**The interactions of genetics and stress hormones – extension material**

The following passage is taken from a PhD thesis submitted by Allyson Mackey from the University of California in 2012.

Mackey, Allyson. (2012). Behavioral and Neural Effects of Reasoning Training. UC Berkeley: Neuroscience. Retrieved from: <https://escholarship.org/uc/item/2f99262s>

Read the extract, then answer the questions underneath:

*Chronic stress can change gene expression. When glucocorticoid receptors bind cortisol, they dimerize and become activated transcription factors. In addition to acting directly as a transcription factor, cortisol can also lead to histone acetylation and increased methylation. An example of a direct link between environment and these epigenetic effects comes from work on the relationship between maternal behaviour and stress reactivity (Weaver et al., 2004). High quality maternal behaviour, as measured by high levels of licking and grooming, alters the epigenomes of rat pups. This experience changes methylation patterns and histone acetylation to lead to reduced expression of glucocorticoid receptors (Szyf, Weaver, & Meaney, 2007). Rat pups that experience low quality maternal behaviour, in contrast, have higher glucocorticoid receptor expression, and have higher levels of stress reactivity. These pups have abnormal behaviours, including impaired novelty seeking, spatial learning (Liu, Diorio, Day, Francis, & Meaney, 2000), and working memory (Barha, Pawluski, & Galea, 2007) that persist into adulthood. This finding from the animal literature parallels the finding deficient early caregiving in humans, as experienced in Romanian orphanages, could lead to long lasting brain changes.*

*In part through its epigenetic effects, stress can alter cellular morphology. For example, exposure to stress hormones in utero leads to decreases in spine density and dendritic complexity in dorsal anterior cingulate cortex, a subregion of mPFC, and orbitofrontal cortex (Murmu et al., 2006). These changes mirror cellular morphology changes in hippocampus, in which cells also show dendritic hypotrophy. Stress actually reshapes neurons in the mPFC, hippocampus, and amygdala, and by changing their structure, affects network connectivity. Interestingly, mPFC seems to be more sensitive to the effects of stress either the hippocampus or the amygdala. Dendrites in PFC begin to change after just one week of stress (S. M. Brown, Henning, & Wellman, 2005), but structural changes in these other regions take several weeks (McEwen, 2005).*

1. What is being said about the relationship between stress hormones and genetics? Summarise the main points of the extract.
2. How does this section deepen your understanding of the effects of stress hormones?
3. What is meant by the term ‘epigenetics’? How might this deepen your knowledge of genetics?
4. In the conclusions of Caspi et al (2003) the authors write:

“Much genetic research has been guided by the assumption that genes cause diseases, but the expectation that direct paths will be found from gene to disease has not proven fruitful for complex psychiatric disorders.”

Do the points made by Mackey (2012) above agree with this assessment? Why or why not?