BY THE NUMBERS

by Stephen Miller, Angus Genetics Inc.

Nature vs. Nurture: What is Affecting Calf Weights?

Once cows have a genomic test, why doesn't calf progeny data shift their expected progeny differences?

In the previous By the Numbers column and in a recent webinar, the accuracy genomics provide in predicting the genetic merit of an animal was demonstrated. It was shown for a trait like weaning weight, that once an animal is genotyped, having an individual weaning weight on that animal does not significantly improve the ability of the expected progeny difference (EPD) to predict the true genetic merit of that animal, as proven by future progeny performance. Breeders have asked about records on cows and have questioned why a cow that might have a great weaning ratio of 108 on three calves does not seem to move her EPD much if she was genotyped. Before genomics, breeders were accustomed to seeing these cows' EPDs reflect their performance to a more significant degree. Before we dig into the data to better understand just why these cow records are not having a bigger effect, lets look to see how cows are changing their EPD with their progeny performance data.

In July 2017, 2,863 cows had genotypes and have since went on to add three or more naturally born progeny. Figure 1 shows the change in their weaning weight (WW) and Milk EPD with the addition of their progeny. As expected, some cows went up and some went down, with the average change close to centered on zero with an average of -0.9 for WW and +0.8 for Milk. A lot of cows did not change more than 2 pounds (lb.) on either trait, with some changing more; but for the most part, these cows' EPD did not change much. With some of these cows adding 10 progeny, why did their

Figure 1a: ***WW EPD Change in Genotyped Cows Adding 3+ WN Progeny***

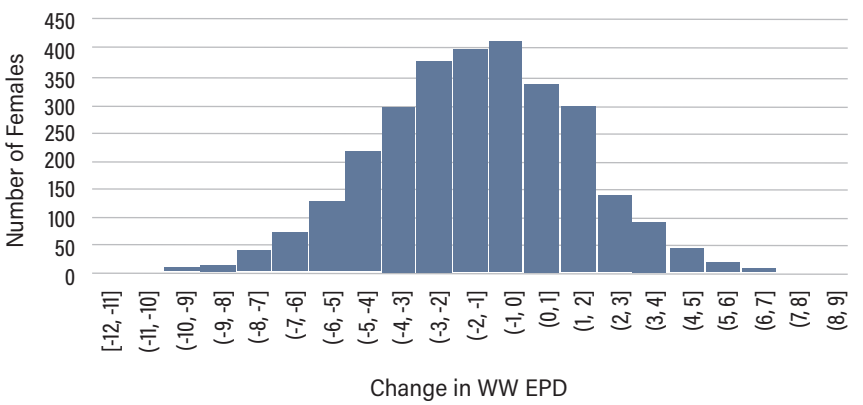
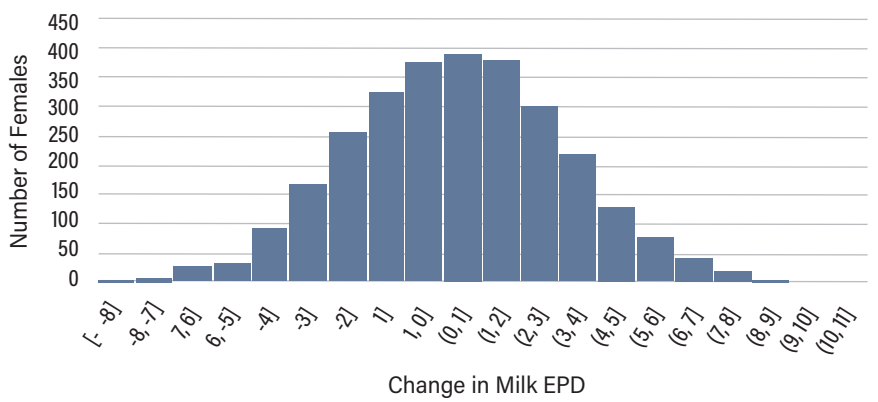


Figure 1b: ***Milk EPD Change in Genotyped Cows Adding 3+ WN Progeny***



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EPD not change more? To better understand this, let's look at the factors influencing calf performance.

Calf performance factors

Figure 2 shows the partitioning of factors that influence the weaning weight of the calf. The largest segment at 51% is residual, or what cannot be attributed to the genetic and known environmental factors we can model. Known environmental factors include things like sex, age of dam, season of birth and creep-feeding influences on weaning weight.

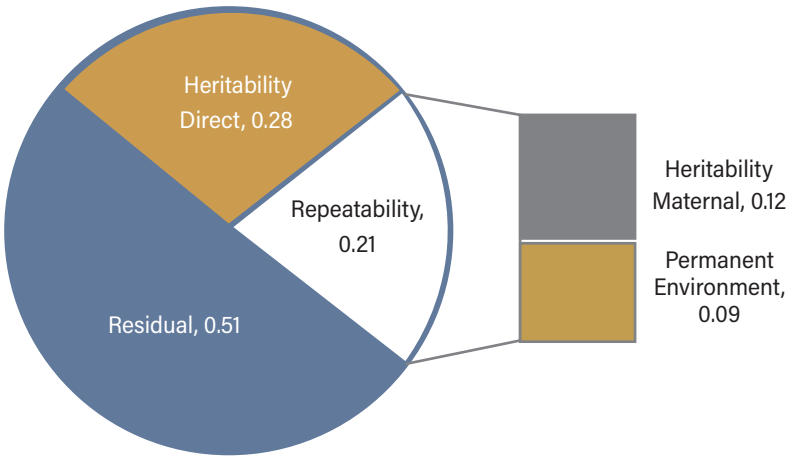
The residual, on the other hand, is attributed mainly to environmental factors which influenced this calf's weight but have not been readily measured, such as the calf having experienced a sub-acute illness like scours or pneumonia when young. Measurement error would also be included in this residual. The calf's own genetics, or the direct heritability component for growth accounts for 28% of the variation.

The dam's contribution to calf weight, which is the focus of this article, accounts for the remaining 21%. The dam's contribution is not all genetic, though. The genetic part or maternal heritability, which breeders will be familiar with as Milk EPD, is 12% and the remaining 9% is something breeders are not as familiar with — the permanent environment component. Together the dam's contribution is commonly known in the genetics field as repeatability (repeatability = maternal heritability + permanent environment).

A permanent environmental effect is a factor,that is not additive genetic (or inherited) like an EPD, but in spite of that still affects every weaning record on that cow. Think of your cow that was born early, on a nice day, got off to a great start and as a result was always one of the bigger females and ended up on the top of the pecking order in the herd. Being at the top of the pecking order allows this cow first access to the round bale in winter, the driest place to lie down, the best shade, etc. This position is not genetic per se as she was just lucky enough to be born early and not in a blizzard. As a result, this lucky cow will wean bigger calves due to this non-genetic position. This is only one hypothetical scenario and we really don't know just what these factors are, but the data say such factors are at play, and they account for 9% of the variation in weaning weight, almost as much as the Milk EPD itself.

The problem is this permanent environment component really discounts repeated records on a cow when it comes to increasing EPD accuracy. So for each progeny weaning weight a cow records, each one means less and less. Why? Because it becomes hard to pull apart if the "good" or "bad" weaning record on a cow with more than three calves is due to her genetics, or just a good "environment" for this cow which exists for each and every calf record.

Figure 2: ***Relative Influence of Genetic and Environmental Components on Calf Weaning Weight, Including Calf and Cow Traits.***



Permanent environment

To better understand how this permanent environment component affects EPD accuracy, lets look at some basic theory. A great textbook is "*Understanding Animal Breeding*" by Richard Bourdon, which I highly recommend. Dr. Bourdon presents a simple equation to show how progeny records contribute to EPD accuracy. When there is a permanent environment at play with repeated records as we have with cows, this limits the increase in accuracy as an animal adds progeny.

Applying the parameters from the Angus evaluation to the equation and converting the accuracy to that which breeders are familiar with, Figure 3 shows how accuracy increases with added progeny records for Milk EPD. You can see

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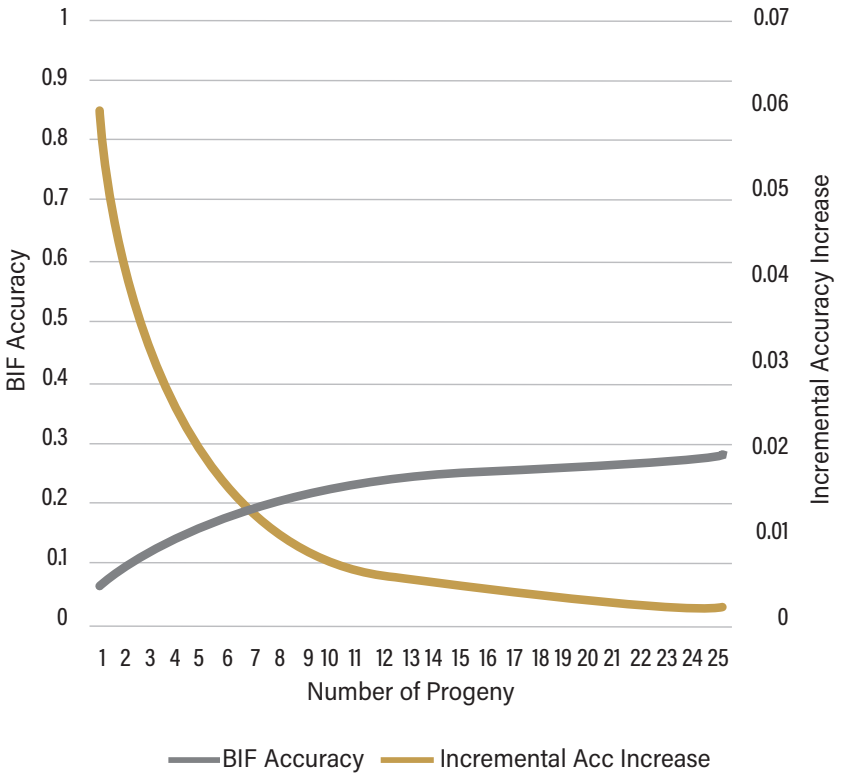
the accuracy increase is small and plateaus quickly. Going from one to two progeny adds 4% to EPD accuracy, but adding five or more progeny increases accuracy by less than 2%. Even with 25 weaning progeny, the cow will not increase her Milk EPD accuracy to 30%. Keep in mind this formula does not take into account relatives, so it is not directly comparable to what we see in the weekly evaluation, but the overall pattern is still valid.

To look at this another way, we showed in the previous article that adding a weaning weight on an individual did not help predict its true genetic merit to a great extent after it was genotyped. A calf's individual weaning weight increases its WW EPD accuracy by as much as four weaning progeny records will increase a dam's Milk EPD accuracy. So as a general rule, we should not expect two to four progeny records on a cow to have a large effect on her Milk EPD.

All this may cause a breeder to wonder, "Why bother turning in the data?" To this point, it's important to keep in mind the accuracy genomics offer is only possible with the data turned in. Without the data, prediction accuracy available with genomics will decrease, so the data remain as important as ever. The ultimate EPD is always based on progeny data, but progeny from females have two limitations. The first limitation is the number of records, where 10 records would be a great run for a female, but still will not give high accuracy. Secondly the non-genetic factors that influence a cow's performance to each and every calf she raises discount these calf records in their contribution to accuracy, as it is hard to determine what of the calf's performance is this dam's permanent environment effect and what is genetic or Milk EPD. Genomics offer a way to increase accuracy on cows for traits like milk, where they are hindered from attaining high accuracy based on their own performance. AJ

Figure 3: ***BIF Accuracy for Cow Milk EPD with Increasing Number of Progeny***



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Editor's note: If you have questions, please contact the Performance Programs department at 816-383-5100.