Research related to SynchroGait®

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The *DMRT3* gene variant we have identified is permissive for alternative gaits in horses. Traditional three-gaited horses such as most dressage and show jumping horses, draft horses and Thoroughbreds have two copes of the C-variant (CC). Horses that can perform alternative gaits have the A-variant.

Most Icelandic Horses with two copies of the A variant (AA) can perform both pace and the ambling gait tölt while horses with one copy (CA) can only perform tölt.

In several of the other gaited breeds we have tested, most individuals are AA. However, unlike the five-gaited AA Icelandic horses, many of these other breeds are described to only preform an ambling gait. Both training and the genetic background may cause the differences observed in the pattern of locomotion between the different gaited horse breeds.

When we tested horse breeds worldwide we found that the mutation is present in all gaited breed (different frequencies, see table) and have a worldwide distribution.

We have published results about the "within-breed" effect of the *Gait-keeper gene* for horse used for harness racing (Nordic and standardbreed trotter), Icelandic horses, American Curly and Morgan horses. We have also collected information about the American Saddle Breed and the result is very similar. I will write a popular Science article about this very soon.

Overview

AA Strongly natural gaited. Usually performed both ambling gaits and pace.

CA Gaited horses but not as strong. Some may even appear not gaited, especially if they have not been trained in alternative gaits. Usually have less lateral movement and is therefor preferred by some riders, as they usually do not go toward pace when ambling. In the multi-gaited Icelandic horse, CA individuals have higher scores for the basic gaits trot and canter than AA horses but somewhat lower scores for tölt.

CC None-gaited (three-gaited) horses.

Findings related to gaited horses in the US

See attached file regarding the distribution of the different gene variants in different horse breeds. It is very evident that this mutation is the key difference between

gaited and non-gaited breeds. We did not have any information about the gaits of the individual horses included in this study. The table below show the gaited breeds with a US origin.

Breeds	number	AA	CA	CC	Frequency of A allele (%)	Gaitedness
American Paso Fino	34	31	3	0	95.6	gaited
Florida cracker	24	15	2	7	66.7	gaited
Kentucky Mountain Saddle Horse	25	21	4	0	92.0	gaited
Missouri Fox Trotter	42	42	0	0	100.0	gaited
Rocky Mountain Horse	27	27	0	0	100.0	gaited
Tennessee Walking Horse	54	54	0	0	100.0	gaited
American Curly	45	0	15	30	16.7	some
American Saddlebred	89	6	37	46	27.5	some
Appaloosa	20	1	3	16	12.5	some
Miniature Horse	109	1	4	104	2.8	some
Morgan	50	1	12	37	14.0	some
Shackleford Banks	41	1	7	33	11.0	some
Spanish Mustang	15	0	3	12	10.0	some

Within breed data show that, in Morgan horses and American Curlies there is a strong correlation between the gene and gaitedness. The correlation is not perfect which might be because i) the horse owners were asked to classified their own horses so some might have been miss-classified, ii) the horse have not been trained in alternative gaits because of age, experience or preferences of rider, iii) some conformation might make it difficult for the horse to use alternative gaits even though they carry the A-variant and iiii) other genes with a smaller effect can also influence gaiting (but I would be very surprised if we find anything major, personal comment).

It is not surprising to see some CA and AA horses classified as not-gaited as, for some horses, this trait has to be trained before the horse show it.

Gaits and SynchroGait result in Morgan horses (p= 8.6E-8)

Gaits	AA	CA	CC	Number
Three-gaited	0	23%	78%	40
Four-gaited	0	86%	14%	14
Five-gaited	60%	20%	20%	5

Gaits and SynchroGait result in American Curly (p=2.2E-16)

Gaits	AA	CA	CC	Number
Not gaited	0	66%	34%	29
Somewhat gaited	31%	54%	15%	13
Gaited	81%	15%	4%	27
Strongly gaited	94%	0	6%	32

Different tendency to trot in relation to SynchroGait in American Curly Horses -How often does the horse trot (p= 1.4E-6)

	AA	CA	CC	Number
Never	89%	6%	6%	18
Rarely	84%	16%	0	32
Often	32%	42%	27%	41

Articles in refereed scientific journals

Jäderkvist, K., Kangas, N., Andersson, L. S. and Lindgren, G. (2014), *Gaitedness is associated with the DMRT3 'Gait keeper' mutation in Morgan and American Curly horses*. Animal Genetics.

Kristjansson T, Bjornsdottir S, Sigurdsson A, Andersson LS, Lindgren G, Helyar SJ, Klonowski AM, Arnason T. (2014) *The effect of the 'Gait keeper' mutation in the DMRT3 gene on gaiting ability in Icelandic horses.* J Anim Breed Genet. Jul 30.

Jäderkvist K*, Andersson LS*, Johansson AM, Arnason T, Mikko S, Eriksson S, Andersson L, Lindgren G. (2014) *The DMRT3 ´Gait keeper´ mutation affects performance of Nordic and Standardbred trotters.* J Anim Sci. 2014 Aug 1.

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