

Ancestral reconstruction

Characterization of ancestral proteins of a possible de novo protein from Homo sapiens

Background: Different species have different proteins encoded in their genome. It has been thought that these proteins evolve via gene duplication. Recently published work suggested, that these so called *de novo* genes don't show any similarity to other genes, meaning that they didn't originate from duplication. But where did these new proteins come from? There is the hypothesis that many of these genes could have evolved out of non-coding sequences (*de novo* gene emergence), but up to now there is no proof of this. With the help of ancestral sequence reconstruction (ASR) one can simulate the ancestral sequences of an existing protein. ASR is a powerful tool to investigate how and when a putative *de novo* protein might have been emerged.

Objectives: In this project we want to express and characterize different ancestral proteins of a putative *de novo* protein from *Homo sapiens*. Structural predictions of these ancestral *de novo* proteins show already some conserved regions. Within this work the ancestral proteins (Bcer, Bhom, and Bant) of WT Human B shall be soluble expressed. After successfully expression the proteins will be purified and further characterized (CD, TSA).

Requirements:

- Interest in evolution at the level of individual proteins
- Interest in lab work on DNA and protein level and basic knowledge of PCR, DNA-cloning, protein expression & purification

Methods:

- Expression and purification of proteins
- Biochemical characterization of the proteins via Western-Blot, CD-spectrometry (CD), and Thermal Shift assay (TSA)

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Selected Literature:

1 Eicholt LA, Aubel M, Berk K, Bornberg-Bauer E, Lange A.

Heterologous expression of naturally evolved putative de novo proteins with chaperones.

Protein Science. 2022 <https://doi.org/10.1002/pro.4371>

2 Lange A, Patel, PH, Heames B, Damry, A, Saenger, T, Jackson, CJ, Findlay GD, Bornberg-Bauer E

Structural and functional characterization of a putative de novo evolved gene essential for male fertility in Drosophila

Nat Comm, 2021 <https://doi.org/10.1038/s41467-021-21667-6> 3 Bornberg-Bauer, E, Hlouchova, K, Lange A

Structure and Function of Naturally Evolved de novo Proteins

COSB, 2021 <https://doi.org/10.1016/j.sbi.2020.11.01>

4 Van Oss SB, Carvunis AR

De novo gene birth

PLoS Genet. 2019 doi: 10.1371/journal.pgen.1008160 5 Keeling, DM., Garza, P., Nartey, CM., Carvunis, AR.

Philosophy of Biology: The meanings of 'function' in biology and the problematic case of de novo gene emergence
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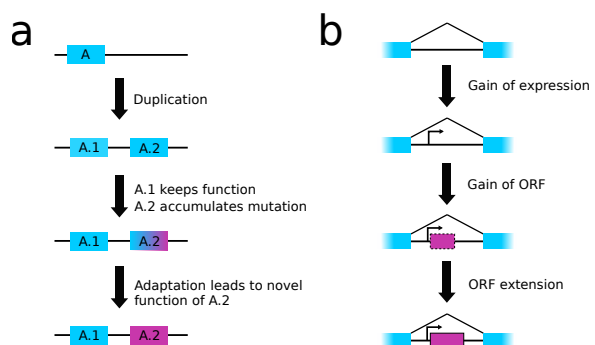


Figure 1: a) Gene emergence via duplication followed by divergence; b) *De novo* gene emergence from non-coding DNA starting from a weakly transcribed proto-gene can eventually result in a functional gene