OLD DOMINION UNIVERSITY

FROM THE WILD WOLF TO MAN'S BEST FRIEND

AN ANALYSIS OF A HYPOTHETICAL WOLF POPULATION & THE CHANGE IN TEMPERAMENT, POSSIBLY LEADING TO THEIR DOMESTICATION

Julia Romanchik

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ABSTRACT:

Multiple theories, speculations, and ideas exist, which attempt to explain the process by which the domestic dog evolved from their wolf ancestors. Although the exact process remains unknown, DNA evidence suggests that the modern domestic dogs evolved from wolf species, possibly in the Middle East and Russia. This experiment uses a hypothetical scenario comprised of various mutation and breeding events between wolves containing various genes for temperament and follows the progression of the overall temperament over ten generations. Here, we assume that the most aggressive animals are the least fit for survival and reproductive success, and are thus omitted from each generation. Through the analysis of the data, we will determine whether the population became less aggressive and more submissive and docile, and thus more suited to coexist with humans, leading to the eventual evolution of the domestic dog.

INTROCUCTION:

The domestication of the wolf and the subsequent evolution of the wild wolf to the modern domesticated dog represent an evolutionary puzzle for which scientists, researchers, and archaeologists continue to investigate in their attempts to solve the questions of how and why this domestication occurred. Multiple theories exist, explaining the reasoning and the methods of the domestication of the wolf; the answers to these questions are a cause of conflict and disagreement amongst scientists. Fossil evidence suggests that the domestication of wolves began "in the late Pleistocene era, possibly as far back as 14,000 years ago… among people who still pursued a hunting-and-gathering way of life" (Morey). Researchers agree that this relationship began simply due to the fact that humans and canines contacted each other regularly, and some scientists believe this led to the human selection of individuals which eventually resulted in the evolution of the domestic dog. However, others disagree, and suggest that instead, the wolves adapted to life around humans, changing their diets and becoming less weary of humans, eventually evolving into the domestic dog via natural selection. Either way, the process occurred due to the constant contact and interaction between humans and wolves and was probably possible due to the communal nature of the wolves, "facilitated by similarities in social structure and in nonverbal modes of communication" (Morey), allowing both the wolves and humans to develop not only an understanding of each other, but also a means of creating a new hierarchal structure which included humans. Wolves which were able to submit to their dominant human companions were more likely to survive and breed due to their more obedient and docile temperament, which after many generations, led to the domestic canine companion we know today. Although the process of wolf domestication has continued for thousands of years to produce domestic pets, similarities still exist between the modern dog and their wolf ancestors.

Both wolves and domestic dogs fall under the same genus and species categories, *Canis lupus*, with the differentiation being in the sub-species, *Canis lupus familiaris* for the domestic dog. Because the two canines are of the same species, this suggests that their genomes are similar enough to allow them to breed with each other. Mitochondrial DNA studies show a distinct similarity between the mitochondrial DNA of the domestic dog and the gray wolf; to such an extent that the analyses of the mitochondrial DNA sequences can be used to trace the lineage and heritage of the domestic dog to their location of origin. These analyses also suggest that "dog

sequences are found in at least four distinct clades, implying a single origination event and at least three other origination or inbreeding events" (Ostrander). This implies that all domestic dogs' genes can be traced back to one to four matriarchal lines. However, the selection for various specific qualities and the creation of limited gene pools, in order to fit breed standards, has caused a high amount of genetic diversity within the sub-species.

This experiment uses a hypothetical population of wolves, and incorporates mutation and mating events to give an example of possible changes in variation of temperament, to illustrate how dogs may have evolved from wolves based on the natural selection for individuals of a more docile and less aggressive temperament. This experiment is centered on the possibility that wolves evolved temperaments more suitable for coexistence with humans, which led to the domestication of the wolves. The experimental hypothesis states that if the meaner more aggressive wolves were less suited for life and less fit for survival with humans, then those most aggressive individuals in each generation would be unfit to reproduce, so that each generation would become more and more docile, making them more fit for survival and more likely to reproduce and pass on their genes for submissive, non-aggressive behavior.

METHODS:

Each student in the class selected six cards, each with a number representing the temperament associated with that gene (Figure 1). They were then asked to add up the total of the numbers on all six cards to determine the overall temperament of the wolf. Higher numbers represented more docile and submissive behavior, while lower numbers represented more aggressive and dominating behavior. The students recorded this first total as the parental temperament. The students shuffled their wolf gene deck and randomly selected one card. The professor then rolled a die; based on the number rolled, the class added or subtracted the specified amount from the chosen card (Figure 2). This represented mutation. The students returned this mutated gene card back to their hand and shuffled them again. Each student selected three of their cards and traded with another student in the class. This represented mating. The students added up the numbers on their new cards, and recorded this value as the first generation. The process was repeated until there were a total of ten daughter generations. However, because mutation does not always occur in every generation, no mutation event took place for two generations. After tabulating all of the students' data, the six wolves with the lowest total number for temperament were "killed off," eliminating them and their future prospective offspring from the population. The students graphed the average temperament of each generation over the ten generations and found the line of best fit. The data was then analyzed and checked for significance using the chi-square test based on the graphical results. This data was then used to decide whether or not the Null Hypothesis was supported, the null hypothesis being that if the chi-squared value did not satisfy the 95% accuracy requirements, then evolution in the wolf population did not occur, and thus did not result in individuals of more docile and less aggressive temperament.

RESULTS:

The graphical data in Figure 3 suggests that the overall temperament number of the wolf populations increased after ten generations, meaning that the wolves in the tenth generation possessed more docile and submissive behavior than their parental ancestors. Although the average temperament increased over all, some discrepancies existed from generation to generation. The average temperament actually became more aggressive in the first, third, fourth, sixth, and seventh generations, and dipped in the ninth generation as well. This was probably due to a back mutation in the genes of these wolves. The trend of doubles of consecutive increase suggests the back mutation occurred in the first of the doublet, and in the following generation, another gene experienced a smaller forward mutation, which needed an extra generation to overcome the back mutation. This occurrence and strength of the back mutation could be explained by that perhaps the mutations for docile behavior making the wolves more fit for survival with humans conflict with the natural selection for more aggressive behavior in order to be most fit for survival in the wild, especially in the initial generations. However, towards the final generation, the temperament number jumped dramatically. This could be due to the random mutation, causing an increase in selection for less aggressive individuals, allowing natural selection and human selection to work together, as it became more advantageous for the wolves to live in conjunction with the humans instead of secluded from them. Or, the variation of temperament over each generation may also be due simply to the randomness of the mutations.

The graph gives an r squared value, which corresponds to the chi-squared value, of 0.2935. For a certainty, alpha, of 0.05, and one degree of freedom, the critical value equals 3.841. Because our value is less than the critical value, the results of the experiment are not statistically significant, and support the null hypothesis; therefore, the population did not evolve.

CONCLUSION:

Even though the final generation of wolves had more docile and less aggressive temperaments than their parental counterparts, the variation in temperament fluctuated between generations, making the transition inconsistent. These non-uniform and fluctuating changes in temperament suggest that the population was not evolving, but was instead subjected to random mutations. This population did not follow the Hardy Weinberg Principle. Some of the wolves mated with the same mate multiple times, meaning that mating was not random, the population size was relatively small, mutations occurred, and there was selective pressure towards wolves with more mild, docile, and less aggressive temperaments. This lack of adherence would normally suggest evolution was occurring. However, these factors did not change the genes significantly from the first generation to the last generation. The data shows that the average temperament values for each generation hovered between forty-four and forty-six, a relatively small range. The only exceptions were in jumps which occurred in generation eight and generation ten. These sudden increases could have a resulted from natural phenomena. For example, perhaps an illness spread throughout the wolf population and only those who had temperaments which allowed them to take care of each other were able to recover and survive. Or maybe even humans aided in healing the sick animals and only those capable of associating with humans and allowed them to assist survived. But once that obstacle passed, the animals no longer had the selective pressure to continue becoming tamer.

Although the experiment does not suggest evolution occurred in the theoretical wolf population, given the specified constraints and methods for mutation and mating, it still illustrates how changes occur in the population. And even though these wolves may not have evolved into domesticated dogs, this scenario is still plausible for wolf populations. Because dogs evolved from wolves and wolves still remain today, not all of the wolf populations evolved. So just because our population did not evolve, it does not mean that another population, under different circumstances or constraints, would not have evolved. In respect to evolving into man's best friend, perhaps those wolf populations lived nearer to human habitats or where suffering from scarcity of food, and therefore needed to adapt to life around humans, and so had a much stronger selection pressure. So however they evolved, whether due to natural selection or human manipulative selection, the wolf population already possessed the means to evolve into the domestic dog through the variety and diversity within the population.

TABLES AND GRAPHS:

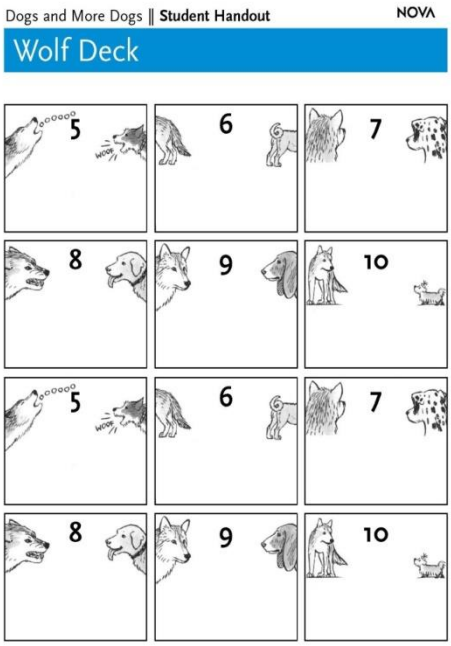

Figure 1:
Wolf deck containing numbers to Represent the temperament genes for Each wolf. Each number has equal Frequency, and each student selected 6 cards from the deck.

Die Result	Value to Add
1	+1
2	-1
3	+2
4	-2
5	+3
6	-3

Figure 2: The table showing the mutation corresponding to each number rolled on the die.

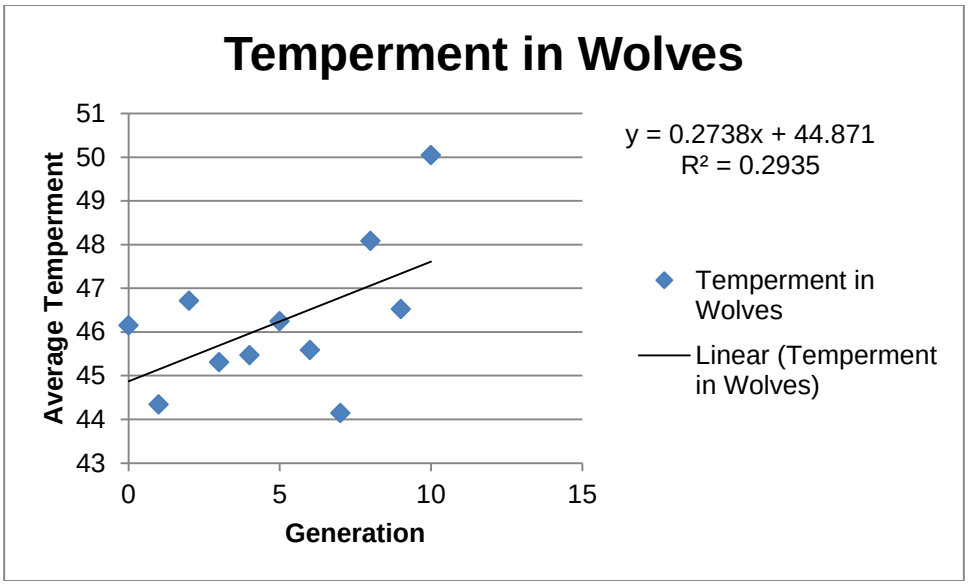

Figure 3: Graphical results of the average temperament per generation, based on the acquired data and tabulation of the cumulative temperaments of each individual over ten generations, following the parental generation.

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