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Macaque At-Birth Adoption: Its Power and Promise

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A compelling piece of science in this month's issue is the work of Wood et al that addresses a long-standing question about adoption in infancy—could the process of adoption affect the later characteristics of adopted children?[1] This question arises from studies showing that children adopted at birth have higher rates of behavioral problems on average later in life.[2] Potential confounds of such studies are that adopted children may enter the adoption with pre-existing vulnerabilities related to the reason for adoption which could in turn could lead to behavioral differences. Scientists trying to minimize this confound previously have capitalized on the benefits of animal model approaches—randomization, controlled genetic background, controlled environmental factors, faster development, opportunities for close observation[3]—showing that adoption at birth can affect rodent offspring long term.[4] But a non-human primate study comes closer to addressing this question specifically for our human, primate vulnerability.

The answer to this question turns out to be—it's possible. Wood et al randomized 147 rhesus macaque infants in a large captive colony to either remain with their biological mother or to be raised by another female macaque, which they equate with adoption.[1] This approach minimizes the potential for non-random, "pre-adoption" differences. In this study, infant macaques adopted at birth compared to those not adopted showed higher levels of serum ACTH when separated from their mother during infancy; this suggests a more reactive infant hypothalamic-pituitary-adrenal (HPA) axis. Perhaps not surprisingly, the behavior of infants during these separations was also different, with more behavioral withdrawal or a lack of social engagement in adopted infants. These ACTH and social responses diminished for all infants with repeated separations over four weeks, and the differences between groups also declined, suggesting that impacts were greatest closest to the adoption experience itself. At distant times points in young adulthood (age 4 years) however, different behavioral reactions to a stressful, threatening social experience were still present. Young adult macaques who had been adopted in infancy were quicker to interact with a potentially dangerous strange intruder, approached it more frequently, but also socially withdrew more in its presence, spending less time engaged with familiar peers in this stressful social situation. These behaviors could be considered disadvantageous for these young primates, just as higher

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externalizing and anxiety symptoms in human teenagers adopted at birth could be.[2] This occurred despite general observations that adoptive and non-adoptive mothers appeared to treat infants no differently and that dominance rank—an important component of macaque social experience—of adoptive and non-adoptive mothers did not differ. This study shows the clear possibility that adoption at birth in primates can cause persistent behavioral changes.

There are important methodological consistencies to increase validity of the study: adoptive mothers had previous parenting experience, recently gave birth, and were confirmed to be lactating; when mothers did not care for the adoptive infant, these animals were removed from the study. There are also some things that limit this study: infants in the two groups were not characterized for factors such as birth weight, birth complications, and gestational age; there were no objective observations of mother-infant interactions; and an incomplete sample was assessed at young adulthood. All of these may impact the outcomes despite the power of the study design that isolated adoption from many other confounds. It also goes without saying that rhesus macaques have many differences from humans, such as no parental pair-bonding. But macaque-human translational relevance is supported by similarities of many kinds including infant-maternal social interaction and development and structure of critical brain systems underlying child emotional functioning, which may also be a cause of macaque potential for understanding and intervening in brain circuitry.[5] This macaque study is therefore an important one for our ability to better understand what may happen when children have adoption as a part of their histories.

While adoption in the “real world” does not affect children in a way isolated from other confounds, it may be one of the components that we could consider in our formulations. Accounting for an adoption effect itself may actually be more warranted than other factors assumed to accompany an adopted child—factors that predict adoption and could be interpreted as vulnerabilities. Studies which have focused on what predicts birth parent decisions to adopt show that generalizing about factors that lead to adoption is challenging. Adoption is often the consequence of multiple other events that reflect complex social values and parent life trajectories and are not necessarily characterized by lower age, socioeconomics, or education of birth parents.[6] In other words, there may be children adopted at birth who have pre-existing characteristics predictive of more vulnerable outcomes, but this is not a characteristic of adopted infants in general.

But even if we factor the experience of adoption into our thinking about the mental health of children, how might the significant number of individuals adopted at birth think about their own vulnerability from this experience? And how much should this factor influence the thousands of birth parents considering an adoption plan in the US each year and the many adoptive parents welcoming newborns into their family? And lastly, how much weight should this factor receive? It would be unreasonable to think that the experiences of adopted children would not have a lasting impact on them. Brains are tuned to record the ever-changing environment and then make adjustments for the individual’s functioning in the future. This applies as much, however, to the subsequent rearing experience of young primates as it does to the event of their adoption. Other non-human primate work has determined that offspring social behavior and ACTH responses to stress may also be

changed by early disruptions to rearing.[7] This larger body of work shows the critical and lasting nature of ongoing, stable, responsive parenting over months of early life, just as Wood et al demonstrate the power of parent placement at birth.[1] Therefore, these animal studies suggest the same thing we already highlight every time we explain a diagnosis and make a recommendation for treatment—that there are many factors playing a role in a child's functioning, unfavorable and favorable, and there are many ways to influence the future in more adaptive directions. In human life stories, the meaning of adoption and of early parental care both add layers of influence beyond the biological and behavioral trajectories set in motion. There are pitfalls and promise to child and parent reflection on these significant experiences, but macaque studies are lacking on these points.

A significant promise that does come from this macaque study, as Wood et al state, is the "powerful methodology to investigate the impact of adoption on human development."[1] This simply means that determining the risk of adoption is not the end goal but rather a first step in taking advantage of this animal model. This study has the potential for multiple other significant hypotheses which the authors are very likely already pursuing. These include whether resilient and susceptible individuals exist within adopted macaques, the detailed trajectories of which may outline potential intervention points for adopted children. For example, if adopted macaques who show few disadvantageous behaviors in young adulthood also had adoptive mothers who groomed them more or adoptive siblings who engaged in more physical play, these suggest experiential factors that could be assessed or modified in adopted children. In addition, rhesus macaques allow for greater close-up study of the biological factors that may play a role in the risk of adoption itself and in the resilience that some individuals may have. Biomarkers could be identified in this primate cohort that predict greater or lesser stress sensitivity, similar to macaque telomere changes in infancy that reflect greater stress sensitivity after parental maltreatment,[8] but may also highlight molecular targets for nutritional or microbiome support of resilience, for example.[9]

This work is significant, not because it tells us to "worry" or not about the children in our lives who were adopted or what decisions to make about pursuing an adoption plan. As with any other vulnerability scientifically identified and known to be a part of some children's lives, this work gives us insight into caring and investing a little bit extra in the lives of children who were adopted. And with further advancements using this animal model, we will learn how to better care and invest for those individuals who have this complex and unique experience at birth.

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References

1. Wood EK, Espinel WF, Hunter J, Emmett A, Skowbo AN, Schwandt ML, Shannon C, Lindell SG, Barr CS, Suomi SJ, Higley JD. The Effects of At-Birth Adoption on Atypical

Behavior and Anxiety: A Nonhuman Primate Model. J Am Acad Child Adolesc Psychiatry. 2021 11;60(11):1382–1393. doi: 10.1016/j.jaac.2021.04.021. Epub 2021 Jun 8. [PubMed: 34116166]

2. Keyes MA, Sharma A, Elkins IJ, Iacono WG, McGue M. The mental health of US adolescents adopted in infancy. Arch Pediatr Adolesc Med. 2008 5;162(5):419–25. doi: 10.1001/archpedi.162.5.419. [PubMed: 18458187]
3. Stevens HE, Vaccarino FM. How animal models inform child and adolescent psychiatry. J Am Acad Child Adolesc Psychiatry. 2015 5;54(5):352–9. doi: 10.1016/j.jaac.2015.01.019. Epub 2015 Feb 12. [PubMed: 25901771]
4. Bartolomucci A, Gioiosa L, Chirieleison A, Ceresini G, Parmigiani S, Palanza P. Cross fostering in mice: behavioral and physiological carry-over effects in adulthood. Genes Brain Behav. 2004 4;3(2):115–22. doi: 10.1111/j.1601-183x.2003.00059.x. [PubMed: 15005720]
5. Kenwood MM, Kalin NH. Nonhuman Primate Models to Explore Mechanisms Underlying Early-Life Temperamental Anxiety. Biol Psychiatry. 2021 4 1;89(7):659–671. doi: 10.1016/j.biopsych.2020.08.028. Epub 2020 Sep 12. [PubMed: 33229035]
6. Wiley MO, Baden AL. Birth Parents in Adoption: Research, Practice, and Counseling Psychology. The Counseling Psychologist. 2005;33(1):13–50. doi:10.1177/0011000004265961
7. Stevens HE, Leckman JF, Coplan JD, Suomi SJ. Risk and resilience: early manipulation of macaque social experience and persistent behavioral and neurophysiological outcomes. J Am Acad Child Adolesc Psychiatry. 2009 2;48(2):114–27. doi: 10.1097/CHI.0b013e318193064c. [PubMed: 19127170]
8. Drury SS, Howell BR, Jones C, Esteves K, Morin E, Schlesinger R, Meyer JS, Baker K, Sanchez MM. Shaping long-term primate development: Telomere length trajectory as an indicator of early maternal maltreatment and predictor of future physiologic regulation. Dev Psychopathol. 2017 12;29(5):1539–1551. doi: 10.1017/S0954579417001225. [PubMed: 29162166]
9. Shively CA, Appt SE, Chen H, Day SM, Frye BM, Shaltout HA, Silverstein-Metzler MG, Snyder-Mackler N, Uberseder B, Vitolins MZ, Register TC. Mediterranean diet, stress resilience, and aging in nonhuman primates. Neurobiol Stress. 2020 10 19;13:100254. doi: 10.1016/j.ynstr.2020.100254. [PubMed: 33344709]