible" ... assuming, of course, that there will be any world to speak of, given the climate emergency. Human-made social and ecological damage calls for what my colleague Peter Mayo calls 'a politics of indignation' (2012), where education cannot but be implicated.

¹For the purpose of this article, I only refer to a selection of the main books and/or papers about specific themes. A more comprehensive list of publications is available here: <https://www.um.edu.mt/emcer/ourresearch/ourpublications>.

3.1 The links between education, work and employment

Starting first with the links between education and work. As Watts (1983) notes, a consideration of these bonds opens up at least four strands of inquiry, focusing on [a] the teaching of technical and vocational competences (TVET skilling); [b] the way schools teach/socialise the up-coming generation about/for work (career education); [c] the orientation of students towards different sectors in an increasingly complex labour market (career guidance); and [d] the ranking by schools of students according to 'ability', thus (in principle at least) facilitating meritocracy (selection).

For a reason I cannot entirely fathom – my first degree is in English after all – I have spent most of my academic life working on this particular area and its four research components. Happenstance partly explains why this is the case: my initial commitment to post-graduate work was to personal counselling – a 'catcher in the rye' syndrome that was instilled in me during my teenage years and which I have never entirely shaken off. However, when I took up doctoral studies in New Zealand, the most suitable supervisor I could find – Peter Ramsay – was more of a sociologist than a psychologist. This led me to carry out a multi-sited ethnography looking at and comparing the way three schools prepared their students for work (Sultana, 1988a), in some ways along the lines of the classic study by Paul Willis (1977), who had tried to understand how schools are implicated in social reproduction, with working class kids ending up in working class jobs. That PhD led to several publications in peer reviewed international journals (*inter alia* Sultana, 1989, 1990a, 1990b, 1990c, 1990d, 1992b) – a wise move since, despite all good intentions, one is unlikely to single-mindedly invest so much time in a research project once lecturing, administration and family commitments take over significant chunks of one's life. These publications generated their own dynamics, in terms of personal investment, the expertise acquired, the reputation earned, and the opportunities they opened up. One netted me the Caltex Prize (Sultana, 1988b), which involved a welcome monetary award.

Another reason for the research interest in exploring the links between education and work is that this is what we could call a 'generative theme' (Freire, 1972): the topic opens up a multitude of important conversations such as: should schools mirror or challenge the way work is conceived in contemporary society? How do schools socialise students into a work ethic and work-related values? Do schools primarily emphasise and justify hierarchy or are they laboratories of democracy? How do schools feed into – or challenge – the classed, gendered, and racialised division of labour? Do schools open up opportunities

and encourage aspirations in all students, or are they implicated in 'warming up' some while 'cooling out' others? Should technical and vocational skills be taught at school? What can be said about the political economy of the curriculum, and what does this tell us about which knowledge is valued, and how it is rewarded? Should schools be involved in sorting out students according to some notion of ability, and direct them to corresponding segments of the labour market? How do such selection mechanisms work in the interest of some and against the interest of others? How do employers 'read' the formal education qualification system when it comes to recruiting workers? What impact does globalisation have on the relationships between formal education and work? What do tracer studies tell us about the course-related work that graduates take up?

The list of research questions is practically interminable, and in my career, I have tried to engage with as many of these issues as I could, both as a researcher and as a member of international projects. A few examples will suffice to give a sense of the breadth of work done in this area.

3.2 TVET and selection

Beyond the doctoral research, I embarked on a four-year-long study about the history of vocational schooling in Malta, looking at its intersections with class and gender interests, as well as ideological and economic aspirations of post-independent Malta (Sultana, 1992a, 1995a, 1995d). This served to ground me back in my home country, which I found to be essential to keep a balance between making a local input while engaging with international projects... a balance that many scholars in peripheral and semi-peripheral countries find difficult to maintain, given the choice between publishing globally and perishing locally, or publishing locally and perishing globally (Hanafi, 2011). The research project established my name in the area known as TVET (Technical and Vocational Education and Training), which was increasingly at the forefront of the European Commission's concerns, especially in the light of its aspiration "to become the most competitive and dynamic knowledge-based economy in the world". This was also the time when worldwide there was a trend to 'vocationalise' education at all levels, and to bring the two worlds of the economy and of schooling closer to each other (Carnoy et al., 1985; Grubb et al., 2004). As with many others, I have critiqued this neoliberal emphasis which reduces education to narrow skilling (Sultana, 1987, 2012b), making a travesty of education, besides being underpinned by dubious economic arguments (and motives) to boot (Brown et al., 2011; Brown et al., 2020).

The examination of vocational tracks in Malta in what were then known as trade schools showed how these streams almost exclusively attracted students from the manual, working class, and gave them a diluted general education, in addition to work-related skills, that ultimately closed down the opportunities for social mobility, directing them back to the manual labouring class they originated from. This was, yet again, an example of Willis' (1977) theme in his book *Learning to Labour*, with work ethic and 'appropriate' work-related behaviour being drummed into the students who, I argued, were not getting their educational entitlement as citizens. Despite the government of that day having a penchant for comprehensive education (Zammit Marmarà, 2017), the economic development plans for the country required a class of skilled and semi-skilled tradespersons to work in the factories, including in the newly established textile industry. Here then was selection operating presumably on the basis of academic ability, but which, as sociologists like Bourdieu & Passeron (1977) have pointed out, is really based on class.

My critique of trade schooling in Malta fed into a movement that saw them being phased out and replaced by the expanded remit of the Malta College of Arts, Science and Technology (MCAST), set up in 2001. I was one of the policy advisers on this reform, and while I am still convinced that this was the right way to go, it would have also made sense to have vocational options within the curriculum of general secondary education, as we have now. Many students who would have been directed towards trade schools could not find anything much in the general academic schooling they were offered in the reformed secondary education sector, with parents complaining that it was becoming difficult to force their children to go to school and that in trade schools they had at least learnt something useful. Teachers too were not overjoyed that their classes now had a different student profile, with some openly resisting efforts to being 'schooled'.

This was an important learning experience for me: my first foray into so-called 'evidence-based' policy work proved challenging since with education there never seems to be a straightforward and predictable answer: 'perverse effects' keep sprouting up, and what you gain on the one hand you tend lose on the other. Few countries have managed to overcome the dilemma between keeping students together to enhance social equity and cohesion, while offering a differentiated curricular diet that satisfies every student's taste. That has proved to be especially difficult in Malta, given that 40% of students attend the non-state school sector where, despite in principle following the same curriculum as state schools, tend to attract a different type of intake, socialise their students in ways

that encourage higher attainment, and direct them more robustly towards higher education (Darmanin, 2003). Add to the mix the impact this has on state school teacher morale and expectations, as well as ‘peer effects’, and one can begin to understand why, despite substantial investment in education, Malta trails behind in the international student assessments we have participated in, such as PISA and PIRLS (e.g. PISA National Centre, 2018).

My work in the TVET area took on an international dimension largely thanks to CEDEFOP, one of the EU’s agencies focusing on technical and vocational education and based in Thessaloniki, who I helped set up a network of TVET teacher training institutions (TTNet). I also became increasingly involved in development work, mostly with such agencies as the GIZ (*Gesellschaft für Internationale Zusammenarbeit*, i.e., Society for International Cooperation), UNESCO, UNRWA, and Save the Children, among others, where TVET issues played a significant part in the effort to provide the skills needed by such countries and territories as Albania, Jordan, Kosovo, Lebanon, Palestine, Turkey (e.g. Sultana, 2008a). As I will note further on, involvement in these kinds of contexts obliges one to rethink much of what one has learnt to take for granted about education and its links with society, leading to sharper thinking about the complex interaction between the local and the global.

3.3 Career education and guidance

The area I have most worked on over the past 20-odd years in respect to the links between education and employment is career education and guidance. I had done some work on this locally, first as a guidance counsellor in schools, and then as an academic. I helped in the introduction of a related new curricular area called Personal and Social Education (Sultana, 1992c), and put together an edited volume of readings on key topics in the subject (Sultana et al., 1997). At the launch of the book, we invited to Malta one of the best-known names in the field to address the audience, Tony Watts: he heard me give my speech, turned to me afterwards and said: “One of these days we must do some work together”. We lost touch for several years, until I received a telephone call from him asking me whether I wanted to be involved in an international project he was co-leading. The rest, as they say, is history: it led to making an input in OECD work in the area, writing a series of technical reports for the European Commission, and to travel the world over researching, writing, speaking at public events, providing training and policy advice, and learning much from my interaction with others working in the same or related fields. My comparative research on career education and guidance focused on services in both the education and

the public employment sectors, and initially looked at the then 11 candidate countries to the EU (Sultana, 2003), then on all the EU members states (Sultana et al., 2006; Watts et al., 2007) and finally on the Middle East and North Africa (MENA) region (Sultana, 2017a; Sultana et al., 2008).

On the basis of such studies, I was engaged as expert to the European Lifelong Guidance Policy Network, helping promote critical studies of career education (also known as Career Management Skills) at a time when school-to-work curricula were becoming increasingly attractive (Sultana, 2012b). My focus on career guidance involved different aspects related to policy (e.g. Watts et al., 2004); curriculum development (e.g. Hooley et al., 2013), and training (e.g. Sultana, 2018) leading to several publications, including two edited volumes published by Routledge triggering a social justice turn in the field (Hooley et al., 2018, 2019). More recently, I co-edited a special journal issue dedicated to the integration of migrants and refugees in the labour market (Fejes et al., 2021).

In this area again, therefore, hard work, luck, and the helping hand of a mentor proved crucial in shaping a very important part of my career.

3.4 Teacher education

While the Faculty of Education has a broad remit over several aspects of education, and provides a space for its members to look beyond schooling (Baldacchino et al., 1997), its core mission remains that of preparing graduates for the teaching profession. For many years, therefore, teacher education was also quite central to my university-based work, and to my practical and research interests. Education and teaching are not a science in the same way that Physics or Chemistry are: there are no formulas or recipes that are likely to ‘guarantee’ success, simply because the variables are too great. The same educational strategy or approach that succeeds with one group will fail with another, or even with the same group on a different day. Despite advances in neuroscience, predictability and repeatability do not feature much in teaching, which is why it deserves to be considered a profession, and why it is both an art and a craft (Dewey, 1929). It also requires moral as much as physical and intellectual stamina, as it endeavours to do no less than to pass on to the upcoming generation the best that humanity has achieved, while alerting them to the worst so that they avoid it and transcend it, creatively engaging with the world as it is to imagine a world as it could and should be.

Preparing teachers for such an onerous and demanding yet essential undertaking requires a constant interaction between theory and practice, with one feeding the other in a never-ending cycle of reflection and action. Getting

this balance 'right' has been another major preoccupation in my university career, and in a way, I have also tried to engage with the theory/practice dialectic by drawing on my everyday experiences in lecturing, thesis supervision, practicum mentoring, and educational leadership (as Head of Department and Dean), making it the subject of formal analysis. This led to a number of publications, looking at, for instance, approaches to initial teacher education (Sultana, 2005), the enactment of critical pedagogy in local schools (Sultana, 1995b), textbooks with reflections on such key educational themes as streaming, the impact of social class, and parental involvement (e.g. Sultana, 1991), as well as projects, mostly with colleagues, chief among them being the *Tomorrow's Schools* (Wain et al., 1995) and *Tomorrow's Teachers* initiatives and subsequent activities that led to significant reforms in teacher training modalities (Sultana, 1999; Sultana et al., 2019).

One particularly successful initiative which ticked many boxes in terms of meaningful academic work was the gathering around me of several undergraduate and postgraduate students who, for their thesis under my supervision, worked with the same Grounded Theory methodology, looking at different aspects of schools in Malta through an equity lens. The group of students shared their data, discussed insights, benefited from each other's feedback, and prepared a chapter for a volume that was used for several years as a reader during sociology of education classes (Sultana, 1997). Each chapter, once duly edited, was published in the students' names. That volume was the first to ground sociological reflection in Maltese qualitative data generated by students, followed up by another collection focusing on a sociology of Maltese society more generally (Sultana et al., 2004). It was also one of the more satisfying collaborative projects carried out locally, which I regret not having repeated with other groups of students as it serves as an excellent form of academic apprenticeship. It moreover led to relationships that overcame the usual expert-student hierarchy, where we worked together to not only get the book off the ground, but also to do some political work in schools, promoting a more humanistic type of education that upheld students' rights (Muviment Edukazzjoni Umana – (Sultana, 1992d)), and encouraging power sharing through parental involvement (Assoċjazzjoni Kunsilli Skolastiċi – (Sultana, 1994b)).

Other projects linked to teacher education, as well as to my interests in comparative education, include a special volume published by Peter Lang on the challenges faced by Mediterranean countries in preparing teachers for teaching in schools that, in many cases, have not yet adopted learner-centred and progressive pedagogies (Sultana, 2002). Related to the same theme was a project coordinated by Malak Zaalouk – erstwhile UNICEF director

for education in the MENA region, and founder of the community and girl-friendly schools in Egypt – who led a major project on the reform of teacher education faculties in several Arab states, and with whom I published a volume highlighting the main findings (Zaalouk et al., 2016).

3.5 International and Comparative education

A third research strand in my academic career involves international and comparative work in education, a strand which is woven into most of my research interests. An important aspect of work in this area started when the University adopted the idea of serving as a hub in the Mediterranean, a joined-up policy vision that had also been adopted by other sectors on the island such as the Freeport and financial services, with the new Mater Dei hospital being the most recent iteration of the same hub idea. The notion resonated with me and, ambitious upstart that I was, decided to set up a Comparative Education Programme focusing on education across the Mediterranean, with the full support of Kenneth Wain, who was dean at that time. This included the launch of the *Mediterranean Journal of Educational Studies* in 1996, the setting up of a network of education scholars in the region, and the organisation of seminars on specific themes, leading to publications on educational innovation (Sultana, 2001), and on teacher education (Sultana, 2002), among others. Funding for the activities came through UNESCO and other European cultural agencies that saw value in what we were trying to achieve. Local colleagues – chief among them being Carmel Borg, Michael Buhagiar, Simone Galea, and Peter Mayo – were also very supportive and contributed to the achievements of the initiative.

As the saying goes, one thing led to another, and all the work invested in and through the Comparative Education Programme started paying off. Here again, effort was supplemented by luck and another unexpected mentor. I gave a talk about the work we were doing at a seminar organised locally in 1999, which happened to be attended by the UNICEF regional director for education in the MENA region, Frank Dall. He liked what he heard, and there and then invited me to carry out a series of qualitative studies about educational innovation in the region, with a view to showcasing interesting practice that could serve as a source of inspiration to others.

Over the next several years I carried out such studies on behalf of UNICEF and other UN and EU agencies. These reinforced my engagement with the field of education for development, which was most valuable in helping me understand facets of schooling that are not often considered in the global North. Most studies involved short country visits to carry out fieldwork with the help of cultural me-

diators and interpreters, accompanied by extensive desk research at home. My travels took me across the region, with each study resulting in at least one book or article (*inter alia* Sultana, 2006a, 2006b, 2008b). Such experiences led to much reflection on the importance of developing indigenous theoretical frameworks grounded in local realities. In line with my effort to reflect critically on my action in the field, I describe the impact these experiences had on me personally, not least in confronting, in a most visceral manner, biases and prejudices, as well as the southern heritage that informs my identity as a Maltese who thought of himself as primarily a 'European' (Sultana, 2011b).

Malta's entry in the EU stimulated critical reflection on the impact of membership on education (Kuhn et al., 2006; Sultana, 1994a, 1995c), and opened up further possibilities for funding, networking, and participation in international projects. Opportunities for those working on Mediterranean studies multiplied given the EU's commitment to the region, formalised in 1995 when the Barcelona Declaration launched the Euro-Mediterranean Partnership. The goal of creating an area of peace, shared prosperity, and human and cultural exchanges implicitly, and sometimes explicitly, highlighted the role that education could play in reaching these objectives. The initiatives taken within the ambit of the Comparative Education Programme became increasingly relevant, with the University upgrading the Programme to an autonomous research centre, EMCER.

Funding was generated through projects, with scholars becoming involved throughout the duration of the project, and then moving on. Others – both local and overseas colleagues – became a mainstay of the Centre's activities, often contributing quite generously despite little if any remuneration. Thanks to their support, further initiatives were undertaken. Among the most significant was the launch of a Master's programme in comparative education, a joint Master's degree on education and development, the publication of the landmark World Yearbook on *Education and the Arab 'world'* (Mazawi et al., 2010), and the transformation of the *Mediterranean Journal of Educational Studies* into a thematic series with Sense (now taken over by Brill). EMCER thematic volumes from 1996 to today include a focus on science education, special education, critical educators, private tutoring, power and education, higher education, career guidance, art education, literature, socio-emotional learning, and educational leadership. Several more volumes are currently in preparation. In most cases the editorial team's tasks went beyond reviews of content to language editing, and while onerous and time consuming, and hardly ever acknowledged, it does help new voices to emerge and to

create possibilities for conversations between the global North and South.

4 Parting shots

I'd like to conclude by drawing some threads together in order to reiterate key lessons learnt during my 33 years in higher education, hoping that this proves of benefit to early-stage researchers and those embarking on their university career.

First, as noted at different points in this paper, a successful academic career is the result of hard and persistent work, but also of luck, being in the right place at the right time, and having mentors who provide opportunities. It is also dependent on what one makes of these opportunities: my experience has been that if one performs well in a particular endeavour, one way or another this will be noted by the people who matter: while meritocracy is flawed in many countries, ultimately competence is what organisations are looking for, and what they are ready to reward. The problem with opportunities is to know what to invest in and what to let go by. At the start of my international work, so many opportunities came my way that I was anxious not to miss any of them, in the belief that one should "ride the wave" as long as it lasts. This of course led to overwork at times, which I (and my family!) were ready to endure knowing that if one allowed oneself to fall outside of the 'loop', one could easily be forgotten as leaders of organisations and networks change, bringing with them their own trusted contacts on board. As I got older, however, I could allow myself to be more discriminating in my choices, and less concerned about visibility and presence in a multiplicity of forums.

Second, one should ask what one is after when embarking on an academic career. 'Success' within a fast-changing university environment is today often defined in terms of numbers: how many students one attracts, how much project money one generates, how many publications one has, and how many citations of one's work feature in databases. Some of these may indeed be indicators of quality, but the danger of what has been called 'governance by numbers' (Shore et al., 2015) is that one confuses quantity with quality, and worse still, that one loses sight of our role as contributors to the public good (Sultana, 2012a). That should be the litmus test for a successful career.

Third, one needs to be philosophic and level-headed about one's achievements: it is very easy to fall into the trap of being so obsessed by one's work that one loses a sense of proportion. It is depressing to see a world-weary academic, but even more depressing than that is an academic that gives in to hubris. We may think of ourselves as important, but in the grand scheme of things,

few of us will do more than work in the 'protective belt' of paradigms generated by others. There is, of course, value in adding, modifying, challenging, revisiting, criticising, revealing new facets, and commenting on the 'hard core' of established knowledge, but swagger and conceit are not the hallmarks of scholarship: wise is the wo/man who knows that s/he does not know. This is perhaps old school, and I do understand that it is important not to be too self-effacing, and that one needs to 'market' oneself in order to avoid being ignored, or to let the mediocre steal the limelight simply because they shamelessly trumpet their 'achievements' or because they are well-connected. Besides, too much humility is often nothing but pride being coy. And yet, in keeping a balance, it might be better to err on the side of modesty. One way I have found to combat the natural tendency to think too highly of oneself is to work with others who are more gifted, have a sharper mind, and are able to see things that fall beneath my intellectual radar. I personally find that necessary, if admittedly not very soothing for one's ego.

Fourth, one can never be sure about what happens to one's work. I have written papers which I thought were valuable and worth reading, and they languished away in books or journals, with few if any citing them. And I have also written papers that I would not consider outstanding which have not only been cited, but got me invited as a keynote speaker in several countries. Go figure! As a visiting scholar once told me, writing is like popping a message in a bottle: you throw it in the sea, not knowing if anyone will ever pick it up. He also advised that what matters is to do one's best, and then let one's writing go ... hoping it is found to be helpful in one way or another, some day. True there are ways of promoting one's work, through reviews, giving papers at conferences, using social media, and making one's work available through open access and the Creative Commons, but unless one has something of substance to say, all that may be immoderate, another example of the shallow and the more unsavoury and glib part of the academic game. And while one is often obliged to 'play the game', the calamity starts when the game plays us.

In conclusion, while younger researchers are likely to find little solace in the fact that life can only be understood backwards, it is hoped that the sharing of the life stories of older academics provides a vicarious glimpse at a 'past', a 'back to the future' moment that could help one contemplate on how they will craft their career over the coming years.

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Research Article

Origins and Destinations: The Career Paths of Male and Female Academics at the University of Malta

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Abstract. 35 individuals (23 men and 12 women) were recruited as full-time assistant lecturers at the University of Malta around thirty years ago. By looking at their administrative responsibilities, by following their career progression, as well as by exploring publically available metrics about the quantity and quality of their scholarship, it can be argued that there is no significant difference among this cohort based on gender. This suggests that men and women in Malta can today achieve similar career destinations in academia; and existing gender gaps are therefore likely to close with the passage of time, on the basis of existing policies.

1 Introduction

During December 2020, I was informed that ten academics working in Malta had recently featured in a list of the top two per cent of the world's scientists. The database was curated by a team of experts at Stanford University, USA, and was published in October 2020 in one of the world's most reputed academic journals, PLOS Biology. The report lists some 100,000 scientists whose published research manuscripts have accelerated progress in their respective fields and influenced the productivity of other researchers. Their exceptional standing is a function of scoring on top after using a composite index that acknowledges scholarship, research leadership and citations (excluding self-citations) from Scopus data made available by Elsevier (Ioannidis et al., 2020). Seven of these scholars are employed full-time at the University of Malta (UM), another two at Mater Dei General Hospital (and part-time at UM), and one at the Malta College for Arts, Science and Technology (MCAST). Table 1 indicates the ten scholars involved, ranked in terms of their research impact as measured during the year 2019.

What is, however, perhaps the most striking observation in table 1, is that **all ten scholars on this list are male**.

1.1 Gender Gaps

The matter of equity of gender representation on UM Boards and committees was brought up during a meeting of the Senate of the University of Malta held on 22nd October 2020. On that occasion, Senate decided that appointees to such boards and committees should be reviewed with an attempt at a better representation of men and women. In the context of this spontaneous discussion—the item was not on the Senate's agenda—reference was made to the glaring 'gender gaps' amongst full-time academic staff the University of Malta. Female representation was only higher than male at the entry (assistant lecturer) level, and the female-to-male ratio at this staff level (54:46) was almost in the same proportion as the female-male ratio of students studying at UM (60:40).¹ However, with every increasing higher scale in the occupational hierarchy of academics, the proportion of females in relation to males deteriorates. These statistics had been highlighted in an article published in the 2017–18 Biennial Report of the Centre for Labour Studies (Baldacchino, 2019), and which can be considered as the companion to this current article. The relevant statistics are reproduced in table 2.

A fresh snapshot of the gender gap among UM's resident academic staff was taken more recently, and almost 2.5 years after the previous exercise. There is clear evidence that female representation has improved across all five occupational scales of the academic class. These include the promotion and appointment of nine female full professors, which increased the complement of female full professors at UM by 60% in just 30 months.

¹There were 6,991 female and 4,753 male students registered at UM in the 2018/19 academic year (University of Malta, 2020, p. 19).

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| Name | Name of Institution | Field | Rank in the Field | Total Scientists in Field |
|-------------------------|---|--|-------------------|---------------------------|
| Baldacchino, Godfrey | L-Università ta' Malta | Geography | 485 | 12879 |
| Balzan, Mario V. | Malta College of Arts, Science & Technology | Entomology | 527 | 25735 |
| Borg, Michael A. | L-Università ta' Malta | Microbiology | 1804 | 134369 |
| Caruana, Albert | L-Università ta' Malta | Marketing | 520 | 10464 |
| Di Giovanni, Giuseppe | L-Università ta' Malta | Neurology & Neurosurgery | 4399 | 227881 |
| Gatt, Ruben | L-Università ta' Malta | Applied Physics | 3405 | 224856 |
| Grech, Victor | Mater Dei Hospital/UM | Pediatrics | 239 | 49820 |
| Grima, Joseph N. | L-Università ta' Malta | Applied Physics | 971 | 224856 |
| Pace, David | Mater Dei Hospital/UM | General & Internal Medicine | 1740 | 106795 |
| Yannakakis, Georgios N. | L-Università ta' Malta | Artificial Intelligence & Image Processing | 1096 | 215114 |

Source: Ioannidis et al. (2020).

Table 1: Ten scholars, working in Malta, ranked among the top 2% of the world's scientists (based on 2019 data).

(The complement of male full professors increased by 21 [25%] during the same period, see [table 3](#)).

This means that the representation of females across the occupational hierarchy that constitutes the academic class at UM is steadily improving. However, all things being equal, it would take decades before anything resembling gender equity is achieved. The gender gap is especially wide when it comes to research. The PLOS Biology article referred to earlier is one that reaffirms the ongoing dominance of Maltese males when it comes to international recognition. Additionally, as of 2019, 92.8% of male resident academic staff at UM are holders of a PhD; but only 79.9% of female resident academic staff hold the same qualification (University of Malta, 2020, p. 18). Looking at the difference between male and female holders of a doctorate, Tabone (2015, p. 101) had concluded that “traditional gender roles which link mothers to caring and men to their breadwinning role are still impacting on the lives of women and men, even when these are highly educated, and are studying for a PhD”. Amongst the top UM academics who are most cited, as manifest via their public Google Scholar user profiles, one is female: retired medical professor Rena Balzan, who is

the fourth most cited. The next female academic at UM to appear on these profiles when ranked by citation counts is chemistry professor Giovanna Bosica, at position No. 21 (Google Scholar, 2021).

And success tends to breed success: the four winners of the 2019 Research Excellence Awards at UM, valued at €60,000 each, were all men (University of Malta, 2021). As it turned out, only men appear in the photo—including the two portraits of past UM Rectors hanging on the Council Room wall as backdrop—which memorialises the presentation of these awards. Here, the awardees are accompanied by the Rector, the Pro-Rector responsible for Research, and a sample of Directors (at UM, all except three of these are women) and Deans (at UM, all except two of these are women, at the time of writing, see [figure 1](#)).

1.2 This article

The data at hand suggests that females and males experience somewhat different challenges as they attempt to move up the occupational hierarchy at the University of Malta. This short article is based on a recent attempt to shed some additional light on this topic, by using a longitudinal research methodology. The idea is inspired by a study that looked at the eventual career paths of boys

| Rank | Male (N, %) | Female (N, %) | Total |
|---------------------|------------------|------------------|------------|
| Professor | 84 (84%) | 15 (15%) | 99 |
| Associate Professor | 90 (77%) | 27 (23%) | 117 |
| Senior Lecturer | 129 (71%) | 52 (29%) | 181 |
| Lecturer | 97 (54%) | 83 (46%) | 180 |
| Assistant Lecturer | 43 (46%) | 55 (54%) | 98 |
| Total | 443 (66%) | 232 (34%) | 675 |

Source: Office of Human Resource Management and Development, University of Malta; Baldacchino (2019).

Table 2: Male and Female representation amongst full-time resident UM academic staff (as of 10 June 2018).

| Rank | Male (N, %) | Female (N, %) | Total |
|---------------------|------------------|------------------|------------|
| Professor | 105 (81%) | 24 (19%) | 129 |
| Associate Professor | 107 (75%) | 35 (25%) | 142 |
| Senior Lecturer | 148 (65%) | 78 (35%) | 226 |
| Lecturer | 100 (50%) | 100 (50%) | 200 |
| Assistant Lecturer | 43 (44%) | 54 (56%) | 97 |
| Total | 503 (63%) | 291 (37%) | 794 |

Source: Office of Human Resource Management and Development, University of Malta; Baldacchino (2020).

Table 3: Male and Female representation amongst full-time resident UM academic staff (as on 10 November 2020).

drawn from different social classes in the United Kingdom, and how their experience of education in particular had been influenced by their social class background (Halsey et al., 1980). In my case, I wanted to explore if there are indeed different career trajectories of academics who start their academic career from the same occupational position and at the same time. Put differently, if you select a group of men and women who are recruited in the same grade at the same time, would they still achieve different career paths and trajectories? Would, in other words, similar 'origins' not secure similar 'destinations'? And could 'gender' be the main, gross, explanatory variable for any such discrepancies?

2 Research Methodology

One way of testing these research questions is afforded by examining the Minutes of Council meetings that include the details of appointments and confirmations (after probation) of academics who joined the University of Malta many years ago. The length of time should be long enough to afford these academics ample opportunities to scale the occupational hierarchy at UM. Additionally, they should all have been appointed and confirmed at the same occupational level, and at around the same time. Per-

mission was sought and obtained from the Office of the Registrar to pore over Council minutes and therefore to be in a position to execute such an investigation. It was decided to go back approximately *30 years*: one should think that this a sufficiently long period of time to allow most recruits to have the chance to apply for promotion to the highest grades. Going back further in time might also have been compromised by the absence of available or complete records. It was also decided to focus exclusively on new academic recruits to the *Assistant Lecturer level*: at that time, when most candidates to academic positions at UM lacked a doctorate, the main entry point would be at grade of Assistant Lecturer, with any successful recruits then being afforded the possibility to start or complete their doctorate while in the employ of UM. It was also decided to focus only on *full-time appointees*. It is understood that various academic appointments to certain faculties—such as Economics, Management and Accountancy, Dental Surgery or Medicine and Surgery—involve part-time resident academics who are loath to leave any current professional engagements or jobs and are prepared to offer services to UM only on a part-time basis. These individuals were not deemed to be interested in or capable of investing all their energy and career aspir-



Source: University of Malta (2020, p. 10).

Figure 1: Prof. Alfred J. Vella (UM Rector) and Pro-Rector Prof. Ing. Saviour Zammit (Chair of the Research Fund Committee)—7th and 6th from left, respectively—congratulating the 2019 Excellence Award Winners, accompanied by their Faculty Deans and other members of UM's senior management (4th October, 2019).

ations to the academic life, and were therefore excluded from this study. Three bound volumes of Council minutes, covering the three academic years 1989/90 to 1991/92, were kindly made available to the author during December 2020. Notes were taken of the names of appointees and their eventual confirmation as UM employees after the successful completion of their probationary period, as indicated in the various meetings of Council. Three academic years were chosen so that the crop of male and female academics appointed within this time window would be large enough to prevent individual cases from skewing results in any particular way. It was also decided to maintain strict anonymity of the academics involved in this exercise, noting only whether they were referred to as men or women. The independent variable, in this case, was gender.

2.1 Data Description

The first set of Council minutes perused referred to the meeting held on 25 October 1989. The last set of minutes perused referred to the Council meeting held on 15 July 1992. These minutes indicate that, during the three academic years of 1989/90, 1990/91 and 1991/92, **45 academics** (29 men and 16 women) were appointed, or confirmed in their appointment, as full-time assistant lecturers at UM.

From this population, **ten** appointees (six men and four women) did not take up the job offer, switched over to an administrative grade, or opted thereafter to resign from UM employment. If the latter, they did so mainly to take up a position in the private sector locally or overseas; landed a position with the Ministry of Education; and/or else switched to a part-time UM appointment. The proportion of female resignations is just around the same as

that of male resignations; though the sample is too small to allow any bold suggestions of correlation or otherwise. Changes in these ten academics' family circumstances—such as pregnancy, parenthood, death of a spouse, or caring for an elderly relative—may have affected their decision to resign from a full-time post at UM. This warrants further investigation. This leaves **35 academics** (23 men and 12 women) who sought and pursued an academic career at UM. Some of these have already reached retirement age.

The 23 men, all recruited as assistant lecturers, occupy the following rank at the time of writing:

- 10 are full professors (43%)
- 7 are associate professors (30%)
- 3 are senior lecturers (13%)
- 2 retired as lecturers (9%)
- 1 retired as an assistant lecturer (4%).

The same crop of male academics include individuals who served as: Pro-Rector (1), Faculty Deans (2) and/or Heads of Department or Directors of Institutes or Centres (12).

The 12 women, all recruited as assistant lecturers, occupy the following rank at the time of writing:

- 5 are full professors (42%)
- 5 are associate professors; 2 of whom retired as such (42%)
- 2 are senior lecturers (16%).

Same as with their male counterparts, these female academics include individuals who have served as: Pro-Rector (1), Faculty Deans (2) and/or Heads of Department, or Directors of Institutes or Centres (7).

2.2 Testing for Significant Differences in Publications and Citations

Next, these 35 academics were compared in terms of the quantity and quality of their academic publications—the latter determined from the number of citations—both as evidenced from their Google Scholar User Profiles. Similar proportions of men and women—twelve out of the 23 males (52%), and seven out of the 12 females (58%)—had such profiles at the time of writing. The results are tabulated as [table 4](#).

This data was subjected to statistical testing by determining p -values. A p -value is a measure of the probability that an observed difference—in this case, between male and female academics—could have occurred just by chance. Hence, the lower the p -value, the greater the statistical significance of the observed difference, and so the stronger the claim that the two sets of data are indeed qualitatively different from each other. A p -value of 0.05 is often taken as a useful threshold: at that value, there is a 5% chance that the difference between two populations is not random. Both the Independent samples t -test and the Mann Whitney test were used in order to compare the average number of published articles and average number of citation between males and females. Both tests yielded p -values larger than the 0.05 level of significance, indicating NO significant difference in the average number of published articles and average number of citations between male and female lecturers. These summative results are described in some detail below. The average number of articles published by the seven females (61) is marginally less than the average number of articles published by the twelve males (68). Indeed, the difference is not significant since the p -value (0.745) exceeds the 0.05 level of significance. The average number of citations of the male authors (1434) exceeds considerably the average number of citations of the female authors (488). However, the difference is not significant since the p -value (0.446) exceeds the 0.05 level of significance. Despite the difference between the two means, the lack of significance may have been caused by the small sample sizes and the large dispersion (spread) in the measurements; the latter is mainly an effect of the large number of citations by M1 (see [table 5](#)).

3 Discussion

The above exercise suffers from the limitations of small numbers, so any attempt at generalisation is dangerous. However, the exercise is based on the total population of scholars who were recruited to UM as full-time assistant lecturers in the period 1989–1992.

In any case, when judged from the data available, one is correct to conclude that there is no significant difference

between male and female academics who started their professional career as UM assistant lecturers at around the same time, some 30 years ago. This observation holds, whether in terms of (1): professional rank; (2) administrative responsibility; (3) number of publications; or (4) quality of publications. For those recruited in 1989–1992, the men and women in academic grades at the University of Malta have fared equally well. The data also suggests that the difference in the number of male and female professors (10 versus 5) and associate professors (7 versus 5) amongst those recruited at UM as assistant lecturers 30 years ago is essentially a function of the fact that many more males than females were recruited into the position of assistant lecturer during that same time period: 23 men as against 12 women; a gender ratio of just under 2:1. Indeed, and in spite of the relatively small numbers involved, the same gender ratio holds for those occupying both full professorial and associate professorial rank from the 35 academics that find themselves as the focus of this study.

One factor that may merit further investigation concerns the resignations from full-time academic employment at UM of those recruited in the 1989–1992 time period under scrutiny. As reported above, the proportion of female resignations is also somewhat similar to that of male resignations. Nevertheless, identifying the reasons for such resignations might illuminate any gender specific variables.

4 Conclusion

On July 23rd 2001, Minister of Education Dr Louis Galea provided a written reply to a parliamentary question number 27616, tabled by Dr Helena Dalli. Dr Dalli wanted a breakdown by gender of: (1) academics at the University of Malta who had applied for a promotion in 1998; (2) how many academics had obtained a promotion; and (3) how many were still awaiting a reply. Minister Galea replied that 10 applicants and 9 applicants had been promoted to (Full) Professor and Associate Professor respectively; all these 19 applicants were male. There had also been 60 promotions to senior lecturer: of these, 48 were male and 12 were female. Three other applicants had been promoted to lecturer; of these, two were male and one was female. There were 77 other academics still waiting for a decision on their promotion application: 68 were male and nine were female. This means that there were only 22 females within the cohort of 159 scholars applying for a promotion at UM in 1992: just under 14% (Kamrat-Deputati, 2001, July 23, p. 40). The gender gap was most palpable.

Just four years before, in 1997, Marie Therese Camilleri Podestà was the only full-time female academic at

| Male | Rank | Articles | Citations |
|--------|---------------------|----------|-----------|
| M1 | Full Professorship | 182 | 11307 |
| M2 | Full Professorship | 57 | 252 |
| M3 | Full Professorship | 86 | 336 |
| M4 | Full Professorship | 122 | 602 |
| M5 | Associate Professor | 47 | 1633 |
| M6 | Full Professorship | 16 | 296 |
| M7 | Senior Lecturer | 22 | 86 |
| M8 | Associate Professor | 61 | 293 |
| M9 | Full Professorship | 99 | 1012 |
| M10 | Associate Professor | 63 | 907 |
| M11 | Associate Professor | 27 | 197 |
| M12 | Associate Professor | 34 | 281 |
| Female | Rank | Articles | Citations |
| F1 | Full Professorship | 76 | 831 |
| F2 | Full Professorship | 66 | 484 |
| F3 | Full Professorship | 114 | 517 |
| F4 | Associate Professor | 58 | 166 |
| F5 | Associate Professor | 25 | 210 |
| F6 | Full Professorship | 63 | 719 |
| F7 | Associate Professor | 27 | 531 |

Table 4: Quantity and quality of scholarly publications (according to Google Scholar on 29 December 2020) ($N = 19$). Males identified as M; Females identified as F.

| Number of Published Articles | | | | |
|------------------------------|-------------|---------|----------------|-----------------|
| Gender | Sample Size | Mean | Std. Deviation | <i>p</i> -value |
| Male | 12 | 68.00 | 48.138 | 0.74 |
| Female | 7 | 61.29 | 30.341 | |
| Number of Citations | | | | |
| Gender | Sample Size | Mean | Std. Deviation | <i>p</i> -value |
| Male | 12 | 1433.50 | 3141.223 | 0.446 |
| Female | 7 | 494.00 | 243.047 | |

Table 5: Measures of significance in the difference between the number of publications and number of citations by male and female academics ($N = 19$).

UM promoted to the rank of full professor. There were 49 other women employed as resident academics at that time, none of whom held the rank of associate or full professor. This situation contrasts with the 312 male resident academics at UM at the same time, 47 of whom were full professors (Sciriha, 1999).

Writing in 2019, after having interviewed nine female full professors at UM, Vella Azzopardi (2019, p. 5) argues that “matters have improved over time, however not rapidly enough”.

This study, while indicative, confirms the improvement in closing the gender gap and breaking the glass ceiling amongst professors at UM. It furthermore suggests that we may have turned the proverbial corner: given similar ‘origins’, the crop of male and female scholars recruited for an academic career at the University of Malta 30 years ago have progressed to rather similar ‘destinations’.

This is welcome news. Some of the stubbornly lingering discrepancies in gender—as manifest, for example, in Google Scholar User Profile rankings—may be largely based on the disproportionate number of men recruited to UM as against women in earlier decades. Additionally, it is well known that younger academics are more likely to set up and make public their Google Scholar Profiles than older ones (Kim et al., 2020).

It will take its time; but it appears that the cadre of female appointees to the highest grades at the University of Malta is slowly but surely closing the gap with its male counterparts.

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Review Article

My 50-Year Research Journey on the Economies of Malta and Other Small States

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Abstract. This article presents an overview of my work since the early 1970s. My early works were mostly related to the Maltese economy. Between 1989 to date, I focused my research interest on economic vulnerability and economic resilience of small states. I associated economic vulnerability with the high exposure to adverse external shocks by small states, mostly due to their high dependence on external trade as a result of their small domestic market. A piece of research on economic vulnerability published in *World Development* in 1995 was highly cited, possibly because it led the way in the construction of economic vulnerability indices, and ushered in a large number of studies on the same subject. I associated economic resilience with policy-induced changes which enable a country to withstand or recover from adverse external shocks. Two later studies on economic resilience which I co-authored pioneered the methodology for creating an economic resilience index, and were highly cited. My work on resilience highlighted the need for good governance. I end this personal overview, with the works that dealt with the pros and cons of island tourism, the role of competition law and policy in small states, the need for small states to be internationally competitive, the high degree of climate change vulnerability of small islands, and the need for sustainable development in islands in view of their environmental fragility. My 50-year research journey entailed thousands of labourious hours of processing and deriving conclusions from qualitative and quantitative information, but this often led to great satisfaction in seeing my studies published, cited and inspiring further research.

1 Introduction

I have been publishing academic papers since the early 1970s. The early works were mostly related to the

Maltese economy. Between 1989 to date, many of my publications focussed on economic vulnerability and economic resilience of small states. A paper on economic vulnerability published in *World Development* (Briguglio, 1995b) ushered in a large number of studies on the same subject. According to Google Scholar this article has been cited 1522 times in different studies (as on 30th June 2021). This excludes numerous citations in reports by international organisations. An article of mine on the vulnerability and resilience framework (Briguglio, 2004) and others which I co-authored (Briguglio et al., 2009b; Briguglio et al., 2006b) were according to Google Scholar cited 1262 times (as on 30th June 2021) together. Other publications relating to small states in which I was involved as a sole-author or as a co-author dealt with tourism, competition law and policy, international competitiveness, climate change, sustainable development and governance, all of which have been cited in related literature. Many of these publications are briefly described in this review.

This rest of the paper is organised in six sections, with each section focussing on a specific topic. Section 2 deals with the publications on the economic vulnerability and resilience, while Section 3 deals with a number of topics relating to small states. Section 4 describes the studies on the Maltese economy and Section 5 deals with topics which are not covered in the previous sections. The concluding section discusses some tendencies derived from my publications, relating to the chances of an author being cited in the literature.

2 Economic vulnerability and resilience

2.1 Evolution of the idea

In May 1985, I, together with Professor John Kaminarides, a visiting Rhodes scholar, hailing from the USA, with Cypriot roots, organised an international conference on

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the economic development of small states. The conference was attended by a large number of foreign scholars and representatives of international organisations, including the World Bank, UNCTAD and the Commonwealth Secretariat. One of the speakers presented a graph showing a scatter diagram with GDP per capita linked to country size, from which the trend line was derived indicating that small states tended, on average, to have a higher GDP per capita than larger states. The main message of the speaker was that small states do not seem to fare badly internationally, and therefore, he argued, we should not worry too much about the economic development of these states. The negative slope of the fitted line was heavily influenced, on the one side, by China, India, Indonesia, the Philippines and other large states with a very low GDP per capita at that time, and, on the other side, by small countries such as Luxembourg, Malta and Iceland, with a relatively high GDP per capita. This set me thinking. Did it follow that Malta, which then had a GDP per capita of about US\$4000, was 13 times stronger, economically, than India, which at the time had a GDP per capita of only about US\$300? I argued that it was true that Malta generated more income per capita than India, but Malta was very economically vulnerable because its existence depended very highly on demand from abroad, and most of its physical resources including oil, wood, textiles and metal had to be imported from elsewhere. This is how the idea of economic vulnerability of small states originated my mind, leading me to construct the so-called economic vulnerability index and to publish a number of papers on this matter, starting in the early 1990s.

The results that emerged from the application of the economic vulnerability index showed very clearly that small states, measured in terms of their population, tended to register relatively high scores when compared to larger states. This implies that small states tended to be associated with a high degree of exposure to external shocks due, mostly, to their very high dependence on international trade, their narrow range of exports and their high dependence on strategic imports. It was argued that small states that wanted to develop economically had no option but to depend highly on exports due to their small domestic markets, and on imports due to their limited natural resource endowment.

There remained the need to explain why many small states succeed in spite of their exposure to adverse economic shocks. As will be explained below, the answer proposed by myself was that a number of small states manage to build their economic resilience, through policy measures, enabling them to withstand or recover from their economic vulnerability.

2.2 Publications relating to the economic vulnerability Index

I was involved in many publications on the vulnerability index, on my own (Briguglio, 1992b, 1995b, 1997, 2014d, 2016a) and with others (Briguglio et al., 2006a, 2009b; Briguglio et al., 2003d; Briguglio et al., 1993). The variables used as components of economic vulnerability indices that I constructed relate to trade openness, export concentration, dependence on strategic imports, such as fuel and food, peripherality and proneness to disasters.

Economic openness captures the degree to which a state is susceptible to economic conditions in the rest of the world. It is often measured by expressing exports or imports, or an average of both, as a percentage of GDP. Export concentration exacerbates the economic vulnerability caused by economic openness. I argued that export concentration can also be observed in merchandise, but in the case of small states, it is likely to occur also in the trade in services, especially in tourism and financial business. For this reason, an export concentration index covering services and merchandise was devised by myself and a co-author (Briguglio et al., 2003d). Peripherality is associated with insularity and remoteness, leading to high transport costs and marginalization. The variables which were used to reflect the effects of remoteness are the ratio of transport and freight costs to imports. The proneness to disasters component was measured in terms of economic damage relative to GDP. These variables were suitably standardised¹, and averaged in a composite index.

As already indicated, Briguglio (1995b), published in *World Development*, is still highly cited 26 years after was published. This paper has been considered by many authors as a seminal one on the issue of economic vulnerability.²

¹The formula I used for standardizing (or rescaling) numerical observations is often utilised when a composite index is made up of components measured in different units. The standardized value of a numerical observation (X_i) in an array of such observations (X_1, X_2, \dots, X_n) is computed as follows. First the maximum and minimum values of the array of numerical observations are found. The minimum value in the array is subtracted from X_i . The result is then divided by the maximum minus the minimum values in the array. As a result, the formula standardizes or rescales the array of numbers so that they take a value of between 1 (maximum) and 0 (minimum). If X_i happens to be the minimum value, its standardized value will be zero. If X_i happens to be the maxim value, its standardized value will be 1. If X_i happens to take a value between the minimum and the maximum value, its standardized value will be a fraction. The procedure is explained further in Briguglio (1995b, 2016i)

²See for example Baldacchino (2015); Sharpley and Ussi 2014; Angeon and Bates 2015; Tita (2014).

2.3 Reference to the vulnerability index in international fora

The vulnerability index featured prominently in various meetings under the auspices of the United Nations (UN). The outcome document of the 1994 UN Global Conferences on the sustainable development of small island developing states (SIDS), called the Barbados Programme of Action (BPoA)³ contained two paragraphs (para 114–115) on this matter. Subsequently, the UN Commission on Sustainable Development called on the relevant UN bodies to accord priority to the development of the index, which led to the UN Department of Economic and Social Affairs to engage me as an expert, in which capacity I wrote a report on the economic vulnerability index (Briguglio, 1997).⁴ The issue of economic vulnerability of SIDS was also featured in the 2005 and 2014 UN international conferences on SIDS, respectively held in Mauritius and Samoa, as well as in the preparatory meetings for these conferences. My work was sometimes used as background documentation for these meetings (e.g. Briguglio, 1993a, 2003d).

The economic vulnerability of small states was also featured in many Commonwealth Secretariat meetings, in which I often participated as an expert on the subject. I published many works on this subject in collaboration with the Commonwealth Secretariat, all of which lead to the conclusion that small states tend to be highly exposed to adverse external shocks as a sole author (Briguglio, 2014a, 2014b, 2014d, 2018e) and with others (Briguglio et al., 2008, 2009b; Briguglio et al., 2011a; Briguglio et al., 2011b). Again here some of my publications were used as documentation for Commonwealth Secretariat meetings relating to economic vulnerability.

2.4 The concept of economic resilience

Economic resilience can be defined in many ways, but in my publications on this subject, I defined it as the ability of an economy to recover from or withstand or recover from the effect of adverse external shocks, as a result of policy-induced measures (Briguglio et al., 2009b).

Initially, I developed a conceptual framework for the measurement of economic resilience (Briguglio, 2004), and I, together with my research associates later constructed the resilience index (Briguglio et al., 2006a, 2009b) capturing policy-induced measures, including macroeconomic stability, market efficiency, good governance and social development. I subsequently added environmental

management to the policy measures that are conducive to economic resilience (Briguglio, 2014c, 2016c). These five variables were again measured using global databases and suitably observations were standardised to enable the construction of a composite index.

Macroeconomic stability is associated with economic resilience as it contributes to efficiency in resource allocation and creates latitude for monetary and fiscal policy to respond to shocks. The relevance of market flexibility to economic resilience arises from the extent and speed with which resources are reallocated following the incidence of a shock, to return to an equilibrium situation. Good governance is essential for an economic system to function properly and in the absence of good governance, it would be easy for adverse shocks to result in economic and social chaos and unrest. Social development is another essential component of economic resilience. This factor indicates the extent to which relations within a society are properly developed, enabling an effective functioning of the economic apparatus without the hindrance of civil unrest, and the extent to which effective social dialogue takes place in an economy, which would, in turn, enable collaborative approaches towards the undertaking of corrective measures in the face of adverse shocks. Environmental governance, or lack of it, has an important bearing on the ability of a country to withstand economic shocks. The connection between environmental governance and economic resilience can be explained in terms of the link between stability and environmental management through enforceable rules, economic instruments and education aimed at encouraging good environmental practices.

On the basis of the results of the economic resilience index, it emerged that there was no correlation between country size, measured in terms of population, and the resilience scores. However, there was a positive correlation between economic success and resilience, a tendency confirmed through the use of the analysis of the relationship between the resilience scores and the GDP per capita of countries.

2.5 The vulnerability and resilience framework

By juxtaposing economic vulnerability and economic resilience, I identified four possible scenarios into which countries may be categorized according to their vulnerability and resilience characteristics. These scenarios were termed as “best case”, “worst case”, “self-made”, and “prodigal son” (Briguglio, 2004). Countries classified as “self-made” are those with a high degree of inherent economic vulnerability and which are economically resilient enabling them to cope with their inherent vulnerability. Countries falling within the “prodigal son” category are

³Available at: https://www.un.org/esa/dsd/dsd_aofw_sids/sids_pdfs/BPOA.pdf

⁴The report of this meeting (UN document A/53/65 - E/1998/5) is available at: <https://www.un.org/esa/sustdev/sids/A5365Vulindex.pdf>

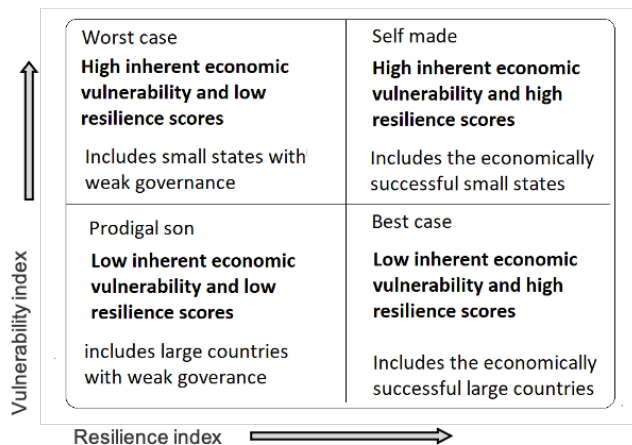


Figure 1: Four country scenarios in terms of vulnerability and resilience scores

Source: Adapted from Briguglio (2004)

those with a relatively low degree of inherent economic vulnerability but whose policies are detrimental to economic resilience, thereby exposing them to the adverse effects of shocks. The “best case” category applied to countries that are not inherently vulnerable and which at the same time adopt good economic policy measures. Conversely, the “worst case” category refers to countries that compound the adverse effects of inherently high vulnerability by adopting policies that run counter to economic resilience.

In Briguglio et al. 2006a, 2009b, the scores of the vulnerability and resilience indices, which I computed together with my research associates, enabled us to identify which countries could be classified in terms of the four categories, as shown in Figure 1.

The V&R framework sheds light on the reason why a number of vulnerable small states manage to do well economically in spite of their inherent economic vulnerability. In Briguglio (2004, p.96), I referred to this reality as the “Singapore Paradox” with reference to a small country, highly exposed to external shocks, which, through solid economic governance, managed to achieve economic success.

The main implication of the V&R framework proposed by myself in 2004, and the follow-up 2006 and 2009 studies, is that given that small states tend to be highly economically vulnerable, inherently, they, possibly more than other groups of countries, need to adopt suitable policy measures to step up their ability to withstand or recover from adverse external economic shocks.

I authored or co-authored many other articles which related directly or indirectly to the V&R framework, including, on my own, (Briguglio, 2002, 2003b, 2003c, 2008a,

2010a, 2012, 2013b, 2016a, 2016g, 2016h) and with others, (Briguglio et al., 2012; Witter et al., 2002; Ziglio et al., 2017).

3 Other works relating to Small States and Islands

3.1 Publications on small states in general

I edited a book on various aspects of small states, which was published by Routledge (Briguglio, 2018a), and contained 29 chapters on political, economic, environmental and social issues. I also wrote its extensive introduction in this book 2018b, which, amongst other matters, discussed the definition of small states, contending that population size is the most common indicator of countries size used in the literature, although different authors use different population cut-off points to distinguish between small states and larger ones. A common population threshold for this purpose is 1.5 million persons and using this definition there are about 45 such sovereign states. Country size can also be measured using indicators other than population size, although population size remains the one most widely used. The area of the territory, which is a geographical factor, and the GDP of the country, which has direct economic connotations, have been used for this purpose.

Earlier, I was involved in two other publications on small states in general (Briguglio et al., 1993; Kaminarides et al., 1989) again covering various issues relating to small states. These two publications in a way anticipated the increasing body of literature that emerged during the second half of the 1990s and later.

3.2 Governance in small states

In many of my publications, I considered good governance as an important requisite of political, economic, social and environmental performance, and I edited a book, published by Routledge (Briguglio et al., 2020b) covering these four aspects of governance. The book carried two articles, co-written by myself, with the first one (Briguglio et al., 2020a) commenting on government complexities in small states and the second one focussing on social governance (St Bernard et al., 2020). The various dimensions of governance were also discussed by myself in earlier papers including Pirotta, Wettenhall and Briguglio 2001 and Briguglio, Saliba and Vella 2015a.

Various governance indicators across countries, assign high scores for democratic countries, such as Germany, where economic growth tends to be slow. Conversely, in some not-so-democratic countries, such as China, economic growth tends to be fast. In fact, in many studies, a negative correlation between GDP growth and governance is found. This paradox was examined in an article

I co-authored (Briguglio et al., 2019c), where it was queried whether or not the negative correlation between GDP growth and governance indicators is to be interpreted as an indication that good governance is undesirable for growth. In the article, it was shown that if governance is measured by improvements, rather than levels, the countries with the highest improvements in governance tended to register the fastest growth, *ceteris paribus*. It was concluded, therefore, that improvements in governance are good for growth, and this could possibly be an explanation why badly governed countries, that show improvements in governance, tend to register high economic growth rates. This tendency was termed "diminishing marginal governance effect". In the article it was emphasised that the results were statistical tendencies and that there were many exceptions.

3.3 Climate change and small islands

Between the mid-1990s and 2014, I formed part of the Inter-governmental Panel on Climate (IPCC) and was one of the lead authors for the chapters on small islands as part of the third (Nurse et al., 2001), fourth (Mimura et al., 2007)⁵ and fifth (Nurse et al., 2014) assessment reports of the IPCC Working Group II on Impacts, Adaptation and Vulnerability. My main contribution to these chapters related to economic aspects, mostly in connection with the links between climate change adaptation and development, as well as on the constraints faced by small states in view of the high cost per capita when undertaking adaptation measures.

In the IPCC fifth assessment report, I drafted the response to a frequently asked question (FAQ 29.2) as to why the cost of adaptation to climate change tends to be relatively high in small islands. The text reproduced in the report, based on my draft, states that adaptation to climate change that involves infrastructural works generally requires large up-front overhead costs, which in the case of small islands cannot be easily downscaled in proportion to the size of the population or territory. This is a major socioeconomic reality that confronts many small islands, notwithstanding the benefits that could accrue to island communities through adaptation. Referred to as "indivisibility" in economics, the problem can be illustrated by the cost of shore protection works aimed at reducing the impact of sea level rise. The unit cost of shoreline protection per capita in small islands is substantially higher

than the unit cost for a similar structure in a larger territory with a larger population. This scale-reality applies throughout much of a small island economy including the indivisibility of public utilities, services, and all forms of development. Moreover, the relative impact of an extreme event such as a tropical cyclone that can affect most of a small island's territory has a disproportionate impact on that state's gross domestic product, compared to a larger country where an individual event generally affects a small proportion of its total territory and its GDP. The result is relatively higher adaptation and disaster risk reduction costs per capita in countries with small populations.

I also contributed actively to the debate on the definition of vulnerability and resilience with regard to climate change, insisting that vulnerability should be reserved for inherent features, such as low-lying area and location, and resilience to policy-induced measures, including adaptation. I discussed this point in an article (Briguglio, 2010a) which dealt with the risk of a population in a given territory being harmed by climate change. The approach adopted in this paper sharpens the definition of climate vulnerability, by confining it to inherent and natural conditions. Man-made or policy-induced factors are, according to this approach, associated with adaptation. It is argued that this distinction is useful as a methodological approach and for policy-making purposes. The same article utilised indices of climate change vulnerability and adaptation, and juxtaposed them to arrive at an assessment of risk of cities being harmed by climate change. The major findings of this paper are that the "lowest-risk" or "managed-risk" category of territories are mostly port cities in high-income countries, whereas the "mismanaged-risk" and "highest-risk" categories of territories are vulnerable port cities located in low-income countries. The methodology emphasizes the benefits of policies that promote adaptation, which is an important component of risk management in the context of climate change. These policies do not reduce the inherent vulnerability of the territories concerned, but they do serve to enable humans to withstand, bounce back from or absorb the effects of climate change. The importance of this study is that it emphasizes the need to distinguish between inherent and self-inflicted changes – a distinction which I consider to be of major importance for policy making.

In other papers on climate change (Briguglio et al., 2003c; Briguglio et al., 2007; Formosa et al., 2017; Moncada et al., 2018), I refer to the already mentioned high cost per capita of adaptation measures in small island states, and the relatively high climate change risks faced by these states in view of the relatively high coast area to land mass, exposing them to sea-level rise and other

⁵In 2007 the Nobel Peace Prize was awarded jointly to the IPCC and to Al Gore Jr. "for their efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change." All those involved in the drawing up of the IPCC Fourth assessment report, including myself, received a certificate for contributing to the award of the Nobel Peace Prize.

ocean borne hazards. In Briguglio and Moncada 2020c, it is argued that the reality of climate change and the need for mitigation and adaption in this regard would be better understood if this subject is treated in a multidisciplinary approach in a University education context.

3.4 Domestic competition and small states

I formed part of the Malta Commission for Fair Trading between 1995 and 2011 and the Competitions and Consumer Appeals Tribunal between 2011 and 2019. These were judicial panels which operated at the law courts, in order to hear and determine appeals from decisions taken by competition and consumer affairs authorities, as provided in the Malta Competition Act. The experience I gained as a member of these panels enabled me to appreciate the constraints that small states face in matters relating to competition law and policy and I published three co-authored studies (Briguglio et al., 2003b, 2004a, 2009a). Subsequently, I published updated and extended versions of the 2009 paper in two edited books published respectively in English by Springer (Briguglio, 2017b) and in French by LexisNexis (Briguglio, 2018c).

These publications highlight a number of characteristics of small states which have a bearing on competition law and policy in these states. A major contention in these publications is that small states face major constraints in applying competition law and policy. In many such states, the culture of competition may not easily take root due to the fear that intense competition may destabilise a small fragile and thin market. Another reason is that government involvement in such states tends to loom large over the market, and public undertakings often clamour for exclusion from competition law provisions claiming that they have a social role to play. In addition, the advantages of business consolidation and the disadvantages associated with business fragmentation often lead authorities of small states to justify monopolistic and oligopolistic structures. For these reasons, certain exceptions, normally based on social considerations are more likely to be hold water in small states.

Even where competition legislation is in place in a small state, its enforcement may be more difficult than in larger countries due to the fact that everybody knows each other, and inter-family business links are common. Thus, it was argued in the mentioned papers on competition law and policy, that in small states, methods other than enforcement may sometimes bring about better results as far as implementing competition policy is concerned. Competition advocacy among citizens, to render them aware of the benefits of competition policy is of relevance in this regard.

Overall, the publications on competition law and policy

in which I was involved, did not put forward the argument that competition rules should be discarded in small states, or that abuse should be tolerated in these states, but that in certain circumstances there may be the need to tweak the mainstream rules to take account of the limitations associated with a small domestic market.

3.5 International competitiveness and small states

I published a number of papers on international competitiveness, some with others, including a study commissioned by the World Bank and the Commonwealth Secretariat (Briguglio et al., 2006c), an edited book published by the Commonwealth Secretariat (Briguglio et al., 2004b) and an edited special issue of Small States and Territories Journal (Allegrezza et al., 2019).

The main argument in these publications is that small states need to be competitive internationally more so than larger states in view of the fact that the former states have a small domestic market and therefore have to rely on exports for viable quantity of production. It also argued that competitiveness is to a large extent an enterprise issue, and it is the individual company at the micro level that needs to be competitive, in order to enhance national competitiveness. However, the public sector has a major role to play in this regard, by taking a lead in placing competitiveness on top of the policy agenda, and in removing excessive bureaucratic business bottlenecks when these occur.

In other papers on competitiveness, I hypothesised that economic resilience and competitiveness are interlinked globally (Briguglio, 2018d), testing and confirming this hypothesis across all countries for which data was available. As a follow-up I co-authored a paper (Briguglio et al., 2019b) testing the same hypothesis, but focussing on the EU small states. In order to test this assertion, the resilience index constructed by myself in 2016 (Briguglio, 2016c) was correlated with the index of competitiveness derived from the Global Competitiveness Report, and a statistically significant correlation coefficient between the two variables was found in both papers. The basic message of these two papers, is that in small states the enhancement of competitiveness is important, in view of their high dependence on exports, but this exposes them to external shocks, calling for appropriate policies based on strategic directions to improve resilience through good economic governance. Given that resilience and competitiveness are multifaceted, requiring economic, social, political and environmental policy measures, the mentioned papers on this subject argued that it would be beneficial for small states to embed these policy measures in their national plans and strategies.

3.6 The economic volatility and small states

The already cited 2018 Routledge handbook which I edited, contained a chapter (Briguglio et al., 2018) on a major characteristic of small states namely trade openness. In this chapter it was surmised that trade openness should lead to economic volatility, but it was found that, in reality, a number of highly-open economies including Malta, Singapore and Luxembourg, do not exhibit a high degree of volatility. The main implication of the econometric results derived from this chapter is that although countries with a high degree of trade openness would expose these countries to external shocks and therefore to GDP growth volatility, such volatility may be attenuated and dampened if the countries concerned adopt appropriate stability policies. Conversely, it is possible that countries which are not highly trade-open exhibit a high degree of volatility, if their economic governance is weak, leading to instability. This is in line with the vulnerability/resilience framework, discussed in Briguglio et al. (2009b) and Briguglio (2014c, 2016g), where factors that lead to economic vulnerability were juxtaposed against factors that lead to economic resilience in order to assess the risk of a country being harmed by adverse external shocks.

3.7 Small-island tourism

In 1996, I was instrumental in the convening of a sustainable-tourism conference in Malta, which attracted top researchers on this matter including Richard Butler, Geoffrey Wall, Jafar Jafari, Brian Archer and others. Taking advantage of the presence of these renowned academics, I co-edited with them two books on sustainable tourism in islands and small states (Briguglio et al., 1996a; Briguglio et al., 1996c), the first book focussing on issues and policies and the second on case studies. The authors of the chapters came from different academic disciplines and included geographers, anthropologists, sociologists and economists, including myself.

In many chapters of these two books there was a conceptual discussion, often backed by country case studies highlighting two major effects of tourism in small islands. While tourism is an important income earner and employment generator in small islands, given the limited diversification possibilities of these territories, this industry also tends to damage their fragile eco-systems. The issue of carrying capacity of small islands, which features in many chapters of the two books, is a very important concept in the case of small islands as these tend to very quickly reach a threshold level beyond which the natural ecosystem could be irreversibly damaged.

4 Publications on the Maltese economy

4.1 General macroeconomic aspects

My publications on the Maltese economy include two books (Briguglio, 1988b, 2011b) where I argue that, in many cases, major macroeconomic theoretical prescriptions are applicable to the Maltese economy. However, it was contended, the Maltese economy has special features which distinguish it from larger countries, including a very high dependence on exports and imports, very high population density, and rapid structural changes over time, all of which have to be kept in mind when applying mainstream economic theory. Other publications on the Maltese economy in general include Briguglio (1984a, 1987, 1988c, 1989a, 1989c, 1992a, 1994a, 1995a); Azzopardi and Briguglio 1993; Van Schijik and Briguglio 1992.

4.2 International economic transactions

In some of my articles on the Maltese economy, I focussed on a specific aspect, such as international economics (Briguglio, 1988a, 1989b, 1993b). In the 1988 and 1989 papers, I argue that a devaluation of the Maltese lira at the time of writing the article, would have in the short run improve export competitiveness, with a positive effect on output and employment. However, such a devaluation would have also increased the price of imports, negatively affecting competitiveness in the longer run. This will also have affected inflation, leading to an increase in wage rates, again negatively affecting competitiveness. The net result of the opposing effects of a devaluation on competitiveness would depend on various circumstances, including the import content of the product in question and the extent to which employee union manage to raise wage rates when prices increase.

4.3 International competitiveness

Another area which I explored in my publications in connection with the Maltese economy is international competitiveness (Briguglio, 1998a; Briguglio et al., 2003a; Briguglio et al., 2004d). In the 1998 article, was written six years before Malta joined the EU, I referred to the feeling of unease which existed at that time regarding the long-term survival or otherwise of small firms. The reason for this was that a sizeable proportion of these enterprises were only able to operate profitably behind a wall of protection, which was due to be dismantled with EU membership. In the same article, I contended that the performance of small firms was crucial for the overall growth and therefore the promotion of competitiveness was of utmost importance for the development of the

economy.

The 2003 and 2004 articles, written with EU membership on the horizon, argued that the Maltese economy at that time faced various competitiveness downsides including lacunae in the educational system, labour market rigidities, lack of an innovation culture, excessive government intervention in the economy, inadequacies in infrastructural services and insufficient research activity. The two articles argued that these downsides needed to be addressed if Maltese firms were to compete successfully in an intensely competitive setting associated with EU membership.

4.4 The Maltese labour market

Another specific aspect of the Maltese economy on which I wrote a number of papers, was the labour market on my own (Briguglio, 1977, 1984b, 1985) and with others (Briguglio et al., 2015b, 2016; Inguanez et al., 1986). Chapters on the labour market were also included in the two books I published about the Maltese economy (Briguglio, 1988b, 2011b).

In most of these publications, econometric techniques were used to estimate the factors that affect labour demand (including wage rates, output and technological change) and those that affect labour supply (including working age population and changing attitudes in the case of women).

In one of my papers (Briguglio, 1984b) I tested whether disequilibrium in the Maltese labour market existed and persisted during the period 1955 to 1979. Persistent disequilibrium would seem to contradict mainstream microeconomics, given that theory suggests that when there is excess demand in the market for a given product, its market price is likely to increase, and conversely, when there is excess supply the price of the product is likely to decrease, and therefore there is a continuous tendency for demand and supply to equal each other. Labour market data in Malta was used to construct a model in order to test the assumption that excess supply in the Maltese labour market persisted indicating that the market was characterised by disequilibrium during the mentioned period. The rate of unemployment is often considered as a measure of excess supply, but I did not rely on published unemployment statistics for this purpose because registered unemployment may have included persons who were employed and still seeking unemployment benefits. The model itself was formulated in such a way as to predict excess labour supply. This paper was considered by a well-known economist (Quandt, 1988, :130) as an important contribution to the literature on disequilibrium economics.

4.5 Tourism

I published several studies on the impact of tourism on the Maltese Islands, on my own (Briguglio, 1992c, 2008c, 2009, 2020) and with others (Briguglio et al., 2019a, 2021; Briguglio et al., 1996b; Briguglio et al., 1995b). The main argument in these writings on tourism is that the tourist industry has positive impacts on the Maltese Islands, mostly economic in nature, but it also has social and environmental downsides, primarily due to Malta's limited carrying capacity.

In many of my writings on this subject, I contend that the Maltese tourism authorities pay lip-service to sustainable tourism, but in practice what seems to matter most for them is the number of incoming tourists. This is a common stance taken by the tourism authorities of many island destinations. One reason for this is that a policy of controlling and possibly reducing tourist inflows would not find much support from those benefiting materially from tourism and tourism related activities. As a result, tourism inflow increased rapidly during 2000s and in the 2019 and 2021 studies, I and my co-author argue that the Maltese Islands had become associated with overtourism.

The main message in my publications on tourism is that there is the need to find ways of minimising environmental damage and social discomfort of the local community, without threatening the economic well-being of the host country – admittedly not very easy objective to attain, and it often involves walking on a very tight rope.

4.6 Sustainable Development in Malta

I published a number of articles on sustainable development, covering various aspects of this concept, including its place in education (Briguglio et al., 2004e), its association with economic resilience (Briguglio, 2008b) and its measurement (Briguglio, 2010b, 2011a).⁶

Sustainable development is often discussed in terms of its economic, social and environmental pillars, but in my writing, I also emphasise the ethical dimension of sustainable development (Briguglio, 2003a), which is not often treated in the literature on this subject. The 2003 paper considers sustainable development as a value to be upheld, given that it is associated with the responsibility towards future generations. There are also ethical considerations relating to science and technology in this regard, because sustainable development should have the improvement of quality of life as a central objective. Ethics also has an important role in the promotion and sharing of knowledge

⁶I was involved as coordinator in drawing up of a sustainable development strategy for the Maltese Islands, which was published in 2006 on behalf of the National Commission for Sustainable Development. <https://sdgtoolkit.org/wp-content/uploads/2017/02/A-SUSTAINABLE-Development-Strategy-for-Malta-2007-2016.pdf>.

and in the participation of stakeholders in the process of pursuing sustainable development goals. In many of my writings on this matter, the term "responsibility" is emphasised with regard to policies and practices relating to environmental quality, political matters, use of economic resources, education, culture, and intergenerational concerns.

4.7 Malta and European Union

I published various works on the relationship between Malta and the EU. The pros and cons of Malta's accession to the EU featured as chapters in Briguglio (1988b, 2011b) and as articles in Briguglio (1994b, 2011c, 2016f); Briguglio and Cordina 2004c.

The economies of small states of the EU, including Malta, was the theme of a book which I edited and which was published by Routledge 2016i. Separate articles on this matter also include in Briguglio (2013a) on the EU competition policy, Briguglio (2016d) on the small states of the EU and Briguglio and Vella 2016 on the EU labour market.

4.8 A focus on Gozo

I edited four books (Briguglio, 1994c, 2000a) and co-edited two others (Briguglio et al., 1995a; Briguglio et al., 1996d) and matters relating to Gozo. Other publications of mine on Gozo affairs include Briguglio (2000b, 2001, 2010c, 2016b).

Most of these works dealt with the specificities of Gozo in various aspects, including its culture, its economic structure and its physical environment. A major implication in these writings is that Gozo is not simply an extension of mainland Malta and in many cases one-size-fits-all policies may not be appropriate for Gozo due to its special needs.

5 Final considerations on citations outcome of the research paper

This article has given an overview of my publications, starting from the early 1970s. In this concluding section, I try to identify factors that may improve the chances of an article being cited, based on the number of citations to my publication, as listed in Google Scholar on 30th June 2020. Three tendencies would seem to emerge from these citations.

First, works with an international dimension, keeping other explanatory factors constant, have a better chance of being cited, than otherwise. In the list of publications presented above, the most highly-cited publications (Briguglio, 1995b; Briguglio et al., 2009b) have such a dimension. On the other hand, the publications focusing on the Maltese Islands, except for a few relating to

tourism, were not cited much, possibly because of the very limited world-wide academic interest in Malta's economy and Malta's affairs generally. This may also be the reason why many well-known Maltese authors, with important publications relating to the Maltese Islands, are very poorly cited in the literature. This is likely to be true also in the case of authors from other small states, who focus on matters relating to their own country only, even if the academic worth of their publication could be very high. This argument may also apply in the case of larger countries when authors from these countries focus on one nation. In this regard, Bornmann et al. (2018) discuss the negative effects of citing with a national orientation in terms of recognition referring to citations in papers from Germany, the Netherlands, and UK.

The second tendency that emerges is that publications that are easily accessible on line free of charge to the user have a better chance of being cited, although this possibility is sometimes contested in the literature (see for example Anderson, 2012; Basson et al., 2021). In the publications listed in the present review, chapters of books, which are normally made available online against a charge, are not as frequently cited as articles in journals, which can often be accessed online free of charge by academics (possibly through their university affiliation). In my view, some of the book chapters that I authored or co-authored, particularly Briguglio and Vella 2018, were of relatively good quality, and the main reason that they received few citations probably relates to lack of ease of access.

A third tendency that emerges from the citations relating to the above list of my publications is that if a study is regarded as seminal, its rate of citation follows an S-shaped pattern of change, as explained below. In the case of my 1995 paper on economic vulnerability, which has been described as seminal, as indicated above, the related citations increased at a slow pace initially as the interest in small states increased slowly in academic circles. However, as the paper became better known, the citations shot up and increased exponentially through a multiplier effect, reaching a peak around 2010, after which the paper continued to be cited but at a lower rate than in previous years. This would seem to suggest that a seminal academic article is not likely to be highly cited *ipso-facto*, and when eventually citations peak a slowdown will follow as the year of publication becomes distant in time. However, a seminal paper is likely to remain being cited for many decades.

It should be emphasised that the three tendencies just discussed do not detract from the fact that there are many other attributes of a publication that are likely to lead to high citation rates, including its quality, the reputation

and competence of the author, the language used, with English being an advantage in the regard, techniques used in generating visibility of the publication, the impact factor of the journal in which it is published, and others.⁷

There may also be random factors affecting the number of citations of a particular publication, including luck. I am sure many an author has experienced situations where a paper developed over a week or two, following an idea that pops suddenly and out of nowhere in the author's mind, gets accepted and cited. Conversely, an author might spend many months if not years labouriously working on a paper, only to be informed that it has been rejected by the journal, and therefore without a chance of being cited.

The tendencies discussed in this concluding section may be of interest to researchers, who wish to improve the chances of their work being cited. As is well known, having one's work cited in the literature does not only carry prestige for the cited author, but can also lead to material gains including securing a university position and getting promoted.

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⁷For a discussion on the various factors affecting number of citations see Tahamtan et al. (2016).

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Research Article

The Politics of Education

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Abstract. In this reflective account, I provide an overview of some of the main currents, particularly in sociological research, and specifically sociology of education research, to which I have been exposed as an academic in my thirty or so years tenure at the University of Malta with temporary academic appointments in other foreign universities. I refer to my research in the context of these currents which have contributed to my ongoing formation as an academic, educator and citizen. The overarching rubric for most of my academic oeuvre would be the Politics of Education. I would like to think that my work is that of an engaged sociologist—a value committed one. The major influences in this piece are Antonio Gramsci, Paulo Freire, some classical sociologists, Henry A. Giroux, Antonia Darder and many others within critical social and political thought. I consider historical movements in the education field as having had an influence on my thinking, notably those concerning workers' education. Lack of space denies me the chance to explore the influence of other currents in political and education thought which made their presence felt in my work but which can easily be tokenized in the restricted space available. I do provide detailed bibliographical references to my several sustained writings, as author and co-author, on some of them, especially those involved in specific forms of difference, race, gender and biodiversity in particular.

Keywords: Sociology of Education, Adult Education, State, Hegemony, Culture.

1 Introduction

I thank the editor of this special issue of *Xjenza* for the invitation to contribute an article covering my research agenda over a span of thirty years. The topics that I engaged with, in my writings, are many, ranging from publications on Antonio Gramsci, Paulo Freire and Don Lorenzo Milani to others in such areas as Adult Continuing Educa-

tion, Sociology of Education, which provided a substantial part of my teaching over the years, Lifelong Learning and related policy issues at the Maltese and European levels, and Museums Education. My work has been published in a range of journals, many in education research journals, and others in sociology and interdisciplinary (e.g. *Capital & Class*, *International Critical Thought*, *Das Argument*) or regionally-focused journals (*Journal of Mediterranean Studies*, *Holy Land & Palestine Studies*).¹

2 This Paper

In this paper, I attempt an overview around the one all-embracing area providing the rubric for my teaching and writing since 1988, the year marking my first University Council appointment at Part-time level in Sociology of Education and the years following my full time appointment in Adult Education in 1993. This full-time appointment, coinciding with my obtaining a PhD, also included responsibilities in the field of Sociology of Education. My research focus at Master's level was in political adult education while the overarching disciplines in my graduate studies in Alberta and Toronto, Canada, were in Sociology of Education and Sociology in Education² respectively. To maintain a sharp focus and to restrict the length of the piece to manageable proportions, also given the focus of the faculty in which I have been ensconced, I shall develop the article around the Politics of Education.

3 Politics of and in education

The relationship between politics and education is marked by a long tradition of academic work—a huge corpus of

¹I also had articles or interviews with me, on some of these issues, published in international popular outlets such as the Maltese press, *Truthout* (USA), *Counterpunch* (USA), *Open Democracy* (UK), *Novosti* (Croatia), *Sol* (Turkey), *Bir Gun* (Turkey), *il Manifesto* (Italy) and *Times Higher Education* (UK). I am a firm believer in wider dissemination of ideas and knowledge beyond academic outlets.

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literature. This area had a strong impact on my weltanschauung and political orientation since my graduate student days. I have therefore been committed to a value-driven sociology with social justice at its core. In this regard, I need to thank a long list of sociologists based in Canada and a number of my colleagues in the field in Malta: Mary Darmanin, who exposed me to UK qualitative and interpretative traditions, Ronald Sultana, Godfrey Baldacchino and Carmel Borg. I was naturally grounded in European sociological traditions but was also attracted to work forthcoming from the geographical majority world, mainly Latin America and Africa. All this is evident in my latest, co-authored book in a series (critical education) I edit for an international publisher (Mayo et al., 2021).

European sociology owes a lot to France and Germany. The major European exponents of classical sociology were found there, although one can trace earlier origins to at least one 14th century Arab scholar, Ibn Khaldun, from whom later French scholars such as Emile Durkheim (1858-1917) are said to have drawn without mentioning him (Santos, 2017, p. 294)—hardly surprising, I would add, given the provenance of a scholar from Muslim North Africa living in a territory (Tunisia) which was eventually, in 1881 (the time when Durkheim was active), to become a French protectorate. I would never lose sight of the strictures, concerning Eurocentric positional superiority, regarding Khaldun's influence on Durkheim, made by Boaventura de Sousa Santos (2017). This ties in with my developing, as someone coming from a country with a long colonial history, a keen interest in a decolonizing politics. With Anne-Hickling Hudson, a Jamaican scholar ensconced in Brisbane, Australia, who had thoroughly researched revolutionary education in Grenada during the 'New Jewel' government years, I gave rise to a refereed journal, *Postcolonial Directions in Education*, currently in its tenth volume and run by the University of Malta as an open access outlet. We both also gave rise, with Antonia Darder, a Puerto-Rican scholar, to a book series with an international publisher, 'Postcolonial Studies in Education' with over twenty volumes to date. My work is therefore rooted in the European tradition and in the struggles for liberation emerging from the geographical Global South.

Early sociological enquiry in Europe, at the basis of my initial studies in the field, focused on the development of a secular 'modernist' society with education regarded as central to this society. Education featured prominently in the talks and writings, gathered in different volumes, of Emile Durkheim. He lectured in both pedagogy and sociology and had some of his lectures on education, at the Sorbonne, gathered in such works as *The evolution of educational thought* (Durkheim, 2006). By contrast,

Karl Marx (1818–1883) and Max Weber (1864–1920), from Germany, the former also living in Paris, Brussels and London, offered little that is systematic when it comes to education, although Marx did promote the idea of a polytechnic education in his address to the First Workingmen's International, commonly referred to as the Geneva Resolution of 1866. This document underlined the elements of academic, technical and physical preparation for the working class (Marx, 1866, 1867), echoing the 1848 *Communist Manifesto* (Marx et al., 1848, 1998) and connecting with certain passages in *Capital Vol. 1* (Marx, 1887). Max Weber, for his part, did write briefly about the rationalization of education and training (Weber, 1998, p. 240–244). Of course one can find much grist for the mill in their discussion of broader areas such as 'the production of consciousness' in Marx and Engels *Die Deutsche Ideologie* (The German Ideology) or in Weber's *Protestant Ethic and the Spirit of Capitalism* and in excerpts from his unfinished *Economy and Society*. These works influenced me profoundly as can be seen from many of my early writings and later ones (Mayo, 2020). Education can, in these instances, be viewed in its much broader contexts and well beyond institutional provision which is the way I view the area in this essay. Much later, Karl Mannheim (1893–1947), a Hungarian social philosopher and great contributor to sociology in many ways, not least through his writings on *sozialwissenschaft* (social science) and of course sociology of knowledge in *Ideology and Utopia* (Mannheim, 1936), would render education central to his view of social reconstruction and democratic planning in his later work such as *A Diagnosis of our time, Man and Society in an Age of Reconstruction* and *Freedom, Power and Democratic Planning*.

While regarding knowledge as socially relational (to avoid accusations of relativisms) he later saw it as central to a process of social reconstruction and de-Nazification during and after the post-World War II period which saw him, since the Nazi rise to power, spend his days, as a Jew, away from Germany and in England. There he taught at the LSE and was later and briefly (one year before his death) to occupy the Chair of Sociology of Education (subsequently named after him) at the University of London's Institute of Education (now part of UCL). I would argue that his vision for education as a source of social reconstruction, in reaction to the devastation of two world wars, was in keeping with the zeitgeist of the time which connects with other developments elsewhere such as the creation of Centres for Social Orientation (COS) in Umbria and other parts of Italy. The brainchild of Aldo Capitini, a peace activist and academic, these centres were seen as key to the development of a grass-roots democracy called *Omnicrazia*. Avoiding a repeat of

Nazi-fascism is something to be worked for, and education in all forms, formal and non-formal, including parent education, was key, a position, for instance, shared by Ada Gobetti.³ Mannheim also wrote of the importance of adult education and the social sciences for such a purpose. On the importance of the social sciences for adult education see his article published in *The Tutor's Bulletin in Adult Education* (Mannheim, 1938). The spirit of social reconstruction also runs through the proceedings of the first UNESCO conference on adult education held in Elsinore, 1946.⁴ Education was considered crucial for a construction of a genuinely grassroots oriented democratic environment. Mannheim influenced me tremendously in my early years of writing and teaching in the field.⁵

4 Grassroots democracy and the 'new' Fascism

As a matter of fact, my first ever published essay in education was on Karl Mannheim's contribution to the development of a sociology of knowledge (Mayo, 1990). His and other's ideas on social reconstruction (Capitini, UNESCO CONFITEA 1, 1949) featured strongly in my writings on adult education and lifelong learning (see especially English et al. (2012, 2021)). A lot is made of the need for grassroots democracy and an education, often within social movements (Borg et al., 2007a), for this purpose. Furthermore, Fascism is not a thing of the past but is very much present taking on different forms. This can be evidenced from various writings on education in the context of a new authoritarianism and its echoes in education.⁶

5 The non-neutrality of Education

There are those, myself included, who would argue that education is not a neutral enterprise. This contention

³Ada Gobetti Marchesini was a former resistance fighter (partisan forming part of Italy's Central Committee for Resistance against Nazi-Fascism), literary scholar and educationist (led several newspaper features and edited reviews in education, especially for parents) (Gobetti, 1982; Leuzzi, 2015). Her writings on education and democracy and on parent education have recently captured my interest as she stands as a prominent critical educator from Southern Europe. A whole chapter dedicated to her ideas is included in Mayo et al. (2021).

⁴<https://uil.unesco.org/adult-education/confitea>

⁵As always, I would never attribute to education powers it does not have, i.e. the power to change society on its own. It is not an independent variable and can only *contribute* to change, in concert with other variables. This is one of the very first maxims I learnt in sociology, especially sociology of education, at Canada's University of Alberta. Alas, this runs counter to popular parlance as a result of which education is made the panacea for society's ills.

⁶This is evident in various writings by Giroux (2018, 2020) especially with regard to New Right and more recently Trumpism in the USA. This also emerges from writings by others on Jair Bolsonaro's policies in Brazil.

is widely attributed to Paulo Freire (1921–1997), much reviled by the Bolsonaro government (Accioly, 2020) and the previous interim government in Brazil, on whom I have written voluminously (Mayo, 1999, 2004, 2013, 2020). Indeed, there is no denying that Freire is my major source of influence as an educator. As a southern and a decolonizing voice, he appealed to me from the time of my very initial in-depth studies in education as a graduate student. His *Pedagogy of the Oppressed* (Freire, 2018), which I read in its earlier published editions in English, and the School of Barbiana's *Letter to a Teacher* (henceforth the *Lettera*, Borg et al. (2009)⁷ are the two most inspiring books in education that I have read, the latter in the Italian original. They highlight the nexus between education, power and personal and collective subjectivity. This view helped fashion my politics. These books are about not only schooling but society in general, as Pier Paolo Pasolini once remarked concerning the *Lettera*. In this regard, I have written comparative works on Milani and Freire, in English and Italian, in edited books and journals (see Mayo (2013)), underlining the collective dimensions of learning and engaging in action, reading and writing the word and the world critically to 'care' about the world and its reconstruction from the standpoint of the marginalised. Freire's work also has its limitations within what bell hooks calls his 'phallogocentric paradigm of liberation' (hooks, 1993, p. 148). She and others help reinvent his work to resonate with the experiences of Afro-American women and men, among others, important mediations and reinventions (hooks, 1988; Sheth et al., 1997; Weiler, 1991) that enhanced my knowledge of oppression and aggressions, micro or macro, rendering my understanding more nuanced (Mayo, 1999).

The non-neutrality of education has been the mantra of several other movements. The politics and non-neutrality of education lie at the core of that long tradition of educational provision known as independent working class education (IWCE) as manifest, for example, in the work of the Plebs league and the labour colleges in Britain. They represented an attempt at a break with bourgeois culture. IWCE occurred through classes and schools, working men's institutes, alternative libraries and sporting events (Waugh, 2009). There are echoes of the Proletkult here as Richard Hoggart infers (Hoggart, 1947, p. 7). For instance, when the Plebs League of working class labour colleges in England and Scotland argued in

⁷Directed by don Lorenzo Milani, the authors are youngsters who were 'pushed out' of the public school system. Their *Letter to a Teacher* is a classic concerning the relationship between social class and educational achievement (Batini et al., 2014; Borg et al., 2009). Among other things, this narrative emphasizes the collective dimension of teaching and learning and the class basis of social selection as manifest in public and private systems.

favour of their secession from the trade union and nominally socialist-oriented Ruskin College, they underlined, in an editorial of their standard publication, *The Plebs' Magazine*:

the worker is either robbed or not robbed; Labour is either paid or unpaid. To ask the workers to be neutral is both insulting, and absurd. The "impartial education" idea has its source in a very "partial" quarter, and so long as the control of education comes from that quarter the working-class movement will be poisoned and drained. . . (as quoted in Waugh (2009, p. 24)).

The idea therefore that education is value driven and is connected to class, ethnic, and gender interest, not to mention many other possible interests, colonial, able-bodied and heterosexual or heteronormative interests, is part and parcel of the various struggles throughout history for greater democratic inclusion. This entails renewal of institutions such as schools, universities and forms of recognised education (e.g. the struggle for the affirmation and validation of Indigenous knowledge/s). These struggles of primarily race, class and gender, feature prominently in my writings (see, for instance, Borg et al. (2006), English et al. (2012) and Mayo et al. (2017, 2021)).

These include the struggle over what kind of lifestyle is to be encouraged, often connected to specific variations in the mode of economic production. Schooling in the steam-propelled first industrial revolution served a particular purpose benefiting the specific type of capitalism in those days, getting people to learn how to work together under one roof and in cities rather than the countryside. It also entailed getting used to routine, 'alienated' work—boys to sell their labour for a wage, while girls to help nourish the male labour force within the domestic sphere at no cost (unwaged labour). They would thus generate 'surplus value'⁸ for the company owners. Different political organisations and movements with different views of how society ought to be run considered education a site of contestation. Socialist oriented organisations challenged the dominant Capitalist view of education. Whose interests does it serve?

The Editorial from *The Plebs' Magazine* reflects this kind of struggle, a radical class struggle. Ruskin college, which novelist Thomas Hardy once referred to as likely to be called Jude Fawley's (main character in Hardy's novel, *Jude the Obscure*) college, was not considered radically socialist enough for the Plebs league which gradually ran its own colleges. Later other socialist thinkers such as

⁸The difference in amount from the sale of a product and the cost of manufacturing it: materials, labour power and plant.

Raymond Williams, Richard Hoggart and E. P. Thompson taught a more complex approach, working 'in and against' established institutions by reinterpreting what was taught in a manner that connected with a 'whole way of life' (Williams, 1958, 1990, p. 239). This was often a way of life of a community (working class) that was different from the mainstream (the middle class mainstream student). This entails, as in Smith's (1987) feminist approach, reading texts according to a particular communal class standpoint and/or other standpoints (mainly women's,⁹ in Smith's feminist sociology, eclipsed in mainstream versions of the subject) and in a manner that connects or otherwise with particular everyday frameworks of relevance.

Quite relevant, in this regard, is also the work of Levi (2006) concerning different communities' interpretations of historical events, rooted in their own contextual experiences, and at the furthest remove from that of mainstream interpretations. One can therefore teach against the grain as there is nothing neutral about teaching. This also applies to the interpretation of texts, in Raymond Williams's view, which appeal to different 'structures of feeling'. According to my interpretation, these are 'elements that have been felt, often deeply, but have not always been articulated in specific communities.' (Mayo, 2019, p. 68).

6 Change within: tactically *inside*, strategically *outside*

One can also work for change 'within' the interstices of established institutions, curricula and systems. This is a far cry from the dominant 'technicist' discourses around education which often promote a monocultural education and hide a dominant insidious ideology, made to look like the innocent flower while being the serpent beneath, as Leona English and I argue, echoing Shakespeare (*Macbeth*) in a recent book about Lifelong learning (English et al., 2021). This position of working relatively outside and in and against, or, as Brazilians put it, tactically inside and strategically outside the system, has been a key mantra throughout my work as indicated, for instance, in Borg et al. (2006) and Mayo (2019).

7 The Neoliberal Scourge

Over the last four decades, we have been swamped by a discourse about education strongly wedded to the market ideology. This is Neoliberalism whereby education is seen as a consumption rather than a public good; *responsibil-*

⁹This, in Dorothy Smith's view, would be opposed to 'generic' constructions by men ensconced in and dominating institutional apparatuses using 'objective' measures that serve to render their [male] standpoints universal. The same holds for social class and racial invisibilities.

isation became a key term in the lexicon. Emphasis was placed on individual self-interest and responsibility when it came to education, as with other areas such as health and now even pensions. This has been the staple of my critique ever since I taught and researched as an academic (English et al., 2021; Mayo, 2019). People like me contrast all this with the concept of education as a democratic public good evoking a variety of thinkers. Henry A. Giroux (b. 1943) has been a very powerful voice in this regard, together with many others including those who contribute to the international book series on critical education I edit. Wedding John Dewey's ideas to critical theory formulations and those of other thinkers, Giroux has been arguing passionately for the urgent need to safeguard public spaces against neoliberal encroachment and commodification. He actually broadens the notion of education (Giroux, 2018) to include several sites of public pedagogy ranging from schools to cinemas and youth entertainment areas, as well as many engaged in producing consumer culture and military culture ideologies. He does this when analyzing the devastating effects and 'terror' of neoliberal policies and when arguing for universities, schools and other learning agencies to help reconstruct, safeguard and revitalise democratic public spheres. Giroux, a good friend, constitutes a great influence on my work. Equally influential, especially in my formative years, has been Michael W. Apple (b. 1942) who argued for the democratisation of the curriculum which he presents as a site of contestation mirroring other sites of struggle such as the state and the domain of textbook publishing. He has been detailing the economic, political, and ideological processes that enable specific groups' knowledge to become 'official' (Apple, 1993) while other groups' knowledge is 'popular'. His influence on me is apparent in my ideas and those of my friend, co-author and curriculum specialist, Carmel Borg with regard to our joint work on the curriculum and museums (Borg et al., 2006; Mayo, 2004). Like curricula, museums also represent a selection from the cultures of society. In whose interest is the selection made?

8 Bicultural Education

Another good friend and collaborator, Antonia Darder (b. 1952) has engaged with issues of cultural democracy and consistently with notions of culture and power concerning conditions of schooling in disenfranchised and racialized communities (Darder, 2011). Coming from a small ex-colony, caught between the need to assert a 'national-popular' culture and vision, manifest through the Maltese language, and a language or languages of international currency, not to remain at the periphery of global political life, I find much purchase in her ideas on bicultural education. This entails the ability to straddle two or more

cultures (Hispanic and English, in her case working among Latin Americans in the USA, and Maltese and English in Malta). This influence is reflected in some of my writings with her, in *Truthout*, in book editorial introductions (Darder et al.) and an essay on her in Mayo (2013).

Most of these writers are exponents of *critical pedagogy*. One major exponent, Peter McLaren (b.1948) describes critical pedagogy as concerned with the power nexus insofar as it raises questions on 'the relationship between what we do in the classroom,' and on 'our effort to build a better society free of relations of exploitation, domination, and exclusion. . . ' (McLaren, 2015, p. xxvi). Critical pedagogy is very much inspired by Freire. Colleagues and I however (Borg et al., 2009; Mayo et al., 2017, 2021) have pointed to many others, especially from the geographical Global South, who demonstrate, in multiple ways, the political nature of education. These include Gabriela Mistral, with her ideas on rural education, Ada Gobetti and once again, Lorenzo Milani (1923–1967) of Barbiana fame. The *Lettera* and Milani's *Esperienze Pastorali* (Pastoral Experiences) anticipate writings associated with critical pedagogy and the 'new sociology of education', the latter born of a series of writings (Young, 1971), more specifically Michael Young's editorial introduction, that signaled an approach indicating the ideological basis and class biases of schooling, a largely 'phenomenological' approach he recently repudiated arguing for learning what he terms 'powerful knowledge' irrespective of its social moorings (e.g. Maths, Science, Logic—shades of Gramsci). The 1971 'Knowledge and Control' group's demonstration of the affinities between the culture of middle class homes and that of the school, and this institution's traditional rupture with working and peasant class cultures, resonated with *Plebs* and the work of Pierre Bourdieu (1930–2002). In Bourdieu's case, reference is made to his writings concerning the school's 'cultural arbitrary' and the issues of 'habitus', and cultural and social capital as determinants of educational success or failure (addressed for instance in Borg et al. (2006) and Mayo (1999, 2015a).

9 Education and the State

These readings and concerns enabled me to veer into other areas with regard to the intimate link between education/culture and power, namely cultural studies, enhanced through my readings of Raymond Williams and Stuart Hall, and theories concerning the state and state formation. To focus on one, the state, Roger Dale (b. 1940), a good friend, analyses the immensely complex relationships occurring between capitalism, state and education. Drawing on Claus Offe, he analyses the process whereby education is linked to both capitalism's legitim-

ation function, by persuading us that inequality is not endemic to the system but a consequence of our different ‘abilities’, and to the production of necessary ‘human capital’ for national and global economic ends. Dale argues that the ways those tensions are felt and addressed through education are central to our understanding and experience of the world. Other authors have also analysed education in the context of the state’s legitimation and accumulation functions (Carnoy et al., 1985), while Green (1990, 2013) has analysed education within the context of state formations in Europe, the USA and South East Asia, among others. Here I would mention another figure from sociology who worked in educational institutions (held positions at Institute of Education—University of London and OISE¹⁰—University of Toronto), focusing on the social relations of cultural production (as opposed to mere reproduction) in education and drawing on cultural studies. This is the recently deceased Philip Corrigan (1942–2021) whose broader areas of historical sociological research included state formation (see Corrigan et al. (1985)). These influences make their presence felt in my work which deals with both the constant and changing features of the state in neoliberal intensive-globalisation times and their effects on public and higher education. I seek to dispel the neoliberal myth, complementing another good friend, Green (1990, 2013, p. 316–318) in doing so, that the nation state has receded into the background in these periods of intensification of globalisation (Capitalism has always been global). To the contrary, I argue that the nation state plays crucial (Mayo, 2019, p. 9), albeit contrasting roles (goods can move freely while labour power does not, often being blocked by the nation state) in the process of capital accumulation, mobility of capital and of labour.

10 Noblesse oblige Gramsci

I re-examine Antonio Gramsci (1891–1937) in this context, expanding his national concerns and analyses into more regional ones, such as the ‘Southern Question’, focused on Italy, being expanded to a more Southern European and larger Mediterranean context. I sought to do this in a paper first published as a stand-alone piece in English, Italian and German and subsequently incorporated into a book (Mayo, 2015a).

Gramsci, of course, wielded a lot of influence on critical education thought, manifest in the works of sorely missed close companions and scholars such as the late Paula Allman who draws rigorously on his work (Allman, 1999) in light of her deep and extensive knowledge of Marx (Allman, 2001). Gramsci’s work has been providing me with an overarching vision of moral and intellectual

reform which lies at the core of my work, enhanced by insights from feminism, anti-racist politics, postcolonial politics, policy studies and cultural studies. All these feature in my oeuvre, though, alas, I cannot address each in the required depth here because of a prescribed word limitation. To do so would result in an absurd exercise in tokenism which I am seeking to avoid. They deserve much more serious treatment which I hope can be found in co-authored books (Borg et al., 2006; English et al., 2012, 2021; Mayo et al., 2017, 2021), both transversally and as entire chapters. They also appear in stand-alone papers (e.g. Borg et al. (2007b) and Grech et al. (2020)), especially insofar as race/ethnicity and gender and women’s issues are concerned.

It would have been amiss to leave Gramsci out, given his centrality and those of his signature concepts, to my oeuvre. The concepts he elaborated on, such as those of hegemony, the intellectuals’ roles, the factory council theory and the integral state, have had a great impact on educational thought and have become central concepts in most discussions on the relationship between education and power in which I have engaged (see Mayo (2015b, 2015a)). Education, from a Gramscian perspective, is viewed in its broadest context and not just in the context of the ‘Unitarian school’ (Gramsci’s notes on schooling), therefore incorporating all elements of the hegemonic apparatus. Gramsci’s major pedagogical philosophy would be the ‘pedagogy of praxis’, inferred from his elaboration of the ‘philosophy of praxis’. Other issues concern the role of education and the integral state, the latter encompassing the heuristic political/civil society divide (Mayo, 1999, 2020, 2015a). It is to an understanding of his conception of education, culture and power that I lay claim to having made my major scholarly contribution (see Buttigieg (2015)), allying his insights to those expressed by Paulo Freire, captured in many of my writings, including a book (Mayo, 1999) which gained traction as it has been published in translation in seven other languages. My ideas have evolved further since then and will hopefully lead to a second much-revised edition with several new insights.

In this oeuvre of mine, including pieces concerning the state (see Mayo (2015a)), the image of Gramsci looms large. Engagement with his ideas and conceptualizations will continue to mark the rest of my academic work. It is fitting therefore that I round off this essay review with him, having referred to key areas, such as theories of the state and state formation (not to mention cultural studies), on which he has exerted and continues to exert such telling influence.

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Research Article

Online Recreational Gambling Intention: The Effect of Subjective norms, Spitefulness and Gender

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Abstract. Online recreational gambling has grown significantly over recent years. This growth has been aided by increasing global internet penetration, the rise of Web 2.0, and the ubiquitous diffusion of smart phones. It has also been assisted by a weakening in subjective norms that has seen recreational gambling become increasingly accepted as a leisure pursuit and more recently also by Covid-19 measures. This research looks at the relationship between subjective norms and gambling intention and the possible mediation effect of spitefulness as an overlooked social behaviour. The study also investigates whether gender plays a moderating role. Hypotheses of these linkages grounded in established behaviour intention models are proposed, and data are collected from a sample of customers of an online gambling firm based in Malta. Moderated-mediated regression supports the role of gender and the partially mediated effect of spitefulness in the relationship between subjective norms and recreational gambling intention.

Keywords: Recreational online gambling, Subjective norms, Spitefulness, Gambling intention, Gender.

1 Introduction

Services account for at least 50% of the GDP in over half of the world's countries and about 65% of the world's GDP (Carlos, 2019). In Malta, the services sector accounts for close to 76% of GDP (O'Neil, 2021). The growth of services generally has been facilitated by the progress in internet development and penetration. More people are confident and capable of buying services online and many services that have traditionally been of a 'brick and mortar' nature, have now either expanded or moved fully online (Wolfinbarger et al., 2001). With more than 65.6% of the world's population currently hav-

ing access to the Internet and an 88.2% penetration in Europe (Stats, 2021), online services such as online shopping, online banking and online entertainment in its various forms, are providing an ever more important form of commerce. Firms like Netflix and Spotify that provide streaming movies and music in many developed and developing countries have achieved rapid growth. However, the more successful adopter and user of the new technologies is the adult industry, including pornography and gambling (Arlidge, 2002; Edelman, 2009; Gross, 2010; Roberts, 2006; Victor, 2017).

Increased Internet penetration across developed and emerging economies, together with the growth in smartphone adoption coupled with the development of Web 2.0 capabilities, has meant that online gambling websites are accessible to almost everyone, everywhere, and at any time (Berthon et al., 2012). The steady expansion in online gambling has also, more recently, been aided by Covid-19 restrictions. These developments have turned the industry into a global multi-billion-dollar business with a market in 2020 estimated at US \$59.6 billion and it is expected to grow to US \$127.3 billion by 2027. The European market accounts for \$22.0 billion with sports betting becoming a dominant sector of the market (Grand View Research, 2020). In 2004, Malta became the first EU member state to enact comprehensive legislation in remote gaming (MGA Gaming in Malta, 2021) and the gambling sector today contributes 8% of Malta's total economic value (Evanova, 2021).

The impact of the Internet and web 2.0 on recreational gambling has been fascinating—it has eliminated the importance of location. This development has meant that a customer desiring to gamble no longer has to go to a racetrack to have a wager, or a casino to play a table game or slot machine. Moreover, there is no longer the need to employ hundreds of people (croupiers, slot machine

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mechanics, etc.) or to own physical infrastructure such as buildings, machines, restroom facilities, restaurants, etc. Similarly, for consumers there have been advantages—they do not need to travel, it is always accessible, and it is available from the comfort of their own homes. Customers are virtually spoilt for choice, and technology has made a world of gambling available literally at their fingertips. On the downside customers face a lower level of social contact and easier access to financial resources which may lead to uncontrolled expenditures (Wood et al., 2009).

The underlying motives for gambling have been considered in the behavioural economics and psychology literature. Behavioural economics e.g. Brenner (1985), Friedman et al. (1948), Kahneman et al. (2012), Kwang (1965) and von Neumann et al. (1944) have provided various monetary utility theories. Psychology recognizes that besides monetary utility, gamblers may derive other forms of utility from gambling. Yet, the overriding focus of research on gambling in psychology has been on problem gambling and related issues concerning health and addiction (e.g., Auer et al. (2013), Gainsbury et al. (2014), Griffiths (2013), Philander et al. (2014), Rousseau et al. (2002), Sutton et al. (2007) and Wardle et al. (2011)) coupled with concern for regulatory measures (e.g., Buil et al. (2015), Gainsbury et al. (2013), Leneuf (2011), McAllister (2014), Rose et al. (2009) and Srikanth et al. (2011)). However, the psychology literature has also highlighted the attraction stemming from gambling as a social activity (Wood et al., 2008; Zaranek et al., 2005) starting from an early age with playing bingo (Gupta et al., 1997) and continuing in later life by visits to a casino with friends (Binde, 2013; Calado et al., 2016). This attraction of gambling is augmented by the glamour that the associated lifestyles, as portrayed in films and advertising, invoke (Sklar et al., 2010).

Online recreational gambling is a fascinating aspect of human behaviour, yet the stigma that gambling addiction carries may have contributed to business and marketing scholars having given it surprisingly little attention. This is especially astounding given just how much money, time and effort is devoted to gambling in so many countries, and by so many consumers (Mizerski et al., 2013). It therefore comes as no surprise that there exists only a limited number of papers that have explored various forms of gambling from a business or marketing perspective (e.g., Cummings et al. (1987), Konietzny et al. (2018), Moore et al. (1997, 1999) and Oh et al. (2001)). Although marketing scholars have exhibited a reluctance to investigate the marketing side of gambling, the business literature potentially provides a number of theories and models that could be useful to better understand and explain the be-

haviour intention of customers in an online recreational gambling context.

This research looks at the theoretical frameworks that seek to explain behaviour intention in consumer behaviour and marketing and adapts these to understanding recreational gambling intention. A common theme highlighted in the behavioural theories is the role of subjective norms and the impact family and friends have on behaviour intention. Deviations from subjective norms may give rise to shame and guilt (Gottlieb, 2004; Shabad, 2000; Stern, 2004) with those that are shame-prone and exhibit higher levels of guilt likely to be more spiteful. Therefore, this research investigates the role of spitefulness as an overlooked social behaviour that may mediate the relationship between subjective norms and gambling intention. Although few would consider spite a desirable motive, it is likely an important one (Marcus et al., 2014, p. 571). Exploring the individual customer's level of spitefulness in a Theory of planned Behaviour—TpB (Ajzen, 1985) and an online gaming context broadens our knowledge of the effect of social influences on behaviour intention.

In addition, a meta-analysis by Byrnes et al. (1999), who looked at sixteen types of risks, showed that in fourteen of these, greater risk-taking among men was evident. Therefore, the study also investigates whether gender plays a moderating role. Hypotheses of these linkages grounded in TpB are proposed, and data are collected from a sample of customers of an online gambling firm based in Malta. Moderated-mediated regression supports the role of gender and the partially mediated effect of spitefulness in the relationship between subjective norms and recreational gambling intention.

2 Subjective norms, online gambling intention and spitefulness

Several behaviour intention theories and models have been proposed in consumer behaviour and marketing that seek to explain general or specific behaviour intention among customers or employees in different industries. Models that look at general behavioural intentions outcomes among customers include the Theory of Reasoned Action -TRA (Ajzen et al., 1980; Fishbein et al., 1975) and the Theory of planned Behaviour—TpB (Ajzen, 1985). The TRA identifies attitudes and subjective norms as drivers of behavioural intention. Attitudes are affective and based upon beliefs while subjective norms concern what customers perceive their network of family and friends to believe. Subjective norm is defined as 'the perceived social pressure to perform or not to perform the behaviour in question' (Ajzen, 1991, p. 188). The TpB built on TRA by adding perceived behavioural control as a further driver of behaviour intention. The added construct rep-

resents the control which users perceive may limit their behaviour. TAM (Davis, 1985; Taylor et al., 1995) and UTAUT (Venkatesh et al., 2000; Venkatesh et al., 2003; Venkatesh et al., 2012) models adapt TpB to the context of information systems and technologies and specifically employees' behaviour intention toward technology adoption. Instead of subjective norms these latter models use the equivalent term social influence, described as capturing how much users are influenced by the opinion of others about whether they should use a system. The ubiquitous presence of subjective norms, or its equivalent social influence, across all models and its expected direct effect on behaviour intention underlines the importance of this driver.

The importance of subjective norms stems from the fact that an individual's behaviour can often be dependent on the social networks and organization that one belongs to. Therefore, subjective norms incorporate perceptions on whether a particular action is expected by family and friends. There is considerable literature linking subjective norm as an antecedent to purchase intention generally (e.g., Cummings et al. (1987) and Sheppard et al. (1988) as well as to gambling intention specifically. Thus, TpB has been used to investigate gambling behaviour of college students in China (Wu et al., 2012) and in the United States (Martin et al., 2010) with both studies reporting that positive attitude towards gambling and weak subjective norms positively influenced gambling intention. We therefore also hypothesise that:

H1: Weak subjective norms result in higher on-line recreational gambling intention.

The literature also suggests that "individual differences in personality traits associated with risk, behavioral preferences for risk, and attitudes toward risk are associated with gambling behavior" (Mishra et al., 2010, p. 619). However, while personality is natural and defines the customer, social behaviour is self-constructed and defines reactions in particular settings. Social behaviours can be categorised into four groups according to the resultant positive or negative effect they entail for the actor and recipient. Hamilton (1964), an evolutionary biologist, provides a 2x2 matrix that consider each of these two sets of outcomes for actors and recipients to provide a classification of the four basic social behaviour outcomes possible. Therefore, social behaviour can be cooperative when it is mutually beneficial, altruistic if the actor suffers but recipient gains, selfish if the actor gains and recipient suffers a loss, and spiteful if both actor and recipient suffer a loss (Gardner et al., 2004). On this basis, spitefulness is therefore generally defined in evolutionary biology and behavioural economics, as the willingness of

an individual to incur a cost to oneself in order to inflict harm on another even in the absence of any direct benefits for doing so (Fehr et al., 2005; Smead et al., 2013). Spitefulness has been described as "the shady relative of altruism" (Smead et al., 2013, p. 698) because spitefulness and altruism both involve a willingness to incur a cost to the self in order to impact the outcomes experienced by recipients. In altruism, the costs are incurred in order to confer a benefit on the recipient. In contrast, spiteful individuals are willing to incur costs in order to inflict harm on recipients (Zeigler-Hill et al., 2015). We should look for spite wherever individuals interact with kin and non-kin in highly competitive environments (Gardner et al., 2004). Although spitefulness has long been considered in evolutionary biology (Hamilton, 1964), it has only more recently received attention in psychology (Marcus et al., 2014; Zeigler-Hill et al., 2015) but remains a neglected concept in marketing. This lack of attention is possibly because unlike cooperation that can provide mutual gain to business parties, spitefulness provides no advantage and incurs a cost to both actor and recipient. However, spitefulness as a social behaviour may be relevant in a number of contexts including online recreational gambling. Online gambling customers are aware of the adage in gambling that one cannot beat the house. Therefore, each bet lost incurs a cost to the actor who is precluded by the odds from winning sufficiently big to inflict a bigger loss onto the recipient—the online gambling firm. In these circumstances, the spiteful individual is likely to gamble less. We therefore hypothesise that:

H2: The higher the level of a customer's spitefulness the weaker the recreational gambling intention.

However, an interesting point is the impact of subjective norms and spitefulness. Subjective norms resulting from family and friends are likely to influence spitefulness that in turn acts to augment or dampen the impact of subjective norms on recreational gambling intention. We therefore propose an alternative mediated hypotheses to H2 that states that:

H2 Alt: The effect of subjective norms on recreational gambling intention is mediated via spitefulness.

In their research, Marcus et al. (2014, p. 7) provide empirical support for a demographic difference in spitefulness "with men being more spiteful than women" in both samples considered. Furthermore, we therefore expect that the alternative mediated relationship proposed in H2 Alt may be moderated by gender. The expected relationships discussed above are depicted in the research model in figure 1.

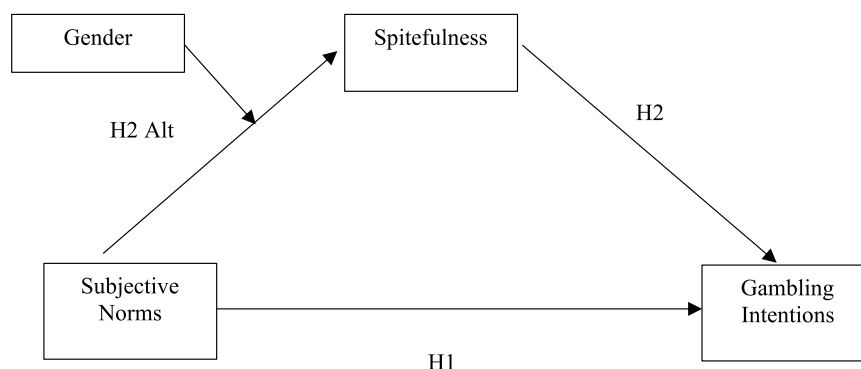


Figure 1: Research Model - subjective norms predicting recreational gambling intention with an interaction between gender and spitefulness.

3 Methodology

Given the nature of the research model in this study, a positivist quantitative research approach is adopted, that requires consideration of questionnaire design, data collection and sample choice issues together with cross cultural data capture challenges.

Questionnaire design: The research approach pursued in this study necessitates the choice of psychometrically sound measures to capture the constructs discussed. Measures used need ideally to have been tried and tested and have acceptable levels of reported internal validity and reliability (Collis et al., 2014; Kothari, 2004) while attention to cross-cultural research challenges related to equivalence also need to be considered (Levine et al., 2007; Marczyk et al., 2005; Sekaren, 1983).

Behaviour intention is considered as the last stage before actual customer action takes place. Behaviour intention is conceptualised as a unidimensional construct and the various measures of intention in the literature often seek to capture the construct using a single item measure. However, multi-item measures are to be preferred over single-item measures and therefore the three-item measure from Venkatesh et al. (2003) that has been shown to have performed strongly in previous research was used. The wording of the items was amended to reflect the online gambling context.

Spitefulness has also been conceptualised as a unidimensional construct originally measured by 17 items that describe a wide variety of situations, including politics, work and salary, academics, physical conflict, and problems with neighbours (Marcus et al., 2014). Four of the items were not used in this research because these items dealt specifically with actions in an education environment which were not found to be appropriate during the initial pre-test piloting of the final questionnaire. Given the uni-

dimensional nature of the construct, reducing the number of items should not impact the psychometric properties of the instrument.

In the case of subjective norm, the 10-item measure by Moore et al. (1999) conceptualised as capturing two subjective norm dimensions, one dealing with friends and the other with family, was used. However, unlike the authors' approach, subjective norm is measured as normative belief without including motivation to comply. A number of researchers have concluded that it is not necessary to include motivation to comply, describing measures of motivation to comply as "unsatisfactory" (Ajzen et al., 1972, p. 4) and that including motivation to comply is likely to attenuate the correlation between subjective norm and behavioural intention (Ajzen et al., 1992). In addition, during piloting it was decided to drop the two negatively worded items that were proving problematic to respondents so that the final measure used for subjective norm consisted of eight items with wording adapted to the online gambling context. While the use of positively worded items may have undesirable consequences in terms of an acquiescence bias, research shows that a combination of positive and negative items often affects the internal consistency of scales by causing careless responding and cognitive fatigue (Merritt, 2012). The inclusion of negatively worded questions is especially problematic in cross-cultural research (e.g., (Wong et al., 2003)) as would be the case with the customer database in this data collection. The wording of the questions used for subjective norm is such that high scores on the subjective norm measure represent approval.

The final research instrument therefore consisted of 24 items: three items adapted from Venkatesh et al. (2003) to capture online gambling intention, 13 items from the measure developed and tested by Marcus et al. (2014)

for spitefulness and eight items from the subjective norm measure by Moore et al. (1999). Each item in the subjective norm and spitefulness measures were accompanied by 5-point response scales while gambling intention was measured using a 7-point scale. The end-point descriptors for the scale were 1 = Strongly disagree and 5 or 7 = Strongly agree. The wording for all items of the three constructs in the data collection instrument are provided in table 1.

In addition, four demographic items for gender, age last birthday, highest education completed and nationality of respondents together with two classificatory variables that asked for average time spent gambling online and how many years respondent had been an active online gambler, were also collected. Therefore, the final research instrument used consisted of a total of 30 questions.

Data collection: Collection of data was undertaken via arrangements made with a Malta-based online gambling firm. A total of 1500 potential participants were chosen at random from the database of customers, who had registered but had not made any deposit for 48 hours with the casino brand, of the participating firm. The data collection was part of a series of studies undertaken. At no time did the company influence the focus of this study or the questionnaire employed. Steps were taken to encourage completion. These included the appeal used in the covering email sent, attention to the length and content of the questionnaire and the provision of a small incentive to respondents (Mercer et al., 2015). The latter consisted of twenty free spins for the value of €0.10 per free spin on a well-known online betting game. To receive the gift, all respondents had to do was to contact the customer service support of the casino website with a code that was provided in the questionnaire. The Qualtrics platform was used for the online data collection.

Cross cultural research involves dealing with countries that have different languages, economies, social structures, behaviour, and attitude patterns. Since this research collects data from customers of an online gambling firm who reside across different countries, it was necessary to seek to ensure comparability and equivalency of results obtained from respondents across the different countries. Malhotra (2010) provides a useful typology consisting of four principal types of equivalence in international marketing research, namely construct, operational, scalar and linguistic equivalence. Although full testing of equivalence was not practical, pilot testing in English of the intended questionnaires for the study was carefully undertaken to at least ensure linguistic equivalence, while for construct, operational and scalar equivalence, reliance had to be based on the use of the tried and tested measures employed.

4 Results

From the 1500 questionnaires sent via email to a sample of customers from the database of the supporting Malta-based gambling firm, 282 replies were received after two weeks. No follow-up emails were sent and no tracking for number of unopened emails was undertaken. Out of the replies received, 266 completed surveys could be used in the analysis. This represents an effective response rate of 17.6% which is in line with similar research with these parameters (Kaplowitz et al., 2004). Men account for 50.4% of respondents, the average age was 35.12 ($SD = 9.04$), and in terms of nationality 56.3% were from Australia, New Zealand and South Africa while the rest were from European countries (excluding the United Kingdom where the supporting firm did not operate). In terms of highest education completed, 56.7% completed secondary education, 25.6% completed a diploma or vocational school and 16.7% completed a university degree. Comparisons of the demographic characteristics collected for respondents were in line with those of the entire customer base of the participating firm providing some support for the absence of non-response bias. In terms of classificatory variables collected, 5% reported an average time spent gambling online of less than 10 hours while 49.2% had been active online gamblers for less than two years.

A challenge of undertaking questionnaire-based research using scales is the possible presence of common method bias (Podsakoff et al., 2003; Podsakoff et al., 2012). This occurs when use is made of similar scale-type measures, and it becomes possible that the results obtained may not be coming from any real difference in the population but rather from the characteristics of the instrument being used. To control and minimize the possibility of this, care was taken in the way the questionnaire was structured. For instance, Podsakoff et al. (2012) mention that it is important that respondents are able to understand the questions asked. This was achieved by conferring with experts in the gambling industry as well as in the piloting stage about the content of the questions as well as the way they were presented to respondents. Second, cover emails were sent to prospective respondents, detailing the nature of the study. Furthermore, respondents were given the contact details of one of the researchers should they have questions about the research. Once collection takes place, one of the simplest ways to test for common method bias is Harman's single factor score, which asserts whether the latent items used in a questionnaire load onto one common factor. The presence of common method bias is said to be within acceptable limits if the single factor explains less than 50% of the total variance (Podsakoff et al., 2003). Testing for

this on the data collected showed multiple factors with high loadings providing no support for the existence of common method bias.

Descriptive statistics in terms of means and standard deviations for items and constructs were computed and are shown in [table 1](#). It can be seen that the subjective norm effect from friends is on the low side as the reported means are all greater than the mid-point on the 5-point scale used. The scores are marginally lower for the items dealing with the subjective norm effect from family. These results suggest that online gamblers face fairly broad acceptance of online recreational gambling by family and friends. The spite scores are below the mid-point across all the items and fairly consistent across items. The intention items all have means that exceed the midpoint on the 7-point scale used showing a fairly strong intention to indulge in recreational gambling. This is understandable given that these are respondents who are customers of an online gambling firm.

To investigate the psychometric properties of the three measures used, a principal components exploratory factor analysis followed by a varimax rotation was undertaken. The results of the loading shown in the last four columns of [table 1](#), provide support for convergent and discriminant validity of the three constructs used. The subjective norm construct splits into the two theoretical dimensions envisaged by Moore et al. (1999), with one dealing with the subjective norm coming from friends and the other from family. The spitefulness items load together on a separate and distinct factor confirming the unidimensional nature of the construct (Marcus et al., 2014) as also happens for the gambling intention items and construct (Venkatesh et al., 2003). Reliability of the measures was tested using Cronbach alpha with results exceeding the 0.70 threshold (Nunnally, 1967). Taken together these results provide support for the psychometric properties of the measures used. The items making up the three constructs were therefore summed and used for further analyses.

Scatterplots of the constructs were investigated prior to computation of Pearson correlations between subjective norm and gambling intention and between subjective norm and spitefulness which provided correlation coefficients of .13 ($p < .05$) and .19 ($p < .01$) respectively, while that between spitefulness and gambling intention provided a coefficient of -.12 ($p < .05$).

To test the research model and hypotheses in [figure 1](#), data was inputted to a moderated-mediated regression model via the PROCESS plug-in in SPSS that corresponds to Model 7 (Hayes, 2017). Gambling intention was entered as the dependent variable, subjective norm as the independent variable, spitefulness as the mediator

and the nominal values for gender as moderator. Bootstrapping inferences for model coefficients were requested in order to overcome any possible variations of the normality assumptions while to overcome any heteroscedasticity concerns, the computation of robust standard errors HC4 were requested. Finally, in running the analyses, mean centering of the continuous variable that is part of the product of the independent variable and moderator, was undertaken. The results of the bootstrapping show that the index of moderated-mediation is significant with a value of $-.025$ while the indirect effect resulting from the categorical values for gender shows that this holds for men but not for women. In addition, there is a direct effect of subjective norm on gambling intention as well as a mediated effect via spitefulness (see beta value results in [figure 2](#)), while the moderated regression effect of subjective norm on spitefulness by gender is shown graphically in [figure 3](#). These results provide support for H1 and H2Alt indicating a partially mediated effect of subjective norms on gambling intention via spitefulness that is moderated by gender.

The analyses of cross tabulations of the demographic and classificatory variable with the constructs provides a number of additional insights. Like Marcus et al. (2014, p. 568) who report a decrease in spitefulness with increasing age ($r(295) = -.27, p < .001$), we also find a similar result ($r(260) = -.16, p < .01$). However, age is not found to affect either subjective norms or gambling intention. Gambling intention increases with the number of years respondents have been active online gamblers ($r(260) = .13, p < .01$) but this has no effect on either subjective norm or spitefulness. Hours spent on online gambling per week provided no statistically significant effect on subjective norms and gambling intention but is significant with spitefulness ($r(260) = .13, p < .01$). In terms of nationality, independent sample t -tests provided no difference in group means between the two categories of European and Australian, New Zealand and South African customers but the latter group exhibited both higher subjective norm ($M = 25.80, SD = 6.65$ vs $M = 21.95, SD = 6.52$; $t(259) = -4.70, p < .001$) and gambling intention scores ($M = 18.03, SD = 3.24$ vs $M = 15.69, SD = 4.05$; $t(259) = -5.18, p < .001$). A one-way Anova test across the three groups for highest education completed for the three constructs provided no statistically significant difference in the group means for spitefulness but there was a statistically significant difference in mean score between at least two groups in the case of subjective norms ($F(2, 244) = [3.84], p < 0.05$) and gambling intention ($F(2, 244) = [3.08], p < 0.05$). Tukey's HSD Test for multiple comparisons shows that the mean value for subjective norm was significantly dif-

| Q | Item | Mean | SD | 1 | 2 | 3 | 4 |
|--|---|--------------|--------------|-----|-----|-----|-----|
| 1 | Most of my friends approve of gambling. | 3.23 | 1.03 | .74 | | | |
| 2 | Most of my friends gamble sometimes. | 3.49 | 1.05 | .84 | | | |
| 3 | My friends often visit websites where gambling occurs. | 3.41 | 1.15 | .80 | | | |
| 1. Subjective Norms—Friends (Cronbach $\alpha = 0.82$) | | 10.13 | 2.78 | | | | |
| 4 | My family approves of gambling. | 2.76 | 1.12 | | .64 | | |
| 5 | People in my family gamble sometimes. | 3.14 | 1.19 | | .78 | | |
| 6 | People in my family often visit websites where gambling occurs. | 2.84 | 1.24 | | .84 | | |
| 7 | My family members spend £20 (€23) or more per week on gambling. | 2.81 | 1.41 | | .88 | | |
| 8 | My family members spend £100 (€115) or more per week on gambling. | 2.40 | 1.32 | | .80 | | |
| 2. Subjective Norms—Family (Cronbach $\alpha = 0.88$) | | 13.95 | 5.18 | | | | |
| Subjective Norms | | 24.08 | 6.90 | | | | |
| 9 | It might be worth risking my reputation in order to spread gossip about someone I did not like. | 2.32 | 1.19 | | | .74 | |
| 10 | If I am going to my car in a crowded parking lot and it appears that another driver wants my parking space, then I will make sure to take my time pulling out of the parking space. | 2.39 | 1.22 | | | .73 | |
| 11 | I hope that elected officials are successful in their efforts to improve my community even if I opposed their election. | 2.32 | 1.11 | | | .76 | |
| 12 | If my neighbour complained that I was playing my music too loud, then I might turn up the music even louder just to irritate him or her, even if it meant I could get fined. | 2.65 | 1.29 | | | .68 | |
| 13 | There have been times when I was willing to suffer some small harm so that I could punish someone else who deserved it. | 2.45 | 1.19 | | | .78 | |
| 14 | If I opposed the election of an official, then I would be glad to see him or her fail even if their failure hurt my community. | 2.35 | 1.22 | | | .81 | |
| 15 | I would be willing to take a punch if it meant that someone, I did not like would receive two punches. | 2.41 | 1.22 | | | .84 | |
| 16 | I would be willing to pay more for some goods and services if other people I did not like had to pay even more. | 2.41 | 1.22 | | | .87 | |
| 17 | If my neighbour complained about the appearance of my front yard, I would be tempted to make it look worse just to annoy him or her. | 2.50 | 1.22 | | | .84 | |
| 18 | I would take on extra work at my job if it meant that one of my co-workers whom I did not like would also have to do extra work. | 2.64 | 1.22 | | | .81 | |
| 19 | Part of me enjoys seeing the people I do not like fail even if their failure hurts me in some way. | 2.41 | 1.22 | | | .87 | |
| 20 | If I am at the checkout at a store and I think that the person in line behind me is rushing me, then I will sometimes slow down and take extra time to pay. | 2.50 | 1.22 | | | .84 | |
| 21 | It is sometimes worth a little suffering on my part to see others receive the punishment they deserve. | 2.64 | 1.22 | | | .81 | |
| 3. Spitefulness (Cronbach $\alpha = 0.95$) | | 31.98 | 12.63 | | | | |
| 22 | I intend to use online gambling systems in the next month. | 5.51 | 1.56 | | | | .88 |
| 23 | I predict that I will gamble online in the next month. | 5.90 | 1.26 | | | | .83 |
| 24 | I plan to use an online gambling system in the next month. | 5.61 | 1.46 | | | | .89 |
| 4. Gambling Intention (Cronbach $\alpha = 0.85$) | | 17.00 | 3.79 | | | | |

Table 1: Descriptive statistics, reliability and results of factor analysis with varimax rotation.

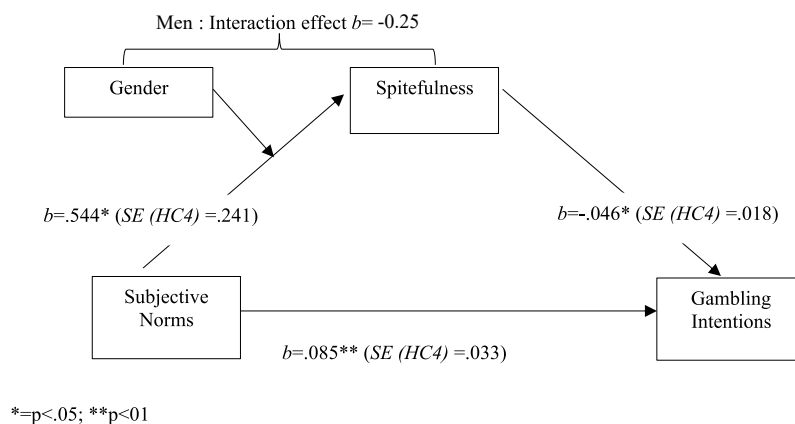


Figure 2: Results of moderated-mediation (Model 7) with subjective norms significantly predicting gambling intention alongside a significant interaction effect between gender and spitefulness.

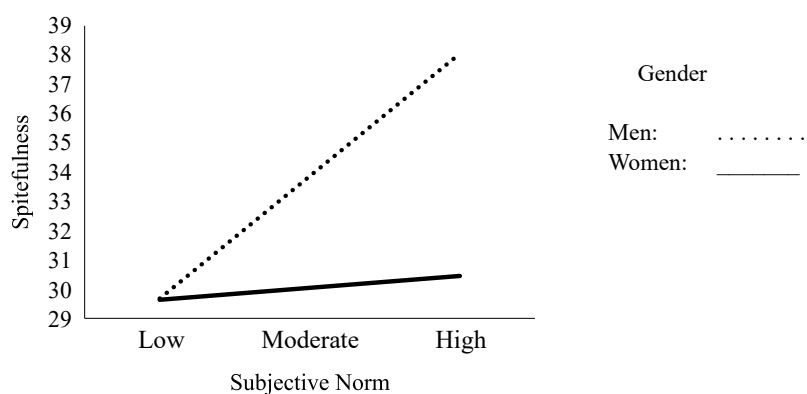


Figure 3: Moderated regression effect of subjective norms on spitefulness by gender.

ferent between those who completed secondary education ($M = 24.60$, $SD = 7.08$) and those who completed university education ($M = 21.41$, $SD = 6.45$), while in the case of gambling intention the difference is between those that completed secondary education ($M = 17.47$, $SD = 3.26$) and those that completed a diploma or vocational school ($M = 16.11$, $SD = 4.32$).

4.1 Findings and Implications

The research possibly represents the first application of spitefulness in the area of consumer behaviour and marketing. The study considers the framework of the Theory of Planned Behaviour (TpB) adapting it to the context of online gambling focusing on the link between subjective norms and gambling intention. Its contribution is primarily theoretical with support for H1 and H2 Alt suggesting the presence of spitefulness as a mediating variable. Therefore, the effect of subjective norms on gambling intention is not only direct but partially mediated by spitefulness which acts to decrease gambling intention. However, the research shows that this effect is gender dependent as support was found for gender acting as a moderator so that the resultant partial mediation is salient only in the case of men. Women report lower levels of spite.

The study also provides a contribution to the psychometric properties of the spitefulness instrument developed and proposed by Marcus et al. (2014). Although the original 17 item instrument was reduced to 13, the factor analysis undertaken shows that the instrument performed well with strong convergent and discriminant validity from the other two constructs of subjective norm and gambling intention. The reduction of items with the elimination of questions linked to spiteful behaviour in the classroom retained the unidimensional conceptualisation envisaged by the developers. Indeed, given its unidimensional conceptualisation there is an argument for further pruning of the instrument for use in future research thereby providing a more parsimonious instrument. The reply to fairly vexatious behaviour described in the items may lead to eye-saying and possibly a less than completely truthful response. A shorter instrument could reduce data collection fatigue among respondents.

Subjective norms concern customers' perceived social pressure to perform or not to perform a particular behaviour. This pressure coming from family and friends and the wording of the subjective norm measure used indicates that higher scores signify approval of a particular behaviour. The findings related to subjective norms are interesting in that the results show a very strong link to spitefulness underlined by the reported standardised beta value of .54 thereby contributing to the nomological network of spitefulness with subjective norms as an important

driver. The effect of spitefulness on gambling intention is small, thereby restricting its application to practical management. However, the crosstabulations of demographic and classificatory variables with the three constructs of interest in the research model provide some interesting additional insights.

The differences reported in the analyses of the impact of demographic on the constructs investigated suggest that the subjective norms related to gambling are more relaxed among Australia, New Zealand and South African respondents than among European respondents (UK not included). Moreover, in terms of highest education level completed, those whose formal education ended on completion of secondary education report higher approval levels from family and friends on subjective norm and higher gambling intentions.

The findings from the cross tabulations have implications for marketing of online gambling products. Women represent an important cohort representing 49.6% of respondents in this survey and gambling intention has been found to increase the longer customers have been active online. Moreover, subjective norms and gambling intention are higher among Australia, New Zealand and South African respondents as well as among those whose highest education level completed is secondary schooling. While further data mining is required, these findings suggests that women, who have been customers for some time, coming from Australia, New Zealand and South Africa whose highest level of education is at a secondary level, may make for a potentially more appealing target for marketing effort than men from Europe with higher formal education achievement. In making such an observation, it needs to be made clear that the authors make no ethical or moral judgements about the potential addiction/harm that may result from the marketing of online gambling services.

4.2 Limitations and Future Research

The current study has a number of limitations. First, the sample was taken from a database of customers who had registered at an online casino, that predominantly offered online gambling on slot machines. The findings reported here may therefore not hold for other forms of online gambling, such as sports betting, poker or other table games. Second, the response rate achieved, although in line with similar online data collections, is somewhat on the low side. Although, generally lower than for paper-based surveys, online response rates are known to vary considerably depending on the extent to which supporting survey completion measures have been undertaken. However, it is to be noted that comparison of the demographics collected to those on the database of customers

provides some comfort for the absence of non-response bias. Of course, in generalising findings academic research does not rely on representative samples but on replication.

Third, it is worth keeping in mind that this study was conducted with the customers of a single firm and any generalisations of findings to all online gambling firms needs to be undertaken with caution. Moreover, the research model used focussed on a particular subset of the nomological net and like most such studies necessarily suffers from specification error. Any attempt at a fuller understanding of gambling intention needs to look at additional drivers that can explain more of the variance in the gambling intention outcome. Future research should consider replicating the study with additional variables across the different types of online gambling forms available.

Fourth, respondents in this survey were offered a small incentive to participate to help improve response rates. However, it may also have encouraged participation from customers who were primarily interested in the incentive and who may not have completed the questionnaire with the desired care. The risk of adding this confounding error has to be counterbalanced by a potentially weaker response rate.

Fifth, there is a distinct possibility that respondents may have tended to underscore the items of the spitefulness scale. This may have occurred despite assurances of confidentiality of responses, and the questionnaire cover email specifically stating that the research was of an academic nature. Notwithstanding, this and the fact that the analyses provided psychometric support for the spitefulness instrument, the possible underscoring of responses should be borne in mind when considering results. Future research could investigate a more parsimonious scale with items that can perhaps be less likely to be under-scored.

Finally, it is possible that the finding of significant differences in the means for the constructs employed in the study may indicate cross-cultural differences in the way respondents react to multiple-point scales rather than real differences in perception across the different respondents. However, given the consistency of respondents from different nationalities across the constructs investigated, it appears unlikely that this may have had an effect on resulting correlations among the constructs investigated. Still, retesting of the model with larger samples across different nationalities could be useful in investigating issues of equivalence.

5 Conclusion

Spitefulness represents an interesting social behaviour that has received minimal attention in business and marketing. It is a construct that has potential in allowing for a better understanding of customers in different situ-

ations. Spitefulness reduces the potential for cooperation in business transactions. It can be relevant in situations of individuals' sensitivity to fairness and equity imbalance in business transactions and in situations of whistle-blowers. It may also be relevant in situations of human resources management where a manager or an aggravated employee may seek to cause maximum inconvenience to an employee or employer. It may also be relevant in the context of partisan politics. Fortunately, the measure used has exhibited acceptable psychometric properties allowing for adaptation and use in different contexts. The measure also permits the development of the nomological network of the constructs that can provide a better understanding of drivers and consequences. In addition, it could also make for better profiling of the spiteful individual.

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Research Article

Students' Attitude towards Academic Misconduct Scenarios: A Review and Pilot Study

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Abstract. To determine the prevalence of academic misconduct among medical students in a predominantly Catholic EU country. Medical students at the University of Malta (UM) responded to an online questionnaire about academic misconduct scenarios. Results were analysed by the Chi-squared and unpaired t-tests. The response rate was 10% ($n = 75$; 57% female; 8% locals; 89% under 25). Significantly more females considered threats upon students, abuse of alcohol/drugs, and inappropriate language as serious offenses. Fewer than 20% agreed that writing a piece of work for another student or lending own work to be copied, were serious offenses; 30% would not inform faculty of serious misconduct and 41% were unsure whether they should. Forging signatures, cheating during exams, damaging property, lying about their CV and threatening others topped the list of offenses considered wrong. 38% of all students and 15% of Year 5 students reported that it was not wrong to inform others about a just completed OSCE ($p = 0.0004$); 10% admitted having done it ($p = 0.001$). Significantly more Year 2 students agreed that failure to inform the University of a previous conviction for theft was wrong ($p = 0.04$); 8–10% of students admitted copying during exams, copying others word-for-word or writing work for other students; 18% had/would forge signatures on official records. Medical students at UM behave similarly to those elsewhere in terms of academic dishonesty. Utilizing only assessment of knowledge to determine academic progression may not adequately equip students with those characteristics that would be expected of them as junior doctors.

1 Introduction

Although honesty and integrity are key characteristics expected of a doctor, academic misconduct among students is not new. Bowers reported that 75% of more than 5,400 students from 99 U.S. colleges and universities had cheated in one or more ways (Bowers, 1964). The study was replicated 30 years later among over 6000 students in 31 U.S. colleges and universities and the two data sets compared (McCabe, 1994). Self-reported cheating was significantly less in universities with honour codes (McCabe, 2002) (McCabe et al., 2001). Although only a small increase in overall cheating was reported, significant increases were found in the most explicit forms of exam cheating (McCabe, 2002). Sierles et al. (1980) reported that almost 90% of 448 medical students in all years at two US medical schools had cheated in their undergraduate course and just under 60% cheated at medical school. Similar findings have also been described among graduate and undergraduate business students in the US (Nonis, 2001).

McCabe (1993) surveyed a random sample of 100 faculty members at each of 16 colleges and universities throughout the United States, some of which had established a student honour code. With a response rate of just under 50%, only 43% of faculty members would report incidents of student cheating to the appropriate authority, most likely because of the time and effort it would have taken in the pre-Turnitin era to investigate such cases. However, faculty in institutions with honour codes were almost twice as likely to report cheating incidents than those without such an honour code (McCabe, 1993, 2002). Although McCabe and Trevino's study of just over 4000 students at nine universities in the US showed that age, gender, and grade-point average influ-

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ence the likelihood of cheating, cheating was reportedly more likely when peer disapproval is low (McCabe, 1993, 1997).

Two thirds of Year 2 students in 31 medical schools across the US reported witnessing cheating among their student colleagues (Baldwin et al., 1996). Dans (1996) compared cheating among students upon entering ($n = 358$) and leaving ($n = 302$) medical school, with a response rate of 97% and 87% respectively. Approximately 20% of students reported having cheated during their undergraduate degree and almost 25% admitted cheating at medical school, most commonly by copying from another student or using unauthorized notes during examinations. Almost a quarter of the respondents admitted to cheating during activities related directly to patient care (Dans, 1996). Lim and Sean investigated attitudes toward cheating among 518 students from three academic institutions in Singapore. The majority admitted lending their own work to another student (94%), plagiarising information without acknowledging the original author (90%), either altering data or entering non-existent results into a database (80%) or communicating with other students about the answers during an examination (53%) (Vivien et al., 2001). In 2001, Rennie and Crosby examined the attitude towards academic misconduct among 676 medical students in all years in Dundee. With a 68% response rate, students admitting that they had or would consider engaging in academic misconduct varied from 2% for copying answers in a degree examination to 56% for copying directly from a publication and only listing it as a reference. About a third of medical students admitted that they had engaged in or would consider discussing an Objective Structured Clinical Examination (OSCE) with other students, writing "nervous system examination normal" when this had not been performed, lending work to others to copy, and plagiarism (Rennie et al., 2001). In the same group of students in the UK, Rennie and Rudland reported no significant difference in attitudes towards academic misconduct across all five years of the course. However, a larger proportion of Year 1 students, compared to other years, regarded scenarios such as forging signatures, resubmitting work already completed for another part of the course, and falsifying patient information⁷ as wrong, claiming they would not engage in such behaviors (Rennie et al., 2003). Hrabak (2004) investigated the prevalence of academic dishonesty among 827 Year 2 to 6 medical students at Zagreb University, of whom 70% completed an anonymous questionnaire. Ninety-four percent admitted to cheating at least once, most commonly signing for an absent student in the class attendance (89%). Remarkably, almost half the students admitted that they would never report any form of cheating

(Hrabak, 2004). Dyrbye et al. (2010) studied 4,400 Year 1 to 4 to medical students from seven US medical schools with a response rate of 61%, of whom almost one third had engaged in cheating or dishonest behaviour. Taradi et al. (2010) investigated the attitude towards academic misconduct among first year medical students in Croatia. With a response rate of 67%, three quarters reported having frequently cheated during assessments in high school. International students attending these four Croatian medical schools were significantly less likely to cheat (Taradi et al., 2010). With a response rate of 62%, similar findings were reported by the same group among Year 3 (preclinical) and Year 5 (clinical) students, of whom a mere 2% admitted reporting another student for cheating (Taradi et al., 2012). Hafeez (2013) surveyed 274 medical students attending three private and public medical colleges in Pakistan, of whom 55% admitted that they had cheated at least once and almost 45% of the clinical students also admitted to inventing clinical histories. Ghias (2014) compared self-reported attitudes and behaviours regarding plagiarism and cheating among 489 Year 1 to 5 medical students in a private and 205 public sector medical colleges in Pakistan, with a response rate of 53% and 41% respectively. More private students reported that cheating in an exam is wrong (87%) compared to those in a public school (66%). Copying an assignment and listing sources as references was considered wrong by 53% of private versus 35% of public medical college students (Ghias, 2014). In summary, although it is imperative that all professionals and perhaps especially doctors should be honest and trustworthy, overall, these data over a span of more than 50 years show that cheating and other aspects of academic dishonesty continue to occur in medical schools across the world. The purpose of this study was to determine the prevalence of academic misconduct among medical students in a Catholic country in the only state university in the smallest southernmost EU country.

2 Methods

This small scale, prospective, pilot study was approved by the University Research Ethics Committee (UREC).

3 Data Collection

All Year 1 to 5 medical students at the University of Malta received an online questionnaire link via e-mail. The questionnaire included the scenarios used in the study by Rennie et al. (2001) in which "John" and "Jean", two fictitious students, engaged in academic misconduct as shown in table 1. We added 10 further scenarios to the Rennie et al. (2001) questionnaire to extend its scope and distinguish between serious and less serious forms of academic misconduct. The face validity of the questionnaire was es-

established by expert evaluation as to whether the questions effectively capture the topic under investigation. The survey was checked for common errors like double-barreled, confusing, and leading questions and was pilot tested on a subset of participants. Students were asked whether they felt John or Jean were wrong and whether they had engaged in, or would consider engaging in the behaviour described in the scenarios. A three-point scale: "yes", "not sure" and "no", was used to record the student responses.

4 Statistical Analysis

The survey results were analysed using Microsoft Excel and differences between the years, age, gender, nationality and previous degree were analysed by the χ^2 -test. Statistical significance was calculated utilizing the unpaired *t*-test. *P* values were calculated and differences were classed as significant where $p < 0.05$.

5 Results

There were a total of 75 responses (10% response rate). Table 1 summarises the descriptive statistics of the cohort.

Tables 2a to 2c show the percentage of students who reported each of the scenarios as wrong and whether they had engaged in, or would consider engaging in the behaviour described in the scenarios.

Just over 61% of students agreed that they ought to inform faculty if they are aware of serious misconduct by other students and a further 36% were unsure. Thirty percent of students reported that they have not (or would not) inform faculty of serious misconduct by another student and a further 41% were unsure.

Table 3 shows the rank order of seriousness of scenarios as reported by students.

There was no significant difference by age regarding which scenarios were considered serious by students, nor whether they would inform faculty if they are aware of serious misconduct. Figure 1 shows the only statistically significant difference in any of the scenarios when analysed by the age of the respondents (Q18: Failure to observe the dress code/infection control policy), where significantly more 17 to 25 year olds reported that this was wrong ($p = 0.005$).

Except for recording a lecture without permission (where the situation is reversed), significantly ($p < 0.02$) more female than male students reported that scenarios 9, 10, 14, 16, 17, 18, 19, 23 and 24 constitute serious misconduct. John threatening Jean was considered serious misconduct by 46% of females and 33% of males; abuse of alcohol or drugs in a University context by 52% of females and 25% of males; and the use inappropriate language with regard to others by 30% of females and

9% of males. However, there was no significant difference by gender in whether students perceived a scenario to be wrong, have ever done or considered doing this. When analysed by year of study, significantly more Year 3 students reported that Q3 (Chatting about the OSCE) was wrong, with an almost equal proportion (15%) of Year 5 students reporting the opposite ($p = 0.0004$). Ten percent of Year 5 students admitted having done it ($p = 0.001$).

There was a statistically significant difference among students of different years agreeing that failure to inform the University of a previous conviction for theft was wrong ($p = 0.04$). The highest rate was among Year 2 students (9%), although 9% of Year 5 students were not sure if it was wrong (figure 3).

Taking overseas holidays during term time was not considered wrong by the majority of Year 5 students ($p = 0.01$), of whom over 13% had done or would consider doing so.

6 Discussion

The purpose of this study was to determine the attitudes of medical students towards a number of scenarios involving various degrees of academic misconduct. Sadly, and perhaps not unexpectedly, medical students at the University of Malta behave very similarly to those in other countries, confirming that academic misconduct, now 55 years since it was first described by Bowers (1964), remains rife among medical students across the world.

As in the study of Hrabak (2004), almost a quarter of our students admitted to having forged a colleagues' signature on an official University record. Somewhat encouragingly, almost 95% of the students in our study felt that cheating during an exam was wrong, 8% more than the figure reported by Ghias (2014) in Pakistan. This is perhaps because the Maltese education system is based almost entirely on exams, thus inculcating in students early on the risk of cheating/failing exams. Also, in keeping with the findings of Ghias (2014), almost half of our students did not feel that copying an assignment was wrong, an alarming statistic that may, in part, be due to the intense pressure they feel to pass high-stakes exams at all costs.

With respect to lending their work to others to copy, our findings are entirely consistent with the published literature (Rennie et al., 2001) in that one third of medical students have done this and a quarter feel that this is acceptable. Irrespective of the underlying causes for these unhappy results, there is undoubtedly a severe lack of education locally on this matter.

Perhaps we should be reassured that unlike the study of Anderson and Obenshain, who reported that the most

| Gender | | Age | | Previous Degree | | Nationality | |
|--------|-----------|-------|-----------|-----------------|-----------|-------------|-----------|
| Male | 32(42.7%) | 17-20 | 32(42.7%) | Yes | 14(42.7%) | Local | 61(81.3%) |
| Female | 43(57.3%) | 21-25 | 35(46.7%) | No | 61(81.3%) | Other EU | 10(13.3%) |
| | | 26-30 | 7(9.3%) | | | Non EU | 4(5.4%) |
| | | 31-40 | 1(1.3%) | | | | |

Table 1: Demographics of the respondents.

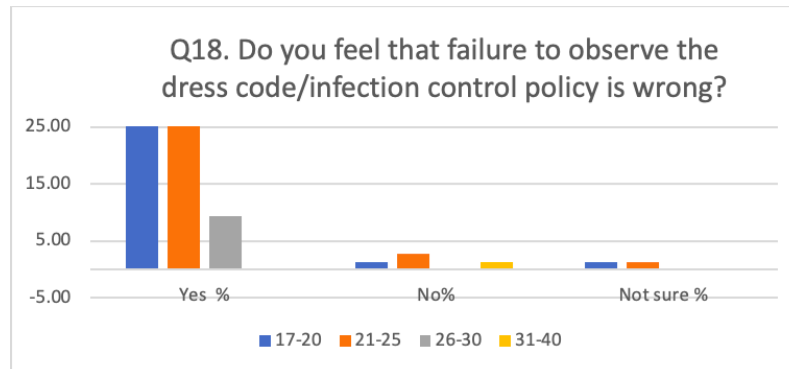


Figure 1: Percentage of students who feel that failure to observe the dress code is wrong by age group.

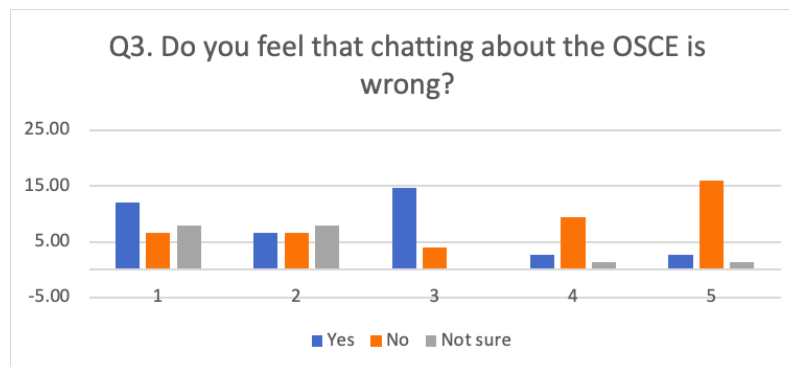


Figure 2: Percentage of students who feel that chatting about the OSCE is wrong by year of study.

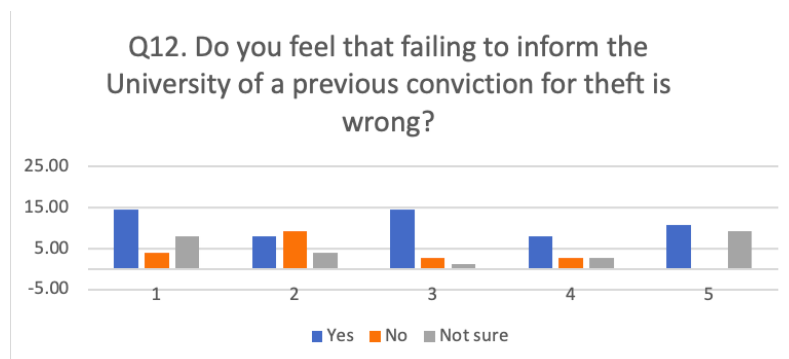


Figure 3: Percentage of students who feel that failing to inform the University of a previous theft conviction is wrong.

| | | |
|---|--------------------------------------|---|
| 1. John forges Dr Cloony's signature on an official University record eg., attendance, logbook etc. | | |
| | Do you feel that John/Jean is wrong? | Have you ever done (or would you ever consider doing) this? |
| Yes | 67 (89.33%) | 14 (18.67%) |
| No | 4 (5.33%) | 52 (69.33%) |
| Not Sure | 4 (5.34%) | 9 (12%) |
| 2. Jean copies answers in a final exam from John. | | |
| | Do you feel that John/Jean is wrong? | Have you ever done (or would you ever consider doing) this? |
| Yes | 71 (94.67%) | 6 (8.00%) |
| No | 2 (2.66%) | 67 (89.33%) |
| Not Sure | 2 (2.66%) | 2 (2.66%) |
| 3. John chats to Jean about the objective structured clinical examination (OSCE) Jean has just completed and John is about to go into. | | |
| | Do you feel that John/Jean is wrong? | Have you ever done (or would you ever consider doing) this? |
| Yes | 29 (38.66%) | 20 (26.67%) |
| No | 32 (42.66%) | 40 (53.34%) |
| Not Sure | 14 (18.67%) | 15 (20.00%) |
| 4. Jean copies word-for-word from textbooks or published papers and lists them as references. | | |
| | Do you feel that John/Jean is wrong? | Have you ever done (or would you ever consider doing) this? |
| Yes | 52 (69.34%) | 9 (12.00%) |
| No | 13 (17.33%) | 62 (82.67%) |
| Not Sure | 10 (13.33%) | 4 (5.33%) |
| 5. John copies word-for-word from textbooks or published papers without acknowledging the source. | | |
| | Do you feel that John/Jean is wrong? | Have you ever done (or would you ever consider doing) this? |
| Yes | 71 (94.67%) | 3 (4.00%) |
| No | 2 (2.66%) | 69 (92.00%) |
| Not Sure | 2 (2.66%) | 3 (4.00%) |
| 6. Jean copies John's work (e.g. case presentation, anatomy/physiology project report, logbook) | | |
| | Do you feel that John/Jean is wrong? | Have you ever done (or would you ever consider doing) this? |
| Yes | 66 (88.00%) | 8 (10.67%) |
| No | 6 (8.00%) | 64 (85.33%) |
| Not Sure | 3 (4.00%) | 3 (4.00%) |
| 7. John lends Jean his work to copy. | | |
| | Do you feel that John/Jean is wrong? | Have you ever done (or would you ever consider doing) this? |
| Yes | 37 (49.33%) | 24 (32.00%) |
| No | 19 (25.33%) | 43 (57.34%) |
| Not Sure | 19 (25.33%) | 8 (10.66%) |
| 8. Jean writes a piece of work (e.g. case presentation, anatomy/physiology project report etc.) for John. | | |
| | Do you feel that John/Jean is wrong? | Have you ever done (or would you ever consider doing) this? |
| Yes | 44 (58.67%) | 6 (8.00%) |
| No | 18 (24.00%) | 61 (81.34%) |
| Not Sure | 13 (17.34%) | 8 (10.67%) |

Table 2a: Scenarios and responses

| | | |
|---|--------------------------------------|---|
| 9. John writes “Nervous system examination—normal” in his patient presentation when he has not performed the procedure. | | |
| | Do you feel that John/Jean is wrong? | Have you ever done (or would you ever consider doing) this? |
| Yes | 73 (97.33%) | 4 (5.33%) |
| No | 1 (1.33%) | 67 (89.33%) |
| Not Sure | 1 (1.33%) | 4 (5.33%) |
| 10. Jean submits a thesis from a previous degree for her anatomy/physiology project report. | | |
| | Do you feel that John/Jean is wrong? | Have you ever done (or would you ever consider doing) this? |
| Yes | 42 (56.00%) | 4 (5.34%) |
| No | 18 (24.00%) | 63 (84.00%) |
| Not Sure | 15 (20.00%) | 8 (10.67%) |
| 11. John adds three papers to his CV that he has not authored. | | |
| | Do you feel that John/Jean is wrong? | Have you ever done (or would you ever consider doing) this? |
| Yes | 70 (93.33%) | 1 (1.33%) |
| No | 3 (4.00%) | 72 (96.00%) |
| Not Sure | 2 (2.66%) | 2 (2.67%) |
| 12. John fails to inform the University that he has a previous conviction for theft. | | |
| | Do you feel that John/Jean is wrong? | Have you ever done (or would you ever consider doing) this? |
| Yes | 42 (56.00%) | 2 (2.67%) |
| No | 14 (18.67%) | 67 (89.33%) |
| Not Sure | 19 (25.33%) | 6 (8.00%) |
| 13. Jean takes overseas holidays during term time without authorisation. | | |
| | Do you feel that John/Jean is wrong? | Have you ever done (or would you ever consider doing) this? |
| Yes | 34 (45.33%) | 25 (33.33%) |
| No | 29 (38.67%) | 42 (56.00%) |
| Not Sure | 12 (16.00%) | 8 (10.66%) |
| 14. John fails to inform the University that he has a physical or mental condition that may interfere with his ability to practice safely. | | |
| | Do you feel that John/Jean is wrong? | Have you ever done (or would you ever consider doing) this? |
| Yes | 65 (86.67%) | 5 (6.67%) |
| No | 5 (6.66%) | 66 (88.00%) |
| Not Sure | 5 (6.66%) | 4 (5.34%) |
| 15. Jean is consistently late for lectures, tutorials, clinical attachments etc. | | |
| | Do you feel that John/Jean is wrong? | Have you ever done (or would you ever consider doing) this? |
| Yes | 56 (74.66%) | 19 (25.33%) |
| No | 5 (6.67%) | 49 (65.33%) |
| Not Sure | 14 (18.66%) | 7 (9.33%) |
| 16. John uses inappropriate language with regard to a staff member, a University employee or another student. | | |
| | Do you feel that John/Jean is wrong? | Have you ever done (or would you ever consider doing) this? |
| Yes | 65 (86.67%) | 9 (12.00%) |
| No | 3 (4.00%) | 59 (78.66%) |
| Not Sure | 7 (9.33%) | 7 (9.34%) |

Table 2b: Scenarios and responses (continued)

| | | |
|---|--------------------------------------|---|
| 17. Jean behaves inappropriately on the wards e.g. sitting on the floor, giggling, inappropriate attire. | | |
| | Do you feel that John/Jean is wrong? | Have you ever done (or would you ever consider doing) this? |
| Yes | 69 (92.00%) | 5 (6.67%) |
| No | 2 (2.66%) | 64 (85.34%) |
| Not Sure | 4 (5.33%) | 6 (8.00%) |
| 18. John fails to observe the dress code/infection control policy. | | |
| | Do you feel that John/Jean is wrong? | Have you ever done (or would you ever consider doing) this? |
| Yes | 39 (92.00%) | 5 (6.67%) |
| No | 4 (5.33%) | 64 (85.34%) |
| Not Sure | 2 (2.66%) | 6 (8.00%) |
| 19. Jean attends fewer than 50% of tutorials. | | |
| | Do you feel that John/Jean is wrong? | Have you ever done (or would you ever consider doing) this? |
| Yes | 64 (85.34%) | 6 (8.00%) |
| No | 8 (10.67%) | 68 (90.67%) |
| Not Sure | 3 (4.00%) | 1 (1.33%) |
| 20. John attends fewer than 50% of clinical attachments. | | |
| | Do you feel that John/Jean is wrong? | Have you ever done (or would you ever consider doing) this? |
| Yes | 65 (86.67%) | 3 (4.00%) |
| No | 6 (8.00%) | 70 (93.33%) |
| Not Sure | 4 (5.34%) | 2 (2.67%) |
| 21. Jean records lectures without the explicit permission of the lecturer. | | |
| | Do you feel that John/Jean is wrong? | Have you ever done (or would you ever consider doing) this? |
| Yes | 21 (28.00%) | 43 (57.34%) |
| No | 29 (38.67%) | 24 (32.00%) |
| Not Sure | 25 (33.33%) | 8 (10.66%) |
| 22. John damages University property. | | |
| | Do you feel that John/Jean is wrong? | Have you ever done (or would you ever consider doing) this? |
| Yes | 72 (96.00%) | 1 (1.33%) |
| No | 0 (0.00%) | 70 (93.34%) |
| Not Sure | 5 (6.67%) | 2 (2.66%) |
| 23. Jean abuses alcohol or drugs in a University context. | | |
| | Do you feel that John/Jean is wrong? | Have you ever done (or would you ever consider doing) this? |
| Yes | 70 (93.34%) | 3 (4.00%) |
| No | 0 (0.00%) | 70 (93.34%) |
| Not Sure | 5 (6.67%) | 2 (2.66%) |
| 24. John threatens Jean. | | |
| | Do you feel that John/Jean is wrong? | Have you ever done (or would you ever consider doing) this? |
| Yes | 72 (96.00%) | 1 (1.33%) |
| No | 2 (2.66%) | 72 (96.00%) |
| Not Sure | 1 (1.33%) | 2 (2.67%) |

Table 2c: Scenarios and responses (continued)

| Scenario | % Students Considering Scenario Serious |
|---------------|---|
| 22 and 24 | 78 |
| 11 | 76 |
| 9 | 72 |
| 14 | 68 |
| 5 | 66 |
| 1 | 60 |
| 22 | 56 |
| 2 | 54 |
| 20 | 48 |
| 17 | 45 |
| 6 and 16 | 41 |
| 12 | 40 |
| 10, 18 and 19 | 36 |
| 4 and 5 | 20 |
| 8 | 16 |
| 3 | 13 |
| 7 and 13 | 8 |
| 12 | 6 |

Table 3: Percentage of Students Considering Scenario Serious

common unethical behaviour was cheating on an examination, arriving late for lectures was the most common “misconduct”, reported by a quarter of students in our study (Anderson et al., 1994). Similarly reassuring is the small proportion of students (5%) in our study who admitted to falsely taking a patient history/performing a clinical examination compared to 44% of students in Pakistan (Hafeez, 2013) and up to a quarter of medical students at John Hopkins University School of Medicine (Dans, 1996).

In the study of Vivien et al. (2001) 94% of students reported lending their work to others, a figure which is three times greater than our data (32% of students reported ever having done this). This is perhaps because the relatively small size of the only state medical school in the smallest EU country, means that our students are highly competitive and perhaps less likely to be willing to help each other.

A surprising 8% of medical students in our study admitted to copying answers in a final exam, although the vast majority (95%) agreed that this was wrong. It is quite possible that when exam questions are ambiguous (which according to students, is unfortunately not rare), the perceived unfairness of the exams may trigger students' dishonest behaviour. It is also possible that the seating arrangements of the exams makes it relatively easy for students to copy answers from each other.

With regards to plagiarism and collusion, an acceptably small proportion (4%) of our subjects reported copying word-for-word without referencing, which is significantly less than the 90% reported by Vivien et al. (2001). It might seem that the University's strong message with respect to referencing may be reaching its target. However, copying another students work word-for-word was reportedly acceptable to 8% of our medical students, with 10% admitting to having done this. These data are significantly lower than the approximately 30% of students who reported lending their work for others to copy in the study of Rennie et al. (2001). Although the vast majority of students were certain that not acknowledging sources was wrong, a troubling 10% who reported that they had copied word-for-word from a textbook while listing the references, claimed that they were not sure whether this was right or wrong, thus confirming that there is room for a great deal more education about what constitutes collusion and plagiarism among medical students in Malta.

While over 75% of students in this study reported that threatening others, damaging university property and adding non-authored papers to their CV were serious offenses, it is troubling to note that 20% or less considered that providing information about a just completed OSCE to a fellow student about to take the exam, writing a piece of work for another student or failing to inform the Uni-

versity about a previous conviction for theft, were serious offenses.

Overseas trips during term time are not allowed at the University of Malta medical school and there is a strict 80% attendance rule, below which students are barred from taking exams. Not surprisingly, almost 40% of students felt there was nothing wrong with travel during term time and one third confirmed that they had indeed done this themselves. This suggests that students feel they should be trusted to make decisions regarding their learning.

Considering that theft is a crime, only just over half of participants felt it was wrong not to inform the faculty of a previous conviction, perhaps due to concern that admitting previous misconduct might jeopardise their chances of being accepted into medical school.

Students may be concerned about the possible lack of anonymity living on a small island studying in a small medical school with only one main hospital. This may explain why approximately 7% of participants reportedly had not informed the faculty of a physical or mental condition that might interfere with their ability to practice safely and a similar number did not feel this was not wrong.

It could be argued that students, especially in a largely Catholic country, should have learned to distinguish right from wrong by the time they reach medical school, but our data does not support this. For example, about one third of respondents stated that they have not (or would not) inform faculty of serious misconduct by another student and another third were unsure whether they should do so. About 5% of the students did not consider that forging a colleagues signature on an official University record was wrong; one third were unsure whether recording a lecture without explicit permission from the lecturer was wrong and almost 40% actually claimed this was not wrong. There is certainly room for improvement.

McCabe (1997) proposed that social learning theory Bandura (1986) which posits that we model our behaviour on that of trustworthy individuals, is the best framework for handling academic dishonesty. Apart from greater education regarding what constitutes academic misconduct, we echo the recommendations of Anderson et al. (1994) that the introduction of academic honour codes including encouraging students to report incidents of academic misconduct which they may observe among their peers, improving teaching methods and emphasizing learning over grades, as well as teaching and modelling honesty and integrity should be embraced by any University committed to minimizing academic misconduct among their students.

7 Limitations

The largest limitation of this study is the relatively low response rate when taken across the whole five-year cohort. Several reminders were sent to students to complete the questionnaire online to no avail. Because the sample size was small, statistical analysis was largely inconclusive. Another major limitation is that we have no way of knowing the extent to which students were being truthful in their responses. A follow up qualitative focus group study will test whether participants find the quantitative findings to be consistent with their own views.

8 Conclusions

Medical students at the University of Malta behave very similarly to those in other countries in terms of academic dishonesty. Traditional courses that utilize only assessment of knowledge to determine academic progression and graduation may not adequately equip medical students with those characteristics that would be expected of them as junior professionals in the workplace.

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Research Article

The Role of Menstrual Stem Cells in Premature Ovarian Failure and Asherman's Syndrome: a systematic review

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Abstract. A new population of stem cells have recently been discovered within the menstrual fluid. These cells exhibit fibroblast-like morphology and meet the minimum criteria for stem cell classification as stipulated by the International Society for Cellular Therapy. Menstrual-derived stem cells (MenSC) exhibit mesenchymal stem cell characteristics, high proliferation and multilineage differentiation potential. MenSC are derived from endometrial cell populations which, together with a large part of the endometrium, are sloughed from the endometrium during the menstrual phase of the uterine cycle. MenSC are cyclically available in large numbers and can be obtained non-invasively and cheaply. Furthermore, MenSC are not limited by ethical dilemmas since they are obtained from menstrual blood which is considered a clinical waste. These attributes make MenSC an attractive alternative to other conventionally used adult stem cells and consequently have attracted substantial interest in the field of gynaecology and regenerative medicine. This systematic review will focus on the potential role of MenSC particularly in premature ovarian failure and Asherman's syndrome.

Keywords: Mesenchymal Stem Cells, Menstrual Stem Cells, Gynaecology, Premature Ovarian Failure, Asherman's syndrome

Abbreviations

AMH anti-mullerian hormone

BMSCs Bone marrow-derived mesenchymal stem cells

CM Culture media

c-MYC Master regulator of cell cycle entry and proliferative metabolism

COL6A5 Collagen Type 6 Alpha 5 Chain

COL9A2 Collagen Type 9 Alpha Chain 2

CTGF connective tissue growth factor

COX-2 cyclooxygenase 2

CXCR41 chemokine receptor type 41

CY cyclophosphamide

DMEM Dulbecco's Modified Eagle Medium

ECM extracellular matrix

EE endometrial epithelial cells

ES Endometrial stromal cells

EVs extracellular vesicles

FSHR follicle stimulating hormone receptor

FST follistatin

HLA-A/B/C Human leukocytic antigen

HRT hormone replacement therapy

HUVECs Human Umbilical Vein Endothelial Cells

IDO Indoleamine-pyrrole 2,3-dioxygenase

IL-4 interleukin 4

IFN- γ interferon gamma

IPSC induced pluripotent cell

IUA intrauterine adhesions

KLF-4 Kruppel-like factor 4

MAC-1 Macrophage 1

MenSC menstrual-derived stem cells

MLR mixed lymphocyte reaction

MPO Myeloperoxidase

MHC-II Major histocompatibility complex class 2

MSCs Mesenchymal stem cells

NK natural killer

PC3 Prostate Cancer 3

PD-L1 Programmed death ligand 1

PBMC peripheral blood mononuclear cell

ROS reactive oxygen species

SOX-2 Sex determining region Y-box 2

SSEA-4 Stage specific embryo antigen 4

STRO1 Mesenchymal stem cell marker 1

TAZ Hippo/Transcriptional coactivator with PDZ-binding motif

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Th2 T-helper 2 cells

T-regs Regulatory T cells

TNF- α tumour necrosis factor alpha

OCT-4 Octamer-binding transcription factor 4

POF/POI Premature Ovarian Failure/Insufficiency

qRT-PCR Quantitative real-time polymerase chain reaction

VEGF Vascular endothelial growth factor

1 Introduction

Since their discovery, menstrual-derived stem cells (MenSC) have been at the centre of research in the field of regenerative medicine. Having the necessary qualities to be classified as stem cells, these cells have been met with great enthusiasm by researchers due to the advantages of being freely available, obtained non-invasively and without any ethical dilemmas. Characteristic evaluation of MenSC shows that these cells employ a dose dependent pro/anti-inflammatory response and are able to resolve inflammation in mice models with different pathologies (H. Wang et al., 2012). MenSC are also able to induce angiogenesis and are superior to fibroblasts in terms of induced pluripotent stem cell (IPSC) production. Additionally, when compared to bone marrow-derived mesenchymal stem cells (BMSCs), MenSC have superior proliferative, migratory, healing and angiogenic potential yielding better results. Finally, the use of MenSC derived exosomes gave impressive results and were shown to be superior to MenSC in wound healing. Several studies have investigated the role of MenSC in the treatment of gynaecological disorders. These include premature ovarian failure and Asherman's syndrome, which to date have been manageable but incurable disorders, which are both associated with infertility. (Feng et al., 2019; Lai et al., 2015; T. Liu et al., 2014; Y. Liu et al., 2018; Ma et al., 2020; Manshadi et al., 2019; Noory et al., 2019; Tan et al., 2016; S. Zhang et al., 2019; S.-X. Zheng et al., 2018; Zhu et al., 2019). Asherman's syndrome occurs secondary to damage to the endometrium (Yu et al., 2008). In this review, the *in vitro* and *in vivo* modulatory effects of MenSC are outlined followed by a description of their angiogenic and induced pluripotential effect, as compared to BMSCs, with a special focus on their role in the management of premature ovarian failure and Asherman's syndrome.

2 Methods

This systematic review aims to evaluate the potential use of MenSC, with a focus on the gynaecological applications of MenSC. The non-gynaecological applications were already reported (Galea et al., n.d.). As previously described, the electronic databases MEDLINE, EMBASE

and Cochrane Central Register of Controlled Trials were searched from 2007 up to August 2020, week 4, using the keywords and MeSH/EMTREE terms reported in the Appendix. Articles published in the English language assessing the clinical applications of MenSC were retrieved. We identified 1295 potentially relevant papers. Among these, 349 papers were excluded because they were duplicate, and 792 were excluded after evaluating titles and abstracts. Thus, 154 articles were retrieved as full text. Another 110 papers were excluded after evaluating the full texts. Finally, 40 studies were included in this systematic review.

2.1 *In Vitro* Immunomodulatory effect

The immunomodulatory properties of MenSC were investigated in a mixed lymphocyte reaction (MLR) and it was shown that they inhibited the secretion of interferon gamma (IFN- γ) and tumour necrosis factor alpha (TNF- α) whereas interleukin 4 (IL-4) secretion was up-regulated. MenSC also successfully inhibited peripheral blood mononuclear cell (PBMC) proliferation and altered T-cell responses towards T-helper 2 cells (Th2) (Murphy et al., 2008). Furthermore, the inhibitory effect brought about by MenSC on allogenic MLR was shown to depend on the ratio between MenSC and PBMCs (Nikoo et al., 2012). At high MenSC to PBMC ratios of 1:1 and 1:2, the MenSC were able to suppress PBMCs, but on dilution to a ratio of 1:32 or lower, MenSC were remarkably able to stimulate allogenic PBMC proliferation. Thus, MenSC have a dose dependent anti-inflammatory /pro-inflammatory effect (Nikoo et al., 2012). MenSC co-cultured with PBMCs at a relatively high ratio of 1:10, exhibited similar T-cell suppression as that caused by BMSCs. However, following dilution to 1:100 MenSC exhibited a lower suppressive effect on PBMCs than BMSCs. This is possibly a result of lower expression of cyclooxygenase 2 (COX-2) and IL-6 and lower secretion of Activin A and Indoleamine-pyrrole 2,3-dioxygenase (IDO), an immunosuppressive agent which can limit T cell function in comparison to BMSCs. Consequently, at low suppressor: effector ratios MenSC induced less anti-inflammatory IL-4, IL-10, and CD4 lymphocytes. As a result, pro-inflammatory CD8 T cells and CD4 Th1 cells were less inhibited (Luz-Crawford et al., 2016). MenSC exposed to pro-inflammatory cytokines such as IFN- γ and IL-1 β secreted more IL-6 and TGF- β , which in turn down-regulated NK cell cytotoxicity and proliferation. Uterine natural killer (NK) cells constitute 50–70% of all lymphocytes in the early pregnant uterus. Effective down-regulation of these cells is important to preserve the semi-allograft foetus to term (Moffett-King et al., 2002). This suggests that endometrial stem cells may play a potential

role in NK modulation and subsequent gestational success (Shokri et al., 2019).

2.2 *In vivo* Immunomodulatory effect

MenSC administration has been shown to significantly ameliorate colitis in various mouse models and improve prognosis (Lv et al., 2014; Shi et al., 2019; Xu et al., 2018). The resolution of colitis was mediated through the immunomodulatory effect of MenSC on the inflammatory milieu. Following MenSC treatment, the pro-inflammatory cytokines IL-1 β , TNF- α and IL-6 were significantly less concentrated in serum, whereas the anti-inflammatory cytokines IL-10 and IL-4 were significantly more concentrated in comparison to the untreated control (Xu et al., 2018). Furthermore, MenSC treatment decreased the levels of Macrophage 1 (MAC-1) positive cells and Myeloperoxidase (MPO) positive neutrophils. Additionally, MenSC treatment also significantly decreased the number of splenic dendritic cells and significantly decreased the Major histocompatibility complex class 2 (MHC-II) expressed on these cells. This limits the antigen-presenting capacities of these cells and therefore limits effector cell activation and subsequent inflammation (Lv et al., 2014). MenSC treatment also significantly alters immune cell populations in colitis. Regulatory T cells (T-regs) have been shown to be significantly elevated whereas CD3+CD25+, CD3+CD8+, CD3+CD4+, CD3+ T cells were decreased (Lv et al., 2014; Shi et al., 2019; Xu et al., 2018). These immunomodulatory effects are mediated by Programmed death ligand 1 (PD-L1); in fact if this is blocked, MenSC fail to attenuate colitis (Shi et al., 2019).

MenSC treatment has been shown to double the survival of heart transplants in treated mice over untreated controls through the attenuation of acute vascular rejection. At MenSC:B-cell ratio of 1:10 or higher, MenSC inhibited B cell proliferation, repressed the expression of surface molecules CD80, CD83 and CD86; and consequently resulted in decreased IgM and IgG levels (Xu et al., 2017). MenSC also exhibit antimicrobial activity and secrete higher levels of hepcidin (Alcayaga-Miranda et al., 2015). *In vivo* MenSC administration to a caecal ligation puncture model of sepsis mediated the uncontrolled inflammatory response through the reduction of various cytokines including TNF- α , MCP, IL-6 and IL-10, which resulted in a 43% survival rate in comparison to 6% in the untreated model. Moreover, with the combined treatment of antibiotic and MenSC, the survival rate stood at 95% which was even higher than the 73% survival rate obtained with antibiotic treatment alone (Alcayaga-Miranda et al., 2015).

2.3 Angiogenic Potential of MenSC

Analysis of growth media following MenSC culture identified the presence of multiple angiogenic factors including Angiopoietin 2 and vascular endothelial growth factor (VEGF) (Meng et al., 2007). Hence, these cells influence angiogenesis through the production and secretion of these factors. Six hours after the introduction of MenSC into an *in vitro* angiogenesis assay, vessel formation was visualised. MenSC were grown under hypoxic and normoxic conditions, following which the culture media was used to grow human umbilical vein endothelial cells (HUVECs). HUVECs cultured on media obtained from the hypoxic culture group contained more VEGF than the culture medium obtained from the normoxic group. Consequently, the hypoxic cultured medium showed increased tube formation in comparison to HUVECs grown in the culture medium obtained from the normoxic group. This was quantified by a significant increase in length, percentage of covered area and loop number, due to more angiogenic factors being secreted (Alcayaga-Miranda et al., 2015). MenSC extracted from patients with a previous history of preeclampsia and from normal patients were cultured, following which, the conditioned medium was used for HUVEC culture. Growth of HUVECs occurred more in the cultured media obtained from healthy patients and consequently the vessels developed significantly more branches (Varas-Godoy et al., 2019). Following these observations, the levels of secreted VEGF was measured (Alcayaga-Miranda et al., 2015; Varas-Godoy et al., 2019). VEGF is a pro-angiogenic molecule which is upregulated through various pathways, such as through the hypoxia inducible factor alpha under hypoxic conditions (Akimoto et al., 2013). VEGF levels were shown to be 174 times higher in the hypoxic group than in the normoxic group and MenSC obtained from preeclampsia patients secreted significantly less VEGF (Alcayaga-Miranda et al., 2015; Varas-Godoy et al., 2019). Matrigel was mixed with MenSC and with Dulbecco's Modified Eagle Medium (DMEM) and both were subsequently injected within mice. *In vivo* transplantation of MenSC in matrigel plug assay promoted the development of vessels and haemoglobin which were significantly higher than changes induced by DMEM in Matrigel (Alcayaga-Miranda et al., 2015). These data support the hypothesis that in women with a previous pregnancy complicated by preeclampsia, their angiogenic and inflammatory properties of MenSC have reduced angiogenic capacity and are more proinflammatory than those with a previous normal pregnancy. This may be present before the development of the pathology, leading to limited vascular remodeling within the developing placenta, and can be used in the future for targeted therapeutic intervention.

2.4 Induced Pluripotent stem cells generated from MenSC

The reprogramming of a human adult fibroblast back to an induced pluripotent stem cell (iPSC) was a major breakthrough in the field of regenerative medicine. The conversion occurs through the expression of Yamanaka's factor genes; Octamer-binding transcription factor 4 (OCT-4), Kruppel-like factor 4 (KLF-4), Sex determining region Y-box 2 (SOX-2) and master regulator of cell cycle entry and proliferative metabolism (c-MYC) (Takahashi et al., 2007). Depending on the cell's genetic makeup all or some of the Yamanaka's factors may be required for iPSC production (Kim et al., 2009; Kim et al., 2008). Mesenchymal stem cells (MSCs) have been shown to reprogram at a faster rate than other cells, since they express some of the Yamanaka factors (C. Zheng et al., 2009). Despite this, difficult extraction procedures limit their potential. The discovery of MenSC, which are freely available in the menstrual fluid, addresses this limitation (Meng et al., 2007). Moreover, MenSC express some pluripotent genes, including OCT-4, KLF-4, c-MYC, SOX-2 and NANOG which make them even more attractive for remodelling into iPSCs (de Carvalho Rodrigues et al., 2012; Li et al., 2013). de Carvalho Rodrigues et al. (2012) managed to reprogram MenSC into iPSCs through lentiviral mediated transduction of KLF-4, SOX-2 and OCT-4. Subsequently, Li et al. (2013) successfully reprogrammed MenSC with OCT-4 and SOX-2, thus avoiding the need for the oncogenic KLF-4 factor. iPSCs produced from MenSC develop at a faster rate (15–17 days vs. 20 days) and with improved efficiency (2–5% vs. 0.01–0.1%) from fibroblast derived iPSCs (de Carvalho Rodrigues et al., 2012; Li et al., 2013). Moreover MenSC-iPSCs are safer than fibroblast derived iPSCs since c-MYC and KLF-4 factors are not needed for their reprogramming (Li et al., 2013). MenSC derived iPSCs express the pluripotent genes OCT-4, SOX-2, TRA-1-60, TRA-1-80 and subsequently develop embryoid bodies containing cells from all three germ lines (de Carvalho Rodrigues et al., 2012; Li et al., 2013). Furthermore *in vivo* transplantation of MenSC-iPSCs develop into a trilaminar teratoma (Li et al., 2013).

2.5 Comparison between MenSC and BMSCs

Both MenSC and BMSCs exhibit a fibroblast-like morphology (Alcayaga-Miranda et al., 2015). Phenotypic characterisation revealed a largely similar profile between the two cells (Darzi et al., 2012; Fathi-Kazerooni et al., 2019; Meng et al., 2007). Mesenchymal markers, such as CD44, CD29, CD105, CD73 and CD146, are strongly expressed in both cell types; however, MenSC do not express Mesenchymal stem cell marker 1 (STRO1)

and Stage specific embryo antigen 4 (SSEA-4). Instead, they show marked expression of the OCT-4 embryonic stem cell marker in comparison to BMSCs (Darzi et al., 2012; Fathi-Kazerooni et al., 2019). Additionally, MenSC express higher levels of CD49a and Human leukocytic antigen (HLA-A/B/C) (Alcayaga-Miranda et al., 2015). Mitochondrial dehydrogenase analysis showed that MenSC proliferate at a significantly faster rate than BMSCs at all intervals assessed. The proliferative potential of MenSC increased from 2.84-fold at day 3 to 4.97-fold at day 9 over that of BMSCs (Alcayaga-Miranda et al., 2015), while the MenSC doubling time was approximately halved in comparison to BMSCs (Darzi et al., 2012). Following induction, both cell types successfully differentiated into adipocytes, chondrocytes and osteoblasts. BMSCs showed a higher capacity to differentiate into adipocytes but no significant variation in chondrocytic and osteoblastic differentiation was noted (Alcayaga-Miranda et al., 2015). Contrary to this result, MenSC showed decreased osteoblast differentiation potential than BMSCs. This was attributed to lower levels of alkaline phosphatase (ALP) expression by MenSC which subsequently resulted in decreased mineralization (Darzi et al., 2012). BMSCs showed a higher potential to differentiate to glial-like cells. Induction with neurogenic factors induced morphological changes which were more pronounced in BMSCs (Azedi et al., 2014). Scratch wound assay showed complete resolution following 24 hours of MenSC treatment, while BMSCs only partially resolved the wound within the same timeframe (Alcayaga-Miranda et al., 2015). 24 hours after addition to a migration assay MenSC were shown to migrate more than BMSCs. The enhanced migratory capacity is correlated to a larger number of MenSC expressing chemokine receptor type 41 (CXCR41) over BMSCs (Luz-Crawford et al., 2016). As mentioned before, HUVEC culturing on conditioned medium derived from MenSC under hypoxic conditions have a greater angiogenic effect on HUVECs than MenSC cultured medium at normoxic conditions (Alcayaga-Miranda et al., 2015). However, BMSC derived culture medium in hypoxia or normoxic conditions show no significant different effect on HUVECs. Therefore, MenSC have an ability to induce angiogenesis based on the microenvironment which BMSCs lack. Moreover, under normoxic conditions MenSC had greater angiogenic effect on HUVECs than BMSCs. Finally, in a rat model of acute liver failure, MenSC administration suppressed miR-122 more than BMSCs. Furthermore, MenSC significantly decreased the collagen content in the liver and reduced the levels of AST and ALT. Therefore, MenSC show more improvement in acute liver failure (Fathi-Kazerooni et al., 2019).

2.6 MenSC derived exosome

MenSC produce three types of extracellular vesicles (EVs) of which exosomes are the smallest subtype ($< 150\text{nm}$). Exosomes are generated through the endosomal pathway and are released following fusion of multivesicular bodies to the plasma membrane. These EVs carry bioactive cargo content from the mother cell to recipient cells where they exert their effect (Hessvik et al., 2018). EVs derived from MenSC are positive for CD81, CD63 and TSG101 exosomal markers and negative for calnexin. Furthermore, these spherical vesicles have a size of 30–170 nm and thus they exhibit the minimum criteria for exosome classification as stipulated by the International Society for extracellular vesicles (Dalirfardouei et al., 2018).

Wound healing has been shown to significantly improve in the exosome treated patients' group (Dalirfardouei et al., 2019). Inflammation at the site of injury was significantly attenuated as a result of a shift towards the tissue healing M2 macrophage phenotype. VEGF upregulation with subsequent increase in CD34 positive vessels indicated improved neoangiogenesis. The wound had faster re-epithelialization and better resolution as a result of increased Collagen I: Collagen III ratio with subsequent reduced scar formation. Furthermore, MenSC-derived exosome treatment resulted in better wound healing than the MenSC treated group (Dalirfardouei et al., 2019). In a diabetic mouse model, administered exosomes successfully homed into the diabetic pancreas after 48 hours. Exosome treatment improved the number of islets within the pancreas, enhanced B-cell mass and insulin production capacity. Improved serum insulin level was observed following treatment although levels remained sub-optimal and showed no effect on the non-fasting glucose (Mahdipour et al., 2019). In the Prostate Cancer 3 (PC3) cells, MenSC-derived exosomes downregulated the NF- κ B transcription factor activity and reactive oxygen species (ROS) production, which subsequently resulted in decreased VEGF production. HUVECs cultured on conditioned medium derived from exosome treated PC3 cells showed no tube formation and therefore VEGF inhibition by ROS was confirmed. Following encouraging *in vitro* results, *in vivo* effects of exosomes on PC3 tumours was investigated. Following MenSC-derived exosome treatment, extra- and intra- tumour angiogenesis was significantly inhibited as visualised by decreased vessel formation (Alcayaga-Miranda et al., 2016).

Exosomes may therefore serve as a potential treatment instead of the direct transplantation of MenSC since exosomes are more stable, not limited by the possibility of rejection and have no genetic risks. However, being so small they are efficiently cleared by the body and may therefore require a very high dose and repeated treatment

(Bozorgmehr et al., 2014).

2.7 The Possible Applications of MenSC treatment for Gynaecological Disorders

The treatment of gynaecological disorders by various types of MSCs obtained from various adult tissues, i.e., bone marrow, adipose and amniotic tissue, have shown encouraging results (Rungsiwiwut et al., 2021). Despite this, their clinical application is restricted due to limited sources, invasive extraction procedures and the risk of infection. The discovery of MenSC in the menstrual fluid represents as an attractive alternative which is cyclically available and freely shed (Meng et al., 2007). These cells meet all the requirements for stem cell classification by the International Society for Cellular Therapy (Hu et al., 2019; Y. Liu et al., 2018). To date, studies on their application for the treatment of gynaecological disorders are still limited. However, from the results obtained so far, there is potential for future clinical use, since MenSC may offer an exciting alternative to the conventionally used adult stem cells.

2.8 MenSC and premature ovarian failure

Premature Ovarian Failure/Insufficiency (POF/POI) is a secondary infertility disorder effecting woman of reproductive age (Anasti, 1998). POF is diagnosed in women under the age of 40 and it is estimated to affect 1 percent of women below this age. POF is characterised by amenorrhea lasting more than 4 months and by hypergonadotropic hypoeestrogenism (Jiao et al., 2017; Tucker et al., 2016). POF does not only impact fertility but can lead to osteoporosis, cardiovascular and neurological disorders and also emotional manifestations (Z. Wang et al., 2017). Chemotherapy is an essential component of cancer treatment however the use of alkylating drugs such as cyclophosphamide (CY) and busulfan lead to the development of POF (Sakurada et al., 2009). CY was shown to stimulate the development of primordial follicles through PI3K/Akt/mTOR, Rictor/ mTORC2/Akt/Foxo 3a signalling thus depleting the finite ovarian reserve (Kalich-Philosoph et al., 2013; B.-F. Zhang et al., 2018; Zhou et al., 2017). Busulfan leads to ovarian cytotoxicity (Kalich-Philosoph et al., 2013). Hormone replacement therapy (HRT) is used to alleviate symptoms caused by POF however it fails to restore ovarian function. Therefore HRT is only a symptomatic treatment, which carries increased risks of thrombosis, stroke, oestrogen sensitive tumours, ovary and breast cancers. Thus, there is an urgent need for alternative treatments (Rantanen et al., 2013).

The regenerative and restorative potential of MenSC has been assessed favourably in many studies involving multiple different cell types (Allickson et al., 2011; Rodrigues et al., 2012) and therefore the possible regenerat-

ing effect of these cells on POF has been investigated in chemotherapy-induced POF murine models. After POF induction, MenSC have been transplanted by intravenous or direct intra-ovarian injection to the murine models and their effect on ovarian function was evaluated (Feng et al., 2019; Lai et al., 2015; T. Liu et al., 2014; Manshadi et al., 2019; Noory et al., 2019). Chemotherapy resulted in weight loss and a decrease in the size and weight of the ovaries (Feng et al., 2019; Manshadi et al., 2019). Z. Wang et al. (2017) reported that from the 9th day after MenSC transplantation, the body weight of the transplanted mice was found to be significantly higher compared to untreated POF mice. In addition, after 21 days, the ovaries showed a statistically significant higher weight than in the untreated POF model. T. Liu et al. (2014) reported that there was no statistical significance between the weight of ovaries from the MenSC treated group and the positive control group which were not treated with chemotherapy. Pathological analysis showed that a large number of follicles in all stages of development were present in the ovarian stroma of healthy mice (T. Liu et al., 2014). Following chemotherapy, the quantity and quality of the follicles were shown to decrease (Feng et al., 2019). Furthermore, the ovarian stroma was mainly composed of interstitial cells and collapsed oocytes largely in primary and secondary follicles (T. Liu et al., 2014). MenSC treatment was shown to increase the number of healthy follicles in all stages of development and improve ovary microstructure (Feng et al., 2019; Manshadi et al., 2019; Z. Wang et al., 2017). Inflammatory molecules which develop as a result of chemotherapy act as signals for mesenchymal stem cells to migrate to the injured site where they can either regenerate tissue by engraftment or induce tissue repair through the secretion of bioactive molecules. Granulosa cell specific genes for anti-mullerian hormone (AMH), follistatin (FST) and follicle stimulating hormone receptor (FSHR) were down-regulated following chemotherapy indicating apoptosis of the granulosa layer (Manshadi et al., 2019). Granulosa cell apoptosis was confirmed by tunnel assay (Feng et al., 2019; Noory et al., 2019). One month after DIL-labeled MenSC transplantation, the levels of granulosa cell specific genes were shown to be restored (Manshadi et al., 2019). MenSC were able to migrate towards the apoptotic granulosa layer after which they were able to engraft and differentiate into granulosa cells (Lai et al., 2015; Manshadi et al., 2019). Z. Wang et al. (2017) reported decreased apoptosis of the granulosa cells following treatment with MenSC conditioned media. The presence of cytokines and growth factors in the conditioned media was analysed and an extremely high level of Fibroblast Growth Factor 2 was identified. Conditioned

media obtained from MenSC previously treated to inhibit FGF2 production had no effect on the rate of GC apoptosis (Z. Wang et al., 2017). In another experiment the levels of B-cell lymphoma-2-associated X protein (BAX) and B-cell lymphoma 2 (BCL2) were evaluated following MenSC treatment. BAX and BCL2 are two important genes which are involved in the regulation of apoptosis. BAX is proapoptotic while BCL2 is antiapoptotic. Quantitative real-time polymerase chain reaction (qRT-PCR) showed a significant variation in the levels of expression of BAX and BCL2 in the POF model in comparison with the normal untreated group. BAX levels were seen to increase while BCL2 levels decreased in the POF mice model. This shift towards BAX resulted in increased atrophied follicles. Following MenSC treatment, the level of BAX showed a statistically significant decrease in comparison to the POF mice model. The decrease in the level of BAX is attributed to the regulatory functions of MenSC which through paracrine factors can influence genetic expression and in this case lead to the cessation of apoptosis (Noory et al., 2019). Pregnancy rates were seen to be restored after MenSC treatment of chemotherapy injured mice. After mating with normal healthy male mice, the MenSC treated group and untreated control group had three pregnancies, while chemotherapy treated mice had only one pregnancy (Lai et al., 2015). Successful pregnancies in both normal untreated controls and MenSC treated groups were significantly higher than in the POF mice model (Feng et al., 2019; Lai et al., 2015). Chemotherapy treatment resulted in high levels of follicle stimulating hormone (FSH) and low levels of oestrogen and progesterone thus giving the classical hypergonadotropic hypogonadism seen in POF (Feng et al., 2019; Guo et al., 2019; Y. Liu et al., 2018; Manshadi et al., 2019; Z. Wang et al., 2017). Z. Wang et al. (2017) reported that at 7 and 21 days following MenSC transplantation the level of FSH was lower while the level of E2 was higher than that in the untreated POF model. Meanwhile Liu et al found no statistical significance between the serum hormone levels of positive control group and treated group thus MenSC reversed the hypergonadotropic hypogonadism (T. Liu et al., 2014; Z. Wang et al., 2017). The ovarian stroma is composed of extracellular matrix (ECM) which serves an important role in follicular support (Rodgers et al., 2003). Chemotherapy induces changes to the ECM microfibrillar system which results in the disruption of homeostasis (Alipour et al., 2015). Two important proteins in the microfibrillar system are Collagen Type 6 Alpha 5 Chain (COL6A5) and Collagen Type 9 Alpha Chain 2 (COL9A2) (Pan et al., 2014). The mRNA expression of these two molecules was decreased with chemotherapy but, after the introduction of MenSC, there was an increase in the

level of expression of these proteins. Thus, MenSC could ameliorate POF through the restructuring of the ovarian stroma microenvironment through the activation of the ECM FAK/AKT signalling pathway (Feng et al., 2019). The positive effects of MenSC treatment on POF are explained by both the secretory and regenerating effect of MenSC. These results merit favourable prospects for the future clinical application of MenSC in the treatment of POF [tables 1a](#) and [1b](#).

2.9 MenSC in Endometrial Dysfunction

Asherman's Syndrome, also known as intrauterine adhesions (IUAs) is a disease of the female reproductive tract (Asherman, 1948). The prevalence of IUA has increased and presently the disease accounts for 4.6% of female factor infertility (Baradwan et al., 2018). IUAs are caused by damage to the endometrium by direct repeated mechanical damage or inflammatory responses to infections which effect the basalis layer (Yu et al., 2008). A functioning basalis is necessary for the cyclic regeneration of the functionalis layer in preparation for implantation (Cervelló et al., 2015). Insults effecting the stratum basalis result in the loss of function of endometrial stem cells thus leading to a decline in the normal function of the endometrium. This results in endometrial functional disorders with clinical manifestations such as painful menses, hypomenorrhea or complete amenorrhea, thin endometrium and fibrotic scarring, which together make the uterine cavity hostile to implantation (Gargett et al., 2012). Conventional treatment is based on surgical adhesion resection followed by hormone replacement therapy. However, this has a poor prognosis with adhesion recurrence commonly seen, especially with severe cases of IUA (Deans et al., 2010; Guo et al., 2019). MenSC supplementation to injured endometrium has attracted some interest and although limited research had been conducted thus far, results obtained are encouraging and may represent a potential cure for IUA in the future (Ma et al., 2020; Tan et al., 2016; S. Zhang et al., 2019; S.-X. Zheng et al., 2018; Zhu et al., 2019). Endometrial stromal cells (ES) and endometrial epithelial cells (EE) are cell types which are found abundantly in healthy normal endometrium. However, following histological analysis these cells were seen to be replaced by fibrotic tissue in patients with IUAs. After culturing with specific growth factors *in vitro*, MenSC were found to differentiate into both vimentin-expressing ES cells and cytokeratin expressing EE cells (S. Zhang et al., 2019). At 9- and 18-days post MenSC treatment immunocytochemistry analysis showed that cytokeratin and vimentin expression was significantly higher in the MenSC treated group than in the control groups, thus confirming that MenSC differentiated *in vivo* to ES

and EE cells (Hu et al., 2019; S. Zhang et al., 2019). Furthermore, combined treatment with platelet rich plasma (PRP) had a synergistic effect with consequential better endometrial repair (S. Zhang et al., 2019). Treatment with MenSC stimulated angiogenesis which subsequently increased micro-vessel density in the treated endometrium (Hu et al., 2019; X. Wang et al., 2020). Significantly higher levels of pro-angiogenic VEGF were secreted in the treatment groups (Hu et al., 2019). VEGF induced micro vessel formation as detected by increased expression of CD34 protein (X. Wang et al., 2020). Effect on angiogenesis is brought about by paracrine influences on the AKT/ERK pathway which is activated by phosphorylation. Activation leads to increased levels of transcription of angiogenic genes resulting in increased expression of angiogenic factors. Asherman's Syndrome showed no improvement in endometrial thickness with oestrogen therapy alone; however, following MenSC transplantation and HRT, endometrial regeneration was induced. This indicated that stem cell loss may be the main cause of Asherman's (Tan et al., 2016). Immunohistochemistry analysis of endometrium obtained from patients with IUAs showed a 20-fold decrease in OCT-4 positive cells. *In vitro* analyses of harvested cells showed a 9-fold decrease in their cloning efficiency when compared to cells obtained from healthy endometrium, thus supporting Tan et al's findings (S.-X. Zheng et al., 2018). MenSC transplantation in murine IUA model significantly increased the thickness of the endometrium which consequentially led to improved embryo implantation and development (Hu et al., 2019). Following assessment of refractory IUA patients, Ma et al reported an endometrial thickness of 3.9 ± 0.9 mm which was described by Tan et al as having a rough morphology (Ma et al., 2020; Tan et al., 2016). Treatment with autologous transplantation of *in vitro* proliferated MenSC and hormone replacement therapy ameliorated IUA. The duration of menses in treated patients increased and the endometrium showed normal morphology and developed a triple line appearance. An increase in thickness to 7-8 mm was observed in 5 of the 7 (71%) women recruited, of whom 3 (43%) successful conceived (Tan et al., 2016). Ma et al increased the dose of transferred MenSC ten-fold from that administered Tan et al. (2016) and while noting the same improvements 83% of treated patients showed increased endometrial thickness. However, the pregnancy rate fell slightly to 41.7% (Ma et al., 2020). Endometrial stem cell expression of collagen I, alpha SMA, connective tissue growth factor (CTGF) and fibronectin were downregulated following MenSC co-culture (Zhu et al., 2019). Additionally, treatment with MenSC conditioned media had the same effect (Lin et al., 2018; Zhu et al., 2019). Reduction of CTGF and Collagen I was also ob-

| | Animal Model | Route of administration of MenSC | Findings after MenSC treatment | Findings after MenSC CM treatment |
|------------|---|----------------------------------|--|-----------------------------------|
| Feng, 2019 | CTX induced POI in C57BL/6 female mice | Tail Vein injection | ↑ body weight ↑ ovarian weight ↑ live births ↑ AMH ↑ E2 ↓ FSH ↑ COL6A5 ↑ COL9A2 | N/A |
| Lai, 2015 | Busulfan induced POI in C57BL/6 female mice | Tail Vein injection | ↑ body weight ↑ ovary size ↑ pregnancy rate ↑ Litter size ↑ oocytes in al stages of development ↓ depletion of germline cells ↑ FSHR (granulosa cell marker) | N/A |
| Liu, 2014 | Cyclophosphamide induced POI in C57BL/6 female mice | Intra-ovarian injection | ↑ ovary weight ↓ atrophied follicles ↑ AMH ↑ FSHR ↑ E2 ↓ FSH | N/A |

Table 1a: Preclinical animal studies showing the response of POF to MenSC treatment

| | | | | |
|----------------|--|-----------------------|---|--|
| Manshadi, 2019 | Busulfan induced POI in female Wistar rats | Intravenous injection | ↑ AMH ↑ FST ↑ FSHR ↑ E2 ↑ P4 ↑ FGF2 ↓ FSH | N/A |
| Noory, 2019 | Busulfan induced POI in female Wistar rats | Injection | ↑ ovary weight ↑ follicles in all stages of development ↑ BCL2 ↓ BAX | N/A |
| Wang, 2017 | Cisplatin induced POI in female C57BL/6 | Tail Vein injection | ↑ body weight ↑ ovarian weight ↑ follicles in all stages of development ↑ E2 ↓ FSH ↓ TUNEL + cells (↓ apoptosis) | ↑ E2 ↑ FSH ↓ ovary fibrosis ↓ apoptosis |

Table 1b: Preclinical animal studies showing the response of POF to MenSC treatment

served in vivo (S. Zhang et al., 2019). Downregulation of these molecules leads to decreased deposition of collagen within the endometrium, thus ameliorating fibrosis caused by IUA. MenSC exert part of their therapeutic effect on IUA resolution by the paracrine activation and the subsequent regulation of endometrial stem cell genes involved in fibrogenesis. This is achieved through various molecular pathways (Lin et al., 2018; S. Zhang et al., 2019; Zhu et al., 2019). MenSC activate the Hippo/Transcriptional co-activator with PDZ-binding motif (TAZ) pathway (B.-F. Zhang et al., 2018; Zhu et al., 2019). Following co-culture with MenSC or MenSC culture media (CM), TAZ was phosphorylated and was subsequently sequestered in cytoplasmic granules. Sequestered P-TAZ cannot interact with TGF- β therefore downstream mRNA expression of fibrotic genes is blocked since their expression depend on TGF- β (Zhu et al., 2019). Zinc finger protein (Gli2), a pro-fibrogenic transcription factor was found to be expressed at a statistically significant higher level in patients with mild to severe IUA. MenSC CM analysis identified extremely high levels of Granulocyte colony stimulating factor (G-CSF). ESC co-culture with CM treated with anti G-CSF had no effect on ESC fibrosis and thus it was concluded that MenSC exhibits their anti-fibrotic effect as a result of G-CSF. G-CSF acts through the inhibition of Gli2 expression and by inducing G0/G1 arrest in endometrial stem cells (Lin et al., 2018). MenSC treated groups showed no statistical difference in body and organ weight from untreated controls and further in vitro analysis showed that MenSC are negatively tumorigenic and toxigenic thus they are safe for clinical application for the treatment of Asherman's syndrome (Chang et al., 2020) (table 2).

3 Conclusion

Initial studies on these relatively new type of stem cells yield a favourable prospect for their application as a potential source of therapy for the treatment of gynaecological disorders and resulting secondary infertility. These cells have been assessed favourably in many animal studies and have been shown to reverse POF and Asherman's syndrome in murine models. Additionally, MenSC gave impressive results when tested against BMSCs, the most studied type of mesenchymal stem cells. Given their innate advantages these cells are the perfect replacement for BMSCs. The advent of their application as mainstream therapy requires more studies and clinical trials to assess their root of application, long term safety and dosing. However despite these grey areas, they seem to be a suitable versatile cellular therapy agent yielding impressive results in the field of regenerative medicine.

4 Declaration

There is no conflict of interest.

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| | Animal Model | Route of administration of MenSC | Findings after MenSC treatment | Findings after MenSC and PRP treatment | Findings after G-CSF treatment |
|-------------|--|---|--|--|---|
| Zhang, 2019 | IUAs induced by mechanical damage in female Sprague Dawley rats. | Intrauterine injection. | ↑ endometrial proliferation ↑ angiogenesis ↑ endometrial thickness ↑ implantation ↓ fibrosis ↓ inflammation | ↑ ↑ endometrial proliferation ↑ angiogenesis ↑ endometrial thickness ↑ ↑ implantation ↓ fibrosis ↓ ↓ inflammation | N/A |
| Hu, 2019 | IUAs induced by mechanical damage in female BALB/c nude mice. | Transplanted in right uterine cavity. | ↑ endometrial thickness ↑ vitamin ↑ VEGF ↑ keratin ↑ pregnancy rate | N/A | N/A |
| Zheng, 2018 | NOD-SCID mice injected with endothelial cell programmed MenSC. | Transplanted in axillary subcutaneous tissue. | ↑ cytokeratin ↑ vimentin | N/A | N/A |
| Lin, 2018 | Female Sprague Dawley rats injected with 95% ethanol to induce IUAs. | G-CSF injected in the right uterine horn. | N/A | N/A | ↓ fibrosis relate proteins (COL1, CTGF, αSMA) ↓ GLi2 |

Table 2: Preclinical animal studies showing the response of IUAs following MenSC treatment.

| | Recruited for study | Findings after autologous MenSC transplantation |
|-----------|-----------------------------------|---|
| Tan, 2016 | 7 patients with sever IUAs. | ↑ endometrial thickness in 5 patients 1 spontaneous pregnancy 2/4 patients conceived following frozen embryo transplant. |
| Ma, 2020 | 12 patients with refractory IUAs. | ↑ endometrial thickness ↑ duration of menstruation ↑ pregnancy rate |

Table 3: Clinical studies showing the response of IUAs to MenSC treatment.

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| Search | Results |
|---|---------|
| 1 Menstrual blood-derived stem cell*.mp. | 37 |
| 2 Menstrual blood-derived stromal stem cell*.mp. | 3 |
| 3 Menstrual blood-derived mesenchymal stem cell*.mp. | 15 |
| 4 Menstrual blood-derived endometrial stem cell*.mp. | 4 |
| 5 Menstrual blood-derived cell*.mp. | 3 |
| 6 Menstrual blood-derived stromal cell*.mp. | 4 |
| 7 Menstrual blood-derived progenitor cell*.mp. | 0 |
| 8 Menstrual blood-derived regenerative cell*.mp. | 0 |
| 9 Menstrual stem cell*.mp. | 5 |
| 10 Menstrual blood stem cell*.mp. | 23 |
| 11 Menstrual blood stromal stem cell*.mp. | 3 |
| 12 Menstrual blood progenitor cell*.mp. | 1 |
| 13 Menstrual-derived stem cell*.mp. | 2 |
| 14 Endometrial stem cell*.mp. | 139 |
| 15 Endometrial stromal stem cell*.mp. | 7 |
| 16 Endometrial mesenchymal stem cell*.mp. | 59 |
| 17 Endometrial progenitor cell*.mp. | 8 |
| 18 Endometrial regenerative cell*.mp. | 17 |
| 19 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 | 286 |
| 20 exp Menstruation/ | 15,751 |
| 21 exp Endometrium/ | 32,210 |
| 22 20 or 21 | 46,533 |
| 23 exp Stem Cells/ | 216,632 |
| 24 exp Mesenchymal Stem Cells/ | 37,597 |
| 25 23 or 24 | 216,632 |
| 26 22 and 25 | 571 |
| 27 19 or 26 | 660 |
| 28 limit 27 to yr="2007–2020" | 612 |
| 29 limit 28 to english language | 584 |

Table 4: MEDLINE (Ovid) (from 2007 to August 2020, Week 4) (Galea et al., n.d.).

| Search | Results |
|---|---------|
| #1 'menstrual blood-derived stem cell*' | 68 |
| #2 'menstrual blood-derived stromal stem cell*' | 4 |
| #3 'menstrual blood-derived mesenchymal stem cell*' | 34 |
| #4 'menstrual blood-derived endometrial stem cell*' | 7 |
| #5 'menstrual blood-derived cell*' | 5 |
| #6 'menstrual blood-derived stromal cell*' | 8 |
| #7 'menstrual blood-derived progenitor cell*' | 0 |
| #8 'menstrual blood-derived regenerative cell*' | 0 |
| #9 'menstrual stem cell*' | 15 |
| #10 'menstrual blood stem cell*' | 59 |
| #11 'menstrual blood stromal stem cell*' | 10 |
| #12 'menstrual blood progenitor cell*' | 1 |
| #13 'menstrual-derived stem cell*' | 8 |
| #14 'endometrial stem cell*' | 320 |
| #15 'endometrial stromal stem cell*' | 15 |
| #16 'endometrial mesenchymal stem cell*' | 144 |
| #17 'endometrial progenitor cell*' | 12 |
| #18 'endometrial regenerative cell*' | 32 |
| #19 #1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 | 632 |
| #20 'menstruation'/exp | 23,693 |
| #21 'endometrium'/exp | 34,082 |
| #22 #20 OR #21 | 56,053 |
| #23 'stem cell'/exp | 378,513 |
| #24 'mesenchymal stem cell'/exp | 60,648 |
| #25 #23 OR #24 | 378,513 |
| #26 #22 AND #25 | 808 |
| #27 #19 OR #26 | 1,212 |
| #28 #27 AND ([conference abstract]/lim OR [conference pa- per]/lim OR [conference review]/lim) | 434 |
| #29 #27 NOT #28 | 778 |
| #30 #29 AND [english]/lim | 728 |
| #31 #30 AND [2007-2020]/py | 690 |

Table 5: EMBASE (from 2007 to August 2020, week 4) (Galea et al., n.d.).

| | Search | Results |
|------------|---|---------|
| S1 | Menstrual blood-derived stem cell* | 4 |
| S2 | Menstrual blood-derived stromal stem cell* | 1 |
| S3 | Menstrual blood-derived mesenchymal stem cell* | 1 |
| S4 | Menstrual blood-derived endometrial stem cell* | 0 |
| S5 | Menstrual blood-derived cell* | 4 |
| S6 | Menstrual blood-derived stromal cell* | 1 |
| S7 | Menstrual blood-derived progenitor cell* | 0 |
| S8 | Menstrual blood-derived regenerative cell* | 0 |
| S9 | Menstrual stem cell* | 8 |
| S10 | Menstrual blood stem cell* | 5 |
| S11 | Menstrual blood stromal stem cell* | 2 |
| S12 | Menstrual blood progenitor cell* | 0 |
| S13 | Menstrual-derived stem cell* | 0 |
| S14 | Endometrial stem cell* | 12 |
| S15 | Endometrial stromal stem cell* | 0 |
| S16 | Endometrial mesenchymal stem cell* | 7 |
| S17 | Endometrial progenitor cell* | 5 |
| S18 | Endometrial regenerative cell* | 0 |
| S19 | S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 | 21 |
| S20 | (MW menstrual) OR (MW menstruation) | 1,489 |
| S21 | (MW endometrial) or (MW endometrium) | 1,673 |
| S22 | S20 or S21 | 3,047 |
| S23 | MW stem cells | 2,493 |
| S24 | MW mesenchymal stem cells | 213 |
| S25 | S23 OR S24 | 2,493 |
| S26 | S22 AND S25 | 1 |
| S27 | S19 OR S26 | 22 |
| S28 | S27 | 21 |
| | Limiters —Published Date: 20070101-20201231 | |

Table 6: Cochrane Central Register of Controlled Trials (EBSCO) (from 2007 to August 2020, week 4) (Galea et al., *n.d.*).



Research Article

The role of orthography in learning a second language: Evidence from Maltese English

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Abstract. Research has indicated that the acquisition of a second language (L2), in particular of its phonology, is influenced by orthography. For instance, Bassetti (2017) found that Italian learners of English produce the /p/ in words with a double letter ⟨p⟩ (such as *pepper*) with a longer [p] than the /p/ in words with a single letter ⟨p⟩ (such as *weapon*). This indicates that Italian learners are influenced by their first language (L1) orthography-to-phonology rules, where a phonological quantity contrast between short and long consonants is cued as such in orthography. We tested whether this pattern is due to a focus on orthography in most formal L2 education by testing Maltese learners of English. Just as Italian learners, Maltese learners have a quantity distinction in their native language that is coded by single versus double letters. However, unlike Italian learners, the English L2 is used spontaneously outside the classroom, so that acquisition is based less on orthography. The results show that Maltese learners do not make a quantity distinction in English words with single versus double letters. This indicates that earlier results are due to the focus on orthography in formal education rather than an automatic use of orthography in speech processing.

1 The role of orthography in learning a second language: Evidence from Maltese English

The relation between spoken and written language is a curious one. Even though spoken language precedes written language both in human evolution and individual development, our thinking about language is strongly based on written language. For instance, most native speakers of English will say that English has five to six vowels, depending on whether ‘y’ should be counted. However, English has more than 10 different vowels, the exact

number depending on the version of English. Going beyond such effects on phonological (un-)awareness, there are claims that learning a written language influences the structure of the system of spoken language (Kolinsky et al., 2021; Morais, 2021; Pattamadilok et al., 2009; Ziegler et al., 1998). In a highly cited paper, Dehaene et al. (2010) investigated brain responses to speech in different groups of adults in Brazil who did not learn to read as children due to socio-economic reasons. Some of them had remained illiterate while others had recently learned to read in adulthood. These groups are hence similar in their socio-economic background, but one has recently learned to read. Dehaene et al. (2010) found that the response to speech in left temporal areas, even when presented by itself without orthography, was stronger in the literate group, suggesting that learning to read changes networks that are used for speech perception. While these conclusions are contested for the processing of the native language (Cutler et al., 2012; Hervais-Adelman et al., 2021; Mitterer et al., 2015), an influence of orthography may be less surprising in the acquisition of a second language. More often than not, learning a second language in formal education relies strongly on the written modality. This may be partly due to the fact that written language provides an additional mnemonic that facilitates learning (for a recent review, see Hayes-Harb et al. (2021)). Moreover, students may very well capitalize on the written modality, as it is the modality which mostly determines their grades. It is hence not surprising that orthography plays a role in L2 speech processing. These influences are, however, not always facilitatory (Hayes-Harb et al., 2021). For instance, English learners of German may produce word-final stops, which are always unvoiced in German due to final devoicing (/hund/ → [hʊnt]), with differences in voicing depending on the orthography. That is, they produced voiced stops for words that end on graphemes that usually indicate a voiced

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stop (i.e., ⟨b⟩, ⟨d⟩, and ⟨g⟩, see Hayes-Harb et al. (2018) and Young-Scholten (2002)). While the German words *Rat* (Engl., ‘advice’) and *Rad* (‘bike’) are homophonous in German (or nearly homophonous, see Roettger et al. (2014)), English learners apparently use their grapheme-phoneme correspondences from their L1 and make a difference between these words, since, in English, a ⟨d⟩ is typically produced as a /d/ and the contrast between /t/ and /d/ is functional in all positions (though the contrast may be neutralized in spontaneous speech in some positions, see Pitt et al. (2011)). Similar negative effects have been found for Brazilian learners of English, who pronounce the “silent” ⟨e⟩ in words such as *bone*, and English learners of Spanish, who associate the letter ⟨b⟩ only with the stop, but not the approximant allophone of the phoneme /b/ in Spanish (Shea, 2017). Another negative transfer of L1 orthography to L2 production has been reported in series of papers by Bassetti and colleagues for Italian learners of English. Italian makes quantity contrasts for consonants, so that there is a singleton /t/ and a geminate /t:/ (e.g., *seta* ‘silk’ vs. *setta* ‘sect’). Acoustically, the difference between singletons (/t/ as in *seta*) and geminates (/t:/ as in *setta*) is mostly signalled in terms of duration (though there are some exceptions to this rule, see Mitterer (2018)), and the difference is made in orthography with single versus double letters. Bassetti (2017) tested whether the difference between a single and double letter also influences the pronunciation of English words by Italian learners, even though English does not have quantity contrast and consonant letter doubling mostly signals the quality of the preceding vowel (so that a double letter is unlikely after a tense vowel or a diphthong). However, Italian learners might use their L1 orthography-to-phonology rules when learning English and produce the word *pepper* with a longer medial /p/ than the word *weapon*. This is indeed what Bassetti (2017) found. Importantly, this was tested under two conditions, one in which the word productions were triggered by a picture prompt that included the written word and one in which the written word was absent. In both conditions, Italian learners produced longer consonants for double letters than for single letters, indicating that the effect even occurs in the absence of any orthographic input at the time of testing. A second study (Bassetti et al., 2018) replicated this pattern with homophones (e.g., *finish* vs. *Finnish*) and also found an effect on English vowels depending on whether they were spelled with a digraph or not (e.g., *seen* vs. *scene*). The latter effect, with a lengthening of about 10%, was, however, considerably smaller than the effect for consonants, with a lengthening of about 30 to 50% when the geminate would have been phonotactically legal in Italian (see also Bassetti et

al. (2020)). A similar, albeit smaller effect was found in Japanese (Sokolović-Perović et al., 2020), in which the geminate is indicated by one abstract grapheme that can be combined with any consonant (Sadakata et al., 2014). Importantly, there are (at least) two competing explanations for such effects. One explanation argues that this is simply another consequence of the automatic activation of orthographic representations during spoken-language processing, as argued for the L1 (e.g., Pattamadilok et al. (2009)). Another explanation focusses more on the learning process, in which learners are exposed to orthographic forms which may then influence phonological representations. This account gains credibility when considering the finding that reading a novel word (in the L1) leads to a phonological representation for that word (Bakker et al., 2014). The two accounts differ in that the influence is automatic according to the first account while it is considered mediated by learning in the second. One way to address this issue is to test whether the effect is moderated by other variables, because a hallmark of automaticity is that it is not strongly moderated by third variables. In this context, Bassetti and colleagues (Bassetti et al., 2020; Bassetti et al., 2018) investigated whether the orthographic influence is moderated by proficiency, comparing intermediate learners in Italy with (late) bilinguals living in the UK. In a first study (Bassetti et al., 2018), both groups performed similarly, with double letters being pronounced 38 to 39% longer than single letters, but in a later study with a larger sample size (80 intermediate learners compared to 80 highly proficient bilinguals, Bassetti et al., 2020), the bilingual group pronounced the double letters 33% longer while the learners produced them 58% longer than the single letters. However, even highly proficient bilinguals still showed an effect. This suggests that the orthographic effect is quite stable and due to an automatic activation of orthography. One important aspect of the bilinguals tested in those studies (Bassetti et al., 2020; Bassetti et al., 2018), however, is that their acquisition was based on high-school experience, in which orthography tends to take centre-stage. That is, the bilingual group learned English in Italian high schools before moving to England at the age of 18 (or later). Young-Scholten (2002), who only tested three English L1 participants learning German, argued that individual differences in orthographic influences on speech production in her sample arose due to exposure to written German. However, with only three participants, this cannot be considered more than a post-hoc suggestion rather than a decisive data point. Therefore, in the current study, we test whether an influence of orthography effect is found in a group of learners for which acquisition is accompanied by spontaneous interactions in the L2

from very early on. Such a sample can be found on Malta, where both English and Maltese are official languages, but Maltese is clearly the language that most learners learn as their first language (Vella, 2013). Even though some claim that English is becoming the primary language (Thusat et al., 2009), a recent survey by the National Council for the Maltese Language found that 97% of the respondents say that Maltese is their primary language (Il-Kunsill Nazzjonali tal-Ilsien Malti, 2021). Maltese is a Semitic language with many lexical borrowings from Italian and English through language contact, but still retaining a non-concatenative root morphology for Semitic words. Moreover, Maltese also distinguishes singleton and geminate consonants, which are signalled in orthography by a contrast between single and double letters (e.g., *daħak* /dɑħɑk/ Engl. 'to laugh' vs. *daħħak* /dɑħːɑk/ Engl. 'to make somebody laugh'). With regard to the use of single versus double letters, Maltese learners of English are therefore in a similar situation as Italian learners. However, a difference arises in how English is acquired. Maltese learners are exposed to English when they start going to school at the age of 5. The situation may be compared to the situation in Catalunya, where Spanish dominant learners are exposed to Catalan from kindergarten age onwards, which already leads to limitations on L2 phonological acquisition (Pallier et al., 1997). Nevertheless, since some speakers in Malta will use English spontaneously, learners are exposed to spoken language in a naturalistic setting from early on. This makes the situation clearly distinct from the Italian-English late bilinguals in the studies of Bassetti and colleagues (Bassetti et al., 2020; Bassetti et al., 2018). We therefore asked the question whether the effect of orthography as reported by Bassetti and colleagues for Italian learners also arises for Maltese learners of English. In doing so, we replicated the procedure from Bassetti (2017) with a delayed word repetition task with no orthographic prompt. In this task, participant first hear and repeat a phrase (e.g., "a pot and a kettle", see figure 1 for details). They then hear the same phrase with a missing word (e.g., "a pot and a...") and have to say three times which word is missing (i.e., "the word kettle is missing").

2 Method

2.1 Participants

Forty native speakers of Maltese participants recruited from the student population at the University of Malta took part in the study. They reported no hearing impairments or visual difficulties. The data from five participants were excluded because they failed to produce a sufficient number of valid responses. Four participants produced the wrong target sentence and replied with "The

missing words is ... " rather than "The word ... is missing". This is problematic because durations are then strongly influenced by utterance-final lengthening. One participant was rejected because only 60% of the utterances were correct, while all other participants scored over 70% correct responses. In the final data set, data from thirty-five participants (nineteen males and sixteen females; age: $M = 23.5$, $SD = 8.9$) were used. In a questionnaire given before the experiment, native speakers of Maltese reported English and Maltese, spoken and written, proficiency use on an average of 3.69 ($SD = 0.16$) on a scale from 1 (not proficient) to 4 (very proficient).

2.2 Materials

We used the same 18 items used in Bassetti (2017) and added 18 items, which were identified with a lexical search for pairs with the same vowel-consonant-vowel (VCV) sequence. As consonants, we looked for voiceless stops because those allow relatively straightforward segmentation in the acoustic signal and consequent measurement of duration. We looked for pairs in which the consonant was once written with a double letter and once as a single letter. Appendix A provides a list of all items, in which there are six pairs each for /p/, /t/, and /k/, including their frequency ('zipf'-scaled, see Heuven et al. (2014) in spoken and written language). Within each pair, the words had the same number of syllables, a comparable frequency in both spoken and written forms, and the critical consonants appearing in the same phonological environment, that is, in the same syllable and consequently same position with regard to stress and the same surrounding phonemes. Note that in Maltese, geminates are less phonologically restricted and can occur before glides (e.g., *nettjar*, Engl., 'netting'), so that pairs such as *acute-accuse* provide an environment where a geminate is legal in the participants' L1. For each target, we generated (or reused from Bassetti (2017)) a phrase in which the target was somewhat predictable (e.g., for *pepper* "oil, vinegar; salt and pepper"). These phrases were recorded by a female native speaker of Maltese English in two versions, a full version and a version with the target word missing.

2.3 Procedure

Participants first filled in an informed-consent form and then a short questionnaire about their use of English and Maltese at various stages in their life (0-6, 6-12, 12-17, adulthood). Then they were familiarized with the production task with two practice items outside the booth. When they indicated to have understood the procedure, they entered the sound-attenuated booth and performed the production task. In the booth, they first completed another test trial and then moved on to the 36 experi-

mental items.

On each trial (see [figure 1](#)) they first heard a phrase while seeing a related picture. They then were prompted to count backwards from five to one before repeating the phrase. The same counting procedure was used by Bassetti (2017) to reduce any influence from hearing the target word during exposure on the pronunciation in the test phrase. After counting backwards, they were prompted to repeat the phrase. Their performance was monitored by an experimenter who then decided whether their repetition was correct. If not, the exposure part was repeated (up to 5 times). After having repeated the phrase correctly, they again saw the picture and heard the phrase with one word missing. They were then prompted three times to name the missing word in the sentence frame “the word . . . is missing”. The order of the 36 items was randomized with the constraint that if one item of a pair appeared in the first half, the other appeared in the second half to minimize any demand characteristic. After the 36 experimental trials, participants did a dictation task, during which they heard the target words in a random order and had to write them down. An experimental session lasted about 25 minutes.

2.4 Apparatus and Equipment

The experiment was designed in PsychoPy v3.0.7 (Peirce, 2007). The participants were seated in a sound-proof booth, viewing the task through a monitor which was connected to the main computer, a standard PC, outside the experimental booth. The experimenter could listen to the participants’ responses and switch between trials using the space bar. All auditory tasks, such as response listening and voice recording, were done through Scarlett Studio 2i2 set, 2nd generation, including a headset, a microphone, and an audio interface that digitized the responses before storing them on the computer.

2.5 Data coding and analysis

The resulting sound files were automatically aligned using the Webmaus tool (Strunk et al., 2014). The resulting segmentations were hand corrected. While it was initially planned to measure closure duration (following Bassetti (2017)), initial attempts at coding revealed that Maltese speakers often produced a lenited fricative version of the phoneme /t/ (see, e.g., Mitterer et al. (2006), for a similar allophonic variation in Dutch). This made it impossible to measure closure duration (see [figure 2](#), where the closure duration would be zero, since no full closure is ever attained). Therefore, the duration of the obstruent was measured from either the onset of frication or closure to the onset of voicing for the following vowel. The resulting duration data were analysed using linear-mixed effect models in R4.0.4 (Team, 2020) us-

ing the package lmerTest (Kuznetsova et al., 2020). We used letter quantity as a treatment coded predictor, with singleton mapped on the intercept. Participant and Pair (i.e., the paired items, such as *weapon-pepper*) were used as random effects. As described below, we explored the effect of using various random-effect structures on the outcome of the analysis and also present some ANOVAs to further elucidate the effect of random slopes on the outcomes. All data and analysis files are available here: <https://osf.io/dzvfb/>.

3 Results

For the 35 participants in the final data set, with 3780 data points, 385 (10.2%) were rejected because the participant did not provide a correct response, or the response was too slow to be recorded in the recording time window¹. Another 192 trials (5.6%) were rejected because the participants failed to provide the correct response in the dictation task. For the remaining 3203 observations, the mean consonant duration was 101ms for single letter words and 105ms for double letter words. [Figure 3](#) shows the mean duration for single- and double-letters for participants and items with the grand means and within-subject standard errors (Morey, 2008) as error bars. There is a small lengthening effect that is relatively stable over participants but not over items. This interestingly is exactly the situation described by Clark (1973) when arguing for the need to take item variability into account. This is currently achieved using linear mixed-effects models (Baayen et al., 2008). As it turns out, the results also show the need for random slopes when using such models. [Table 1](#) shows the results of the models with and without random slopes. These results indicate that the inclusion of random slopes is necessary here. Without a random slope of quantity over pair, there seems to be a highly reliable effect of letter quantity. This analysis is in fact similar to a by-participant ANOVA on participant means. Indeed, such an analysis also provides an estimate that would indicate a significant effect of letter quantity ($F(1, 34) = 77.1, p < .001$). However, once a random slope for the quantity effect over item-pairs, no effect is observed anymore (just as in an by-item ANOVA, $F(1, 33) = 1.11, p = 0.306$). This indicates that the effect is highly variable over items, but not over participants. Given that there is no significant effect, it is important to consider what kind of effects are unlikely given the current data. The effect of a double letter is estimated at

¹Pretests had shown that the PsychoPy version used at time of testing was not storing recordings correctly if those were ended by a button press (e.g., by the experimenter). Therefore, a fixed recording time window of 3s was chosen that was long enough to contain the majority of the responses without making the procedure too slow for the participants.

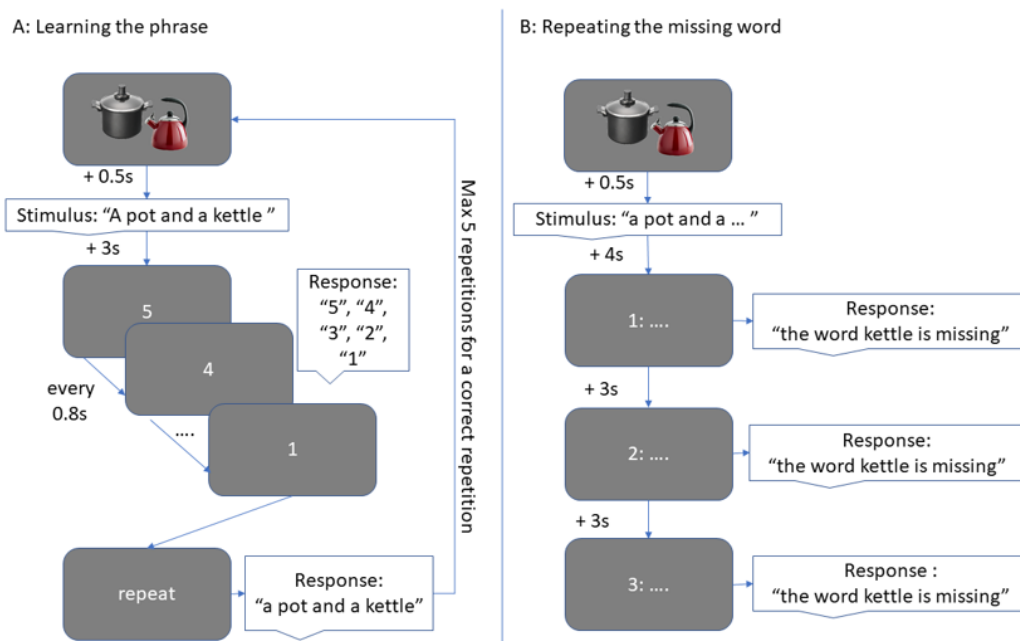


Figure 1: Schematic representation of a trial with a learning phase (left panel) and the test phrase (right panel).

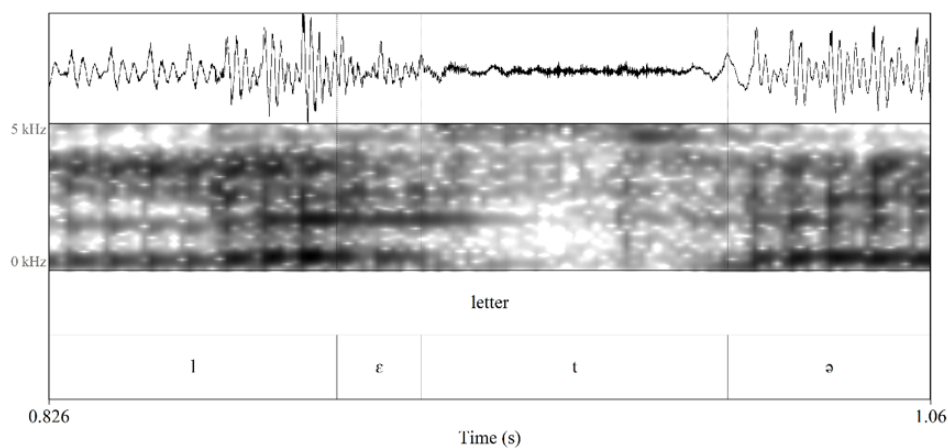


Figure 2: Example of a coded utterance with oscillogram and spectrogram for the item letter, in which no full closure is achieved for the /t/.

3.5ms with a standard error of 3. With an estimate of 18 degrees of freedom, the critical t -value is 2.11, meaning that the strongest elongation by a double letter in the confidence interval is 9.8ms. This is roughly 10% increase in duration (singletons are on average 101ms long), which is much less than the elongations of about 30-50% of elongation reported in the studies by Bassetti and colleagues (Bassetti, 2017; Bassetti et al., 2020). That indicates that the failure to find an effect is not due to a lack of power.

The variability by items was further investigated by examining the random slopes. Figure 4 provides a histogram of the item random slope for letter quantity, showing two items with a strong effect, it turns out that the two items that generate a clear effect in the expected direction are *broccoli* vs. *crocodile* and *opposed* vs. *proposed*. Importantly, in both cases, the double-letter word has a cognate in Maltese. With these items removed, the mean consonant duration for single- and double-letter items are nearly identical (single letters: 101.7ms, double letters: 102.0ms). It is worthwhile to consider whether the effect is moderated by speaker properties. We tested three potential variables, the amount of English spoken within the first 6 years of life, the self-estimated proficiency in written and spoken English. Amongst themselves, these were only moderately correlated (early English-spoken proficiency: $r = 0.31$, early English-written proficiency $r = 0.24$, spoken proficiency – written proficiency: $r = 0.54$), so that there are no issues with collinearity. The variables were normalized (i.e., z -scored) for this analysis (as suggested by Baayen et al. (2008)), so that the regression weight for letter quantity is representative for the values observed in the study. Table 2 shows the outcome of the analysis, with no moderation of the effect of quantity by proficiency.

4 Discussion

The current data show that Maltese speakers of English do not routinely use their L1 orthography-to-phonology rules when speaking English, unlike the Italian listeners in the studies of Bassetti and colleagues (Bassetti, 2017; Bassetti et al., 2020). As indicated above, the lack of an effect is not due to a lack of power. In the earlier studies, effects of 30-50% elongation were reported. Such effect would have been clearly significant with the current design, the confidence interval observed in this study makes effects of more than 10% unlikely. How do we explain the difference between the results with Maltese learners here and those of Bassetti et al. (Bassetti et al., 2020; Sokolović-Perović et al., 2020)? One obvious explanation would be that the Maltese group is more proficient in English than the Italian learners tested by Bassetti

and colleagues. However, this explanation has problems accounting for some aspects of the data. First of all, while Bassetti et al. (2020) found effects of proficiency, the contrast between participant groups in their study was drastic, comparing high-school children at around 17 years of age, who were “studying English for 3 hours a week as a compulsory school subject, using British English textbooks” (Bassetti et al., 2020) with Italian-English bilinguals that had lived in England for on average more than six years. This massive difference in language experience lowered the effect of orthography by only about one third (from 53% to 33% longer consonants for double letters). Based on this finding, it is difficult to see how much proficiency would be needed to push this effect down to zero. Moreover, within the Maltese group, there were some proficiency differences, but those did not influence the results. As such, it seems that Maltese English is acquired as a community language, and that even the more Maltese-dominant children get “pulled along” by those who use English more regularly (the use of English outside formal settings is highly variable in the Maltese community, see Vella (2013)). Since proficiency differences are hence unlikely to explain the differences between the results with Maltese and Italian learners, the best remaining explanation is that effects of L1 orthography on L2 phonology may be dependent on how the L2 is acquired. If acquisition is initially strongly based on the written modality, orthographic influences of the L1 are clearly observed and persist even when learners are immersed in the L2 for many years (Bassetti, 2017; Bassetti et al., 2020; Bassetti et al., 2018). However, if language acquisition early on includes spontaneous usage, as in Malta, such effects are apparently not observed, at least not consistently across items. As a consequence, the current data indicate that effects of orthography are not due to an automatic activation of orthographic knowledge, since this account would predict that the effect should also be found in Maltese learners of English. Instead, it is more likely that the effect comes about as early word learning for Italian learners is highly dependent on reading experience, which is not necessarily the case for Maltese learners. The current data, therefore, support the assumption that the processing of spoken language can proceed without the automatic activation of orthography (Hervais-Adelman et al., 2021; Mitterer et al., 2015; Viebahn et al., 2018). This does not mean that learning to read does not influence the processing of spoken language (Mishra et al., 2012), but that those influences may be mediated by learning rather than by an automatic activation of orthography during speech processing. In this context, it is useful to note that item effects were strong in the current study but negligible in the study of Bassetti and colleagues, with

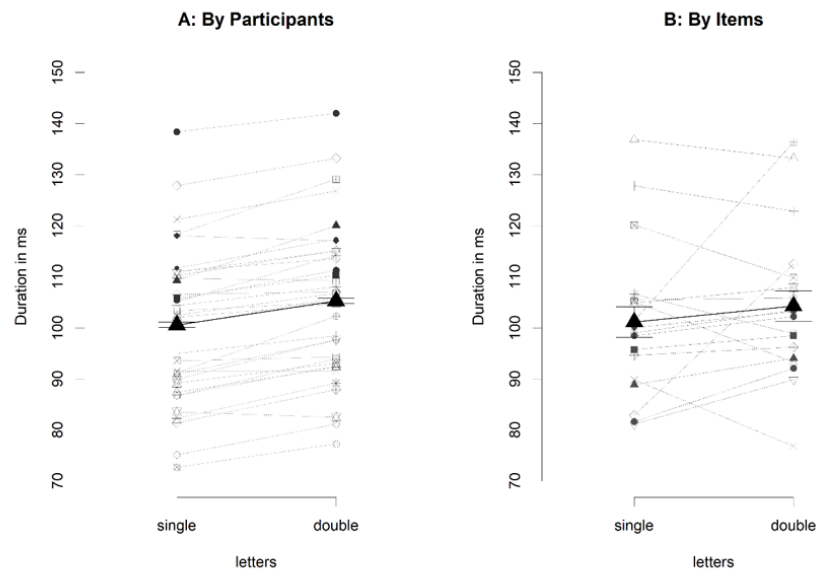


Figure 3: Mean duration for single-letter and double-letter words by participants (Panel A) and items (Panel B). The larger triangles represent the grand mean and the respective standard error for within-participant (or within-item) designs following Morey (2008).

| Model | $B_{\text{letters}}(\text{SE})$ | t | df | p | Model comparison |
|--------------------------|---------------------------------|-------|------|--------|-------------------------------|
| Random intercepts only | 4.1 (0.6) | 7.226 | 3152 | < .001 | |
| +Random slope by item | 3.5 (3.0) | 1.173 | 18 | 0.256 | $\chi^2(2) = 421.0, p < .00$ |
| +Random slope by speaker | 3.5 (3.0) | 1.162 | 18 | 0.261 | $\chi^2(2) = 0.8, p = 0.0670$ |

Table 1: Effect of the number of letters in different linear mixed-effects models with different random-effect structures.

| | B(SE) | t(df) | p |
|-----------------------------------|-----------------|-------------|---------|
| Intercept | 101.309 (4.279) | 23.674 (34) | < 0.001 |
| has2letters | 3.459 (2.977) | 1.162 (18) | 0.26 |
| ProficiencySpeaking | 2.639 (2.832) | 0.932 (35) | 0.358 |
| ProficiencyWriting | -1.707 (2.895) | -0.589 (35) | 0.559 |
| earlyEnglishUsage | 1.856 (2.573) | 0.721 (35) | 0.476 |
| has2letters : ProficiencySpeaking | -0.513 (0.66) | -0.777 (34) | 0.443 |
| has2letters : ProficiencyWriting | 0.962 (0.687) | 1.401 (36) | 0.17 |
| has2letters : earlyEnglishUsage | -0.725 (0.603) | -1.202 (35) | 0.237 |

Table 2: Output of the linear mixed-effects model with English proficiency measures as co-variates.

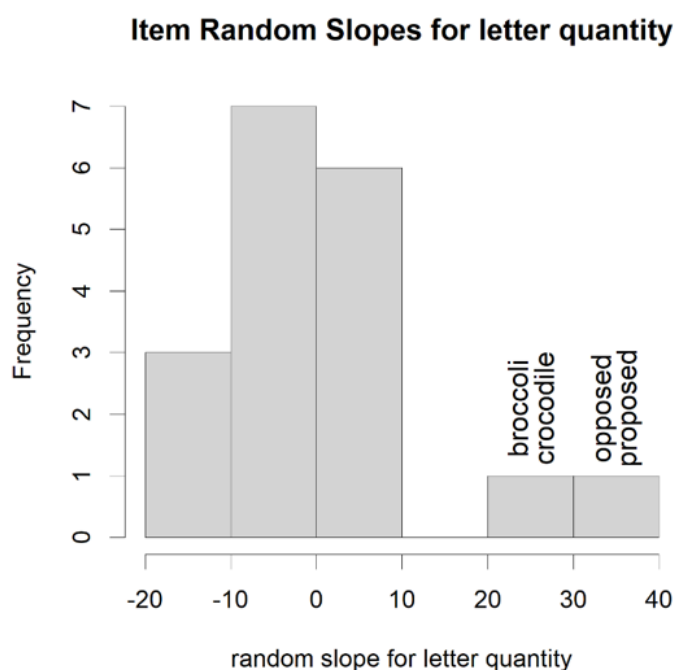


Figure 4: Histogram of the random slopes of the letter-quantity effects for the 18 item pairs.

item and participant-analysis always agreeing with each other. Moreover, random slopes in Bassetti et al. (2020) over item pairs were taken out of the model since they were not supported by the data. This indicates that the large item variability found here may also be specific to the Maltese situation. There are two things to consider in this context. First, the data structure here replicates closely those “made-up” data structures in publications that argue that participant and item variability must be taken into account (Barr et al., 2013; Clark, 1973). On those made-up data sets, one item usually has a strong effect while all others do not. Because each participant is exposed to this item, participants’ means are likely to reflect an effect and all participants show an effect quite consistently. While such scenarios may seem unlikely and the examples provided by, for instance, Clark (1973) may seem exaggerated, the current study shows that such examples are in fact realistic and underscore the need to consider both participant and item variability in a statistical analysis (Westfall et al., 2014). Secondly, we find an effect on two items for which the double letter parts of the pairs have cognates in Maltese. This effect might potentially be explained by current theories on lexical selection in bilinguals. There is a general consensus that words are activated non-selectively in bilingual speakers (Dijkstra et

al., 2002; Lauro et al., 2017), that is, when trying to name an apple, a Maltese-English bilingual are likely to also activate *tuffieħa*, the respective word in Maltese. It is likely that this co-activation may then influence production, especially as the claim that bilingualism leads to an advantage in conflict monitoring remains controversial (de Bruin et al., 2015; Duñabeitia et al., 2014; Lowe et al., 2021). Given that this is a post-hoc observation, however, we need to be careful to draw strong conclusions, but these data at least suggest that the influence of the L1 on the L2 may be partly moderated by cognate status. This is an avenue for further research. To summarize, the current study tested the influence of L1 orthography on the phonological processing of the L2 in a situation in which the acquisition of the L2 is accompanied by spontaneous usage outside the classroom from early on. In contrast to earlier reports that L1 orthography influences the acquisition of an L2, no such effect was found here. It is therefore argued that orthographic influences in L2 acquisition are not automatic but may be tied to the type of acquisition of the L2.

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Appendices

| Item | Sentence | Frequency in | | | |
|------------|---|------------------|--------------------|----------------------|---------------|
| | | All BBC programs | Preschool programs | School-kids programs | BNC (written) |
| Acute | We both felt an acute pain. | 3.66 | 2.23 | 3.42 | 4.36 |
| Accuse | I don't want to accuse anyone. | 3.58 | 2.23 | 3.26 | 3.56 |
| Document | Please look at this document here. | 4.18 | 2.53 | 3.19 | 4.72 |
| Occupy | How do you occupy your time? | 3.55 | 2.23 | 3.07 | 4.02 |
| Nicaragua | I have friends from Peru and Nicaragua. | 2.58 | 2.23 | 2.47 | 3.68 |
| Piccadilly | An expensive shop near Piccadilly Circus. | 3.29 | 2.23 | 2.34 | 3.50 |
| Weapon | This is a very ancient weapon. | 4.29 | 2.93 | 4.59 | 4.29 |
| pepper | Salt and pepper, oil and vinegar. | 4.38 | 4.68 | 4.21 | 3.98 |
| Rapidly | Nowadays the world is rapidly changing. | 4.01 | 2.53 | 3.51 | 4.66 |
| Happily | A group of happily married couples. | 4.11 | 4.41 | 4.18 | 4.25 |
| Copy | Could I please have a copy? | 4.38 | 4.66 | 4.62 | 4.78 |
| Floppy | Take a CD or a floppy. | 3.31 | 4.18 | 3.72 | 3.71 |
| Latin | She studies Greek and Latin poetry. | 4.20 | 3.57 | 4.26 | 4.44 |
| Chatting | She is chatting on the phone. | 4.03 | 3.97 | 4.00 | 3.79 |
| City | They both work as city lawyers. | 5.40 | 5.30 | 5.03 | 5.36 |
| Kitty | My god, a Hello Kitty room. | 4.02 | 4.23 | 4.40 | 3.59 |
| Vitamins | This drink contains vitamins and sugar. | 3.35 | 3.41 | 3.65 | 3.68 |
| Littering | No littering, take your litter home. | 2.83 | 2.53 | 3.21 | 2.64 |
| Sweater | Jeans and a sweater | 3.24 | 3.63 | 3.38 | 3.78 |
| Letter | number and letter | 4.85 | 4.87 | 4.82 | 5.13 |
| Broccoli | carrots, peas, and broccoli | 3.71 | 4.09 | 4.05 | 3.13 |
| Crocodile | He went to see the Nile crocodile | 3.95 | 4.86 | 4.52 | 3.41 |
| Apple | Banana and apple | 4.58 | 5.08 | 4.62 | 4.42 |
| Chapel | There was a church and a chapel | 4.06 | 2.23 | 3.28 | 4.33 |
| Kettle | A pot and a kettle | 4.02 | 4.37 | 4.05 | 3.96 |
| Metal | He used wood and metal | 4.63 | 4.67 | 4.69 | 4.66 |
| Mitten | In winter, wear scarf, mitten, and hat | 2.43 | 3.19 | 2.77 | 2 |
| Britain | It's rainy in Britain | 2.56 | 3.19 | 3.01 | 2.59 |
| Piccolo | He played trombone, piccolo, and trumpet | 3.06 | 2.23 | 2.34 | 3.26 |
| Nicotine | Caffeine and nicotine | 2.57 | 2.71 | 3.37 | 2.04 |
| Raccoon | A trashcan with raccoon alarm | 2.84 | 3.66 | 3.26 | 3 |
| Cocoon | First larva then cocoon | 4.25 | 2.53 | 2.82 | 4.92 |
| Proposed | Last Saturday, he proposed | 4.3 | 2.23 | 3.47 | 4.42 |
| Opposed | His argument was opposed | 4.88 | 4.83 | 4.83 | 4.81 |
| Proper | His attire was proper | 4.25 | 3.41 | 3.85 | 4.27 |
| Copper | There was silver, copper, and gold | 4.66 | 4.72 | 4.61 | 4.9 |

Note: Frequencies are zipf-scaled (see Heuven et al. (2014)).

Table 3: The items used in the experiment.



Research Article

Green Organic Synthesis via Multicomponent Reactions

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Abstract. The success of the modern pharmaceutical industry is largely due to the remarkable achievements of organic synthesis over the last century. However, many of these reactions were developed at a time when the toxic properties of many reagents and solvents were not known and waste minimisation and sustainability were not significant issues. By the latter half of the 1980s, the worldwide chemical industry knew that it had to clean up its act: its environmental reputation was terrible. In the past two decades, the Green Chemistry movement has helped industry become much cleaner. Green chemistry efficiently utilises (preferably renewable) raw materials, eliminates waste, and avoids the use of toxic and/or hazardous reagents and solvents in the manufacture and application of chemical products. There are several ways in which organic synthesis can be carried out in line with the Green Chemistry principles and, among these, multicomponent reactions under green conditions prove to be useful and versatile tools. Recent examples of applications will demonstrate the molecular diversity that can be obtained from this green synthetic approach.

Keywords: Green chemistry, organic synthesis, heterogeneous catalysis, one-pot multicomponent reaction

to the design, manufacture and application of chemical products. This is by no means an easy task, as most chemicals are not benign, making the development of a fully “environmentally-friendly” process practically impossible. Therefore, in order to reduce the environmental impact caused by chemical processes, rather than trying to only achieve the perfect environmentally-benign synthesis, twelve guiding principles were developed in order to facilitate chemists in designing more sustainable chemical processes (Anastas et al., 2010). The fundamental idea behind green chemistry is the awareness that it is better to prevent waste than to treat or clean up after it is formed, as specified in the first and most important of the twelve principles (Anastas et al., 1998). Quite recently, Paul T. Anastas and Julie B. Zimmerman published an alternative “Periodic Table” highlighting key elements present in Sustainable and Green Chemistry (Anastas et al., 2019). This format was an interesting approach towards explaining the multifaceted nature of Green Chemistry. In fact, the table summarises the general approaches taken in green chemistry and engineering into element-group type categories and includes humanitarian aspects, which reveal the more sustainable tomorrow towards which human society is generally striving for.

1 Introduction

1.1 What is Green Chemistry?

In the 1980s and 1990s, several environmentally conscious terms entered the chemical arena. Specifically, after Anastas and Warner's contributions in 1998, the use of green chemistry has clearly been growing rapidly in a linear fashion (Linthorst, 2010). Green Chemistry can be generally described as “the design of chemical products and processes to reduce or eliminate the use and generation of hazardous substances” (Anastas et al., 1998). Rather than a separate field of chemistry, Green Chemistry is a philosophy, a way of thinking which should be applied

1.2 Why Green Chemistry?

This issue of environmental protection and sustainable development has been gathering awareness since the late years of the 20th century, initially starting from Rachel Carson's *Silent Spring* which highlighted the detrimental effects caused by the release of pesticides in the environment (Carson et al., 1962). This spark set in motion the development of various policies and practices, such as USA's Pollution Prevention Act in 1990, which emphasized the environmental and economic urge to adopt the policy of pollution prevention instead of end-of-pipeline control (Congress, 1990). It became clear that a paradigm shift was needed in industrial organic synthesis

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from traditional concepts of reaction efficiency and selectivity, that focus largely on chemical yield, to one that assigns value to raw materials utilisation, elimination of waste and circumventing the use of toxic and/or hazardous substances. More than 50 years later, the general goal has shifted towards the development of a more sustainable future, with the United Nations outlining 17 Sustainable Development Goals in the 2030 Agenda for Sustainable Development. Goal 9 in particular states the need to: “*Build Resilient Infrastructure, Promote Inclusive and Sustainable Industrialisation and Foster Innovation*” (Nations, 2021). This goal directly specifies the need to innovate as it is the main driver which allows understanding and development. However, the means by which innovation is met also has to be sustainable itself (Anastas et al., 2018). One could say that sustainability is our ultimate common goal and green chemistry is a means to achieving it (Sheldon, 2000).

1.3 Green metrics—a way to measure the reaction environmental benignity

One very important aspect of Green Chemistry is the use of certain metrics which can quantify how environmentally-benign a given chemical process is and allow comparisons to be made between different methods. The E-factor is one of the most widely used metrics as it quantifies the amount of waste generated relative to the amount of product produced in a chemical process (equation 1) (Sheldon, 2007). The higher the E-factor, the more waste is generated, ergo meaning that in green chemistry the aim is to always keep the E-factor as low as possible. This concept is particularly illuminating in organic synthesis, as the metric that in the past was generally regarded as important was the overall reaction yield, with high yielding reactions implying efficient conversion of the limiting organic substrate. However, the reaction yield does not consider the consumption of excess reagents, organic or inorganic, which end up being wasted at the end of the reaction. Meanwhile, the E-factor does take into account all the waste generated which includes by-products, excess reagents and any chemicals required for work-up and which are ultimately discarded as waste. The E-factor can be lowered only if certain “waste materials” are recycled or repurposed for other uses. This can be put in practice by opting for fully recyclable catalysts and trying to convert by-products into raw materials for other processes. It is also interesting to note that such a case can be made for solvents, which can be mostly recovered using distillation processes in certain circumstances.

Another important measure used in Green Chemistry is the Atom Economy (AE) metric, which can be defined as the proportion of reagent atoms which are incorporated

$$\text{E-Factor} = \frac{\text{Mass of waste (kg)}}{\text{Mass of product (kg)}}$$

Equation 1: The Environmental Impact Factor—A green metric which quantifies the amount of waste generated in the production of 1 kilogram of product.

$$\text{Atom Economy} = \frac{\text{RMM}_{\text{product}}}{\sum \text{RMM}_{\text{reagent}}} \times 100$$

RMM = Relative Molecular Mass

Equation 2: Atom Economy—A green metric which quantifies the proportion of reagent atoms which are incorporated in the final product.

in the final product (equation 2) (Trost, 1991).

The metric quantifies how efficient a reaction is in terms of incorporating raw material atoms into the desired product. A higher atom economy is preferred as it implies a more efficient use of the starting reagents. In truth there are other green metrics which exist apart from the two aforementioned terms. Yet, the ease and simplicity with which the E-factor and AE metrics can be determined, makes them more generally used.

1.4 Multicomponent reactions

Multicomponent Reactions (MCRs) can be defined as reactions that combine three or more reagents in the same reaction pot to yield one main product (Zhu et al., 2014). As illustrated in figure 1, these types of reaction are different from typical linear synthetic reactions whereby reagents are added sequentially in to form a final product. Instead, they have a convergent nature whereby different reactions occur in parallel and intermediates combine to form the final product. However, MCRs are more efficient when compared to typical convergent synthesis. Whereas the reactions in a convergent synthetic pathway typically occur under separate conditions, the reaction steps in an MCR occur in the same pot, thus avoiding the need to isolate and purify any synthetic intermediates.

A large number of MCRs have been developed over the years, all furnishing diverse products. This allows MCRs to be powerful tools in modern-day drug discovery, due to ease with which a wide-variety of structurally similar compounds containing privileged scaffolds can be generated (Kalinski et al., 2010). MCR innovation is one of the current developments in these types of reactions. One of the most common techniques employed is the single reactant replacement (SRR) approach, whereby one of the starting reagents is replaced with a different functionality that mimics some of its chemical properties (Ganem, 2009).

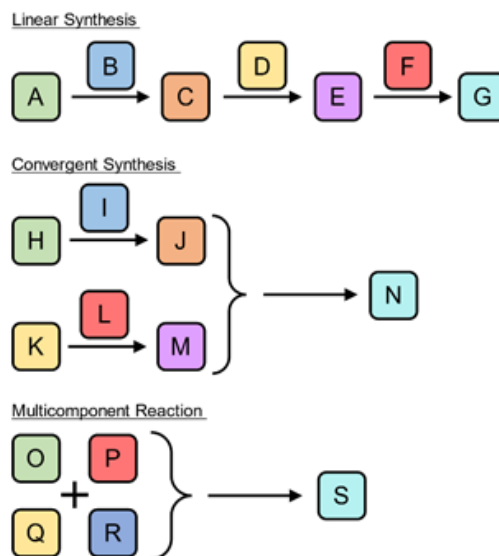


Figure 1: Schematic representation of linear synthesis, convergent synthesis and multicomponent reactions.

There are also many advantages associated with MCRs in the context of Green Chemistry (Cioc et al., 2014). The “one-pot” nature of these systems greatly reduces the need of auxiliary solvents and chemicals that would be required in the isolation and purification of intermediates. MCRs also typically consist of addition and condensation steps, which have high atom economies. Hence, this implies more efficient use of raw materials and reduced waste generation. The combination of three or more reactants in a single reaction also generates a product with a larger molecular weight (and different functionalities) compared to its precursors and by-products. These factors contribute to differing solubilities and opens up the possibility for purification via recrystallisation rather than chromatography or distillation, which in turn makes use of less solvents and auxiliary chemicals. More so, well-established MCRs typically exhibit a high degree of chemo- and regioselectivity, further reducing the need for derivatising steps and the use of blocking groups.

1.5 Solvents in green synthesis

Solvents play important roles in synthetic organic chemistry. Apart from facilitating reaction progression via reagent solvation, the appropriate solvent can also favour certain reaction mechanisms rendering certain synthesis more viable. However, from a Green Chemistry perspective, solvent use can be problematic principally because it results in significant levels of waste generation. Furthermore, since commonly used solvents are volatile, environmental containment is difficult and workers are more exposed during use. In light of this, there has been significant focus on decreasing the hazards and environmental

impact caused by solvents. One general approach involves switching to less harmful solvents whenever possible (Alfonsi et al., 2008). More modern approaches involve using greener solvents. An alternative tactic is actually not using a solvent at all and running the reaction neat (Zangade et al., 2019). This can be done if some of the reagents are liquids under conventional heating conditions, although this technique can also be coupled with the use of alternative energy-transferring mechanisms (Sainath et al., 2019).

1.6 Heterogeneous catalysts preferred to homogeneous ones

The use of catalysts over stoichiometric quantities is fundamental in Green Chemistry, with the main aim being to further reduce the waste generated in a reaction (Anastas et al., 2001). A catalyst can be loosely defined as a chemical which participates and speed up a reaction but is ultimately chemically unaltered. This should, in principle, allow the catalyst to be recycled for further runs, thereby further minimizing the waste generated. However, catalyst recycling can be a laborious and energy-intensive process if the catalyst in question is homogeneous in nature, as it would probably require the use of other solvents and materials to isolate and reuse. This is where employing a heterogeneous catalyst becomes advantageous, as it allows the catalyst to be easily separated from the reaction mixture through filtration, which allows for easier catalyst recycling and reaction quenching. The nature of heterogeneous catalysis must also be discussed as the difference between homogeneous and heterogeneous catalysts is not as clear cut as it might seem. This argument applies

especially for catalysts consisting of a catalytic species immobilised onto a heterogeneous support. Sheldon described three main scenarios that can occur (Sheldon et al., 1998):

1. The active species remains bound to its support throughout the duration of the reaction, making the catalysis observed truly heterogeneous or,
2. The active species leaches but does not act as a homogeneous catalyst or,
3. The active species leaches and acts as a homogeneous catalyst.

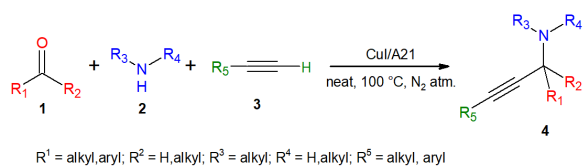
The presence of these three potential scenarios brings about the need for determining whether the catalyst is truly heterogeneous in nature and whether catalytic leaching occurs throughout the course of the reaction. A number of different tests have been developed, which can be used to determine which scenario is present, with one of the most commonly used being the Sheldon hot filtration test, which determines whether the catalyst is truly heterogeneous in nature or not (Crabtree, 2012). A wide variety of heterogeneous catalysts have been employed over the years, either directly as reagents or as supports for active catalysts. These range from clays and zeolites (Varma, 2002) to functionalised polymer resins such as Amberlyst A-15 (Kuchukulla et al., 2019; Yadav et al., 2007) and Amberlyst A-21, naturally-derived supports such as chitosan (Bodhak et al., 2015), metal organic frameworks (MOFs) (Pascanu et al., 2019), and even magnetic nanoparticles (MNPs) (Abu-Dief et al., 2018). Each support has its own advantages and special properties, ranging from increased porosity, stability, functionality, versatility, handling and ease of recovery (particularly in the case of MNPs). But the common theme between all these examples remains the ease with which they can be recycled, which in turn further contributes towards making synthesis more environmentally-benign.

1.7 Bosica et al. and research in green synthetic chemistry via MCRs

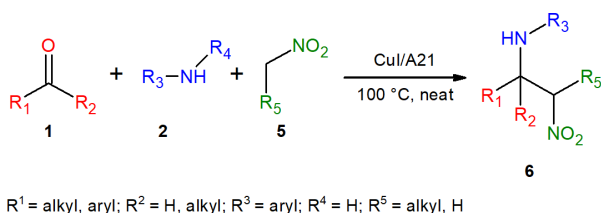
Organic synthesis needs to go hand in hand with the pillars of green chemistry (waste prevention, renewable feedstock, catalysis, alternative solvents, less toxic and safer reaction conditions, energy efficiency, and synthetic efficiency) especially since it plays a critical role in the preparation of functionalized products with special physical, chemical, and biological utilities. Synthetic efficiency is particularly important because it is not only driven by the green chemistry considerations but may also have huge economic benefits. One-pot organic reactions are important methods to achieve high synthetic efficiency. As described in the previous section, there are different tools

that can be employed in order to make a particular synthesis greener. The research group led by Prof. Bosica has recently made a shift towards investigating certain MCRs and improving on existing protocols by modification of the substrates, hence expanding their versatility and making them more environmentally friendly via the use of heterogeneous catalysts and either solventless conditions or green solvents. The work focuses on applying green chemistry principles in the development and improvement of one-pot multicomponent reactions. Over a variety of projects, the group is applying the idea of single reactant replacement (SRR) which involves the replacement of one of the reactants by a related one which may or may not have a similar role in the overall mechanism of the reaction. As a general approach, a number of heterogeneous catalysts are screened on a model reaction, followed by a reaction optimisation whereby the most ideal conditions are determined by altering certain reaction conditions such as catalytic quantities, reaction temperature and solvents. The model reaction is also studied extensively by using GC analysis in order to understand the mechanism by which it is proceeding. The robustness of the developed procedure is then assessed by systematically altering the starting reagents to expand the scope of the reaction protocol. A number of green metrics are also calculated to quantify how “green” the reaction is, whilst recycling tests are carried out in order to determine to what extent the catalyst can be re-used after recovery. Scheme 1 shows one of the earliest MCRs tackled by this group i.e. the synthesis of propargylamines via the A^3 coupling reaction (Bosica et al., 2015), as well as its similar counterpart, the KA^2 coupling reaction (Bosica et al., 2017). Whilst the reaction itself had already been previously reported, the novelty in the developed protocol was the application of copper(I) iodide supported on Amberlyst A-21; a heterogeneous catalyst with both Lewis acidic and basic properties. In both cases, the reaction was also carried out under solventless conditions, further reducing the use of solvent in the overall process. In both studies a plethora of products were obtained in excellent yields and in relatively short reaction times. Furthermore, under the developed protocol, the reaction showed a high Atom Economy of 95%, a low E-factor of 0.3, and appreciable catalyst recyclability potential (catalyst could be reused in six consecutive trials in case of the A^3 and for four times in case of the KA^2 coupling).

This $CuI/A21$ catalyst was also applied in another MCR investigated, namely the nitro-Mannich reaction (scheme 2) (Bosica et al., 2018b). In order to arrive at this reaction, the SRR approach was applied, with the nitroalkane replacing the ketone owing to its similar chemical reactivities i.e. the presence of acidic α -hydrogens.



Scheme 1: Synthesis of propargylamines via the A³ or KA² coupling reaction in which substrate 1 is an aldehyde or a ketone respectively.



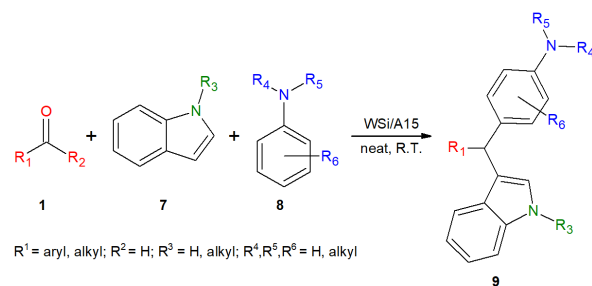
Scheme 2: Synthesis of β -nitroamines via the nitro-Mannich reaction.

Thus, the scope was to investigate a less well-known MCR and optimize it under heterogeneous catalysis and solventless conditions.

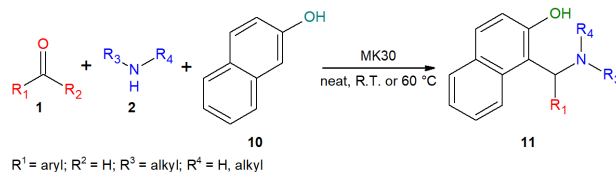
Once again, the recyclability and stability of the catalyst indicated consistent performance with a reduction of only 10% of the original yield over eight cycles and the loss of only 1% (by mass) of copper content. The green metrics results of this reaction were also highly praised with a high atom economy of 93% and a low E-factor of 1.26. Furthermore, the reaction showed a broad scope of reactants and the group was able to synthesize over twenty-five novel products in moderate to high yields.

Another example of investigating an MCR variant is shown in [scheme 3](#), whereby a green protocol was developed for a modified aza-Friedel-Craft reaction (Bosica et al., 2017). Noteworthy, in an unprecedented approach, three types of anilines (primary, secondary and tertiary) all were reacted successfully with the other two components of the reaction, ergo indoles and aldehydes to generate 3-substituted indoles. Solventless conditions were likewise employed, and the reactions proceeded under ambient conditions, making them energy efficient. Similar to the above studies, the catalyst used, silicotungstic (WSi) acid immobilised on Amberlyst A-15 beads, was heterogeneous in nature.

The protocol developed was especially renowned because for the first time it was reported that primary anilines gave excellent yields under neat conditions with a heterogeneous catalyst. More importantly, while pre-



Scheme 3: Modified aza-Friedel-Crafts reaction employing primary, secondary and tertiary anilines (9)



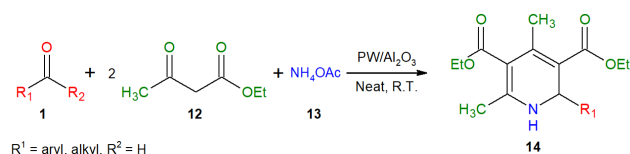
Scheme 4: The Betti synthesis reaction catalysed by MK30 clay in neat conditions.

vious publications highlighted alternative product formation when utilising tertiary amines, in this study, all the reactions involving primary, secondary, and tertiary anilines proceeded regio-selectively. Lastly, the catalyst was fully and easily recoverable (due to its physical spherical nature) and recyclable up to 5 times with the yield only decreasing by 10%.

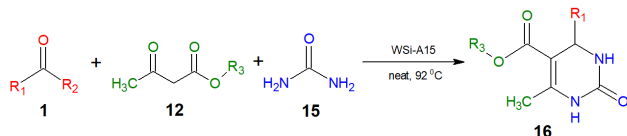
[Scheme 4](#) shows a modified Betti synthesis which was optimised under heterogeneous catalysis and solventless conditions (Bosica et al., 2018a). In this case, the ammonia reagent present in the original Betti reaction was replaced with a secondary amine instead. An acidic clay catalyst, Montmorillonite K-30, was employed.

The resulting E-factor and atom economy were 3.92 and 94% respectively. As part of the study, the library of products obtained from the scope of reaction were tested for pharmacological applications. Impressively, a number of products manifested anti-proliferative activity prompting further research of the respective Betti bases as privileged scaffolds in tryptophan mimetics in blocking the solute carrier transporter SLC6A14 (Puerta et al., 2019).

More recently, a modified version of the Hantzsch synthesis was optimised under green conditions ([scheme 5](#)) (Bosica et al., 2020). Whilst the classical Hantzsch reaction tends to furnish 1,4-dihydropyridine products, the use of certain conditions was noted to result in the formation of the 1,2-dihydropyridine regioisomers as the main product instead. Indeed, this variation was investigated, with phosphotungstic acid (PW) immobilised on alumina



Scheme 5: Modified Hantzsch synthesis resulting in the formation of 1,2-dihydropyridine derivatives (14)



Scheme 6: The Biginelli synthesis catalysed by silicotungstic acid supported on Amberlyst 15

in solventless conditions at room temperature proving to be the ideal catalyst and conditions.

Silicotungstic acid, a heteropoly acid structurally similar to phosphotungstic acid, was supported on Amberlyst-15 beads and used successfully as a heterogeneous catalyst for the Biginelli reaction under solventless conditions (scheme 6). The three-component Biginelli reaction involves the combination of an aldehyde, a β -ketoester and urea to produce 3,4-dihydropyrimidin-2(1H)-ones, also known as DHPMs. The synthesis of these products is highly important due to their myriad of medicinal properties, amongst them acting as calcium channel blockers and antihypertensive and anti-inflammatory agents.

The catalyst was fully recoverable and reusable for up to five runs and the heterogeneity of the reaction was confirmed by carrying out a hot filtration test (Bosica et al., 2021). Again, a high atom economy of 87% and a low E-factor of 0.95 highlighted the greenness of the procedure.

2 Conclusion

Green chemistry emerged in the 1990s to address the increasing number of health and environmental issues caused by hazardous chemicals and materials. Their toxicity was either not considered or undervalued and sometimes even just simply ignored. The use and development of MCRs in the future must not be underestimated as they represent a truly viable solution for more sustainable synthesis. The general approach taken by Prof. Bosica research group is to optimize certain less-investigated variations of known MCRs or to develop new ones whilst always aiming for environmentally-benign conditions. At the heart of the strategy, the best heterogeneous catalyst for the reactions is identified on the basis of recyclabil-

ity, cost, yield of the product and rate of reaction. The catalysts can be either found commercially as Montmorillonite clay or synthesised in the lab as in the case of Amberlyst-21-immobilised copper(I) iodide. Therefore, a particular emphasis is being placed on the use of heterogeneous catalysts due to their recyclable nature, with the advantages of being easily separated from reaction mixtures, having high catalytic activity, not requiring hydrolytic workup and solvent extraction, and last but not least being easier to handle and causing less risk to human beings.

3 Acknowledgements

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