Supplementary note to the paper:

Physics of DNA homology recognition from a distance without unzipping

The principle of a "couple life-time"

The most straightforward social analogy of interaction of nonhomologous DNA with the torsional adjustment[1,2,3,4] is the phenomenon of a "couple longevity and late divorce". What keeps a human couple together is attraction (love). What does not allow to realize the potential of attraction in full is incommensurability of behavioral patterns (mismatch). Another factor in the game is flexibility (adjustability). Strong attraction and large flexibility will relax the mismatch continuously, i.e. practically at every moment of life together; this will not let the mismatch to accumulate (in this social analogy, time is equivalent to the axial coordinate *z* of our DNA-DNA interaction problem). On the contrary, low flexibility at potentially strong attraction will cause an accumulation of the mismatch and consequent growth of irritation. This will result in a nonlinear, 'soliton-like' or catharsis-like relaxation; relaxation that follows a conflict/scandal. If a number of such unfavorable events is large, they will affect the stability of the pair, albeit they are needed to relax the mismatch and maintain an overall attraction. Last but not least, there is a trivial case of a week attraction and strong incommensurability: flexible or not, two molecules will not be able to pair over a long juxtaposition length – two people will not stay together for a long time.

If the coupling is maintained by solitons, let another 'molecule', soft or commensurate or both, come to one of the two paired molecules: with high probability the latter will leave the initial couple to form a new one.

On the contrary, a pair kept together not only by strong attraction, but also by substantial flexibility continuously relaxing minor incommensurabilities, has high chances to stay together the whole life.

Whereas the recognition and pairing theory for DNA has been built on a random walk pattern of mismatch, in the life of a human couple there could be positive and negative memory, and changes of parameters subject to environmental conditions. These could make the three main factors -- attraction, commensurability and flexibility, variable in time. But generally the principle will not be changed.

This mini-theory of *hot relationships* has one practical consequence. Neither the partners who split should blame each other, nor the life-long couple should be particularly proud of themselves: these two categories of partners correspond to different sectors of the phase diagram on the λ_c, λ_h - plane. An exception, when long term partners can indeed be proud of themselves, is when it is clear that during staying together they have learned how to decrease λ_h through a growing attraction and flexibility, independently of varying environmental conditions.

---

[1] A.G.Cherstvy, A.A.Kornyshev, and S.Leikin, Torsional Deformation of Double Helix in Interaction and aggregation of DNA. *J. Phys. Chem. B*, 2004, **108**, 6508–6518.

[2] A.A.Kornyshev and A.Wynveen, Nonlinear effects in torsional adjustment of interacting DNA. *Phys .Rev. E*, 2004, **69**, 041905.

[3] A.Wynveen; D.J. Lee; A. A. Kornyshev; S. Leikin, Helical coherence of DNA in crystals and solution *Nucleic Acids Research*, **36**, 2008, 5540–5551.

[4] D.J. Lee and A.A.Kornyshev, Homology recognition funnel, *J. Chem. Phys.*, 2009, **131**, 155104; erratum: *J. Chem. Phys.*, 2009, **131**, 219901.