

Parenting in the field of myrmecology: career challenges in the 21st century

Parentalidade no campo da mirmecologia: desafios da carreira no século XXI

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Abstract: Female representation in STEM fields is often explained by the leaky pipeline metaphor, and previous work has shown that the arrival of children is one of the main causes. Thus, understanding how the arrival of children can impact the careers of scientists in the field of myrmecology could provide insight into how to promote a better policy to support women in the sciences and reduce gender disparity. Therefore, we aimed to 1) understand myrmecologist parents and identify the challenges they face, and 2) compare academic productivity between parents and the control groups (researchers without children). Our results indicate that even though myrmecologist parents work less at home, they maintain productivity in activities that are part of the regular academic research routine (such as publishing manuscripts, submitting grant proposals, advising mentees, and teaching classes). However, even after five years of their children's arrival, activities such as field trips, public speaking and conference attendance are still affected. This is the first study about parenting in the field of myrmecology, and our findings can help funding agencies and institutions promote the best policies, workplace flexibility, and inclusivity to support parents in science, especially women.

Keywords: Children. Academic career. Inclusion. Gender. Women in science.

Resumo: A representação feminina nas áreas de STEM é muitas vezes explicada pela metáfora do *'leaky pipeline'*, e trabalhos anteriores mostraram que a chegada dos filhos é uma das principais causas. Assim, entender como a chegada dos filhos pode impactar a carreira dos cientistas na mirmecologia pode fornecer informações importantes para promover políticas públicas de apoio às mulheres nas ciências e reduzir a disparidade de gênero. Portanto, objetivamos: 1) conhecer os pais mirmecologistas e identificar os desafios que enfrentam; 2) comparar a produtividade acadêmica entre pesquisadores com filhos e sem filhos (grupo-controle). Nossos resultados indicam que, apesar de os pais mirmecologistas trabalharem menos em casa, eles mantêm a produtividade em atividades que fazem parte da rotina regular de pesquisa acadêmica (publicação de manuscritos, submissão de projetos, orientação de alunos e realização de aulas), entretanto, mesmo depois de cinco anos da chegada de seus filhos, atividades como saídas de campo, palestras e participação em conferências ainda são afetadas. Este é o primeiro estudo sobre parentalidade no campo da mirmecologia, e nossas descobertas podem ajudar agências e instituições de fomento a promoverem as melhores políticas, buscando oferecer flexibilidade no local de trabalho e inclusão para apoiar os pais na ciência, especialmente as mulheres.

Palavras-chave: Filhos. Carreira acadêmica. Inclusão. Gênero. Mulheres nas ciências.

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INTRODUCTION

Female representation in science, technology, engineering, and math (STEM) fields is reduced and this is often explained by the leaky pipeline metaphor, where at each subsequent stage of academia there is further reduction or absence of female researchers occupying the highest level of academia, resembling a leak in a pipeline (Blickenstaff, 2005; Goulden *et al.*, 2011; Shen *et al.*, 2018; Ysseldyk *et al.*, 2019). Various reasons for women to discontinue their scientific careers have been identified, and include a hostile environment for women in science, discrimination, sexist attitudes, gender pay inequality, stress, intense workflow in the scientific career, and sexual harassment, among others (Preston, 2004; Blickenstaff, 2005; Adamo, 2013; Ysseldyk *et al.*, 2019). Additionally, the arrival of children is one of the main causes of disparity between men and women during career progression (Ginther & Kahn, 2009; Ecklund & Lincoln, 2011; Goulden *et al.*, 2011; Adamo, 2013; Silva & Ribeiro, 2014; Walker, 2018; Machado *et al.*, 2019; Swann, 2019; Ysseldyk *et al.*, 2019). One of the explanations for women feeling more of an impact on their career is rooted in cultural and historical issues. Even in the 21st century, women are still considered more responsible for domestic tasks and childcare (Preston, 2004; Beltrame & Donelli, 2012; Cech & Blair-Loy, 2019; Ysseldyk *et al.*, 2019), even when they have a professional career and are responsible for financially supporting the household. In addition, as the arrival of children brings many stressful changes in the regular routine (e.g. reduced sleep and work time) (Alstveit *et al.*, 2011). Ideally, a more even division of childcare among all family members, as with other household tasks, may alleviate this burden disproportionately experienced by women.

Finding a way to balance the responsibilities of both one's personal and professional life is a big challenge, one not only faced by scientists (Mobilis *et al.*, 2008; Parsons *et al.*, 2009; Gartke & Dollin, 2010). For mother scientists, the demands of housework and attention to children, coupled with the pressures of academia, make up the most important factors that results in women leaving a scientific career at

higher rates than their male counterparts (Ceci & Williams, 2011; Goulden *et al.*, 2011). The decrease in publications and productivity (Machado *et al.*, 2019), the impossibility of being full time in the laboratory or in the field to continue research (Leventon *et al.*, 2019), and difficulty traveling to attend lectures and conferences (Swann, 2019) are some of the obstacles listed by researchers who have children.

Some extremely effective actions based on inclusive strategies that can be adopted are supervisors that permit more work flexibility, having a collaborative network within a team to move forward on possible segments of research while a member is away on parental leave, and enacting laws that guarantee paid parental (not only maternity) leave (Adamo, 2013; Infanger & Lima, 2019). However, despite the importance of maternity leave for researchers, in Brazil, unlike many countries in Europe (Mascarelli, 2014), this benefit of four months extended maternal leave was only started in 2010, through the Brazilian National Council for Scientific and Technological Development (CNPq) and the Coordination for the Improvement of Higher Education Personnel (CAPES). Two years later, the São Paulo State Research Support Foundation (FAPESP) also extended the term of maternal leave for women fellows to four months during graduate programs (Infanger & Lima, 2019).

Other initiatives in Brazil are emerging, such as the "Parent in Science" project, founded by a researcher's group led by Dr. Fernanda Staniscuaski from the Department of Molecular Biology and Biotechnology of the Federal University of Rio Grande do Sul (UFRGS). The project's focus is raising discussions about maternity/paternity within science in Brazil. The group has already presented several seminars and lectures, taking discussions about motherhood and careers throughout Brazil and was collected preliminary data to carefully assess the impact of the arrival of children on the scientific career of women and men, in different stages of academic life. Through the group's actions, some practical effects have already been implemented, for example, addition of maternity leave in the curriculum analysis (Parent in Science, 2019).



The field of entomology (in which myrmecology, the study of ants, is included) is one of the main fields that attract a great number of scientists scattered throughout the world. Within entomology, women scientists still have to deal with lower salaries compared to men (Reece & Hardy, 2017; Walker, 2018). In addition, entomological studies often necessitate field work to collect material/specimens, which becomes complicated with young children. There are few studies that have addressed these questions specific to the field of entomology. Also, we recognize that women are more impacted by the arrival of children, but as a first step to identify challenges and propose substantial changes this study proposes to compare the productivity of all myrmecologist scientists who have children to those who do not. We used indicators such as number of manuscripts published, grant proposals submitted, mentees advised, classes taught, field trips taken, public speaking participation, and conferences attended, among other indices including estimating the average time for recovery of total productivity and the work routine of scientists who had children.

In order to gather data on how the arrival of children can impact the career of scientists (regardless of gender) within the field of myrmecology, we developed an online survey that was released and answered in several myrmecological research groups. As specific objectives, the study intends to 1) understand myrmecologist parents and identify the challenges they face, and 2) compare if parenthood impacts productivity in academic activities that fit the regular routine (publications, grant proposals, mentees, and classes taught) and activities that involve leaving the regular routine (field work, public speaking engagements, and conferences). With our results we aim to suggest measures that promote inclusion and facilitate both the parenting journey and the scientific career of any myrmecologist choosing to have children.

MATERIALS AND METHODS

In order to conduct this study, a literature review was first carried out to collect data on the reality of myrmecologists

who become parents. The bibliography was based on issues such as the existing legislation to support these parents regarding the work environment, maternity/paternity leave, scientific production, and participation in scientific events hampered by the exclusion of researchers who need to bring their children, and lack of support from advisors, supervisors, and institutions, among other topics that were recurring. As it is a research with humans, before starting our study, we submitted all the documentation for the Institutional Review Board for Human Participants' office at Cornell University for obtaining ethical and legal approval.

Then, a survey through the Google Forms platform was created to collect data on the field experiences of researchers who become parents. Before launching this questionnaire, a pilot survey was conducted with both groups (parents and control – researchers without kids) to incorporate suggestions, and after these accepted suggestions, the survey was widely publicized at the XXIV Simpósio de Mirmecologia – An international ant meeting (XXIV Myrmecology Symposium) in Belo Horizonte, MG, Brazil in September 2019. It was also circulated via email and social networks (such as Facebook, Instagram and Twitter) to reach various research groups and both domestic and international institutions in the field of myrmecology. Myrmecologists with/without children were invited to answer the survey, with researchers without children being used as the control group. The survey was available for 45 days. The script used for the form was built through a line of questioning that involved: 1) Getting to know the researcher and whether or not they have children; 2) Country where the children were born; 3) Academic stage of parents when children were born; 4) Family context when the children arrived; 5) If there was a period of leave such as paid maternity/paternity leave; 6) Support given by a supervisor and the institution; and 7) Impact on academic career (such as numbers of publications, proposal of grants, mentors, classes taught, events attended, public lectures, and field trips etc.). To accomplish the first objective of the study, which is to identify the myrmecologist parents

and their challenges, the answers were submitted to exploratory content analysis and through statistical tests (t-test and linear regression) performed in the software R (R Development Core Team, 2019) to compare both groups (parents and control). To achieve the second objective of the study, evaluating parents' productivity compared to the control group, data were filtered to maintain results only from professors, postdoctoral researchers, museum curators, and other researchers. We used the Poisson distribution (dependent variable) with the relaxed constraint through Conway-Maxwell Poisson (compois) (Lord *et al.*, 2008) applied in the GlmmTMB (Magnusson *et al.*, 2017) and Emmeans (Lenth, 2018) package in R software (R Development Core Team, 2019). With this data we could apply Type III tests of the fixed effects, which gave us a p-value to check for differences between the two groups.

RESULTS

GENERAL PROFILE

Our study had 161 participants, but as answering all questions was not mandatory, the total number of answered questions showed some fluctuation (45-161). We analyzed all participants without gender distinction. We had 159 participants including 49.7% (N = 79) women, 49.1% (N = 78) men, and 1.2% (N = 2) non-binary gender. The age range of the participants ranged from 23-72 years old (N = 157), and the vast majority were between 25-45 years old (N = 128). Our study had participants from 20 different countries from the Americas, Europe, Asia, and Oceania, with 43.9% (N = 69) residence in the USA, 28.7% (N = 45) Brazil, 5% Mexico (N = 7), followed by other countries in smaller numbers (N = 36, Germany, Colombia, Austria, France, England, Canada, Australia, Israel, Spain, Portugal, Pakistan, Finland, France, Switzerland, Japan, Argentina, and the Philippines).

The large majority of participants (66.2%) have a Doctorate with (N = 106), followed by 22.5% (N = 36) Masters, and 10.6% (N = 17) Bachelors, as the highest

academic degree, and 59.4% (N = 95) received their highest degree between 2013 and 2019. In addition, 30% of participants declared themselves professor, followed by 27.5% students, 18% postdoctoral, 13.1% research/scientist followed by other positions in smaller numbers. Finally, 47.2% (N = 76) of participants stated that they had children, while 52.8% (N = 85) did not (thus constituting our control group).

UNDERSTANDING THE PARENTS WITHIN THE FIELD OF MYRMECOLOGY

Within the parent group, the vast majority reported parenting with partner help (85.1%), followed by family help (28.4%), and solo parenting (4.1%). Also, the career stage at which the first child was born varied, with graduate/undergraduate student (33.8%) being the most common, followed by postdoctoral researcher (28.4%), professor (18.9%), and research/scientist (10.8%), followed by others in smaller numbers. Regarding maternity and paternity leave, more than one third of participants (35.1%) stated they did not receive any such leave. Only 27% of participants received paid leave, while 29.7% received unpaid leave. Mothers in Brazil stated that they had on average 4 months of leave, while mothers in the USA on average stated 3-4 months. Mothers who had their child in Europe declared 7 months-1 year on leave. On average, fathers received 1-2 weeks of leave.

Overall, the supervisor and the institution provided support for myrmecologist parents, though 12.2% of participants report that they did not have this support (Figure 1A). Part of this majority positive response resulted from the institution providing flexible working hours for at least 66.7% of participants, which in the majority of cases is already a feature of a scientist's work schedule. These and other benefits/amenities offered to myrmecologist parents are listed in Figure 1B.

During workdays, the majority of myrmecologist parents are entrusting the care of their children to a childcare facility/school (58.9%), but they also rely on other arrangements such as care by a spouse/partner (49.3%), relatives (21.9%), and a nanny (19.2%). One of the more



interesting and important data points in our study was that when children are young, most parents described difficulties working at home (Figure 2A). When comparing researchers with kids (parents) to the control group, this

data is even more notable (T.test = 4.0863, p-value = 0.002732), because the researchers in the control group also believe the time devoted to work at home positively impacted their careers (Figure 2B).

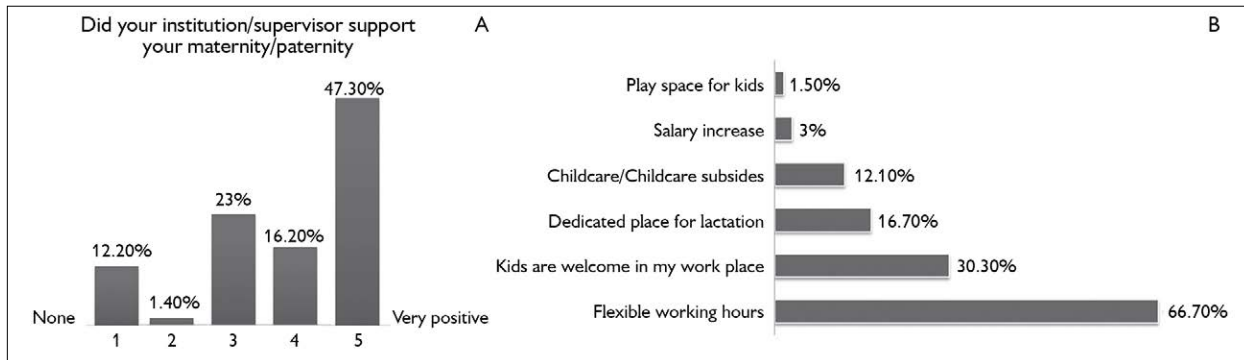


Figure 1. Institutional and supervisor maternity/paternity support offered to myrmecologists: A) participants' views on the support they received from supervisors and their institution; B) benefits and amenities offered by the institution to research parents.

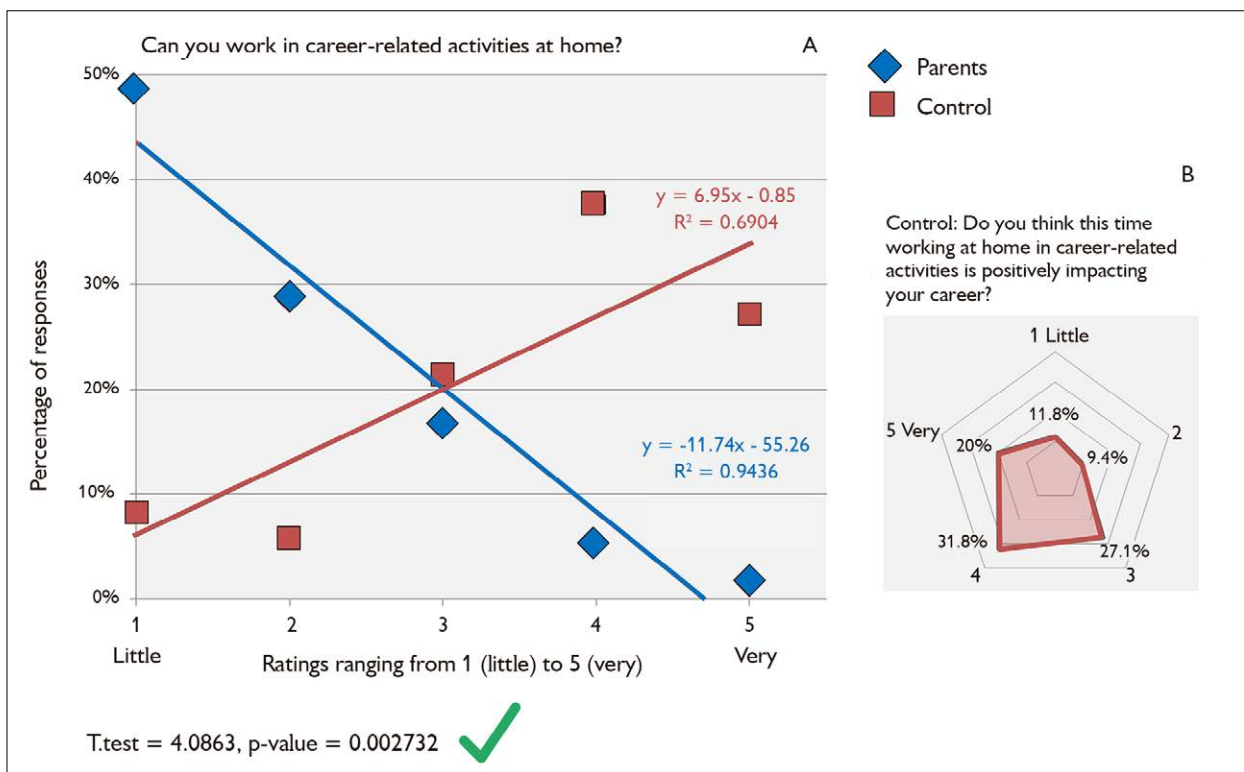


Figure 2. Work at home in career-related activities: A) averages and linear regression of self evaluation of how much the researcher can work at home in career-related activities separated by groups (parents in blue and control in dark red). Note that there is a difference between parent and control groups regarding work at home in career-related activities; B) the majority of the control group believes that this time working at home significantly impacts their career. Response averages are highlighted in dark red.

ASSESSING PRODUCTIVITY IMPACT

A significant majority of parents participating in our research believe that their children's arrival impacted academic productivity (Figure 3A), and returning to the regular pattern of productivity before their children's arrival is extremely variable (Figure 3B). Our research also assessed the impact of parenting on the number of publications, grant proposals submitted, mentored students, classes taught, field trips, public speaking engagements, and conferences compared to researchers without children. However, we filtered results only by professors, museum curators, postdoctoral and other researchers because some of these categories are not part of the student routine for some graduate programs. Overall our results for publication (F value = 1.3285, p value = 0.2507), grant proposal submissions (F value = 0.7784,

p value = 0.5656), mentees (F value = 0.5806, p value = 0.7149), and classes taught (F value = 0.4114, p value = 0.8409) did not show statistical differences between parent and control groups, and by the fifth year of the child there is a recovery, with no further difference between the two groups (Figure 4). However, this is not the case for field work (F value = 3.2058, p value = 0.007426), public speaking engagements (F value = 2.657, p value = 0.0086), and conferences attended (F value = 5.8118, p value = 0.0178), where even after the child's fifth year (Figure 5), our results show significant differences between the two groups.

DISCUSSION

This is the first study that focuses on identifying myrmecologist parents (women and men) and evaluating the impact of children on their careers. Through this approach, our study provides insight in order to reassess and develop ways to make our field a fairer and more inclusive environment. There are few studies that address the effect of male and female parents compared to those who do not have children, and this makes our study even more novel. However, as most of the previous studies only focus on the impact of motherhood, it makes our discussion enriched by these data. Most of the household chores and childcare are still considered the responsibilities of women, therefore, often have less time to dedicate to their careers (McGuire *et al.*, 2012; Williams & Ceci, 2012; Walker, 2018). The arrival of a child is a unique moment and requires many changes in routine (Alstveit *et al.*, 2011) which seem to be easier when shared by all family members. According to our data, most myrmecologist parents report that they share childcare with a partner, which is higher compared to most parents reported in the study by Machado *et al.* (2019) where about 54% of participants who were mother scientists were the sole childcare provider. In that study the authors also add that only 5% of fathers help occasionally. The division of tasks with the arrival of children is certainly one of the most impactful factors for keeping parents, and especially women, in science (Hensel, 1991; Rausch *et al.*, 1989; McGuire *et al.*, 2012; Williams & Ceci, 2012).

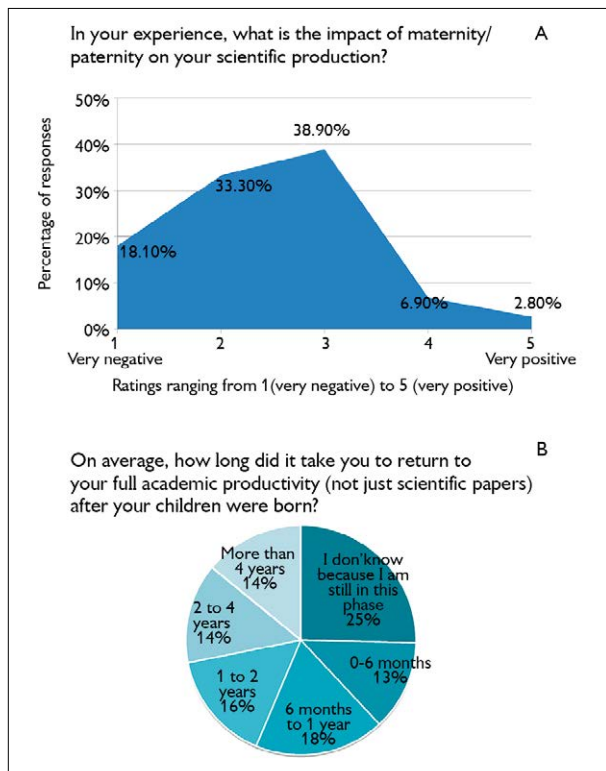


Figure 3. Assessing the impact of productivity upon arrival of children: A) most participants believe that the arrival of children impacted productivity. Note that most of the graph is concentrated between points 1-3; B) time to return to productivity achieved before the arrival of children is variable.

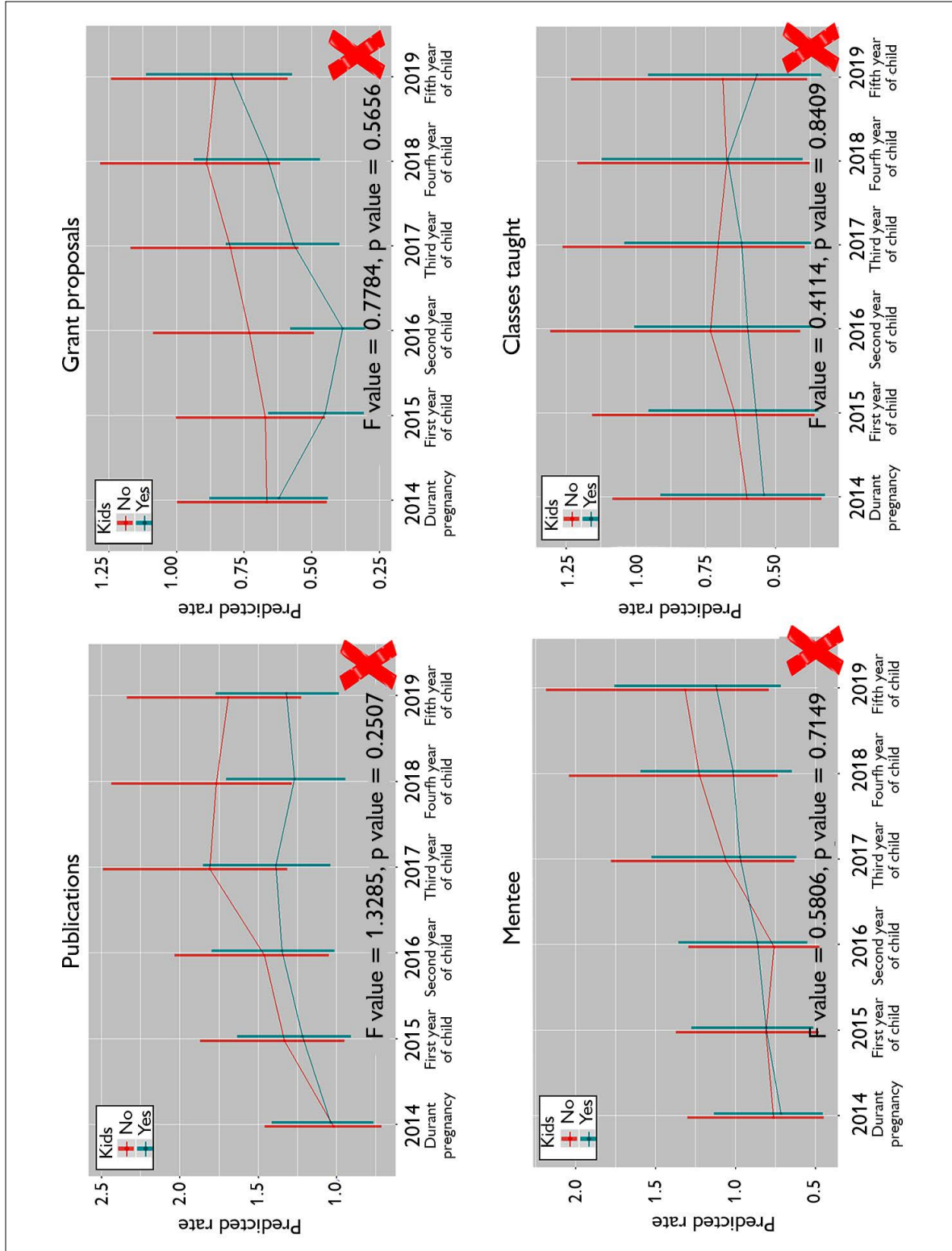
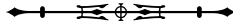


Figure 4. Impact of myrmecologists' academic productivity on number of publications, proposals, mentees, and classes taught for parents and the control group. Type III Analysis of Variance Table with Satterthwaite's method was used to recover statistical differences between the two groups.



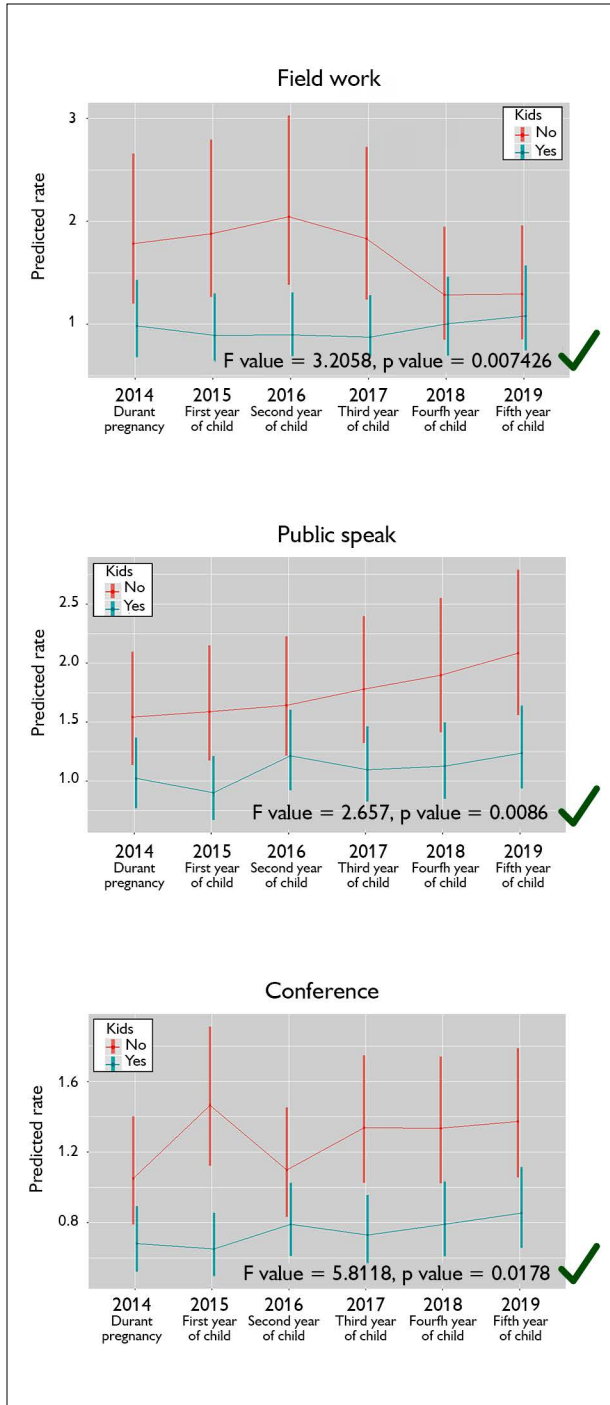


Figure 5. Impact of myrmecologists' academic productivity on number of field trips, public speaking engagements, and conferences for parents and the control group. Type III Analysis of Variance Table with Satterthwaite's method was used to recover statistical differences between the two groups.

Regarding maternity and paternity leave, myrmecologist parents follow the pattern governed by the laws of the country of residence, being in Brazil on average four months (paid), and USA at 12 weeks (unpaid), and Europe above six months (paid) (Mascarelli, 2014). Even so, some researchers report that they took no leave (paid or unpaid). In addition, feeling that one's institution/supervisor values and supports the personal choices of the employee is an important driver that ensures productivity and career success (Sax *et al.*, 2002). Institutional and supervisor support were highly rated by myrmecology parents, but one of the biggest benefits listed by parents was flexible hours that are already part of the nature of the job (Infanger & Lima, 2019). Despite this natural flexibility, the academic work environment is also competitive in its pursuit of financial success and productivity through often unfair metrics (for example, number of manuscripts published and received grants), which adds pressure to avoid taking parental leave (Bell, 2009).

Scientist parents in Brazil believe that the arrival of their children had a negative impact on their career (Machado *et al.*, 2019), and our data also corroborate this finding. However, productivity recovery is a more complex matter, and it depends on several variables, so it is natural that myrmecologist parents have different opinions regarding recovery time. Machado *et al.* (2019) show that productivity increases again from the third year of parenthood, and indeed, the first two years of parenthood can be even more challenging (Alstveit *et al.*, 2011). The productivity parameters analyzed in the present study (publications, proposals, menteeships, classes taught) did not show significant difference between the two groups (parents and control), especially after five years of the arrival of the children, which includes the recovery time and adaptation to the new routine with the arrival of the child (Alstveit *et al.*, 2011). This result corroborates Sax *et al.* (2002), which showed that family issues, such as the arrival of children, affect productivity less than other professional variables such as job recognition and salary.

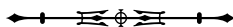
Brazilian scientists report difficulties in working at home for academic-related work (Machado *et al.*, 2019) and the present study also shows that myrmecologist parents face the same challenges. However, our data also show that this did not affect productivity, especially after five years, which warrants an explanation. In fact, Hamovitch & Morgenstern (1977) and Cole & Zuckerman (1987) suggest that children do not interfere with women's research productivity because there is a limitation of free time (leisure) and practically an exclusive dedication to family and career. This may be one of the explanations for why myrmecologist parents do not face a decrease in productivity.

Despite this excellent performance, these results reveal a pattern that indicates that activities that involve leaving the regular routine such as field work, public speaking engagements, and attending conferences affect parents even after five years of parenthood. Parents still need to look for alternatives to these events (e.g. who picks up their child at school when the father is at a conference?), an endeavor which may not be successful and end up contributing to the leaky pipeline. Notwithstanding, we recognize that these data do not capture the impact of these academic categories on the arrival of more children, and although our study was widely publicized on social networks and attempted to reach as many people as possible, our results were unable to capture those who have already abandoned their scientific careers due to the imbalance between their personal and professional lives.

Participating in conferences and making contact with students and other researchers is part of a typical career in science, so this result suggests that actions are needed to ensure that myrmecologist parents do not fail to attend those events that may be critical to their career success. Although not yet a reality in all events, providing help and support for parents to bring their children to the conference is increasingly common. Each event has its own way of including parent scientists – for example, the Evolution Meeting (USA) often creates a childcare and nursing space

with professionals who can take care of the children so parents can attend the lectures (Evolution 2020, n. d.). As another example, since 2014 the annual meeting of the Entomological Society of America (EntSoc) has offered a small grant to parents who will bring their children to the event or who incur extra expenses in leaving their children at home (e.g. extra daycare or babysitting services). The Parent in Science group started these discussions in Brazil and this issue has been gaining more attention in recent years (2018-2019), with events seeking to find alternatives to include parents (and children) even in times of generalized national and local budget cutting. Therefore, through the data presented in this study, the next step and challenge for the myrmecological community is to create measures that make conferences (such as meetings, events etc.) family-friendly activities or propose that event institutions and organizations provide some form of financial assistance so that parents can afford to pay someone to care for their children while they attend conferences.

Our study sought to be inclusive for parents of all genders, nationality, and whether or not they have biological children. The arrival of children and the challenges for parents to maintain a balance between personal and professional life is not a matter of pity, but of inclusion, especially for women in science. Our data show that parents of myrmecology are focused and dedicated to maintaining productivity on publications, grant proposals, mentees, and classes taught, (routine matters activities). However, we are not able to determine from our data why and how this is achieved. It is possible that the problem-solving, time-management, and budgeting skills that are routine parenting tasks can give scientists excellent transferrable skills as well, so thinking about measures to ensure that parents do not abandon or pause careers is critical. In addition, although looking for differences between male and female parents is not part of the scope of this study, additional studies are needed to assess the impact of different gender on parenting not only in myrmecology, but throughout the entire entomological community.



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