>> Welcome, you are listening to Poverty in Focus, a podcast series of the UC Davis Center for Poverty Research. This series brings scholars and policy experts from around the country to discuss their work on poverty and poverty research. I'm Amanda Guyer, a CPR research affiliate, and a professor in human development, and a researcher at the UC Davis Center for Mind and Brain.

Today it is my pleasure to host Dr. Kimberly Noble, a neuroscientist who studies socioeconomic disparities in children's neurocognitive development. She is currently an associate professor of neuroscience and education at Teachers College, Columbia University. Dr. Noble's recent research focuses on environmental factors that affect children's brain development, including socioeconomic factors.

Today we are gonna talk about the impact of childhood poverty on brain development, and what this means for the future. Welcome, Kim.

>> Thank you, Amanda.

>> Kim, I'm fascinated by your work at the intersection of neuroscience and the social sciences. Particularly your research that relates poverty and socioeconomic circumstances to brain development in children.

Can you tell me how this field has developed and how you first got involved in it?

>> Sure, well, about 15 years ago, I was a graduate student in Dr. Martha Farah's lab at the University of Pennsylvania. Martha had spent the first several decades of her career involved in sort of very basic aspects of visual cognition.

And, in her words, wanted to turn at that point in her career to more real-world applications of cognitive neuroscience. And the first such application she was interested in pursuing was how poverty might relate to children's brain development. So she asked if I would be the first graduate student to work with her on this topic, and I felt very privileged and honored to do so.

>> How have you witnessed the field changing since then?

>> Well, it's interesting. So initially social scientists were really quite supportive of us bringing the lens of neuroscience into the field of poverty. While back then, a number of neuroscientists were really quite hesitant to bring these issues of socioeconomic disparities and disadvantage into the ivory tower of neuroscience.

I'm happy to say I think that the tide has turned somewhat, and people are pretty supportive of supplying a social lens to neuroscience issues.

>> Yeah, and certainly the interdisciplinary movement we've been seeing across universities has certainly helped that.

>> Absolutely.

>> Yeah, you really have a very impressive record of publications on these topics.

Some of the studies show that living in poverty has some serious consequences for children in terms of their cognitive development. Can you summarize some of the main results from the work that you've published?

>> Sure, so we've known, of course, for decades that there are dramatic socioeconomic disparities in things like IQ or school graduation rate.

But, of course those, kinds of outcomes aren't neurocognitively specific. Or to put another way, there's no high school graduation nucleus in the brain. So we can be much more specific in thinking about the different kinds of cognitive and brain circuit differences that we see along socioeconomic lines. So the initial studies set out to really sort of paint a neurocognitive picture of what are the socioeconomic disparities using brain-based behavioral circuits.

And what we found across several different studies was that we see the most dramatic socioeconomic disparities in children's language development. With more modest but consistent differences in memory and certain aspects of executive function or self-regulation. More recently, work in my lab and that of others has tried to get under the hood a little, as it were.

To try to understand what are the differences in brain structure and function that are accounting for these socioeconomic differences in cognition. And the neural work seems to recapitulate the behavioral work, in that we see the biggest differences in brain structure in the very regions that support language, memory, and self-regulation.

>> That's so fascinating. Have you worked on any papers that focus on the non-cognitive skills and the influences of social economic disparities?

>> Yeah, so there is some work in other labs that have looking at differences in social-emotional skills, and certainly we see socioeconomic disparities there as well.

And in our work, we've looked at an executive function, broadly speaking. Including things like inhibitory control and a little bit of emotion regulation. So we are seeing some disparities there as well. Although we've tended to focus more on the cognitive disparities.

>> Mm-hm, and what do you think are some of the mechanisms behind these associations that you've been finding?

>> Yeah, so we are investigating the mechanisms right now. And we do think that there are likely different pathways or mechanisms supporting disparities in different cognitive outcomes. So for example, we know from work of researchers like Hart and Mosley, and many others, that there are socioeconomic differences in the quality and quantity of language that kids hear at home.

We think it's quite likely that these disparities in the home language environment are leading to differences in the development of language supporting brain circuitry. Simultaneously and relatively independently in the literature, we know that there are dramatic socioeconomic disparities in family stress. And of course, there are certain regions that are particularly susceptible to stress in the brain, like the hippocampus, the prefrontal cortex, and amygdala.

All of which have heavy concentrations of glucocorticoid receptors, and which support things like memory and self-regulation. And so we think that these different pathways of the home language environment and family stress are likely mediating these different outcomes.

>> And what role does a child's age play in understanding these links?

Have you focused more so on early childhood years, given the types of mechanisms with regard to cognitive development, like learning, and memory, and language? And in a sense that some of those processes are really settling in during those early years.

>> Right, it's a great question, we don't have clear answers yet.

Most of our work has focused sort of separately on relatively narrow age ranges. We are seeing disparities pretty early. So in terms of behavioral disparities, we detect pretty large differences in both language and memory development already by the time kids are 21 months of age, so before they're even 2.

And some of our ongoing brain work suggests differences in brain function by the end of the first year of life, so we are detecting differences early. In terms of whether age seems to be a moderator, we haven't

found that ton of evidence for that, suggesting difference socioeconomic disparities in brain structure or function as a function of age.

We have a little bit of evidence suggesting that might be the case for one aspect of brain structure, specifically, cortical thickness. Where in a large cross-sectional study, we found some evidence that children from more disadvantaged environments may show steeper age-related cortical thinning earlier. Whereas children from more advantaged environments may show sort of more protracted gradual cortical thinning.

With the caveat that that is a cross-sectional study, so we can't say for sure what the longitudinal data would show.

>> Yeah, yeah, and that's so interesting. You've published research that suggests that specific parts of the brain related to language, memory, and reasoning tended to be smaller in children from disadvantaged socioeconomic backgrounds.

What might be the implications of this? Have these results at all been controversial as you've polished them and gone around talking about them?

>> Yeah, so those findings have gotten a bit of press. And one thing that I always like to remind members of the media is that when you've looked for those links in this large samples of over a thousand children and adolescents, on average, we see these links where higher family income is associated with larger cortical surface area in the kids.

But again, the sort of the key phrase there is on average. So we see many children from disadvantaged backgrounds with relatively larger cortical surface areas. Many kids from more advantaged backgrounds with relatively smaller cortical surface areas. An analogy I like to use is with gender and height, right?

So we all know that in childhood, on average, boys tend to be taller than girls. But go into any elementary school classroom across the United States, and you'll find some girls who are taller than some boys. So the analogy holds here, right? I can sort of talk about patterns in the data, but I can't know with any certainty what a particular child's brain is going to look like just by looking at his or her family income.

And another point that I think is really important is to recognize that the brain is not destiny, right? The brain's structure or function is that output of both genetics and experience. And as neuroscientists we have every reason to believe that the brain in childhood is really quite plastic or malleable to experience.

And so we have good reason to believe that by changing children's experiences, we could improve children's brain trajectories for the better.

>> Mm-hm. Social science research, it often supports anti-poverty policies of one sort or another for families. What do you think is unique about the policy implications of your research?

What should policy makers know, and how might they think about acting based on the findings from your research?

>> Well, one thing about this work is that it reframes it a bit away from adults living in economic disadvantage. And really focusing it more on children, and particularly their brain development, right, which is critical for the future of society.

Policies that really focus on reducing economic disadvantage for children, they have the potential to improve the economic output and human capital of society in the future.

>> Do you have some upcoming research projects that are oriented towards, that might have some implications for policymakers and programs out there?

>> We sure do. So all of the poverty and brain work to date from my lab and others has been correlational. Meaning we can say that economic disadvantage is associated with these differences, but we certainly can't say for sure whether it's causing these differences. So I'm really excited to report that we are planning a study to move beyond correlation and really be able to start to estimate the causal impact of poverty reduction.

So the goal of the study is pretty simple, although the ambition is large. Our plan is to recruit 1,000 low-income mothers from four sites across the country. And randomize half to receiving a large income monthly supplement and the other to receive a nominal monthly income supplement. We'll then be able to track the causal impact of this unconditional cash gift on the children's cognitive emotional and brain development.

Over the first three years of life, when we believe that the developing brain is most malleable to experience. So if our hypotheses are borne out, it has the potential to inform policies that effect millions of disadvantaged families.

>> This is gonna have a really big impact on the field, what we learn from this.

I'm really excited to follow-

>> Thank you, we-

>> Follow it as it continues on.

>> We're very excited as well. And I should say that this is truly an interdisciplinary collaboration across neuroscience as well as economics and social policy and developmental psychology. So there are five core PIs in the project, Greg Duncan, Katherine Magnuson, Lisa Gennetian, Hirokazu Yoshikawa, and myself.

And the five of us have been spending the last five and a half years planning this project, which we are hoping to launch this spring.

>> That's really exciting.

>> Thank you.

>> Sounds great, congratulations.

>> Thank you so much.

>> Aside from the policy-oriented types of solutions, is there a role here for families to play?

What might parents do to minimize the impact of their socioeconomic situation on their children's growth and development? Especially if they aren't really in a position to change their wages or pursue further education.

>> Sure, absolutely. So parenting really seems to be the single strongest predictor when we look at socioeconomic disparities.

And so certainly, we know there are lots of positive parenting practices that parents can adopt. Things like talking frequently and richly with your kids, playing with them in a warm and nurturing manner, is very important for a healthy child development. So you don't necessarily need to increase your wages or get more education to be able to interact with your kids in a way that will promote healthy development.

>> Mm-hm, and finally, I'm curious what the future holds for this area of cognitive neuroscience that's accounting for children's environmental experiences and influences. You mentioned the RCT study that you're rolling out very soon. Are there other directions that you are hoping to go in in the future, or sort of dream studies that you would like to see done out in the field?

>> Yeah, I mean, I think having the random assignment study is really key to be able to make causal inferences and really be able to make clear arguments about policy. That said, I think sort of an understanding on the mechanisms that are explaining these links is also really critical.

Understanding what are the particular family processes that can be intervened upon, that may be accounting for these links. And so that's, I think, where the next generation of research on poverty and the brain is headed.

>> Mm-hm, great, thank you so much. It has been my pleasure to speak with Dr. Kimberly Nobel, neuroscientist and associate professor at Teachers College, Columbia University.

I'm Amanda Guyer, a research affiliate at the Center for Poverty Research at UC Davis, and I wanna thank you for listening. Our mission is to, our mission is to facilitate nonpartisan academic research on domestic poverty. To disseminate this research, and to train the next generation of poverty scholars.

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