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## Transfer of Learned Response by RNA Injection

In their report of an experiment on the performance of untrained rats injected with ribonucleic acid from the brains of trained rats [*Science* **149**, 656 (1965)], Babich, Jacobson, Bubash, and Jacobson properly caution that the data do not conclusively demonstrate transfer of training, and that we cannot be confident that RNA was the active factor in the injections. This being the case, the title of the report, "Transfer of a response to naive rats by injection of RNA extracted from trained rats," makes an excessive claim which could lead to misunderstanding.

Other problems of logic and design typical of much RNA-learning research are illustrated by the research in question. Let us look at some of the obvious requirements:

1) Precise definition of the response. In this study, rats were trained to *eat* from a food cup at the sound of the feeder. But a mere *approach* to the general area of the sound source was counted as a response in the injected rats. These are clearly not the same response patterns. Did the rats with experimental injections make consummatory responses, such as licking or chewing the food cup? Did they, indeed, pay any attention to the food cup at all?

2) Proper control groups. The authors say only that the experimental and control groups from which the RNA was obtained had been given equal amounts of food. Were the control rats also subjected to magazine clicks in equal number, and were they fed in the Skinner box without association with the clicks? Were they even adapted to the box? Were they handled equally often and in the same manner as the experimental rats? A deprived group of controls might well have fewer "activating" brain factors.

3) A behavioral criterion capable of discriminating between pseudoconditioning and learning. Generalized greater responsiveness is likely under the conditions employed, and the criterion must provide a test for true learning. Would the experimental injected rats also orient to a flashing light at the end of the cage opposite the food cup? A test of choice or discrimination behavior would have made possible a clear-cut distinction between simple activation and specific transfer.

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Carney is in error in asserting that the principal response in question was eating from the food cup. As we stated in our report, the operant response to the discriminative stimulus (click) was running to the food cup. The rat was rewarded for this behavior with a food pellet, and consumption of the pellet was the last step in the chain of behavior. The link which concerned us was that between the click and the cup-approach response for which the click was discriminative.

We regret that Carney found our title misleading.

Carney is correct in pointing out the several differences between our experimental and control donor animals. This was the major reason we were cautious in our conclusions. In a subsequent experiment (*Science*, in press) this problem has been overcome: One group of donor rats was magazine-trained with click as discriminative stimulus, a second group with a blinking light (at the end of the chamber opposite the food cup) as a discriminative stimulus. Handling, box adaptation, and so forth were identical for the two groups. On testing, recipient rats responded (approached the food cup) predominantly to the stimulus with which their respective donor rats had been trained. In another experiment (*Proc. Nat. Acad. Sci.*, in press), control donors, instead of being untreated, were matched to experimental donors in terms of handling and adaptation to box and click. The behavioral differences between experimental and control recipients were similar to those described in our first *Science* report. The donor animals in this new experiment were hamsters and the recipient animals were rats. The RNA transfer effect has also held up in our laboratories (i) in a two-alternative maze apparatus, (ii) in classical conditioning of planarians (with pseudo-conditioning controls, and replicated four times), and (iii) with purified RNA in the case of planarians. An experiment with purified RNA in rats is now under way.

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