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Unravelling the Minion Genome

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Abstract
This paper gives a cursory overview of some of the potential genes that are present in the minion genome. Minions are the cute creatures first introduced in the *Despicable Me* films. The genes considered include those important to body structure and plan, eye development, language ability and yellow skin pigmentation. Included is an estimate of the DNA base-pair sequence length for the genes considered, with the exception of certain pigment-related genes.

Introduction

In the summer of 2010, Universal Pictures introduced the world to the loveable characters, Gru, Dr. Nefario, Margo, Edith and Agnes in *Despicable Me* [1]. However, the characters that caught the hearts of all its viewers and became a phenomenon, were the minions (see figure 1). These minions have spent their seemingly immortal lives working for various evil villains in order to aid in their endeavours. Now they just make jam.

Figure 1 – Phil, a minion, showing short stature and limbs, human-like eyes and yellow skin [2]

These minions however, are not just cuddly little miscreants, but are complex beings. They are quite human like in their structure and behaviour, and according to the upcoming Minions movie, first came onto land at the same time as tetrapod's, which is approximately ~400 million years ago [3]. In this paper, the ideas are mainly based on a comparative analysis to the human genome.

Homeotic Genes

All organisms are built uniquely. However, there can be similarities in structures, such as skeletal properties or limbs. Homeotic genes are the regulatory genes that are responsible for organism development and body plan through various transcription factors. Hox genes are an example of ancestral homeotic genes. Researchers discovered that defects in the Hox genes within organisms caused homeotic transformations that differed from the organism's normal morphology [4]. Like all organisms, minions would need such homeotic genes. Any mutations in this gene would cause deformations in the minions, e.g. limbs growing out of place.

Dwarfism is a genetic disorder whereby an individual is short in stature. These individuals normally measure less than 1.47m [5] in height. In the movie, it is shown that the tallest of minions measures up to the knees of Gru. Considering that an average European man (such as Gru) measures in at around 1.78m [6], and assuming that the average length from sole to knee is 0.45m, it is inferred that a minion can be as tall as ~0.45m indicating minions potentially have fixed dwarfism. Furthermore, researchers have indicated that changing the levels of expression in homeotic genes can lead to dwarfism.

As a very cursory estimate for the base pairs (bp) length of Hox genes contributing to the minion genome, a simple calculation was done using the Homeobox domain sequences in humans. Each homeobox domain has 180 bp and there are 235 functional Hox genes in humans. In order to calculate the approximate number of base pairs:

$$180 \times 235 = 42,300\ bp$$

This gives 42,300 bp as an underestimate [7].

FGFR3

Minions are humanoid in their structure, so assumptions can be made that compare them to humans. Hypochondroplasia (HCH) is a type of skeletal dysplasia, which causes the individual to be short in stature due to having short limbs. In the majority of people that exhibit hypochondroplasia, they have mutations in the FGFR3 gene [8] on the chromosome 4p16.3 [9] and is an autosomal dominant condition. As can be seen in Figure 1, the minion has very short legs that are slightly un-proportional to their bodies. Another feature of HCH macrocephaly [8] is an enlarged cranium, which, again looking at a minion, one can see is prevalent in their species. Therefore, perhaps minions have a mutation on an FGFR3 gene, causing disproportionate limbs in relation to their bodies, and an enlarged cranium.

In humans, the FGFR3 gene has ~15,573 bp [8].

Pax6

Minions also have camera-lens structured eyes, similar to humans and cephalopods. The Pax6 gene has been discovered to play a master regulatory role in eye development. This ancestral gene, may also be important in the development of minion eyes. Since minions have been around for several hundred million years, coming onto land at the same time as the tetrapods, their lens eyes would have evolved significantly before humans . Thus, human and minion eyes may be analogous by convergent evolution, perhaps both times involving Pax6 recruitment [10] .

The Pax6 gene sequence is ~33169 bp in length [11].

FoxP2

Minions exhibit complex social behaviour, facilitated by the existence of their own spoken language system. The words of their language can sometimes bare phonetic similarity to the modern human languages. Speech ability that is comparable to that of humans may be used to infer that the minions carry similar genes that are associated with complex, spoken communication. However, there is no one sole gene that is responsible to speech. Instead, there are genes, such as the Forkhead box protein (FoxP2) gene in humans, that when mutated, impair spoken articulation. This suggests a contributing role of the normal FoxP2 gene to linguistic ability. Thus, the minion genome may also carry this gene, which codes for a transcription factor. Nevertheless, other animals that also have a version of this gene, such as mice, do not show any signs of spoken language. Most definitely, other genes must be involved in a complex pathway. The question is therefore whether this pathway is similar in minions and humans, although the chances of this are low given the vast evolutionary time separating the two species [12].

Gene sequence length for FoxP2 in humans is ~607,462 bp [13].

Xanthophores

Animal colouration, such as in fish and amphibians, is due to the expression of pigments in dermal chromatophore cells. It is assumed here that because minions apparently had oceanic origins, their pigmentation is also manifested by similar biological mechanisms. Yellow pigments are due to pteridines bound inside pterinosomes of xanthophores, a subset of chromatophores. For minions to have their characteristic yellow colour, they may require successful xanthophore formation. In studying xanthophore pigmentation in zebrafish, 17 genes have been indentified which play a role xanthophore development. Amongst these, 5 were categorized as important for the pigment synthesis in the zebrafish: *edi, tar, bri, yob, yoc*. Perhaps these genes are also present in the minion genome. Again, gene interaction is very complex and the interaction with other genes would no doubt be necessary [14]. Sourcing the sequence lengths for the xanthophore genes proved difficult, so these genes are not included in our simple calculation.

Conclusion

This paper mentions certain genes proposed to be present in the imaginary minion genome. The genes that we have listed, with the exception of the xanthophore pigment genes, occupy an underestimated minimum of ~700,000 bp. It must be emphasized that this is based on a comparative analysis to the human analogue genes. The minion genome is expected to be well above this size. Of course, it is assumed that minions are terrestrial and share the same genetic language as all other organisms on Earth. However, apparent minion immortality as well as lack of reproductive ability suggests atypical genetic activity. The vast time separating human and minions also indicates there is low likelihood of close evolutionary links. Hence, the comparisons to humans here is simply conjecture and this paper is an attempt to genetically justify the existence of minions within the world of animation.

References

[1] Despicable Me (2010) Universal Studios.

[2] Minionslovebananas.com (2015) *Galleries Of Minion Images & Videos | Minions Love Bananas*. Available: http://minionslovebananas.com/galleries-images-wallpapers/ [Accessed 29/01/2015].

[3] Standen, E.M., Du. T.Y. & Larsson, H.C.E. (2014) *Developmental Plasticity And The Origin Of Tetrapods*. Nature, 513.7516: 54-58.

[4] Quinonez, S.C. & Innis, J.W. (2014) *Human HOX Gene Disorders*. Molecular Genetics and Metabolism 111.1: 4-15.

[5] Mayoclinic.org (2015) *Dwarfism Definition - Diseases And Conditions*, Mayo Clinic. Available: http://www.mayoclinic.org/diseases-conditions/dwarfism/basics/definition/con-20032297 [Accessed 29/01/2015].

[6] Parkinson, C. (2013) *Men's Height 'Up 11Cm Since 1870s*. BBC News. Available: http://www.bbc.co.uk/news/health-23896855 [Accessed 29/01/2015].

[7] Genetics Home Reference (2015) *Homeobox Gene Family*. Available: http://ghr.nlm.nih.gov/geneFamily/homeobox [Accessed 24/02/2015].

[8] Bober, M.B., Bellus, G.A., Nikkel, S.M. & Tiller, G.E. (2013) Hypochondroplasia. In: Pagon RA, Adam MP, Ardinger HH, et al., editors. GeneReviews®. Seattle (WA): University of Washington, Seattle; 1993-2015. Available from: http://www.ncbi.nlm.nih.gov/books/NBK1477/ [Accessed 29/01/2015].

[9] Genetics Home Reference (2015) *FGFR3 Gene*. Available: http://ghr.nlm.nih.gov/gene/FGFR3 [Accessed 29/01/2015].

[10] Barton, N. H., Briggs, D. E., Eisen, J. A., Goldstein, D. B., & Patel, N. H. (2007). *Evolution.* New York: Cold Spring Harbour Laboratory Press.

[11] Genetics Home Reference (2015) *PAX6 Gene*. Available: http://ghr.nlm.nih.gov/gene/PAX6 [Accessed 24/02/2015].

[12] Marcus, G. F., & Fisher, S. E. (2003) *FOXP2 in focus: What can genes tell us about speech and language?*. Trends in Cognitive Sciences, 7, 6, 257–262.

[13] Genetics Home Reference (2015) *FOXP2 Gene*. Available: http://ghr.nlm.nih.gov/gene/FOXP2 [Accessed 24/02/2015].

[14] Odenthal, J., Rossnagel, K., Haffter, P., Kelsh, R. N., Vogelsang, E., Brand, M., van Eeden, F. J., Furutani-Seiki, M., Granato, M., Hammerschmidt, M., Heisenberg, C. P., Jiang, Y. J., Kane, D. A., Mullins, M. C. & Nüsslein-Volhard, C. (1996) *Mutations affecting xanthophore pigmentation in the zebrafish*, Danio rerio. Development (Cambridge, England), 123, 391–398.