

## Women in Science and Engineering: What the Research *Really* Says A panel discussion co-sponsored by WISELI and the Science Alliance. Thursday April 14, 2005 Biotechnology Center Auditorium, University of Wisconsin – Madison

"How Does the Brain Respond To Social Competition?"

Assoc. Prof. Linda Oakley, School of Nursing, University of Wisconsin - Madison

Well, I'm also happy to be here this evening. And my talk falls very closely on to the comments you've heard so far because what I'm going to be looking at looks at the hypothesis or the assumption that bias has no real impact that we need to pay attention to. Most of the work I'm going to be focusing on now really comes from the study of bias and discrimination effects on academic performance and competition [on] African-Americans, especially black women, in mostly white institutions. So with that, what the research really says – I took that ten minute part very literally so I sort of compact it all in here – [is] in socially competitive work environments, and that's going to be academic especially in science, social bias against females gives important performance advantages to male competitors. And really that's the hypothesis and that's the position that I'm going to spend the next nine slides trying to give you some evidence on why I'm hypothesizing that.

Competitive academic women who are unaware of social defeat as an expression of this bias methods [sic.] – and social defeat is a method I'm going to be telling you about – and if they lack the effective support in the face of stress, [then they] are essentially being exposed to what has to be called health disparities in women. In this case particularly, depression. So literally I'm trying to make an argument using relatively decent data that bias matters. And it's as equally strong a way of understanding what we're seeing and not seeing.

We'll look at the social research first. Male advantages gained through social bias. Just that is a very loaded phrase. Male advantages that are gained through social bias against females are a use-it-or-loose-it perk. And that means that no matter how you how you've capitalized on being male you still have to get on the soapbox and announce your advantages. You are compelled to do that because no matter how much you have everyone has the same goal, which is more. And particularly if you have somebody you're looking to compete against. So it's essentially the chest pounding. So that people who you would never think would say things like aptitude and differences in gender in the same sentence are compelled in some ways to do so.

The less-aware, advantaged males are the ones most likely to use social defeat strategies based on these biases. And that's to say that males who are more aware don't rely on this strategy. And you've had that in our first talk, the description of the lab and the people who are in it. They don't rely on that. In that case they don't use this perk which in case means that you can't turn back to claim it. You can't after awhile say, well I should be in

charge of everything here, I should be the president of everything here because I'm male. At the end of the career is not a good time to try to use that strategy. So the less-aware, advantaged male can use social defeat methods to compete with females.

In an academic work environment this allows several perks. One is that they can internalize their social advantages into personal entitlements. And this is critical to understanding bias. It's not that I'm biased against you, it's that I'm entitled to be ahead of you. I'm entitled to be ahead of you because I'm me and you're not me. To internalize his social advantages, the personal entitlements and privileges that I can continue to be me, ahead of you, because after all I'm me. And lastly, which might be very important and it's much more difficult to go down this route without dealing with this is that from this position the male can then externalize his advantages into social status. And this is a library worth of work that says that you can start out here, end up here, claim your rights to stay here and then by being there say this is the best place for me to be because I'm on top. Social status is a very complicated system but you have to have biases against a certain group of people so that they never can claim that they belong on top too. That's a very large part of that. But only in less aware males will you see this.

Social competition is an extremely important part of this formula because interpersonal interactions that take place when carry-out action is directed at achieving goals that some other group is motivated to achieve, that's automatically putting two groups of people into a very stressful, tension-type of a situation. And I think it's much more important to think of social competition in the work environment than it is to sit back and say well, my

science is better than your science. Anybody who's been on this campus for more than two seconds knows you have to live with that. It doesn't matter what you do, someone's going to come down the hall and say my science is better than your science. I am talking about using social competition as a perk of institutionalized bias to compete with people. This produces a very well characterized type of stress, very well characterized. And again, jamming all of this into one slide, the best model of characterizing this has to do with allostatic load, cortisol, social defeat, and depression. Jamming all this together, I think it's much more helpful to look at the stress of bias, the stress of prejudice, the stress of somebody claiming status and denying it of others, especially in a competition around science and who's getting what.

Allostasis is an extremely adaptive process because it produces biological stability and the brain is doing most of the work. That's a very important way of understanding this. This is not - maybe thirty years ago you only talked about behavior. The bigger, taller one was always dominating the smaller, lighter one. We're way past that now, we're talking about a biological process where the brain is doing much of the work but the energy costs of doing this work are at these vital systems that manage our stress responses to social competition. Primarily the neurotransmitters [are doing this work]. You can't watch two minutes of reality TV without hearing about your neurotransmitters – all the serotonins and dopamines and epinephrines, and the adrenal glands, which are producing the stress hormones, and the immune system. Who's getting sick from the stress and who isn't.

Allostatic load, though, is a much more interesting concept because it talks about the cumulative wear-and-tear of allostasis on these systems. Now in the essay I prepared to really give this information in detail, I talk about the allostatic load as really where you can really gain some ground using bias against the women you're competing with. You literally give them a heavier biological load using your advantages and your status to do so.

Cortisol, which is the hormone that again if you watch late-night television they're selling two-dollar pills that will make it go away, but cortisol is a very dangerous stress hormone. Because it's released by the adrenal cortex, it can be measured in response to human competition. Its been shown to be closely related to the symptoms of depression and this illness must be considered a two-fold gender disparity. Much of the very sophisticated research is saying women get this disease and men get that disease. That has not told us anything about depression, which happens to be my area of interest. What's much more realistic is to ask the question why is [there] this two-fold disparity? Why is that there?

I think that social defeat models using bias as one of the ways that might explain that, especially in competition. Social defeat is a unique stress response to competition under the conditions of disadvantagement. We could all go out right now and design an experiment where there's no way you can win. Right? There's no way you can win but we force you to compete. And then we go over to the lab and we light up your head and we take some measures of what we're going to see. It's very predictable what we're

going to see. That's how you want to compete. If you want to internalize all the games, if you want to have the best status, you always want to compete where the other person is under the disadvantages.

The most fascinating studies of this kind of work have used what they call aggressive and cooperative animals, so they're either biologically modified or behaviorally modified to have either very aggressive responses to competition or very cooperative. In these lab studies of animals social defeat experiences in the unaware animals, in which they were repeatedly subjected to defeat by larger, more aggressive animals resulted in the same, negative effect whether you were a hawk or a dove, whether you were aggressive or cooperative. In other words being a hawk didn't help the animals in these lab studies anymore than being cooperative. They both had the same penalties, which was [sic.] in competition, eventually under the allostatic load, eventually what happens is you end up with this persistent immobility. In other words, you freeze. You sit there, you face the competition, you face the science you're trying to do and you freeze. This is what has always been called a conditioned fear response but the persistent immobility I think is very fascinating.

The animal research has been shown consistently – now you have to work this in both directions – that you can reverse this. And the way they've done this is with antidepressant medications, all the horrors and all the good things we know about that, but antidepressant medications will reverse this persistent immobility. Housing defeated animals with colony mates will reverse that immobility. Housing them in an enriched

environment, in which your environment doesn't dismiss you at every single minute of every single day, will reverse that immobility. New information learning experiences, in other words one of the ways you can dominate somebody is withholding information. If you go into a new competitive environment and you never ever, ever figure out the maze, you're not a player and you never will be. And voluntary exercise, the good news and the bad news is that not only does voluntary exercise reverse the immobility in these animals, it did it better than anything else. Nothing else was as effective.

I like to show this slide [slide depicts brain scan images], I have no claims on brain research, but I show this again to remind us that we're not talking about behaviors we are talking about stuff that can be seen depending on what microscope you're using. So when we talk about bias against women we're not talking about bad behaviors and bad manners. We're talking about bad biology. I just show this to show that when the lights are off they're off. One of the things that happens if you stress somebody into depression is that they cannot think. If you're in a science competition that we call academia that is a huge advantage to who ever is competing with you. [A] huge advantage.

Innate neurobiology. Cooperative animals have been found in different lab experiments, in different labs, depending on what they're doing to the animals, to have better developed hippocampus. Kind of like a cousin to the megula, [the] hippocampus is the brain processor for emotionally important information. It has to be important emotionally. And this is our processor for it. Cooperative animals build better social environment maps. In other words, you can go into an important competitive social

environment, if you have this cooperative sort of tendency, you're going to map that out better. You're going to know who's dangerous and who's okay and who's not and you're going to map that out very quickly. The down side of that is that you're going to have more anxiety because you know you're in a very dangerous social environment. You're more aware of it. The upside of it is that the better awareness tends to protect you against that immobility and you also get better performance. Again, I don't know anything about these slides except I collect them. I study the information about them and I have [included them here in an] effort to remind you that we're not talking about behavior bias. We're just talking about the bias biology.

And last but not least, I wanted to say that in evidence conversations the capacity to regulate negative emotions by taking actions to decrease the duration of the negative emotion ultimately determines the biological impact of social stress. And females appear to have an innate neurobiological advantage in this regard because females will map their environment, especially when they are disadvantaged and especially when it's a competition. And I was going over this with a colleague and she explained to me, she said, "Oh yeah, that's right. My husband never knew where our children were. When my children were growing up, at any minute of any day in my head I knew where they were. [I knew] where they were supposed to be next, how they were going to get there and how I was going to hook-up with them. And I kept those mapped in my head at all times." The complexity that women live with as a way for them to deal with their lives.

And I have the rover here [slide depicts NASA's rover] because even though they didn't invite me to be part of it, I thought that was pretty good science and a lot of science people were there and again just to remind you that we're way past behavioral social stress and behavioral bias and behavioral advantages. We're talking about how you can use somebody's health to your advantage when you want to defeat their competition with you. And so that's what I brought to the conversation tonight.