An Australian Government Initiative

Women in STEM Ambassador

MAKING RESEARCH APPLICATIONS ANONYMOUS

RESEARCH BRIEF

A boost for early-career researchers while preserving pre-existing gender equity

UNSW SYDNEY

womeninstem.org.au

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EXECUTIVE SUMMARY

We led a trial across Australia to study the effects of anonymising applications for the use of specialised scientific equipment. The twofold purpose of the study was to observe the degree and existence of disparities, and to evaluate how anonymising applications would affect application scores, success rates and resource allocation based on the gender and career seniority of the lead researcher.

The trial involved four cross-disciplinary research entities that manage access to national scientific facilities:

- *Anglo-Australian Telescope* (AAT)
- *Australian Centre for Neutron Scattering* (ACNS)
- *Australia Telescope National Facility* (ATNF)
- *National Computational Merit Allocation Scheme* (NCMAS)

The entities implemented anonymisation differently. AAT, ACNS, and NCMAS required applicants to anonymise their applications by excluding names and affiliations in the application text, using third-person language, and providing team expertise and background in a separate document. ATNF applied 'semi-anonymisation' by using first initials and surnames for names, removing affiliations, shifting the applicant list to the last page, and arranging it alphabetically to conceal the lead investigator's identity.

We modelled the data from each entity individually to make allowances for the differences in implementing anonymisation. We accounted for factors such as the career seniority of the lead investigator and the type of program features where the entities provided those data. We then conducted a meta-analysis to explore the overall effects of anonymisation across all four entities.

KEY FINDINGS

The introduction of anonymisation boosted the success rates for applications led by early-career researchers at ACNS, irrespective of the applicant's gender. Before anonymisation, there were no differences in success rates according to career seniority at ACNS and NCMAS, the two entities for which career seniority data were available. At ACNS only, anonymisation increased the success rates for early-career researchers, while success rates for more senior-career researchers decreased.

In gender-related outcomes, there was a noteworthy absence of gender differences in application scores, success rates and allocated resources before anonymisation at all four entities. The introduction of anonymisation generally maintained the existing gender equity landscape, with one organisation experiencing improved success rates for women-led applications. At AAT only, anonymisation elevated women's success rates, with higher success rates for women-led than men-led applications after anonymisation.

CONCLUSIONS

Anonymising applications for scientific equipment opens doors for early-career researchers, enhancing their chances of success. Since no prior gender gap existed, anonymisation would not be expected to impact gendered outcomes. Our results confirm this.

The implications extend beyond application outcomes, which represent one only piece of the puzzle that contributes to inequity in STEM research[1]. By enhancing success rates for early career researchers, anonymisation may create a positive ripple effect in the career pipeline, diversifying the research pool, and supporting the broader issue - retaining and advancing researchers facing barriers in STEM research.

Future research examining cultural, racial, and other biases will be key to refining equity efforts in the STEM research sector.

INTRODUCTION

Worldwide, gender disparities in the outcomes of competitive grant programs exist. However, the evidence is mixed, and the nature and source of these differences remain unclear[2–5]. These disparities are particularly evident in science, technology, engineering, and mathematics (STEM) research fields[1]. Some evidence suggests that the trend is partly due to implicit biases against women and other marginalised groups in grant application assessment processes[6–10].

Anonymising applications for access to scientific equipment has been shown to reduce existing bias[11,12] - for women, early-career researchers and other marginalised groups[11]. Specifically, in the astronomy and planetary science sector, anonymising applications for telescope access reduced existing gender gaps by increasing the scores[12] and success rates[11] for women-led applications. Equity benefits are not only limited to gender. Some research found that concealing the lead investigator within a randomised list of team members in one cycle, and anonymising applications in the next, led to higher success rates for early-career researchers. However, it did not impact on gendered outcomes[13].

Adverse effects of anonymisation have also been observed outside of the research sector. A study conducted in the Australian public service revealed that anonymising job applications inadvertently *lowered* the employment shortlisting chances of women, Indigenous, and other racial/ethnic minorities whilst simultaneously increasing the chances for men - eliminating favourable chances for these before anonymisation[14].

WHY WE DID THIS STUDY

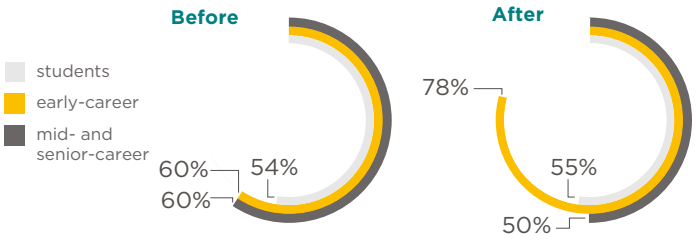
We aimed to bring clarity to the mixed evidence on the effectiveness of anonymisation to advance equity and diversity, specifically for applications from scientists to use Australian national scientific facilities. The goal was to assess the impacts of anonymisation on application outcomes according to lead investigator gender and accounting also for career seniority. We also aimed to broaden the research to include fields outside of astronomical and planetary sciences to extend the evidence on this topic.

ABOUT US

The Women in STEM Ambassador initiative was launched by the Australian Government in 2018 with the appointment of the inaugural ambassador, Professor Lisa Harvey-Smith. The Women in STEM Ambassador and her team conduct research, create resources and engage with stakeholders, including government, industry leaders, students, educators and research funding bodies. The work of the Ambassador supports and informs the STEM sector to make coordinated, research-backed efforts to improve equity.

SUMMARY AT A GLANCE

The Office of the Australian Government's Women in STEM Ambassador led a trial across Australia to study the effects of anonymising applications for using specialised scientific equipment. The study focused on how this change would affect application scores, success rates and resource allocation, based on the gender and career seniority of the lead researcher. Four research organisations that manage access to national scientific equipment participated: AAT, ACNS, ATNF and NCMAS[i]. Each organisation implemented anonymisation differently, with ATNF using semi-anonymisation.



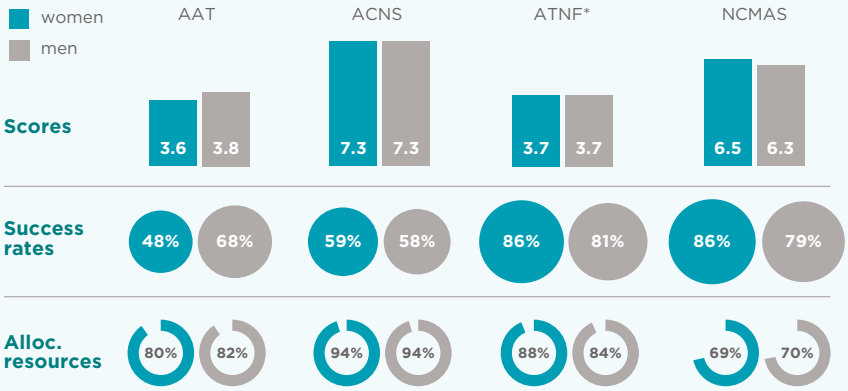
IMPROVED EARLY-CAREER RESEARCHER OUTCOMES

Anonymisation statistically significantly boosted the success rates for applications led by early-career researchers at ACNS, irrespective of the applicant's gender.

GENDER BEFORE ANONYMISATION

NO PRIOR GENDER GAPS

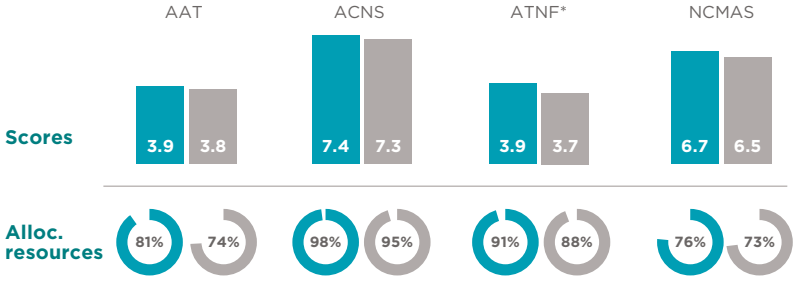
Before anonymisation, there were no statistically significant gender differences in application scores, success rates and allocated resources across all four research organisations.



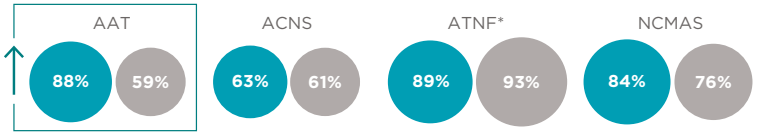
GENDER AFTER ANONYMISATION

GENDER EQUITY MAINTAINED

The existing gender equity in scores and allocated resources prior to anonymisation was not statistically significantly impacted by anonymisation.



** The ratio of resources granted to successful applications compared to the amount initially requested.



IMPROVED WOMEN'S SUCCESS RATES AT AAT

Anonymisation notably elevated women's success rates at AAT, with statistically significantly higher success rates for women-led than men-led applications.

Anonymising applications for scientific equipment opens doors for early-career researchers, enhancing their chances of success. Since no prior gender gap existed, anonymisation would not be expected to impact gendered outcomes. Our results confirm this. As we look to the future, examining cultural and racial biases will be key to fine-tuning equity efforts in research.

[i]Anglo-Australian Telescope (AAT), Australian Centre for Neutron Scattering (ACNS), Australia Telescope National Facility (ATNF), and National Computational Merit Allocation Scheme (NCMAS)

*ATNF semi-anonymised applications by using first initials only and listing research team members alphabetically to hide the identity of the lead researcher.

WHAT WE DID

ABOUT THE ENTITIES

Four STEM research entities that manage access to Australian national scientific facilities participated in the trial:

- *Anglo-Australian Telescope* (AAT) is a 3.9 metre equatorially mounted telescope operated by the Australian National University on behalf of a consortium of Australian universities that manages and oversees access to the AAT. The consortium is operated by Astronomy Australia Limited (AAL), an independent non-profit organisation administering funding from the Australian government and access to facilities.
- *Australian Centre for Neutron Scattering* (ACNS) is Australia's leading facility for neutron science, comprising fifteen neutron beam instruments. ACNS is operated by the Australian Nuclear Science and Technology Organisation (ANSTO), Australia's national nuclear organisation, operates and manages access to much of Australia's landmark infrastructure.
- *Australia Telescope National Facility* (ATNF) is an Australian facility comprising a collection of world-class radio astronomy observatories. ATNF is owned and operated by CSIRO, Australia's national science agency.
- *National Computational Merit Allocation Scheme* (NCMAS) is Australia's premiere grant scheme for access to high-performance computing resources at two main facilities: the National Computational Infrastructure and the Pawsey Supercomputing Research Centre.

IMPLEMENTING ANONYMISATION

The entities implemented anonymisation differently (see Appendix 1). AAT, ACNS, and NCMAS requested that applicants anonymise their applications for use of scientific equipment according to guidelines adapted from a previous study at NASA[11]. Applicants were asked (a) not to include applicant names and affiliations within the text of the application, (b) to use third-person, neutral wording when citing references and self-referencing, (c) to use the phrases "obtained in private communication" when citing exclusive access datasets or non-public software, (d) not to include acknowledgements or grant funding sources, (e) to submit a description of team expertise and background in a separate document. ATNF implemented semi-anonymisation by using first initials and surnames for names, removing affiliations, shifting the applicant list to the last page, and arranging it alphabetically to conceal the lead investigator's identity.

When assessing applications, assessors were instructed to resist guessing who applicants were. First, the assessors individually assessed and scored assigned applications. Then, the assessors met to discuss applications and assign final scores collaboratively. These final scores informed decisions on which applications would receive access to scientific equipment and the resources allocated to those successful applications. Some entities allowed assessors to access applicant identities to cross-check the veracity of the team, but this practice varied across entities (see Appendix 1).

ABOUT THE DATA

We sourced the data from each of the four participating entities. The dataset contained the outcomes (scores, successful/unsuccessful, allocated resources) and the self-identified gender of the lead investigator for each application. Gender data included female, male and indeterminate. We excluded applications for which the gender of the lead investigator was classified as indeterminate (n = 4) because they were only present in applications *before* anonymisation; thus, we could not study the impacts of anonymisation on this group. In relation to the analysed data, we use the term 'women' for gender data classified as female and 'men' for gender data classified as male. We acknowledge the limitations of the binarisation of a nonbinary construct. The dataset also included career seniority data for applications managed by ACNS and NCMAS.

After data processing, the final dataset contained 4,582 applications and their outcomes (AAT = 212, ACNS = 2,232, ATNF = 1,098, NCMAS = 1,039). Of those, 3,348 applications were from rounds before anonymisation, and 1,231 from rounds after anonymisation was implemented[+].

HOW WE ANALYSED THE DATA

We analysed the data using a regression approach; a given outcome was predicted by key variables (e.g., gender and career seniority of the lead investigator).

The models examined three grant application outcomes - application scores, success rates, and allocated resources - before anonymisation and the impacts of anonymisation on them according to the gender of the lead investigator, also accounting for career seniority where those data were available. Another model comprised a meta-analysis to assess the overall effects of anonymisation on the three outcomes across all four entities.

All procedures undertaken in this research were approved by the UNSW Sydney Human Research Ethics Committee (Approval HC200129).

RESULTS

The results reported below are all estimates from our modelling, which accounts for the key variables outlined above; they are not raw percentages. We describe statistically significant effects in terms of differences or changes (e.g. between women and men) and statistically non-significant effects in terms of no differences or changes. Effects are statistically significant if their confidence interval does not include 0 (as 0 means no effect).

CAREER SENIORITY BEFORE ANONYMISATION

ACNS and NCMAS shared career seniority data for lead investigators, allowing us to assess the effects of anonymisation based on seniority.

At ACNS, the average scores before anonymisation varied across levels of career seniority. The scores before anonymisation (out of 10) were:

- 7.2 among students,
- 7.4 among early career researchers and,
- 7.3 among senior-career researchers.

There were no differences in success rates or allocated resources between career seniority levels before anonymisation.

CAREER SENIORITY AFTER ANONYMISATION

Anonymisation boosted the *success rates* for applications led by early-career researchers at ACNS, while success rates for more senior-career researchers decreased.

As a function of anonymisation, success rates:

- Remained stable, slightly shifting from 54% to 55%, among students,
- Rose from 61% to 78% among early-career researchers and,
- Declined from 61% to 50% among senior-career researchers.

Anonymisation did not impact the allocated resources according to career seniority at ACNS[i], nor did it impact the scores, success rates, or allocated resources according to career seniority at NCMAS, noting again the absence of career seniority differences in these outcomes before anonymisation at ACNS and NCMAS.

i The observed difference in scores that existed across career seniority levels before anonymisation at ACNS was not observed in the dataset that included the before and after outcomes. However, this effect was not a function of anonymisation. Instead, the result may be due to random variation, trends over time, natural regression to the mean, sample size, and other conditions in the before and after dataset.

GENDER DIFFERENCES BEFORE ANONYMISATION

Before anonymisation, there were no statistically significant gender differences in application scores, success rates, or allocated resources at most entities.

Table 1. Before anonymisation: application scores, success rates, or allocated resources

		Application scores	Success rates	Allocated resources
AAT	Women	3.6	48%	80%
	Men	3.8	68%	82%
ACNS	Women	7.3	59%	94%
	Men	7.3	58%	94%
ATNF	Women	3.7	86%	89%*
	Men	3.7	81%	84%*
NCMAS	Women	6.5	86%	69%
	Men	6.3	79%	71%

Scores for AAT and ATNF are out of 5, and scores for ACNS and NCMAS are out of 10.
*There were gender differences in allocated resources that varied according to the type of program at ATNF (described in text).

There was one exception. There were gender differences in allocated resources that varied according to the type of program at ATNF. Specifically, the gender differences favoured women in the Large Projects program. In the Large Projects program, women-led applications received 95% of the requested resources, and men-led applications received 80%. In the standard program, women-led applications received 82% of the requested resources, and men-led applications received 87%.

GENDER DIFFERENCES AFTER ANONYMISATION

Anglo-Australian Telescope (AAT)

Anonymisation improved women's success rates at AAT, with higher success rates for women-led than men-led applications after anonymisation. The average success rates:

- Rose by 40 percentage points to 88% for women-led applications and declined by 9 percentage points to 59% for men-led applications as a function of anonymisation

The existing gender parity in scores and allocated resources before anonymisation was not impacted by anonymisation. As a function of anonymisation, the average:

- Scores were 3.9 (out of 5) for women-led applications and 3.8 for men-led applications
- Allocated resources to successful applications were 81% for women-led applications and 74% for men-led applications

Australian Centre for Neutron Scattering (ACNS)

The existing gender parity in scores, success rates, and allocated resources before anonymisation was not impacted by anonymisation at ACNS. As a function of anonymisation, the average:

- Scores were 7.43 (out of 10) for women-led applications and 7.33 for men-led applications
- Success rates were 63% for women-led applications and 61% for men-led applications after anonymisation
- Allocated resources to successful applications were 98% for women-led applications and 95% for men-led applications after anonymisation

Australia Telescope National Facility (ATNF)

The existing gender parity in scores and success rates before anonymisation was not impacted by semi-anonymisation[ii] at ATNF[iii]. As a function of semi-anonymisation, the average:

- Scores were 3.87 (out of 5) for women-led applications and 3.65 for men-led applications
- Success rates were 90% for women-led applications and 92% for men-led applications

National Computational Merit Allocation Scheme (NCMAS)

The existing gender parity in scores, success rates, and allocated resources before anonymisation was not significantly impacted by anonymisation at NCMAS. As a function of anonymisation, the average:

- Scores were 6.68 (out of 10) for women-led applications and 6.47 for men-led applications
- Success rates were 84% for women-led applications and 76% for men-led applications
- Allocated resources to successful applications were 76% for women-led applications and 73% for men-led applications after anonymisation

ii ATNF implemented semi-anonymisation by using first initials and surnames for names, removing affiliations, shifting the applicant list to the last page, and arranging it alphabetically to conceal the lead investigator's identity.

iii The gender difference in allocated resources favouring women in the Large Projects program observed before anonymisation was not observed in the dataset including both before and after outcomes. However, this effect was not a function of anonymisation. Instead, the result may be due to random variation, trends over time, natural regression to the mean, sample size, and other conditions in the before and after dataset.

META-ANALYSIS: IMPACTS OF ANONYMISATION ACROSS ENTITIES

Pooling the results from the four entities, our meta-analysis shows that anonymisation preserved the existing gender parity in scores, success rates, and allocated resources present before anonymisation (Fig. 1–3).

Note: Anonymisation impacts gender differences only if the confidence interval does not include 0 (which means no effect). Even though anonymisation seems to have a small overall impact on gender differences in application scores (as shown in Fig. 1), the confidence interval includes 0, indicating no significant impact.

Figure note: The values on the right of the figures are the model estimates of how anonymisation impacts gender differences in application scores, success rates, and allocated resources. A 95% confidence interval range accompanies the numbers. The "RE Model" values represent the overall impact of anonymisation on gender differences for that outcome, calculated using a meta-analysis model. Anonymisation impacts gender differences only if the confidence interval does not include 0 (which means no effect). In the case of scores and allocated resources (Fig. 1 and 3), we looked at the combined impact of anonymisation, gender and program type at ATNF (three-way interaction). We incorporated this into our meta-analysis by accounting for the effects of different grant programs and their correlation.

Figure 1. Scores

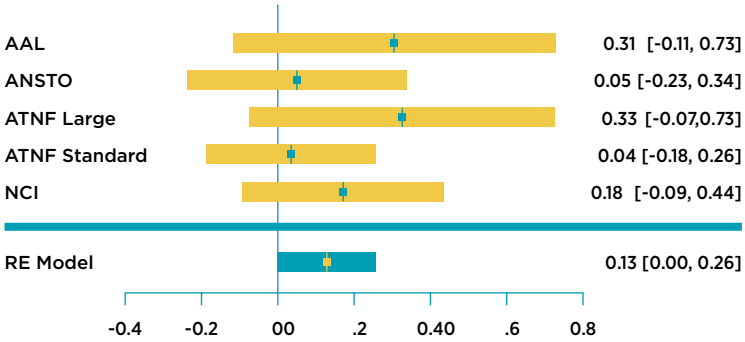


Figure 2. Success rates

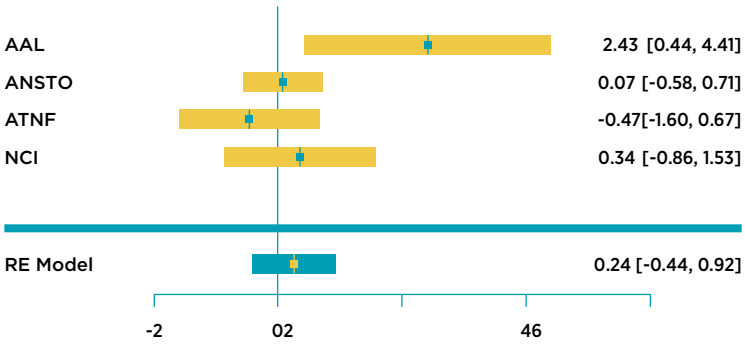
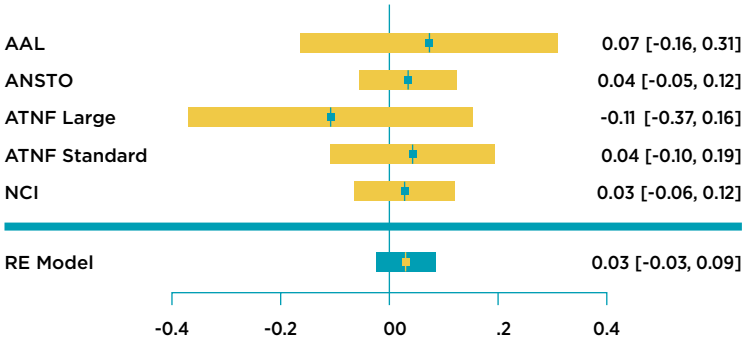


Figure 3. Allocated resources to sucessful applications



CONCLUSION

Our research reveals a noteworthy absence of gender disparities in application outcomes before implementing anonymisation measures across computing, nuclear, and astronomical and planetary science. The introduction of anonymisation notably improved success rates for early-career researchers while maintaining the existing gender equity landscape. These results suggest that anonymisation serves as a positive intervention, particularly benefiting individuals at the early stages of their research careers.

The implications of this research extend beyond application outcomes, which is just one point of a larger spectrum of barriers in time and place that contribute to inequity in the research workforce[1]. By improving the success rates of early career researchers, anonymisation has the potential to create a positive chain reaction throughout the career pipeline. This can lead to greater diversity in the research pool and contribute to addressing the larger issue of retaining and advancing researchers who face barriers in STEM research.

In the future, examining cultural, racial and other biases will be crucial to refining and improving equity efforts in the STEM research sector.

RECOMMENDED ACTIONS

In recent years, there has been a growing focus on improving equity and diversity in the research sector, with many organisations and institutions implementing policies and interventions to address gender equity[15]. The granting entities involved in this trial appear to have already been promoting gender equity in the application assessment, as no gender gaps existed in the two to three years before implementing anonymisation. Yet, research resource allocation is just one aspect of a broad spectrum of entrenched barriers contributing to women's underrepresentation in the research sector[1].

The responsibility to continue to promote fairness, beyond binary gender equity, and remove entrenched systemic barriers rests with several entities, including granting entities and higher education and research institutes. We provide the following evidence-based recommendations.

ANONYMISATION FOR BROADER EQUITY BENEFITS

Granting entities have a social and legal responsibility to ensure fairness and equal opportunity to all researchers when allocating research resources.

We recommend granting entities use anonymisation to continue promoting equity and diversity beyond binary gender. Our research shows that anonymising applications enhances success rates for early career researchers, regardless of gender. Anonymisation allows application assessors to focus on the quality and merit of the research proposal rather than the researchers' track record, an approach with documented success at levelling the playing field - not just for women but also other marginalised groups and early career researchers[11–13].

By enhancing success rates for early career researchers, anonymisation may create a positive ripple effect in the career pipeline, diversifying the research pool and supporting the broader issue - retaining and advancing researchers facing barriers in STEM research.

FIX THE SYSTEMIC ISSUES

While improved outcomes for early-career researchers from anonymisation alone may not guarantee the progression of women and marginalised groups into senior positions, they may play a pivotal role in dismantling systemic barriers and creating more supportive and equitable research environments. Complementing these interventions with broader institutional changes and policies addressing the multifaceted challenges underrepresented groups face throughout their research careers[16] is essential.

We recommend that higher education and research institutions implement evidence-based workplace gender equity initiatives and policies, such as inclusive recruitment practices[17,18], gender-equal hiring at all levels[18], extending recruitment shortlists to include more women candidates[18–20], retention targets of gender-equal departures relative to cohorts[18,21], appointment targets for women to senior positions[18,21], and organisational structures that embed accountability, authority and expertise (e.g., equity action plans, diversity committees and diversity training)[22]. Combining initiatives is likely to accelerate outcomes[18,21].

USE A DATA-DRIVEN APPROACH

Our research highlights the importance of evaluating the existing state of play before introducing interventions, as the success of interventions for a specific equity outcome can critically depend upon the amount and direction of existing disparities[14].

We recommend granting entities and research institutions systematically collecting and interrogating diversity metrics, including diverse genders, career seniority, institutional affiliation, disability, race, and ethnicity. These data can help pinpoint disparities, direct resources to areas of need, and ensure evidence-based interventions, enhancing the potential for success and minimising unintended consequences—such as the documented case of setting back gender equity efforts within the Australian Public Service[14].

Evaluation is essential to gauge effectiveness over time. It provides important insights to inform decision-making on what should be extended, scaled, or changed[23]. The Australian Government's Women in STEM Ambassador initiative offers a framework to evaluate equity interventions and a public repository to promote transparency, consistency and comparability of evaluation data to understand what interventions work[24].

RESEARCH OTHER POTENTIAL BIASES

As we look to the future, examining the impacts of anonymisation on other intersecting biases will be key to fine-tuning equity efforts in the STEM research sector.

We recommend that research institutions prioritise and fund studies to investigate the impacts of anonymising research resource applications on other biases. An intersectional and non-binary approach to gender is needed to determine the effects of anonymisation on reducing potential sources of bias from ethnicity and/or race[25,26], disability[27], and other structural biases, such as institutional affiliation, reputational prestige, and prior track record[11,28].

Research must provide access and opportunities for all marginalised groups, not just women, to truly benefit science and society.

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APPENDIX 1: ANONYMISATION PROCEDURES BY ENTITY

	Application phase			Peer review phase		
Org	**Anonymisation**	**Compliance measures**	**Scoring**	**Specific project recommendations**	**Option to view investigators' identities and team background**	**Option taken. Yes/No?**
AAT	Mandatory	Severely non-compliant applications were flagged for disqualification. Applications with less serious compliance issues were asked to correct and resubmit (e.g., change in-text references from first to third person).	0 (low) to 5 (high)	Applications led by doctoral students were explicitly recommended to reviewers to ensure new PhD projects received resources.	After reviewing all applications, the review committee could optionally access proposal teams' expertise and background if concerns about feasibility arose. Initial scoring could not be upgraded. However, in cases of extreme concern, a proposal could be downgraded through a majority vote.	No
ACNS	Expected	A separate technical review team flagged non-compliant applications, but no changes were recommended to the applicants.	0 (low) to 10 (high)	No	No *Note:* Reviewers could see potentially identifying information, as non-compliant applications were flagged but not corrected. Reviewers were asked to respect impartiality when assessing flagged applications.	NA
ATNF	Semi-anonymisation Applicants received no anonymisation guidelines. Before peer review, research team members' names were changed to first initial and surname, affiliations removed, relocated from the first to the last page, and alphabetically ordered to conceal the lead investigator's identity.	NA	0 (low) to 5 (high)	Applications led by doctoral students were specifically highlighted to ensure the time constraints of PhD projects were considered during the review process.	Yes *Note:* No background information was supplied to reviewers and external raters. However, the lead investigators' identity was visible to all reviewers when submitting their scores to the online portal.	NA
NCMAS	Mandatory	Applications with compliance breaches were recommended materials and changes and asked to be corrected and resubmitted. Further non-compliance meant an application was disqualified.	0 (low) to 10 (high)	No	No. The proposals are assessed according to the published guidelines during the initial scoring round. The scores are weighted by the confidence level of the reviewers' expertise, and the final weighted scores are ranked. The allocations are discussed and finalised at the NCMAS Scientific Advisory Committee meeting.	Yes, though limited*

* E.g., In the 2020 assessment, 87 out of 1086 assessments (8%) accessed full, non-anonymous applications.

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