Epigenetic programming by experience

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Early life exposures are known to have long-lasting impact on the phenotype later in life. What are the mechanisms that mediate between exposure and long-term effects on physical and mental health? We will review data from rodents, nonhuman primates and humans that is consistent with the idea that differences in “maternal care” result in system wide changes in DNA methylation that are detectable later in life in the offspring. We propose that the changes in DNA methylation in response to early life experience are “adaptive genomic” mechanisms that adapt life-long genome programming to the anticipated life-long environment based on stress signals received during gestation and early life. What is the mechanism that mediates between maternal stress and offspring epigenome? We will discuss the hypothesis that stress hormones might be mediating the genome wide and system wide response of the methylome to stress. Glucocorticoids might act as “integrators” that translate the social stress signals during gestation to genome wide methylation changes across multiple systems. The idea that DNA methylation is mediating the effects of early exposures on later phenotypes has important implications for mental health. DNA methylation biomarkers could be used to screen for past exposures, to predict high risk for developing pathology later in life. Epigenetic marks are potentially reversible and therefore epigenetically mediated phenotypes could potentially be reprogrammed by epigenetic therapeutics. Examples of reversing experience triggered phenotypes such as cocaine addiction through an epigenetic approach will be discussed.