

Supplementary Material for *Innovation in the Collective Brain*

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Lone Geniuses or Individual Insight in Innovation

Some readers may wonder if we are setting up a straw man argument for the role of lone genius or individual insight in innovation. Our reading of the literature is that the role of the individual and individual insight is overemphasized, and historians have noted this repeatedly [1, 2]. There is a large literature on the evolution of technology regarding “the myth of the heroic inventor”. For example, Pinker [3] has argued that our species has entered the “cognitive niche” by gaining mental abilities for building causal models “on the fly”. We argue that’s exactly wrong. Many fancy technologies emerge with no causal model, and the good causal models we do have are built once the technology emerges (by studying the cultural product).

But, even if we don’t take the above quote at face value, there remains a sense that even if individuals require the input of generations of accumulated knowledge and even if individual insight is not sufficient, individual insight remains necessary. In the main text we have tried to argue that because our societies operate as “collective brains”, individual insight is *not* necessary and at best, plays a minor role—that is, lots of fancy and sophisticated cultural adaptations have emerged with zero individual insight. What *is* necessary is having the right combination of cultural elements, which can meet by chance.

IQ and Innovation Rates

Some readers may also wonder if we are setting up a straw man argument for the relationship between IQ and innovation rates. Does anyone argue that differences in innovation or innovation potential between individuals within the one culture is largely driven by IQ differences? Does anyone argue that cross-cultural differences in innovation rates are driven by cross-cultural differences in IQ?

Indeed, these exact claims have been made, often in high profile publications. In *Psychological Science*, psychology’s flagship journal, Rindermann and Thompson [4] examine the effect of IQ on national wealth, arguing that higher IQ causes greater national wealth through various intermediate processes. In the journal *Intelligence*, at the within-society level, Jauk, Benedek, Dunst and Neubauer [5] review 60 years of research on the relationship between intelligence and creativity. They offer evidence for the so called “threshold hypothesis”—that a certain level of intelligence is a necessary condition for creativity—and evidence that higher intelligence predicts

creative gains at all levels. At the between-society level, Richard Lynn and Tatu Vanhanen [6, 7] have most famously argued that IQ differences between societies are responsible for wealth differences. More recently, also in the journal *Intelligence*, Lynn and Meisenberg [8] have shown that cross-national IQ differences predict cross-national educational-attainment. These claims are controversial, but well cited and not alone. Other recent examples directly relevant to the present paper, include: Rindermann [9], who argues that intelligence specifically increases national wealth through scientific-technological progress and higher quality economic institutions. And Burhan, Mohamad, Kurniawan, and Sidek [10], who argue that individuals with 95th percentile and above IQ have the greatest impact on economic growth and technological innovation across nations and that priority should be given to these individuals in research and development.

Relationship between Asocial and Social learning in Cultural Brain Hypothesis Simulation

The Cultural Brain Hypothesis simulation assumes a trade-off between *time* invested learning by yourself vs. learning from others; however, in our formalization, when selection for social learning drives bigger brains, asocial learning also improves, since asocial learning is dependent on brain size/complexity (whereas social learning is dependent on the abundance of knowledge). Thus, these bigger-brained social learners are capable of more potent asocial learning—acquired as a selective byproduct—than their smaller brained ancestors, but engage in it less often. Hence, our theoretical findings are consistent with Reader et al.'s [11] positive correlation between asocial and social learning ability.

IQ and Marriage Practices

IQ is lower among those who marry among closer kin or co-ethnics [reviewed in 12]. More recently, genomic data suggests the corollary; higher heterosis predicts higher general cognitive ability [13]. By our account, the “anti-Flynn effect” we see among populations who marry closer kin or co-ethnics may have less to do with genetic inbreeding and more to do with the loss of knowledge and skills we see when broad, non-kin-based sociality drops [14, 15]. And by corollary, the increase we see with interethnic marriage may have less to do with heterosis (“hybrid vigor”) and more to do with exposure to more distinct, previously isolated ideas—cultural recombination. These explanations require further investigation. However, that any of these IQ differences have neural correlates is no more surprising than the neural changes caused by other experiences (it would be rather disturbing if they did not have neural correlates [16!]).

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