



Intervention and Policy Implications for Behavioral Epigenetic Research

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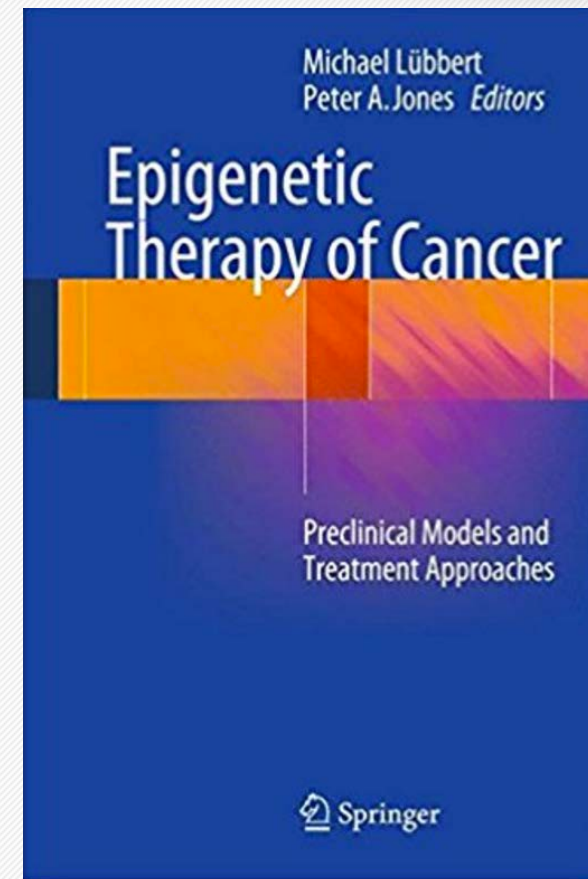
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HARC Collaborative Science of Home Visiting

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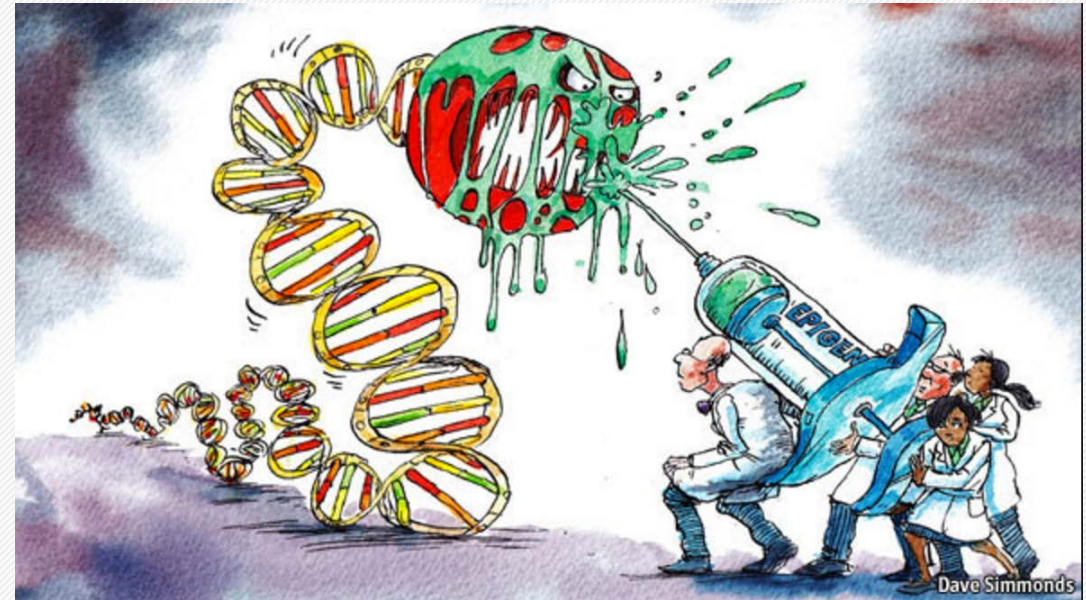
Editing the epigenome

- The prenatal and early postnatal period are formative windows when the environment can produce durable, and perhaps reversible, changes in physiology and behavior
- Sensitive period for epigenetic treatment that may program gene expression?



Role of Epigenetics in Treatment

- As an objective tool for assessing the impact of the environment on the epigenome
 - “Health monitoring marker”
- As an objective measure of the progress of an intervention
 - Implies DNA methylation is a mechanism
- As the basis for pharmacological treatment



Loi, Del Savio, & Stupka, 2013; Szyf, Tang, Hill & Musci, 2016; Park & Kobor, 2015; Weaver et al., 2005

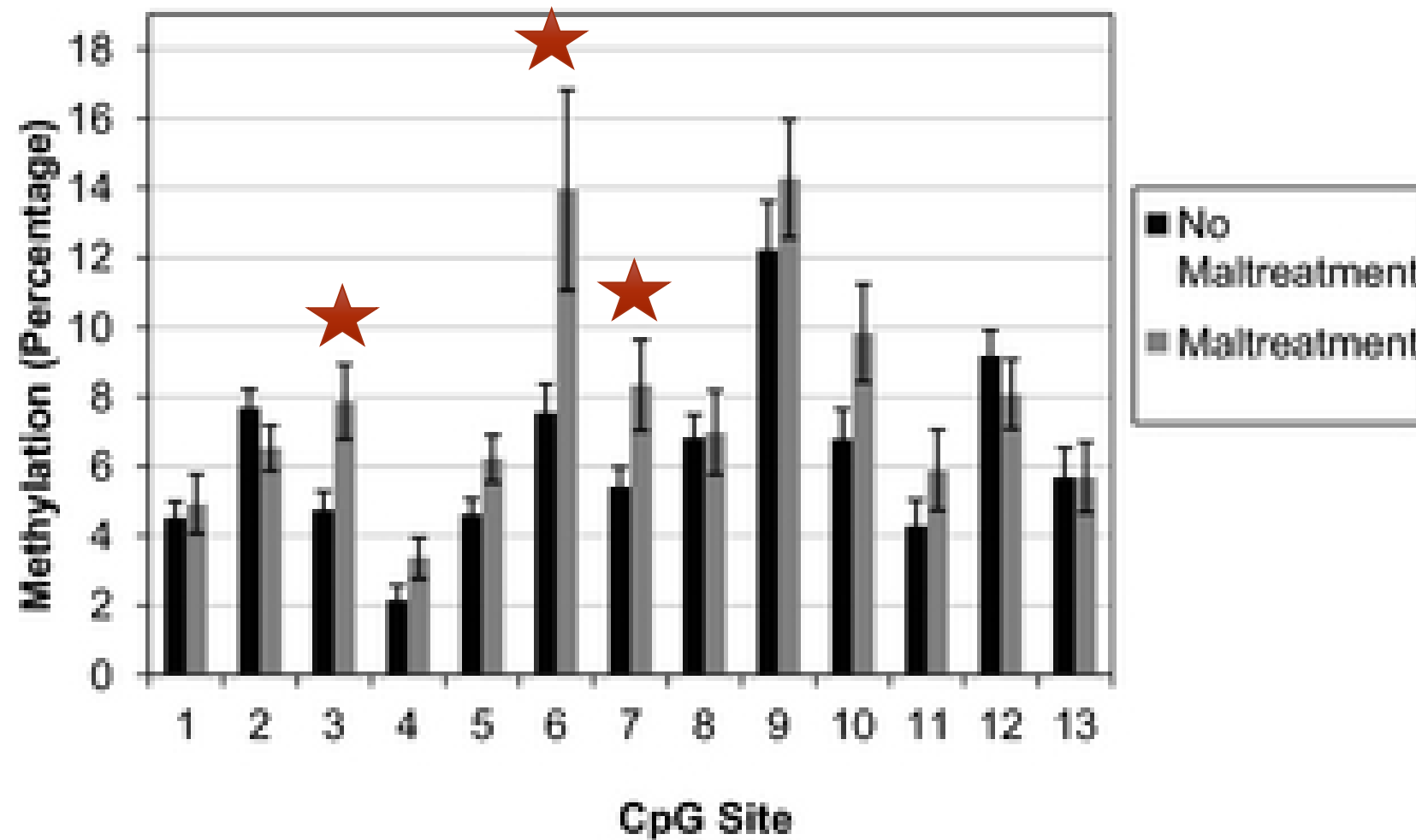
An objective tool for assessing the impact of the environment on the epigenome

- Low licking and grooming → greater DNA methylation of *NR3c1*
- In humans: poor maternal care related to greater DNA methylation of *NR3c1*?



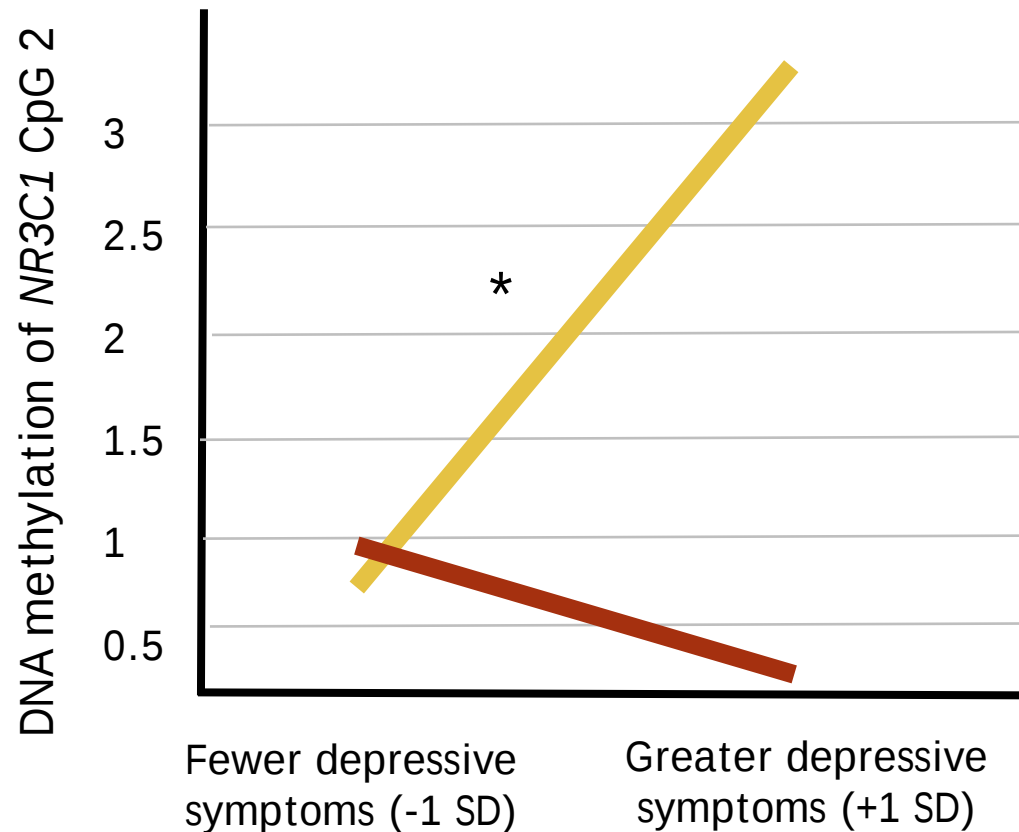
Liu et al., 1997; Weaver et al., 2005

Trauma exposure is related to greater DNA methylation of *NR3c1*



Depression is related to increased DNA methylation of *NR3c1*, but only if the mother is less sensitive

Less maternal sensitivity (-1SD)
Greater maternal sensitivity (+1SD)



An objective tool for assessing the impact of the environment on the epigenome

- Researchers could examine the impact the environment had on the child methylome
- Tool for assessing who is most at risk for developing a “high stress” phenotype?
- Tool to capture inherited initial disadvantage (from birth?)
- Ethical implications: DNA is not destiny, and neither is the epigenome



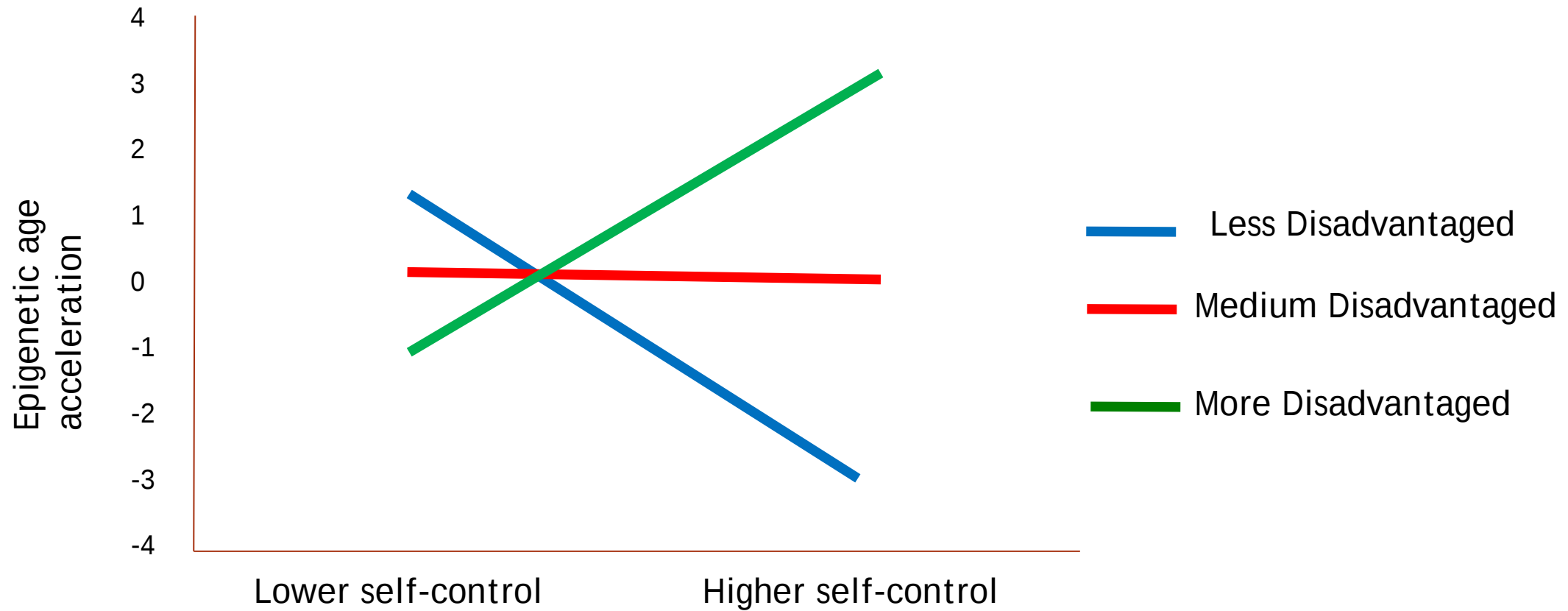
Loi, Del Savio, & Stupka, 2013; Szyf, Tang, Hill & Musci, 2016; Weaver et al., 2005

An objective measure of the progress of an intervention

- Following treatment, examine the child methylome
- Are there differences pre-and post intervention? Does the magnitude of these differences predict changes in child and/or caregiver behavior?
- Does changing parenting behavior alter DNA methylation of *NR3c1*?
- Example: Intervention to enhance self-control in African-American men



Intervention increased self-control, but at a “cost” seen at the epigenetic level



Ethical Implications

- Treatment to reduce stress reactivity in early childhood: Is this the “ideal” infant phenotype?
- The importance of the “fit” between the infant and caregivers
- Infant may be “programmed” prenatally to adapt to a particular postnatal environment



Genes as Mirrors of Life Experiences

By BENEDICT CAREY NOV. 8, 2010

Grandma's Experiences Leave a Mark on Your Genes



The Dutch Hunger Winter of 1944 left health effects on people who were in utero at the time.

Dutch National Archives

Mom's environment during pregnancy can affect her grandchildren

Why Your DNA May Not Be Your Destiny

By Denise Chow, Assistant Managing Editor | June 4, 2013 12:52pm ET

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How A Pregnant Woman's Choices Could Shape A Child's Health

Fathers May Pass Down More Than Just Genes, Study Suggests

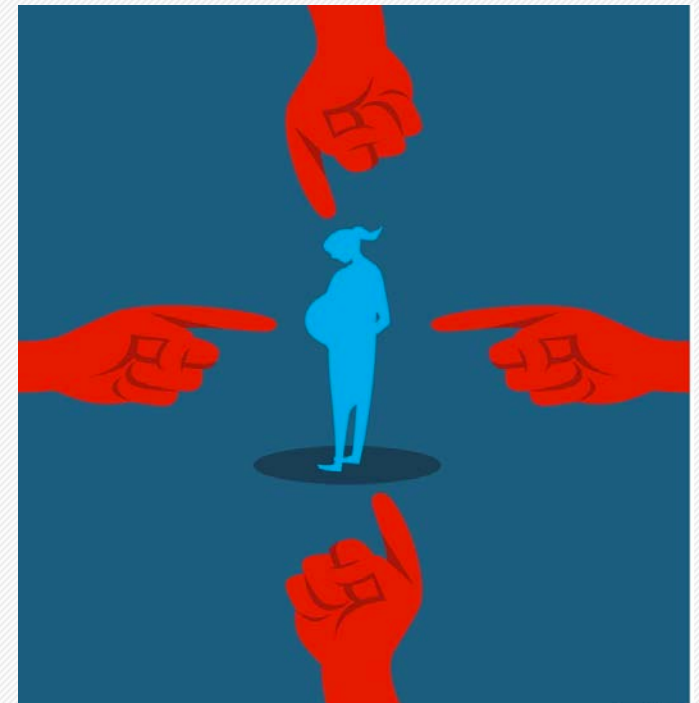
EPIGENETICS

Don't stress dad — it's bad for your kids' health

Lappé, 2016

Ethical implications: The burden is on the parent (and typically the mother)

- “Careless discussion of epigenetic research on how early life affects health across generations could harm women by implying the burden is on the mother for her child’s well-being”
- Could increase surveillance and regulation of pregnant women
- Epigenetic research is preliminary and inconsistent



Richardson, Daniels, Gillman, Golden, Kukla, Kuzawa, & Rich-Edwards, 2014

Ethical implications

- Epigenetics may bring back eugenic thinking
 - “DNA is our destiny” → Our ancestors may also make us “who we are” and we can be “poisoned” by the bad choices of our ancestors
 - Concern: If a population is exposed to a pathogenic environment for multiple generations they could be irreparably damaged
 - Racist groups could use epigenetics to claim the “acquired inferiority” of particular groups



Sterilisation protest 1971. Southern Studies Institute, CC BY-SA

Ethical implications: 4 caveats

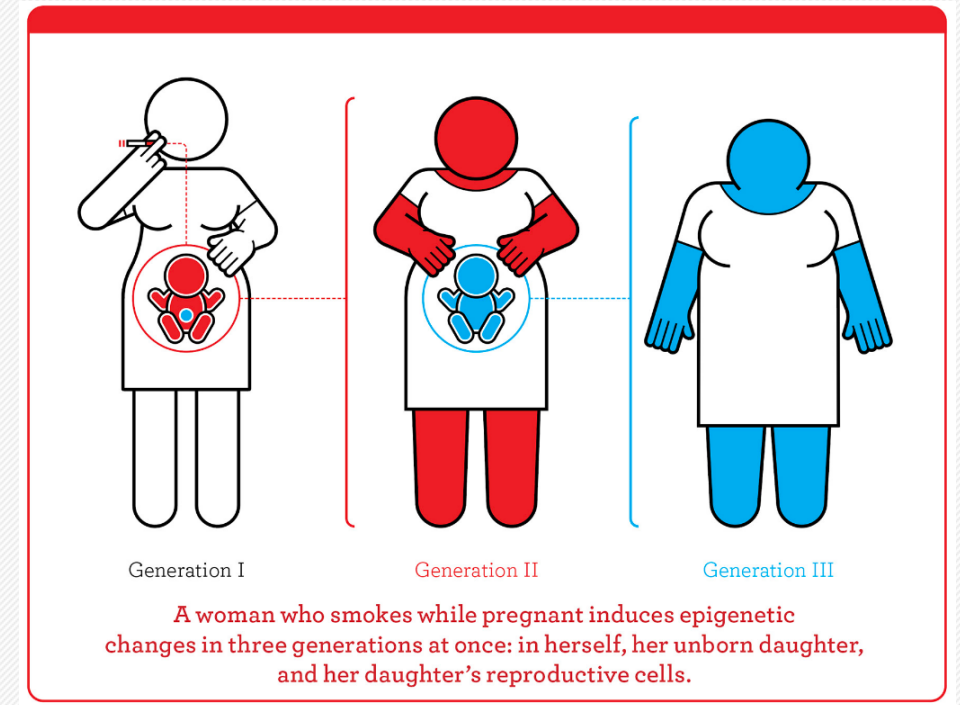
1. Avoid generalizing animal studies to humans without qualification
2. Recognize both paternal and maternal influences to the health of the baby
3. Convey complexity
4. Recognize the role of society
 1. Prenatal stress correlates with class, race, and gender



Richardson, Daniels, Gillman,
Golden, Kukla, Kuzawa, &
Rich-Edwards, 2014

Policy Implications

- Our DNA is not insensitive to social structures and social class
- Reducing social inequalities already at birth
- Having a deeper explanation of precisely how early life stress can become biologically embedded may provide policy-makers with the evidence needed to support policies that support families and young children
- Example: Research briefing in the UK highlights the importance of epigenetic research in policies to improve the nutrition of pregnant women



Conclusions

- The science of epigenetics reveals that the environment may be more important than we thought
- Compelling evidence that epigenetic processes might be used as a marker of the effects of the environment, as a marker of treatment progress, and it could be leveraged for pharmacological treatment
- We should be careful about what we expect an “ideal” treatment outcome should be
- The science of epigenetics has important policy implications but concerns remain about epigenetic determinism and epigenetic eugenics



Thank you!