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The paradox of participation: gender, autonomy, and suppression in academic science

Abstract:

Women have made significant contributions to science, yet continue to face barriers to full participation and recognition within academic institutions. While research has examined gender disparities in career outcomes, less attention has been paid to how structural conditions constrain women's autonomy and academic voice. This study addresses that gap by analyzing survey data from a nationally representative sample of 780 Croatian scientists and scholars across six disciplines. Using a quantitative approach—including t-tests, hierarchical regression, and cluster analysis—we examine gender differences in research productivity, leadership, institutional belonging, scientific values, and perceived suppression of academic voice (SAVE). Findings show that women's research productivity is largely comparable to men's, but they report significantly higher levels of suppression—particularly at senior ranks and in fields such as the natural sciences and humanities. Gender emerged as the strongest predictor of suppression, even after accounting for rank, output, and job satisfaction. Women also expressed stronger identification with their institutions and a more socially engaged view of science, yet were more likely to fear professional repercussions for expressing critical or controversial views. These findings reveal a structural paradox: women are key contributors to science's public mission, yet face systemic constraints on their ability to speak, lead, and shape academic discourse. Addressing gender equity in science therefore requires not only improving representation, but transforming the institutional cultures that limit academic autonomy and participation.

1. INTRODUCTION

1.1. Gender and the Academic Profession

The history of science has long been shaped by male dominance—first through exclusion, then through structural advantage—and by women's ongoing struggle for inclusion and recognition. Masculine norms have historically defined the culture and organization of academic science (Bagilhole & Goode, 2001; Faulkner, 2001), influencing not only institutions but also the framing of legitimate knowledge (Rubin, 2024). Scholars have described this as the "masculine default" in academia—a norm in which male perspectives, values, and life patterns are unconsciously treated as standard benchmarks for success, while those associated with women are framed as deviations (Cheryan & Markus, 2020). Academia remains a "chilly climate" for many women (Britton, 2017; Hughes et al., 2023), marked by implicit bias, professional alienation, tokenism, and unequal service and mentoring burdens. Women continue to face systemic barriers in hiring, tenure, leadership, and research recognition (Guarino &; Larivière et al., 2013; Borden, 2017; Carr et al., 2018). They are frequently expected to prove their competence repeatedly (Griffin et al., 2011), while also bearing the responsibility of challenging systemic bias (McClelland & Holland, 2015). Hughes et al. (2023) elaborate these dynamics by analyzing both overt and subtle forms of harassment and discrimination in academia, highlighting institutional tendencies to suppress or dismiss such reports. Together, these challenges hinder productivity, stall advancement, and inflict lasting psychological strain (Ahmed, 2021; Settles, Buchanan, & Dotson, 2013). These forms of structural and symbolic exclusion not only limit women's advancement but also restrict their epistemic autonomy, undermining their capacity to shape what counts as legitimate knowledge and to participate fully in its production and dissemination.

1.2. Autonomy, Epistemic Exclusion, and Feminist Frameworks

Feminist theory offers valuable insights into how structural barriers translate into epistemic injustices (Stoljar, 2000). Suppression of academic voice, reluctance to engage in public discourse, and avoidance of controversial topics, such as institutional critique, gender inequality, or the social responsibilities of science, are not merely personal hesitations but reflect systemic limitations on women's autonomy and authority as knowledge producers (Fricker, 2007; Dotson, 2012, 2014). Academic autonomy is a precondition for epistemic authority, as the ability to direct one's research agenda freely underpins the credibility and legitimacy of one's contributions to knowledge. Autonomy, understood as self-directed action aligned with one's values, depends on conditions that allow dissent without punishment. Gendered academic environments often fail to meet these conditions.

Gendered academic environments often fail to meet these conditions. Feminist scholars have long argued that the absence of women's voices in epistemic matters distorts the very knowledge science produces reinforcing dominant hierarchies and rendering women's, often more socially engaged, concerns invisible (Bird, 2011; Ahmed, 2012).

In this study, we conceptualize the suppression of academic voice as a multidimensional phenomenon encompassing exclusion from formal participation in institutional decision-making or public discourse, as well as epistemic suppression the constraint on researchers' autonomy to pursue particular lines of inquiry due to perceived or real lack of institutional support. This perspective aligns with scholarship on epistemic injustice and gendered academic marginalization, demonstrating how structural conditions shape whose knowledge is legitimized and whose contributions are undervalued (Fricker, 2007; Dotson, 2012; Zappala et al., 2024).

The concept of academic voice builds on Hirschman's (1970) influential framework of exit, voice, and loyalty, three fundamental responses to organizational dissatisfaction. Exit denotes withdrawal or departure, while loyalty implies remaining committed despite dissatisfaction. Voice, central to our study, involves actively expressing concerns or attempting to influence change. We extend this notion by situating academic voice within the complex institutional and epistemic contexts of higher education (Kezar & Eckel, 2002; Fricker, 2007). Academic voice encompasses not only speaking out but also the autonomy to pursue and legitimize research agendas and shape knowledge production. Suppression reflects interpersonal marginalization, structural barriers, and epistemic silencing, cumulatively impacting career trajectories and inclusivity (Bird, 2011; Ahmed, 2012). These patterns are particularly pronounced in scholarly publishing, where women face persistent barriers to epistemic recognition, authorship visibility, and editorial influence (Hultgren & Habibie, 2023), reinforcing systemic inequalities in whose knowledge is legitimized.

Recent research by Vogel and Utoft (2025) deepens this argument by showing how institutional norms of academic excellence systematically devalue relational, collaborative, and care-oriented labor, forms of contribution disproportionately made by women. Drawing on feminist epistemology, they argue that epistemic injustice in academia extends beyond underrepresentation to include the symbolic and structural devaluation of the kinds of knowledge and labor that sustain academic life. This reinforces gendered inequalities in recognition, advancement, and voice, and highlights the need to rethink institutional conceptions of merit and autonomy in light of epistemic marginalization.

By integrating these perspectives, our analysis illuminates how gendered dynamics shape not only academic voice expression but also longer-term consequences for women's participation, authority, and advancement within academia. Understanding these disciplinary variations is crucial, as they interact with broader gendered social roles and expectations that further shape the academic experiences and career trajectories of men and women. Understanding these disciplinary variations is crucial, as they interact with broader gendered social roles and expectations, shaping not only epistemic autonomy but also concrete patterns of research productivity, institutional recognition, and career advancement across academic systems.

1.3. Research Productivity and Gender in the Croatian Academic Context

A long-standing issue in gender and academia is the so-called "productivity puzzle": are women in science truly less productive, or is their work undervalued or underrecognized? Productivity, typically measured through publication counts, citations, and funding success, is often treated as a neutral metric of scientific merit. Yet these measures are deeply embedded in institutional structures that reward visibility, continuity, and networking, dimensions shaped by unequal access to time, resources, and recognition (Bailyn, 2003; Acker, 2006). Results vary by field, country, and measurement (Schmaling & Gallo, 2023; Huang et al., 2020). While some disciplines exhibit persistent disparities in publication and citation counts, others indicate that women often produce higher-impact research or surpass men in specific areas (Zhou et al., 2024; van den Besselaar & Sandström, 2016).

The Croatian academic system is primarily composed of public universities and government-funded research institutes, which constitute the core of national academic research and education. Private higher education institutions and other non-university research entities play a smaller role and were not included in this study. This institutional configuration shapes the career trajectories and organizational cultures experienced by Croatian academics. Recent data show that, while men still dominate among full professors, the gender gap is closing at lower ranks, with women now constituting a majority among assistant professors (Wild et al., 2020). At some Croatian institutions, moreover, women have higher citation counts than men. However, structural gender gaps persist, especially in fields like physics and computer science. Bibliometric analyses show that women's productivity is often comparable in volume but remains shaped by differences in funding access, leadership roles, and collaboration networks (Prpić, Šuljok & Petrović, 2009; Brajdić Vuković & Vignjević, 2017).

Extensive research documents that gender disparities in academic productivity, recognition, and career advancement are often field-specific. STEM fields - particularly physics, engineering, and computer

science - tend to exhibit more pronounced gender gaps in representation and productivity compared to the social sciences and humanities, where women's presence and outputs are relatively stronger (Xie & Shauman, 2003; Ceci & Williams, 2011). This disciplinary variation reflects not only differential access and cultural climates but also distinct epistemic cultures and evaluation criteria that shape career trajectories (Bailyn, 2003; Acker, 2006). By incorporating disciplinary analyses, we aim to capture these nuances and contribute to understanding how gender operates within diverse academic environments.

As widely recognized, gendered social roles and expectations shape the experiences of men and women in academia and beyond. Despite higher educational attainment and the rise of dual-career households, women continue to shoulder a disproportionate share of unpaid domestic labour, limiting their time, focus, and autonomy for academic work and career advancement (Craig & Mullan, 2011; Hochschild & Machung, 2012; Bianchi et al., 2012). Recent Croatian research confirms that women perform the majority of domestic and caregiving tasks, with mental labour, planning, organizing, and emotionally managing household responsibilities, remaining a significant yet often invisible burden (Klasnić & Degač, 2024). These gendered divisions also shape academic careers: for instance, married men benefit more from partnerships in terms of publishing productivity than married women (Prpić, 2002), and motherhood continues to be a source of professional discrimination (Brajdić Vuković & Vignjević, 2017).

1.4. Women's Role in Science and Society

Recent research suggests that women in science are more likely than men to endorse values aligned with social responsibility, public engagement, and equity in research agendas (Ceci & Williams, 2011; Zhang et al., 2021). These socially oriented scientific commitments often reflect both individual ethical orientations and structural experiences of marginalization, which sensitize women to broader questions of justice and inclusion in science (Fricker, 2007; Dotson, 2012). Importantly, women also tend to report stronger identification with their institutions and departments, which some scholars interpret as a manifestation of "academic care work" (Guarino & Borden, 2017). This care work is closely linked to the ideal of collegiality, a value associated with institutional loyalty, peer support, and shared governance. While collegiality is sometimes derided as vague or inefficient in managerial cultures, it remains a meaningful indicator of institutional engagement and academic citizenship (Thomson, 2017). However, the burdens of collegiality are unevenly distributed: women are often expected to assume disproportionate service and mentoring roles, reinforcing a culture of institutional compliance at the expense of autonomy and recognition (Bird, 2011; Acker, 2006). These tensions are particularly acute in technical disciplines, where women navigate gendered expectations not only in service work but also in how they must

perform, resist, or adapt to masculinized norms of scientific authority (Powell, Bagilhole, & Dainty, 2009). These dynamics suggest that women's engagement with science and academia is not only shaped by structural barriers, but also by normative expectations that conflate gender with service, responsibility, and institutional loyalty.

1.5. Research Aim, Analytical Approach and Contributions

While most studies on women in academia focus on career outcomes, such as hiring, promotion, or research productivity, fewer examine how structural and cultural conditions shape women's ability to contribute meaningfully to knowledge production and to science's broader social role. In this study, we draw attention to a central institutional paradox: women are often key agents of care within academic institutions, shouldering responsibility for collegial support, student engagement, and public communication, yet they continue to face systemic constraints that limit their autonomy and recognition. Rather than passive recipients of exclusion, women actively sustain the academic and civic functions of science, but do so under conditions that undermine their authority to shape those systems.

This paradox is not easily captured through traditional career metrics alone. It requires examining how values, institutional attachments, and perceptions of legitimacy and voice intersect with gendered structures of work and recognition. This multidimensional approach enables us to examine not only whether women and men differ in perceived suppression of academic voice, but also how these perceptions are shaped by institutional belonging, disciplinary identity, career rank, and job satisfaction, factors explored through hierarchical regression models in this study.

This paper addresses these gaps by analysing survey data from a nationally representative sample of 780 scientists and humanities scholars in Croatia. Our study focuses on researchers employed in public Croatian universities and nationally recognized research institutes, which together constitute the core of the country's academic landscape. Private institutions and other non-university research organizations were excluded. This sampling strategy ensures broad coverage of the national academic system and reflects the typical institutional environments in which gendered academic dynamics unfold.

Our approach builds on feminist and sociological perspectives that view science not simply as a meritocratic field, but as a gendered institution shaped by norms, hierarchies, and invisible labor. By situating women's scientific participation in relation to institutional engagement and epistemic constraint,

we aim to clarify how structural dynamics affect not only career trajectories but also the ability to speak, dissent, and shape the future of academic science.

We explore two interrelated questions:

(1) How autonomous are women in academia across different disciplines, as reflected in their self-reported suppression of academic voice and engagement?

(2) What kind of force are women in science today—measured through their research outputs, collegial engagement, and attitudes toward the social role of science?

While some quantitative studies pose directional hypotheses, we adopt a theory-driven exploratory framework, formulating research questions that allow us to examine gendered patterns in academic voice suppression without reducing the analysis to binary hypothesis testing. This approach is consistent with feminist and sociological traditions of studying structural inequality in science, where complex social dynamics often require combining descriptive, explanatory, and exploratory methods.

By integrating performance indicators, perception scales, and attitudinal dimensions, this study contributes to both the organizational and epistemic understanding of gender inequality in science. To address our research questions, we employed a sequential analytic strategy, combining descriptive statistics, hierarchical regression models, and cluster analysis, to test how gender and institutional factors predict suppression of academic voice and to explore how suppression patterns vary across ranks and disciplines.

2. METHODS

A web-based survey was conducted using LimeSurvey, targeting a stratified random quota sample of 2,474 Croatian academics across six disciplinary domains: natural sciences, biomedical sciences, social sciences, technical sciences, biotechnical sciences, and humanities. Stratification was based on discipline, gender, and academic rank to ensure proportional representation. Data collection occurred in two waves (June–July and September–October 2024), with four reminders sent. The final response rate (RR2, including partials with ≥10% completed) was 37.75% (N = 934), consistent with standards for academic surveys. For analysis, only fully completed surveys were retained (N = 780). Table 1 presents the sample by academic rank and discipline. The achieved sample closely matches the national academic population,

with minor deviations: a slight overrepresentation of women in the natural and social sciences (+2%) and fewer early-career scholars in biotechnical sciences (–10%).

Table 1. Academic rank by discipline, with number of respondents (N) and column percentage of women by discipline and rank (N = 780)

Academic Rank	Biomed	Bio-technical	Social	Humanities	Natural	Tech	Total
Research Assistant	24 (14) 20.9%	7 (4) 10.8%	30 (26) 6.3%	6 (3) 5.4%	47 (35) 30.7%	49 (23) 32.9%	163 (105) 64.2%
Postdoc	10 (6) 9.0%	4 (3) 8.1%	11 (9) 9.1%	3 (2) 3.6%	19 (16) 14.0%	15 (7) 10.0%)	62 (43) 69.4%
Assistant Prof.	16 (8) 11.9%	9 (8) 21.6%	27 (18) 18.2%	22 (11) 19.6%	21 (14) 12.3%	13 (5) 7.1%)	108 (64) 59.3%
Associate Prof.	26 (20) 29.9%	10 (4) 10.8%	38 (26) 26.3%	29 (18) 32.1%	45 (25) 21.9%	37 (12) 17.1%	185 (105) 56.8%
Full Professor	43 (19) 28.4%	50 (18) 48.6%	34 (20) 20.2%)	36 (22) 39.3%	48 (24) 21.1%	51 (23) 32.9%	262 (126) 48.1%
Total	119 (67) 56.3%	80 (37) 46.3%	140 (99) 70.7%	96 (56) 58.3%	180 (114) 63.3%	165 (70) 42.4%	780 (443) 56.8%

2.1. Instruments

Most instruments were developed for the research project [*anonymised*], which investigates social responsibility as part of academic identity. Instrument design was guided by the project's conceptual framework and refined through cognitive testing with project members (N = 10), external academics, and a cross-disciplinary group (biology, mathematics, physics, biomedical sciences, engineering, philosophy).

2.1.1. Main Dependent Variable

To assess the boundaries of academic autonomy, we developed the Suppression of Academic Voice and Engagement (SAVE) scale, a six-item additive composite designed to measure perceived constraints on academic self-expression and autonomy. The items reflect personal restraint or hesitancy in relation to:

- (a) institutional or collegial interactions,
- (b) public engagement (e.g., media), and
- (c) fear of professional repercussions.

Each item is measured on a 4-point Likert scale ranging from 1 (never) to 4 (always):

1. I feel that I cannot openly express my opinions at the scientific/faculty council.
2. I do not feel comfortable speaking publicly in the media due to potential reactions from colleagues in my field/institution.
3. I do not feel comfortable speaking publicly in the media due to the public's negative attitudes toward scientists.
4. I do not pursue certain research topics that I consider important because I lack institutional support.
5. I do not feel comfortable expressing my opinions on science policy in front of colleagues.
6. I fear that if I offend someone powerful, I will not be able to advance in my career.

Exploratory factor analysis (orthogonal rotation) confirmed a single-factor solution explaining approximately 58% of the variance (see Appendix Table A1). The scale demonstrated high internal consistency (Cronbach's $\alpha = .85$).

2.1.2. Independent and Control Variables

Gender was coded as 1 = male, 2 = female. Discipline was assessed by selecting one of six fields: biomedical, natural, social, biotechnical, technical sciences, or humanities.

Academic rank was coded as 1 = Research Assistant (doctoral student), 2 = Postdoctoral Researcher, 3 = Assistant Professor/Research Associate, 4 = Associate Professor/Senior Research Associate, and 5 = Full Professor/Scientific Advisor. In analyses, academic rank was modelled as an ordinal variable representing career seniority, rather than as a categorical factor. This approach is consistent with established practices in academic career research and reflects the structured, ordered nature of academic progression. As shown in Table 1, the sample distribution supports this decision, with sufficient representation at all rank levels. Robustness checks using categorical coding confirmed substantively consistent results.

Research productivity was measured by participants' self-reported average number of publications per year over the past five years, and the number of competitive projects led (PI role) over the past ten years. While self-reports may introduce bias, this approach is appropriate in the Croatian context. The national Research Evaluation System (RES) standardizes output expectations across disciplines and ties them directly to career progression, making researchers well-informed about their productivity levels. Nevertheless, these measures emphasize quantity over quality, authorship, or international collaboration. The project leadership variable helps partially offset this, though further research is needed to capture the complexities of academic contribution and leadership.

Administrative roles held within the last two years, assessed with the question: "During the past or current academic year, have you done any of the following?" * Held a leadership position in professional or academic associations/organizations, 1 = yes, 0 = no.

Perceived importance of belonging to one's scientific discipline and institution/department was assessed with two items (e.g., "How important is your belonging to your discipline/institution?"), measured on a 4-point Likert scale from 1 (not important at all) to 4 (very important).

2.1.3. Attitudes Related to Social Responsibility and Gender Equity in Science

We included four attitudinal scales to capture how institutional cultures of legitimacy, inclusion, and epistemic authority shape gendered patterns of academic voice. These scales reflect perceptions of science's social responsibility, accessibility, and normative values, factors that help situate individual experiences of suppression within broader structural and cultural contexts. Prior research has demonstrated how such values are shaped by disciplinary cultures and institutional climates (Becher & Trowler, 2001; Rhoten & Pfirman, 2007; Cech & Blair-Loy, 2010), making them especially relevant to understanding variation in perceived autonomy.

Scientific Social Responsibility and Engagement Scale (SSRES).
This 7-item additive scale assesses the perceived importance of scientists' obligations to society, ethical reflection, and public communication. Respondents rated each item on a 4-point Likert scale (1 = not important at all, 4 = very important):

1. Consider the societal benefit of their research.
2. Consider risks and potential harms of their research.
3. Disclose risks to the public.

4. Take steps to mitigate risks.
5. Serve on advisory bodies.
6. Engage in public policy discussions.
7. Participate in media/public appearances.

Exploratory factor analysis (orthogonal rotation) identified two dimensions—public responsibility and expert role—jointly explaining 65% of variance (see Appendix Table A2). These subdimensions were merged into a single additive scale (Cronbach's $\alpha = .81$).

Science for Social Equity and Justice Scale (SSEQJ).
This 5-item scale captures beliefs about the normative role of science in promoting justice, equity, and sustainability. Items were rated on a 4-point agreement scale (1 = completely disagree, 4 = completely agree):

1. Science should promote democratic societal development.
2. Science should help reduce social inequalities.
3. Science should promote human rights and freedoms.
4. Science should influence laws and policies toward justice.
5. Science should prioritize environmental protection.

Factor analysis revealed two components - justice and gender equity - explaining approximately 67% of variance (see Appendix Table A3). A unified composite score was used for analysis ($\alpha = .87$).

Gender Equity in Scientific Advancement Scale (GESAS).
This 2-item scale assessed beliefs about gender equality in science and higher education. Items were rated from 1 (completely disagree) to 4 (completely agree):

1. Responsible science promotes gender symmetry in career advancement and leadership.
2. Gender-sensitive science benefits both science and society.

Internal consistency was high ($\alpha = .87$).

Elitism in Science Perception Scale (ESPS).
This 2-item composite measured exclusionary or elitist attitudes about science, with items rated on a 4-point agreement scale:

1. The public is not competent enough to discuss science.
2. Science and technology are too complex for most people.

The composite demonstrated acceptable reliability ($\alpha = .70$).

2.2. Analytic Strategy

Our analytic strategy combined regression, descriptive, and exploratory methods to examine gendered patterns in academic participation and voice suppression (SAVE).

We first ran hierarchical linear regressions to identify predictors of SAVE. Step 1 included demographic and professional factors (e.g., gender, rank, productivity); Step 2 added disciplinary and institutional belonging; and Step 3 introduced job satisfaction variables (governance, evaluation, workload, student preparedness). We also ran gender-stratified models to explore whether suppression operates differently for men and women.

To contextualize these findings, we conducted independent samples t-tests to assess gender differences in research productivity, project leadership, perceived productivity, belonging, and views on science's societal role.

We then examined SAVE scores across academic ranks and disciplines to identify where suppression is most pronounced.

Finally, K-means cluster analysis identified three suppression profiles—low, moderate, and high—based on participants' responses to six SAVE items, allowing us to explore associations with gender and career stage.

3. ANALYSES

To investigate how structural conditions shape academic voice suppression through a gendered lens, we conducted hierarchical linear regressions using the SAVE scale as the outcome. These models allow us to assess whether markers of institutional authority (such as rank, discipline, and productivity) and dimensions of academic climate (belonging and satisfaction) operate differently for men and women. Framed by our theoretical understanding of epistemic suppression as a constraint on institutional voice and autonomy, this analysis aims to uncover the structural mechanisms through which gendered disparities in voice emerge and persist.

3.1. Regression Models Predicting Suppression of Academic Voice (SAVE)

We begin by analyzing predictors of perceived suppression of academic voice (SAVE) among Croatian academics. The SAVE scale comprises six items (1 = never; 4 = always) capturing constraints on expressing opinions within academic institutions, engaging in public discourse, and concerns about career consequences. Higher scores reflect more frequent experiences of suppression, offering insight into how institutional cultures affect academic autonomy.

We used hierarchical linear regression (Tables 2 and 3) to examine how gender, career rank, discipline, and job satisfaction contribute to perceived academic voice suppression. Step 1 included demographic and professional factors; Step 2 added disciplinary and institutional belonging; Step 3 introduced job satisfaction (governance, evaluation, and student preparedness). Gender was the strongest individual predictor, with women reporting significantly higher suppression ($\beta = .180$, $p < .001$), highlighting persistent gendered asymmetries in academic autonomy. This persistent gender effect suggests a structural dimension to suppression, where women's academic voice is systematically constrained, even after accounting for rank and productivity, highlighting epistemic inequalities embedded within institutional hierarchies.

Table 2. Hierarchical regression predicting suppression of academic voice and engagement (SAVE), full sample

Predictor	Model I (β [p])	Model II (β [p])	Model III (β [p])
Gender (1=male, 2=female)	.119 (.013)	.150 (.001)	.180 (.000)
Scientific rank	-.139 (.009)	-.129 (.012)	-.125 (.009)
Avg. annual publications	.085 (.087)	.060 (.212)	.025 (.577)
Projects led (10 yrs)	-.025 (.623)	-.020 (.690)	.005 (.915)
Held admin role (past 2 yrs)	-.064 (.196)	-.053 (.262)	-.054 (.215)
Discipline*: Natural sciences	.077 (.193)	.035 (.548)	.006 (913)

Discipline: Biomedical sciences	.265 (.000)	.241 (.000)	.225 (.000)
Discipline: Social sciences	.207 (.000)	.192 (.001)	.138 (.008)
Discipline: Humanities	.039 (.487)	.033 (.542)	-.012 (.808)
Discipline: Biotechnical sciences	.041 (.447)	.024 (.649)	.021 (.670)
Importance: disciplinary belonging		.103 (.035)	.112 (.013)
Importance: departmental belonging		-.266 (.000)	-.242 (.000)
Satisfaction: evaluation criteria			-.145 (.001)
Satisfaction: workload distribution			-.012 (.798)
Satisfaction: university governance			-.257 (.000)
Satisfaction: student preparedness			-.181 (.000)
R^2	.128	.185	.331
Adjusted R^2	.107	.161	.305
F-statistic (df)	F(10, 413) = 6.06	F(12, 411) = 7.78	F(16, 407) = 12.61
Model p-value	.000	.000	.000

* Technical sciences are omitted (controlled for)

To explore gendered dynamics more closely, we conducted separate hierarchical regressions for men and women (Table 3; full models in Appendix). This stratified approach allows us to examine whether predictors of academic suppression differ by gendered academic positioning.

Table 3. Hierarchical regression predicting suppression of academic voice and engagement (SAVE) stratified by gender

Predictor	Men (β [p])	Women (β [p])
Scientific rank	-.130 (.054)	-.134 (.054)
Average annual number of scientific papers published (last 5 years)	.054 (.245)	-.013 (.849)
Number of competitive projects led (last 10 years)	.018 (.782)	-.008 (.904)
Administrative roles held within the last two years (yes=1, no=0)	-.102 (.104)	-.012 (.857)
Discipline*: Natural sciences	-.088 (.237)	.085 (.279)
Discipline: Biomedical sciences	.229 (.002)	.250 (.001)
Discipline: Social sciences	.052 (.455)	.206 (.009)
Discipline: Humanities	-.068 (.317)	.040 (.595)
Discipline: Biotechnical sciences	.088 (.911)	.042 (.551)
Importance of disciplinary belonging (higher = more important)	.166 (.012)	.077 (.259)
Importance of departmental belonging (higher = more important)	-.260 (.000)	-.210 (.001)
Satisfaction with research evaluation requirements (higher = more important)	-.205 (.003)	-.108 (.078)
Satisfaction with workload distribution (higher = more satisfied)	-.003 (.963)	-.011 (.862)

Satisfaction with university governance (higher = more satisfied)	-.285 (.000)	-.242 (.000)
Satisfaction with student preparedness (higher = more satisfied)	-.054 (.397)	-.269 (.000)
R^2	.363	.307
Adjusted R^2	.311	.257
F-statistic (df)	F(15,199) = 7.0	F(15, 208) = 6.14
Model p-value	.000***	.000***

* Technical sciences are omitted (controlled for)

Gender-stratified models revealed distinct predictors of suppression. Among women (Adj. R^2 = .257), higher suppression was linked to weaker departmental belonging (β = –.210, p = .001), dissatisfaction with university governance (β = –.242, p < .001), and concerns about student preparedness (β = –.269, p < .001). Among men (Adj. R^2 = .311), significant predictors included disciplinary belonging (β = .166, p = .012), dissatisfaction with evaluation criteria (β = –.205, p = .003), and institutional governance (β = –.285, p < .001), as well as departmental belonging (β = –.260, p < .001).

Academic rank influenced suppression differently by gender. In the male model, rank remained a significant predictor even after accounting for disciplinary affiliation in Step 1, and institutional belonging in Step 2. This suggests that rank itself, rather than disciplinary positioning, shapes perceived suppression for men. For women, rank was not a significant predictor in any model, showing only marginal influence in the final step (β = –.134, p = .054). This indicates that seniority does not confer the same autonomy benefits for women, pointing to a gendered limitation of rank-based academic authority. Full regression tables showing all three steps for both gender-stratified models are available in Appendix, Tables A4–A5.

Departmental belonging and dissatisfaction with governance predicted suppression for both genders. This finding supports the interpretation of suppression as relationally embedded: for women, stronger departmental affiliation may buffer against epistemic exclusion, aligning with the notion that institutional legitimacy conditions the capacity to voice dissent or shape knowledge agendas. Concerns about student preparedness were significant only for women, while disciplinary belonging, dissatisfaction with evaluation, and rank (before controlling for satisfaction) mattered only for men. These results suggest

distinct gendered mechanisms: men's suppression relates to disciplinary status and authority, while women's is shaped by institutional culture, care concerns, and limited returns on seniority.

3.2. Descriptive Patterns in Suppression Across Rank and Discipline

To complement the regression results, we examine descriptive SAVE patterns by gender, rank, and discipline. Rank predicted suppression only for men, and this effect weakened after controlling for discipline. For women, seniority offered limited protection. These comparisons reveal how structural position and disciplinary culture intersect with gender in shaping academic voice.

We conducted independent samples t-tests ($\alpha = .05$) to assess gender differences on individual SAVE items. Normality and variance assumptions were tested, applying Welch's correction where needed. Table 4 shows gender differences across the six SAVE items (scale: 1 = never; 4 = always). Women reported significantly more suppression than men in all dimensions. They were more likely to feel unable to express opinions at council meetings ($p < .001$), uncomfortable speaking in the media ($p < .001$), and reluctant to discuss policy with colleagues ($p = .001$). They also reported greater fear of career repercussions ($p < .001$) and more often avoided research topics due to weak institutional support ($p = .038$).

Table 4. Gender differences on individual items of the suppression of academic voice and engagement (SAVE) scale

Item	Men (n = 284–325) M (SD)	Women (n = 362–413) M (SD)	p value
I feel that I cannot openly express my opinions at council meetings	2.11 (1.03)	2.50 (1.06)	< .001
I do not feel comfortable speaking in the media (colleagues' reactions)	1.85 (0.94)	2.16 (1.06)	< .001
I do not feel comfortable speaking in the media (public perception)	1.68 (0.89)	1.88 (0.98)	.008
I avoid topics due to lack of institutional support	1.60 (0.81)	1.74 (0.92)	.038
I do not feel comfortable expressing policy opinions to colleagues	1.63 (0.84)	1.85 (0.94)	.001

I fear offending someone influential may hurt my career	1.91 (1.04)	2.30 (1.14)	< .001

Further comparisons revealed that gender disparities in SAVE scores were most pronounced at senior levels: women reported significantly higher suppression than men among associate professors ($p = .001$) and full professors ($p = .021$), with the largest gap at the associate level (see Appendix Table A6). No significant gender differences were observed at earlier career stages, including among research assistants, postdoctoral fellows, and assistant professors.

Disciplinary differences were also evident. The highest average suppression scores were observed in both the biomedical and social sciences, regardless of gender. However, gender disparities were most statistically pronounced in the natural sciences ($p < .001$), social sciences ($p = .048$), and humanities ($p = .050$), where women reported higher suppression than men (see Appendix Table A7). The largest gender gap occurred in the natural sciences. In contrast, no significant differences were found in the biomedical, biotechnical, or technical sciences.

These descriptive patterns complement the regression results and confirm that suppression is not evenly distributed across rank or discipline. Women report higher suppression than men at senior ranks and in several disciplinary domains, with notable variation across academic contexts. These trends are taken up more fully in the discussion.

3.3. Cluster Analysis of Suppression Profiles

To explore patterns in perceived academic suppression, we conducted a K-means cluster analysis using responses to the six SAVE items (scale: 1 = never, 4 = always). Table 5 presents results of a cluster analysis that identified three distinct profiles of academic voice suppression, low, moderate, and high, based on participants' responses to the six SAVE items. The largest group (45.0%) reported low suppression, characterized by comfort in expressing opinions, engaging publicly, and minimal concern about institutional barriers. A second group (33.1%) reflected moderate suppression, with some hesitation in meetings and media engagement, moderate institutional barriers, and elevated concerns about career repercussions. The final group (21.9%) experienced high suppression, marked by strong constraints on academic voice, avoidance of public discourse, and fear of negative consequences for dissent.

Table 5. Clusters of suppression of academic voice and engagement (SAVE) among faculty

Cluster	Size (N, %)	Expression in Faculty Meetings	Comfort in Public Engagement	Institutional Support	Career Progression Concerns	Overall Suppression Level
Low Suppression	232 (45.0%)	Comfortable	Comfortable	No major barriers	Minimal concern	Low
Moderate Suppression	171 (33.1%)	Some hesitation	Hesitant to engage with media	Moderate barriers	Elevated concerns	Moderate
High Suppression	113 (21.9%)	Unable to express freely	Avoids public discourse	Significant barriers	Strong fear of repercussions	High

A Chi-square test confirmed a significant association between gender and suppression cluster membership, $\chi^2(2) = 16.372$, $p < .001$. Women were disproportionately represented in the moderate (36.3%) and high (26.6%) suppression clusters, while men were more likely to fall into the low suppression group (54.2% vs. 37.1%). These profiles underscore the gendered nature of academic voice suppression, highlighting unequal constraints on epistemic and institutional participation. To contextualize these patterns, we examine descriptive differences in suppression across academic ranks and disciplines, emphasizing how gendered autonomy is not uniformly shaped by seniority or disciplinary authority. This multi-level approach reflects our theoretical view of academic voice as both a structural and relational phenomenon.

3.4. Gendered Views of the Role of Science in Society and Gender Equality in Science

This section examines gender differences across professional activity and scientific values, including research productivity, leadership, perceptions of productivity, academic belonging, and views on the social role of science.

Across most disciplines, no significant gender differences were found in average annual publication rates or the number of competitive projects led over the past ten years. The exception was the Social Sciences, where men reported significantly higher publication rates (M = 5.02, SD = 5.76) than women (M = 3.20, SD = 2.93), t(138) = 2.475, p = .015, and more project leadership experience (M = 1.22, SD = 1.75 vs. M = 0.67, SD = 1.13), t(138) = 2.22, p = .028; though the latter did not remain significant under Welch's correction (p = .068). In all other fields, gender differences were non-significant (p > .25). Perceived productivity showed a similar pattern: men rated themselves slightly higher than women at national and international levels in select disciplines (e.g., Natural Sciences: t(178) = 1.97, p = .050; Social Sciences international: t(138) = 2.33, p = .021). No significant gender differences were observed in leadership roles in academic or professional associations. Detailed statistics are presented in Appendix A, Tables A 8–A10.

Independent samples t-tests (α = .05) were conducted to examine gender differences in perceived importance of academic affiliation, specifically to one's scientific discipline, department, and institution. Assumptions of normality and homogeneity of variance were met. Table A11 in Appendix presents gender differences in these dimensions of academic belonging, showing similar disciplinary identification across genders, but significantly stronger institutional and departmental attachment among women. Women placed more importance on belonging to their department (M = 3.17, SD = 0.84) than men (M = 2.88, SD = 0.91), t(770) = -3.091, p = .002, and similarly rated their institutional belonging higher (M = 3.20, SD = 0.81 vs. M = 2.97, SD = 0.89), t(770) = -2.446, p = .015. Disciplinary identification did not differ significantly by gender (p = .204).). Detailed statistics are available in Appendix A.

Independent samples t-tests (two-tailed, α = .05) were conducted to assess gender differences across four attitudinal scales related to perceptions of science. Assumptions of normality and homogeneity of variances were met, and Welch's correction was applied where needed. Table 6 summarizes mean scores on four scales: Scientific Social Responsibility (SSRES), Gender Equity in Science (GESAS), Science for Social Equity and Justice (SSEQJ), and Elitism in Science (ESPS). Women scored significantly higher than men on all three socially engaged science scales. On SSRES, they averaged M = 22.26 (SD = 3.11) compared to men's M = 21.21 (SD = 3.32), t(695.33) = -4.47, p < .001. On GESAS, women scored M = 6.04 (SD = 1.57) vs. men's M = 5.34 (SD = 1.90), t(627.79) = -5.39, p < .001. On SSEQJ, the scores were M = 13.09 (SD = 2.51) for women and M = 12.52 (SD = 2.53) for men, t(701.26) = -3.06, p = .002. Conversely, men were more likely to view science as exclusive and inaccessible, scoring higher on the ESPS (M = 5.30, SD = 1.30) than women (M = 4.97, SD = 1.24), t(702.31) = 3.56, p < .001.

Table 6. Gender differences in attitudes toward the social role of science

Scale	Men (n)	Women (n)	Men M (SD)	Women M (SD)	Mean Diff. (F – M)	t (df)	p value
Scientific Social Responsibility (SSRES)	336	442	21.21 (3.32)	22.26 (3.11)	+1.05	-4.474 (695.33)	< .001
Gender Equity in Science (GESAS)	328	429	5.34 (1.90)	6.04 (1.57)	+0.70	-5.392 (627.79)	< .001
Social Equity & Justice in Science (SSEQJ)	328	429	12.52 (2.53)	13.09 (2.51)	+0.56	-3.056 (701.26)	.002
Elitism in Science Perception Scale (ESPS)	335	437	5.30 (1.30)	4.97 (1.24)	-0.33	3.563 (702.31)	< .001

These findings show that academic voice suppression follows structural and epistemic lines, with gender and rank shaping who can speak freely in academia. While rank predicted suppression for men in early models, its effect diminished once satisfaction variables were included. For women, rank was never a strong predictor, suggesting that seniority does not confer equivalent epistemic autonomy. Instead, suppression among women was more closely linked to weak institutional belonging and dissatisfaction with governance. Descriptive results also highlight that suppression is highest in biomedicine and the social sciences, fields with distinct epistemic cultures, especially among senior women, where voice is expected but constrained. These patterns call for viewing academic voice not as an individual trait but as a function of institutional legitimacy and the unequal distribution of epistemic authority. The discussion interprets these results through that lens.

4. DISCUSSION

This study examined gendered patterns of academic voice suppression in Croatian academia, focusing on how institutional roles, disciplinary contexts, and individual orientations shape experiences of constraint and autonomy. Our findings reveal a central paradox: although women are often key contributors to the academic system through research and engagement with science's societal role, they nonetheless report significantly higher levels of suppression than men. This pattern persists even after accounting for

research productivity, academic rank, leadership roles, disciplinary affiliation, and satisfaction with institutional conditions. These findings underscore that gendered structural inequalities are embedded not only in formal hierarchies but also in the perceived autonomy to speak, dissent, and shape the direction of research and institutional life.

Hierarchical regressions and gender-stratified models reveal that while gender consistently predicts academic voice suppression, the mechanisms underlying this experience vary in important ways. Academic rank, for instance, is a significant negative predictor of suppression for men in the earlier models (Model I and II), but loses significance in the final model (Model III) once job satisfaction variables are introduced. For women, rank is not a significant predictor in any step of the model, showing only marginal influence in the final step ($\beta = -.134$, $p = .054$). This pattern suggests that seniority may offer men some institutional protection, but this effect is partially mediated by their relative satisfaction with evaluation and governance processes. For women, by contrast, seniority does not confer similar autonomy benefits, pointing to the gendered limitations of rank-based academic authority. Overall, suppression among women is more strongly predicted by relational and institutional climate variables, especially dissatisfaction with university governance, weak departmental belonging, and concerns about student preparedness. Among men, disciplinary belonging and dissatisfaction with evaluation criteria emerge as additional significant predictors. These results underscore how academic suppression is shaped not only by formal status or productivity, but by how gender interacts with institutional culture and epistemic expectations.

Gender disparities in suppression were most pronounced among associate and full professors, where women reported significantly higher constraints than men. Although our models include academic rank as a structural indicator of career stage, we also conducted robustness checks by adding age. Due to high multicollinearity between age and rank, only one could be meaningfully included; we retained rank in the final model as it more directly reflects institutional positioning.

These results suggest that career advancement does not uniformly translate into increased autonomy, particularly for women, highlighting the gendered limitations of seniority in academic settings. While institutional rank may confer visibility or formal authority, it does not necessarily guarantee epistemic autonomy—the freedom to shape research agendas or speak out without constraint. This pattern aligns with theories of cumulative disadvantage and the "leaky pipeline" (Long, 1992; Stack, 2004), and echoes research showing that structural and cultural barriers may intensify over time (Bird, 2011; Kezar & Eckel, 2002).

When disaggregated by discipline, the highest average suppression scores were observed in both the biomedical and social sciences, regardless of gender. This convergence is particularly striking given the distinct epistemic cultures of these fields, suggesting that elevated suppression may arise from different institutional or normative pressures. These patterns underscore the need to contextualize voice suppression not only through gender, but also through disciplinary and institutional dynamics.

Attitudinal measures further illuminate these dynamics. Women express significantly stronger support for the social responsibility of science, equity, and justice-oriented engagement. They are more likely to value the public and ethical dimensions of scientific work and to reject elitist conceptions of science. This normative orientation aligns with feminist critiques of epistemic exclusion (Fricker, 2007; Dotson, 2012), suggesting that women's heightened commitment to inclusion may render them more sensitive to, and burdened by, institutional silencing. Our findings echo prior research indicating that institutional engagement by women often coexists with structural constraints (Ahmed, 2012). This paradox, of greater normative investment coupled with constrained voice, underscores the epistemic and emotional labor demanded of women in academia. These scales allow us to examine how scientists' normative orientations—such as commitment to equity, resistance to elitism, and endorsement of science's public role—are distributed by gender and how they correlate with perceived suppression. Women's stronger endorsement of social responsibility and justice-oriented science, as demonstrated in our findings, helps to explain both their greater institutional engagement and their heightened vulnerability to epistemic constraint.

We conceptualize suppression of academic voice not only as interpersonal silencing, but also as structural constraint on epistemic autonomy. For instance, one component of the SAVE scale reflects researchers' reluctance to pursue certain topics due to lack of institutional support. While topic avoidance may have multiple causes, we interpret this item as capturing a form of epistemic gatekeeping: where institutional disincentives shape research agendas, contributing to subtle but powerful forms of knowledge suppression. This broad conception of academic voice aligns with Hirschman's (1970) theory, where voice, exit, and loyalty serve as indicators of institutional power and individual agency. In our findings, women's stronger institutional loyalty, evident in their normative commitments, coexists with heightened suppression, suggesting a form of "loyalty under constraint." Voice, in this context, is not simply a behavioral outcome but an index of institutional legitimacy and epistemic inclusion. In this view, suppression of voice operates not only as an individual experience, but as a mechanism of epistemic injustice that shapes academic careers and knowledge production itself. As other scholars have noted,

exclusion from institutional decision-making, agenda-setting, and public engagement diminishes the epistemic authority of underrepresented groups and reinforces dominant academic norms (Fricker, 2007; van den Brink & Benschop, 2012).

While our study provides important insights into gendered suppression, several limitations must be acknowledged. First, the cross-sectional design limits causal inference, and reliance on self-reported data introduces the possibility of recall or social desirability bias. Second, although the SAVE scale addresses potentially sensitive experiences, the broader survey in which it was embedded focused on scientists' perceptions of responsibility and the societal role of science, rather than explicitly on suppression, making strong self-selection bias less likely. Nonetheless, we cannot entirely rule out the possibility that individuals with heightened sensitivity to issues of autonomy or institutional climate may have been more inclined to participate.

Third, our productivity measure is based on self-reported publication counts, which may not fully reflect research quality, authorship hierarchy, or international reach. We partially addressed this limitation by including project leadership experience as an additional indicator of research engagement, though future work could benefit from integrating bibliometric or CV-based data. Fourth, while academic rank was included as a structural proxy for career stage, we were unable to control for age, career interruptions, or tenure status, which may independently influence perceived suppression. Lastly, our survey did not capture intersecting social positions such as ethnicity, disability, or first-generation status, which may compound epistemic inequality. Future research should address these gaps through an intersectional lens. Importantly, we conducted robustness checks by modeling rank both as an ordinal and a categorical variable; results remained substantively consistent, reinforcing the stability and reliability of our findings.

Despite these limitations, our study makes several contributions. It draws on a nationally representative sample of scientists across six disciplines and all academic ranks in Croatia, and introduces a new scale, SAVE, to capture multiple dimensions of academic voice suppression. Our analytic strategy combines hierarchical regression, gender-stratified models, and attitudinal profiling to provide a rich, multidimensional picture of institutional inequality. By integrating attitudinal, institutional, and disciplinary factors, we offer new insights into how suppression operates differently across gendered career trajectories.

5. CONCLUSION

This study contributes to a growing body of scholarship on gendered dynamics in academia by analyzing how scientists and scholars perceive and navigate their professional environments. While women in our nationally representative sample report comparable levels of research productivity to their male colleagues, they also experience significantly higher levels of suppression in expressing academic voice, particularly at senior academic ranks and in disciplines such as the natural and social sciences. These findings suggest that formal markers of success (e.g., publication output or project leadership) do not fully capture the structural and epistemic constraints women face in academic life.

Women's stronger identification with their departments and institutions, as well as their heightened sense of social responsibility in science and academia, contrast with the persistent institutional exclusion they encounter in decision-making processes and autonomy over their academic roles. Our regression analyses demonstrate that dissatisfaction with governance and weakened departmental belonging are among the strongest predictors of perceived academic suppression, especially among women. In contrast, men's academic autonomy appears more closely linked to disciplinary identity and career rank. Notably, scientific rank was a significant predictor of suppression for men in early models but not for women, indicating that rank-based authority does not offer the same protections or benefits across genders. This asymmetry underscores how even the institutional value of rank is not equitably distributed.

These structural barriers extend into the epistemic domain, limiting not only participation in governance, but also freedom over research direction and expression. The reported avoidance of certain research topics due to institutional discouragement represents a subtle yet potent form of epistemic suppression. Such constraints shape which knowledge claims are legitimized and which are sidelined, reinforcing existing gendered asymmetries in the production of academic knowledge. Addressing these dynamics thus requires not only improved access or representation but also transformation of the epistemic cultures and institutional logics that determine what kinds of scholarship are valued.

This points to a deeper systemic imbalance: women represent a socially engaged and institutionally committed force in science, yet their academic environments often curtail their influence—creating a paradox of participation without power. Remediation must go beyond inclusion, aiming to recognize and protect academic voice, reward epistemic diversity, and redistribute the hidden costs of institutional citizenship. Concrete steps include fostering inclusive departmental cultures, equitably sharing service responsibilities, and supporting mid-career women through targeted mentorship and leadership

development. Senior academics, especially those in secure, tenured roles, carry a responsibility to advocate for alternative academic cultures: ones that recognize plural forms of knowledge, enable full participation, and reflect the broader societal responsibilities of science.

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Statements and Declarations

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Ethical approval

This study adhered to the principles of the Declaration of Helsinki and the ethical guidelines of the Code of Ethical Conduct of the Institute for Social Research in Zagreb. Ethical approval for the project "Social Responsibility and Professional Ethics of Croatian Scientists (RESETH)" was granted by the Ethical Committee of the Institute for Social Research in Zagreb on 8 September 2023 (Protocol No. 7/2023).

Informed consent

All participants provided informed consent prior to participation. The informed consent form was presented at the beginning of the online survey, and participants indicated consent by proceeding to the questionnaire after reading the study information. Data were collected anonymously between June and October 2024, and participants were informed of the study's purpose, data protection measures, and their right to withdraw before submitting responses.

Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Competing interests

The authors declare no competing interests.

Author contributions

The first author contributed to the conceptualization, study design, data collection, analysis, and writing of the manuscript. The second and third authors contributed to the theoretical framing and development of the discussion. All authors read and approved the final version of the manuscript.