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Bello, Dr. Skinner:

We haven't met but I have read much of your work, and Marian has told me of her's and Keller's early '40 years at Minnesota and General Mills. Marian and I were married in June of 1976. I thought I'd take the opportunity to introduce myself. I've already met Dick Herrnstein. Dick and Animal Behavior had something cooking with an ill-fated animal training venture some years ago.

I haven't read your paper, "The Phylogeny and Ontogeny of Behavior". (I would appreciate a reprint if convenient). We have expanded considerably our species experience base since the "Misbehavior" was published. We have rather consistently found a confusion of unlearned gustatory behavior with certain conditioned responses. Suppose, for instance, a rabbit has been trained to pay at a miniature piano keyboard ("playing" the piano). Sooner or later, the rabbit will begin to chew at the piano keys. We do not reinforce the chewing behavior. Our efforts to ~~eliminate~~ chewing by normal extinction have proved fruitless. We can reduce the chewing in most, but not all, rabbits by very careful reinforcement. Occasionally, a rabbit proves unsuitable as a pianist because the chewing behavior becomes so strong. A similar problem crops up with ducks on the ivories. In this act, one of our more popular coin operated units, a small signal lamp comes on when the unit is activated. This signal tells the duck it is time to pull a chain to turn on a candelabra lamp mounted atop the piano. When the duck pulls the chain, the lamp turns on and the piano keyboard is now ready to be played. The duck is then obliged to play the keyboard, scanning up and down several times before the feeder fires and the equipment shuts down and recycles, ready for another play.

The duck must follow this sequence to ultimately receive a reward. The hitch here is that a fairly high percentage of the ducks get carried away with pulling the lamp chain and will repeatedly pull long after the light is on. Sometimes, the duck will even interrupt its piano playing for some chain pulling. This, of course, only delays reinforcement. Increasing the drive level generally does not improve performance. We have not made a great effort to extinguish this unsolicited behavior. Fortunately, we have another duck act that makes use of this strong food-getting behavior, so economics dictate a transfer of duty, rather than a long and expensive program of extinction.

Animal species exhibit a marked difference in food drive. Since we can't ask the animal what his drive level is, we try to measure it by response rate, latency, etc. If a rat and a rabbit are both trained to pull levers on a variable ratio, and one measures each animal's latency of response to the firing of a feeder at the conclusion of lever pulling, the rat will show a pronounced latency difference between low drive and high drive states. A rabbit will show little difference between low drive and high drive states. It hardly needs a kymograph to notice a difference. If both animals are near ad-lib weight and are reasonably content with the food ration for the day, both will dally at the lever when the feeder fires. Perhaps the rat will give an additional pull or so before strolling over to the feeder. The rabbit is almost surely going to give some free lever pulls and maybe a few false starts to the feeder before it finally takes the reward. Sometimes, the rabbit fails to respond at all to a single firing of the feeder. Now, put both animals on a high drive--80% of less of ad-lib body weight. The rat becomes all ears for the sound of the feeder. There is very little delay in leaving the lever when the feeder clicks and even less in getting to the food. The "hungry" rabbit often behaves quite like the sated rabbit--it continues to pull a few times or even several times before leaving the lever. Once the rabbit heads towards the food, there is generally a noticeable quickening of pace over the well-fed rabbit's gait. We have come across a number of species where food drive does not seem as pronounced as one would think. Dolphins, though a sea predator in habit, seem to fit more the mold of a low drive "browser" than a high drive "predator." In testing response rates during paddle pressing, there was very little difference between the kymograph curve when the dolphins received 4 lbs of food per day (not adequate to sustain life) and 14 lbs per day (adequate to sustain life). There were some slightly noticeable differences in behavior as the dolphins declined in weight. This revelation (and in 1963, when I did the work, it was new and startling to me) explained why some dolphin researchers were having difficulties keeping dolphins alive. The dolphins were being literally starved to death, and yet the animals continued to swim and act in an almost normal manner. A researcher unfamiliar with or not paying close attention to the animal wouldn't notice the problem until too late.

My reason for discussing these examples of different drive levels is to bring up the point that perhaps drive level or the expression of drive level is, in itself, a species specific trait. This trait, while maybe founded in the beast's evolutionary history, is expressed today behaviorally.

The rabbits' ancestors were not terribly concerned ~~about the~~ grasses getting up and walking away, so quick response to food was not particularly selected for. Perhaps the rats forebearers were not so fortunate and competitive pressures for food were greater.

About the chicken and the capsule, all of our trainers agree on this one. The higher the drive, the more likely the chicken is to pursue the capsule and thus delay reinforcement. I must admit we haven't really pushed the chicken to ultimate starvation, but the overwhelming evidence is that the hungrier the chicken gets, the stronger is the behavior of eating (or trying to eat) the first thing it perceives as food; in this instance, the capsule. We have tried the converse and, indeed, a well-fed chicken is less likely to drag the capsule onto the floor and attack it. For practical reasons, we haven't considered lowering the drive as a solution to the problem.

Wour water reinforcers in a cross drive context is very clever. No, we haven't tried that, and the results would be very interesting. We'll have to put that one on the back burner for a test in the future. My guess would be the rooting behavior would come out anyway, though perhaps not as strongly. The wooden disc, or most other objects, would still elicit gustatory instinct, even though the end of the behavioral chain we have built would ~~had~~ water rather than food. I just wish there were time to conduct such experiments at will.

I appreciate the opportunity to share my views and experiences with you.

Very truly yours,

Robert E. Bailey

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