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# Mommy Brain and the Mommy Mathematician

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## Synopsis

Is mommy brain real? Are pregnant women and mothers ditzier than non-mothers? If mommy brain is a real phenomenon, what are the implications for women mathematicians whose careers depend on their mental agility? While anecdotes and references to the phenomenon in pop culture abound, concrete evidence is decidedly murky. In this article, I discuss some of the recent research on so-called mommy brain. I delve into the implications of its alleged existence, particularly for mother-mathematicians. I include perspectives of several mother-mathematicians on the consequences of mommy brain ... or its perceived existence.

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*... my daughter's pediatrician said it best, "Once the baby is born, and you deliver the placenta, your brain goes with it." I used to remember so many phone numbers, my schedule by heart, also my ex-husband's schedule as well. Thank God for my iPhone. It helps me remember all that I need to do.*

-Monika Kiss, Professor at Saint Leo University and mother of one

*When I was pregnant with my twins I could not think straight, even during the months I felt kind of ok and not too unwell. I simply could not concentrate. I tried to write a paper together with my postdoc and it was a disaster. I only noticed after having the babies all the mistakes I had put in there.*

-an anonymous mother-mathematician

*I can't keep anyone's names straight anymore. I remember being so annoyed when my mom would do that, and look at me now! I feel like I can't think on a deeper level anymore. For example, my research suffers tremendously. I can't concentrate on advanced mathematics with mommy brain. I lose motivation to cook intricate or tedious meals. I'm ENTIRELY less productive in the way of research. Instead of being ahead of schedule for my courses, I find myself preparing for lecture the night before. I'm more apt to make silly errors on the board in front of the class. I forget to respond to emails or attend previously scheduled meetings.*

-Susie Brooks, Assistant Professor, Western Illinois University, Quad Cities Campus

*It regularly happens that someone asks me about some conference we both attended and I stare at them blankly. Then I realize that the conference occurred 5 or 6 months after one of my kids was born, and I know that I have big blanks in my long-term memory for those periods!*

-Tara Holm, Cornell University, mother of two

“It’s just mommy brain,” laughs a pregnant professor’s friend, as the professor locks herself out of her car. Months later, after returning from maternity leave, the professor searches a little too long for the right word during a hallway conversation. “You’re thinking for two,” jokes her colleague. Mommy brain, baby brain, momnesia, placenta brain, pregnancy brain. . . There are many different names with sometimes subtly different meanings, but the basic idea is the same: a pregnant woman or mother of a young child becomes forgetful or more generally cognitively impaired. References to mommy brain abound in pop culture, from celebrities moaning about being personally afflicted, to claims of methods to supposedly overcome it. “Forget Mommy Brain!” declares one headline, explaining that a mother’s zodiac sign can ease her struggles [16].

Some of these articles point to scientific evidence that the phenomenon of mommy brain is not only real, but biologically founded. “In fact,” justifies Ruffin, “research has determined that a woman’s brain shrinks during pregnancy” [16]. Indeed, one study found that women’s brains after pregnancy are actually smaller [14]. In a review of fourteen studies spanning seventeen

years that compared pregnant and postpartum women to control subjects, Henry and Rendell found some evidence that the pregnant and postpartum groups performed worse on some memory tests [9].

So there it is. Science has proved, it seems, that pregnant women and mothers of young children are cognitively deficient. Moreover, science has proved that this cognitive decline is biologically based and totally inevitable (unless, perhaps, we consult our horoscopes).

Or has it?

### 1. Mommy Brain: Existence, or Misinterpretation?

Not so fast, argues Nicole Hurt [10]. While the media picked up on Henry and Rendell's review, citing it as proof that mommy brain exists, a game of telephone is at play. According to Henry and Rendell's results, the pregnant and postpartum groups did perform more poorly than the non-pregnant controls on some measures of memory, but even for these measures, effect sizes were small. Henry and Rendell's sentence "The results indicate that pregnant women are significantly impaired on some, but not all, measures of memory, and, specifically, memory measures that place relatively high demands on executive control may be selectively disrupted" [9] likely uses the word "significantly" in the sense of statistical significance. That is, in Hurt's words, "it can be interpreted as 'probably caused by something other than mere chance'" [10]. Since the article is published in an academic journal, and the authors are careful to point out limitations to the results later in the article, this is likely the intent. When a layperson or reporter reads the words "significantly impaired," however, the interpretation may change, well, significantly. According to Hurt,

*From this sentence alone, the reader is led to believe the research has found that pregnancy has a considerable, negative impact on a woman's memory capabilities. Although Henry and Rendell later state their findings must be further investigated for their "functional consequences," the damage is done with the prior sentence. The elision of the term "statistical" from the abstract is crucial, not only because it allows the lay reader to give functional significance to Henry and Rendell's findings, but also because that sentence is what gets picked up and replicated by the mass media [10].*

What about the Oatridge group's study that determined that pregnant women have shrinking brains? Among other weaknesses, the study only included fourteen subjects, five of whom had pre-eclampsia. And, as unsettling as the idea of a "shrinking brain" may be, when it comes to brains, the assumption that "bigger means better" is unfounded [17].

Recent studies on mommy brain have led to different conclusions. The Personality and Total Health (PATH) Through Life Project, a prospective longitudinal study, followed a group of over one thousand women over eight years, and assessed four domains of cognitive functioning at different times [4]. The authors write:

*... we were also not able to establish substantial or consistent cognitive deficits. Except in a brief period in later pregnancy, these findings challenge the common myth that women develop "placenta brain" or "baby brain". We found no deficits on memory tests in particular [4].*

Because prior studies (such as those included in Henry and Rendell's review) showed only modest effects, argue the authors, these effects could have "resulted from relatively subtle biases to which samples of convenience and non-randomly assigned groups are at risk." Notably, most studies compare a group of pregnant or postpartum women who are recruited after pregnancy to a control group, but the PATH Through Life Project followed women who were recruited before pregnancy.

This research suggests that pregnancy and early motherhood have no measurable cognitive effect (other than a minor one during a period in late pregnancy), but a different group of researchers found results that demonstrate an even more intriguing possibility: the idea that cognition may actually be *improved* by pregnancy and early motherhood ... well, at least in rats [12].

## **2. The "Mommy Brain" Advantage**

More specifically, Kinsley and collaborators found that "a combination of reproductive and pup experience and stimulation is beneficial to learning and memory in female rats" [12]. The researchers tested rats who had given birth and lactated twice versus those who were the same age, but had not

given birth or lactated. The rats were put through mazes. The authors found that the rats who had experienced birth and lactation made more correct choices than those who had not.

The idea that motherhood increases female rats' maze skills is logical, argue the authors, since these behaviors "contribute to the survival and rearing of pups." Perhaps relatedly, Tomizawa and collaborators found that oxytocin, a hormone that plays a major role in mammalian labor and lactation, was "critically involved in improving hippocampus-dependent learning and memory during motherhood in mice" [18].

But it's not just rodents who experience changes to their brains during pregnancy. Kinsley and Franssen describe the numerous fundamental transformations, ranging from attention to memory that happen in a pregnant woman's brain [11]:

*Neurons in the part of the brain that largely regulate maternal behavior, called the medial preoptic area (mPOA), grow impressively during late pregnancy, increasing the protein-synthesizing capabilities of the cell. Like a race-car burning rubber before the green light, these mPOA neurons are readying themselves to respond to offspring stimuli with appropriate and sensitized impulses.*

So, early motherhood, one could argue, is associated with some awesome, positive changes in the brain. Since the brain is preparing itself during pregnancy, the process of "revving," as Kinsley and Franssen describe, could result in the observed minor memory changes during a brief period of late pregnancy that Christensen's group mentions in [4].

Reports of improved function in early motherhood are not limited to scientific studies. Sharon McCathern, Associate Professor at Azusa Pacific University, reports, "I think motherhood has boosted my ability to focus well for short bursts, because I've had to become much more efficient on work/mental tasks." Susie Brooks mentions, "I will say that since I have less time to myself, I feel that I have to work more efficiently in order to make the most of my allowed time." An anonymous mathematician-mother describes how skills she learned through motherhood equipped her to become better at responsibilities such as organizing conferences.

Similarly, Monika Kiss has found herself seeing the forest for more than the trees, so to speak. About motherhood, she writes,

*Our thoughts are now centered on something more important than ourselves. I feel now that my daughter is almost 13, my memory is working on not so much the mundane schedules and information of that type, but rather big picture stuff. Like the next year what I need to accomplish. I think in some ways my ability to think has improved. I am much better at realizing the world around me, my daughter, my students, the community at large. I am better for this ability.*

She goes on to describe how her daughter has changed the way she does work.

*I think I am a better professor/educator. I feel more productive especially now that [my daughter] is older. She inspires me to do things I never thought of before. And, yes, because of her, I am doing things I did not do before. And, I love that!*

Tara Holm describes some positive changes to her work when her second child was small.

*I was able to think about some education topics - I was getting very involved in TPSE Math leadership (<http://www.tpsemath.org>), and being home with the baby, it was very easy to join phone calls and have "big picture" conversations about undergraduate and graduate mathematics education in the US. I'm not sure I would have had the time to commit to that at other points in my career.*

An anonymous associate professor also finds herself at an advantage after becoming a mother.

*I am far more productive after having children than I was before. I am smarter about using my time - I am very aware of which tasks I can do while distracted, tired, or multi-tasking, and which tasks need focus. When I have the chance to focus I defend and use that time to the fullest. And because I no longer expect to rely on my memory, I am meticulous about using a calendar and planner in which I write down every single task that needs to be completed.*

Perhaps like rats in a maze, mathematician-mothers develop job-related superpowers to allow us to better care for our young “pups.” Being compared to rodents may inspire some mothers while giving others the creeps. Still, there is a lingering question: if pregnancy and motherhood don’t truly cause any major cognitive or memory deficits, why do so many mothers feel like they do?

### 3. Why We Think We’ve Lost Our Minds

Katherine Tombeau Cost examined spatial ability during pregnancy and motherhood both in rats and in humans [6]. According to Cost, 50 to 80 percent of pregnant women report lapses in thinking and/or memory. Cost found that, “Despite objectively equivalent performance, both pregnant and lactating women subjectively rated themselves as more impaired on spatial tasks than never-pregnant women.” That is, lactating women and mothers did not perform worse on spatial tasks than other women, but they thought that they did. Christensen’s group found similar results for memory [5].

Why is this? One possibility is the “revving race car” that Kinsley and Franssen described in [11]. While the mother’s brain prepares for the daunting task of taking care of a child, the major changes happening may make the mother feel cognitively impaired, even if the brain is working toward achieving quite the opposite effect.

Another possibility is attributional bias. When we try to explain behaviors of other people or ourselves, we sometimes mistakenly attribute the behavior to an irrelevant factor. For example, if an expectant mother’s friend tells her that her baby will be a girl because the mother-to-be has bad acne, when in fact the baby is a boy, this is an example of attributional bias, since the friend blamed the acne on the baby’s (incorrect) gender.

A woman who is pregnant or a new parent is unlikely to forget for very long about her new status as pregnant or a parent. It’s tempting, then, to attribute minor mishaps such as locking herself out of her car, or forgetting an appointment, to her new status. Sharon McCathern mentions that while it may seem logical to attribute some lapses to mommy brain, she became a mother and started using a smartphone at the same time, and the smartphone may actually be to blame.



The effect of stereotype internalization may also be a factor. Activating negative stereotypes about aging worsened elderly individuals' performance on memory tasks [13]. Bonnot and Croizet found that women who endorse the stereotype that women are weaker at math than are men had lower self-evaluation in math, and also lower grades in statistics than those who did not [2]. In light of these studies, it is plausible that endorsement of the "mommy brain" stereotype actually affects mothers' cognitive performance. Further, according to a study by Brescoll and LaFrance, participants were more likely to endorse gender stereotypes when exposed to a fictional newspaper article reporting research that cited biological (versus sociocultural) factors [3].

This finding suggests that reports of biological evidence for mommy brain in the media are more likely to convince people that pregnant women and new mothers are, in fact, in a cognitive slump, whether or not it is true. That is, if a newspaper article cites a study whose results suggest that pregnant women's brains shrink, people are more likely to believe in mommy brain than if a newspaper article cites a study whose results suggest that mothers do not get enough family support during the early months of an infant's life. Furthermore, if we are primed to think of biological justifications rather than sociocultural ones, then we are more likely to find confirmation for biological explanations than sociocultural ones.

And when it comes to "mommy brain," there are some major sociocultural factors involved.

#### **4. Cognitive Load**

For most new parents, bringing a child home means a major increase in responsibility. Hwanhee Lee, a mother of two who had children during her PhD work in mathematical sciences, writes "I found myself thinking about what I need to do at home first. It seemed like my priorities changed from my degree work to baby and family." An anonymous mother-mathematician describes her children's early days: "I also could not really work if I knew the kids were not alright, as in not well, not taken care of."

Certainly, both fathers and mothers experience this dramatic increase in responsibility, but some tasks are generally considered the mother's domain, for a variety of reasons. Kristi Lampe, Professor at Carroll University and mother of three, writes,

*I also think that (speaking very broadly) fathers do not have the same experience. The physical “trauma” of childbirth and recovery isn’t there. Social expectations usually fall on the mother in the day-to-day running of the family. The mother is the one to keep track of play dates, birthdays, school, deadlines, scheduled activities, etc. This creates an overload that fathers (again speaking broadly) don’t experience.*

She sums it up, that mommy brain isn’t (at least entirely) because of cognitive changes, but because of “cognitive challenges.” Sharon McCathern describes, “I feel like I have a constant process running in the background of my brain, which pops up worries and reminders about every ten minutes and keeps me from fully focusing on other things.”

Many mothers of infants, of course, are responsible for breastfeeding. Nursing an infant twelve or more times per day is a big responsibility. If this responsibility continues when the mother returns to work, it may mean pumping multiple times during the work day. When asked what a typical work day looks like when she is caring for an infant, Kristi Lampe responds,

*It was probably four to six months before I started getting quality sleep (so I was very lucky!). When I first went back to work as a nursing mother, my mornings started an hour earlier than before I had children because I had to wake/change/feed/change/pack (and the packing is NOT trivial) for the baby as well as getting myself ready. Morning workouts disappeared, replaced by child care. Drop off at daycare, head to work. Spend eight hours trying to be as efficient as humanly possible because I knew the chances of accomplishing much after dinner were small. Pump twice during the day and hope no one knocked on my office door. Child pick-up, home, nurse. Chores/dinner/quality time with older kids and husband. Nurse. Since my kids resisted bottles, they usually cluster-fed in the evening. So there would be one more nursing session before bedtime.*

The addition of full-time work on top of mothering a nursing child may indeed feel overwhelming. But it is not really about being unable to do math when mothering. One anonymous mathematician-mother of three describes,

*most [women in my family] take time off for a new baby because of the cost of childcare and the difficulty nursing while working and the late nights. I took one year off for two of the three and enjoyed the break. I even managed to get research done during the leave while watching a toddler and an infant. Towards the end of the leave I eased the baby into daycare and got even more research done. It is easier to do research home with babies than while teaching with a high teaching load. These leaves saved my research career.*

The theme of caring for an infant—especially a young nursing infant—while returning to work feels familiar to many US-based mothers. The United States is notorious for its poor parental leave practices [7]. Writes Eve Torrence, Professor at Randolph-Macon College, “I don’t think I was allowed enough time off to recover from pregnancy so that I could come back well rested enough to be effective. Hence it may have taken me longer to recover.” This, of course, brings up an important question: would working women feel less afflicted by so-called “mommy brain” if we (and our partners) could take a more reasonable amount of time off?

## 5. Sleep

Sleep deprivation is known to adversely affect cognitive performance [1]. Many parents experience sleep deprivation with a new child in the house. Writes an anonymous mother-mathematician, “After [my twins] were born I suffered severe sleep deprivation for several years, which of course did not help with doing research, but at least after some months to a year I felt I could think again like a normal person, assuming I got enough sleep say.” Hwanhee Lee adds, “I felt less productive because of the sleep deprivation or less of me time because of constant baby feedings, about every three hours.” Tara Holm recalls, “while I’m exclusively breastfeeding and being woken lots at night, I really lose my ability to concentrate on hard math.” She adds, “I never deal well with lack of sleep, and exclusive breastfeeding really compounds it.”

Indeed, since breastfeeding babies are known to wake multiple times at night, a nursing mother often must wake as well. In fact, breastfed infants “continued to sleep in short bouts with frequent wakings” through age two [8].

Given these physical and cognitive demands of a young child on a caregiver, it is remarkable that parents are able to function at all. In light of these factors, the push to attach a biological explanation to “mommy brain” seems to be unfounded.

In fact, it may also be dangerous.

## 6. Dangers of the “Mommy Brain” Label

According to Hurt, in 2009 “the United States Equal Employment Opportunity Commission received 6,196 pregnancy-related discrimination charges, which is nearly a 50% increase from the charges filed a decade previously” [10]. Interestingly, after peaking in 2009, by 2016 the numbers have decreased back down to 3,486, similar to their levels in the 1990s [15]. As Brescoll and LaFrance found that fictional biological explanations lead people to endorse stereotypes more easily than do sociocultural explanations [3], offering biological explanations for mommy brain may put pregnant women and new mothers into dangerous waters, by providing ammunition to people who would like to undermine workers who are pregnant or new parents.

One anonymous mathematician-mother describes such a story. “The term [mommy brain] has only been used only to hurt me. I was told when giving a talk pregnant that I would no longer be able to do math after having a baby.” She continues,

*... people’s attitudes led to comments like how if I had a baby now I wasn’t serious anymore. Invites to speak went down. People said they didn’t want to hire or promote me until they were sure I’d be serious again... I proved myself but they all had to wait and see.*

Hurt argues that mommy brain discourse

*... encourages pregnant and postpartum women to link any cognitive difficulty to their hormones and, therefore, to interpret memory lapses as individual, biological deficits. It is, the discourse suggests, nothing they can fix because it is literally “all in their heads.” This individualizing and personalizing rhetoric*

*diverts attention away from the host of obstacles that await pregnant women as mothers. For example, women may experience cognitive difficulty due to the changes in sleep, eating, and exercise, in addition to increased stress levels, that may accompany both pregnancy and infant care. By masking the material conditions that contribute to how women will experience pregnancy and motherhood, baby brain encourages women to settle for the status quo [10].*

Christensen and collaborators suggest,

*Since both women and their partners believe that women experience cognitive deficits in pregnancy (see [5]) women and their partners need to be encouraged to be less automatic in their willingness to attribute common memory lapses to the salient causal factor of a growing or new baby. Obstetricians, general family doctors and midwives may need to use the findings from this study to promote the view that ‘placenta brain’ is not inevitable, and that perceptions of impairment may reflect emotional or other unknown factors. Not so long ago pregnancy was ‘confinement’ and motherhood meant the end of career aspirations. Our results challenge the view that mothers are anything other than the intellectual peers of their contemporaries [4].*

## 7. Conclusion

An anonymous associate professor and mother writes:

*I am careful about when and to whom I talk about mommy brain. I certainly do not use it as a self-deprecating deflection when I make mistakes. I talk about this with other mothers (and mothers-to-be), particularly as they prepare to return from maternity leave. I think it can be extremely damaging to the causes of advancing women in academia and promoting family-friendly workplaces for there to be a narrative that having children makes women dumber, when the reality is that every mother I know, without exception, has returned to work more productive, more focused, and more*

*efficient than before they had children. And it is worth noting that there are cognitive changes that new fathers experience as well (and adoptive parents)—due to sleep-deprivation, hormonal changes, and the “mental load” of having an increasingly complicated home life. So I would love to see the conversation switch from mommy brain as a kind of biological flaw that makes women weak, to an acknowledgement that most people at some point will experience a life circumstance (whether it’s parenthood, an illness, or the care of an aging parent, etc.) that will affect their cognitive abilities. Then we could, as an academy and as a society, have more productive conversations about how to support each other through these circumstances.*

Biological adaptations are usually logical. Just as rat mothers become more skilled at tasks that may benefit their ability to rear pups, human mothers likely adapt in ways that benefit (or at least don’t harm) their infants. It seems highly unlikely, then, that a human suddenly becomes cognitively deficient upon becoming a mother. Changes in priorities, time available to work, and changes in physical health (such as sufficient sleep) are more likely to contribute to a mother’s mental state. For an exhausted mother of a three-month-old who sleeps only twenty minutes at a time, needs to eat every hour-and-a-half, and has a daycare bag the size of a small car full of absolutely essential items, being able to laugh at her own—perhaps inevitable, under these circumstances—mistakes may save her sanity.

Just as good mathematics often comes from collaboration, however, the raising of children is not meant to be a solo endeavor, at least for humans. As the anonymous mathematician-mother above describes, maybe it’s time to change our focus. Perhaps we should think of the “mommy brain” concept as an opportunity to start a conversation about sociocultural factors (child-care, parental leave, balanced work between parents) that are critical not just to the well-being of mathematician-mothers, but to all mathematicians and their families.

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