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PROCEDURES FOR GIVING IMMEDIATE REINFORCEMENT IN PROGRAMMED INSTRUCTION[1]

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This paper describes several procedures for using special chemicals or inks to immediately reinforce a response to a multiple-choice stimulus. These procedures are known to be currently available, economically feasible, and administratively practical.

The *National Cash Register Company* (Dayton 9, Ohio) has developed a chemical system for reproducing data on subsequent sheets without carbon paper. The paper, trademarked NCR (No-Carbon-Required) Paper, makes use of a reaction between two different chemical coatings applied to it. Conventionally, the underside of a sheet is coated with one chemical and the top side of a second sheet is coated with another chemical. Any writing or typing on the first sheet presses the two chemical coatings together, so that the information inscribed on the first sheet is reproduced on the second sheet. Copy can be restricted from transcribing on certain areas of the second form ("incorrect" answer spaces) through the use of a desensitizing ink. The paper is also available in a Self-Contained form in which the front coating contains all of the components of the NCR Paper system and will develop color from the direct impact of the writing stylus or uninked type. By staggering the positions of the answer spaces on various pages, the NCR Paper can be used with self-instructional materials.

Consolidated Lithographing Corporation (Carle Place P. O., Long Island, New York) has been licensed to process a chemical technique developed by the New York Institute of Technology. In this process, the paper is treated with a colorless reactor that turns color when it is dampened with a water-filled pen. A green color indicates "correct" responses, and a red indicates "incorrect" responses. The process worked very well with the sample materials the company sent us.

Revising procedures developed by Peterson (1930) and Stephens (1941), the Response Research Branch, Bureau of the Census, U. S. Department of Commerce, Washington 25, D. C., has devised an effective "invisible ink" process. In this process, a colorless solution is pre-applied to paper and turns color when it is dampened with a ferric sulphate solution. This procedure allows a good deal of flexibility: either one or two colors may be produced; the colorless inks may be pre-applied either manually by using a stencil, or mechanically by using a mimeograph machine; and the developing ink may be either colorless or colored. One type of pre-application ink turns green in the presence of the developing ink. The active agents in this ink are distilled water, "Cellosize" (patent name, Union Carbide), sodium hydroxide, glycerine, potassium ferrocyanide, and sodium carbonate.[2] A second type of pre-application ink turns brown in the presence of the developing ink. Active ingredients in this ink are distilled water, "Cellosize," sodium hydroxide, glycerine, and potassium thiocyanate. These inks are pre-applied, either manually or by machine, in one operation for each ink. The developing ink is a solution of ferric sulfate and a small amount of potassium thiocyanate in distilled water. This ink may be colored with red writing ink in a one-color process if a record of "incorrect" responses or the possibility of additional writing is desired. It is important to note that this process requires

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[2]The Response Research Branch is most cooperative in providing specific formulas and instructions for using the processes.

the use of iron-free paper to avoid a premature ferric reaction with the pre-printed mimeograph ink. Except for this restriction, the process works admirably.

Use of the Ni-DMG complex was suggested by C.A. Whittemore (U. of Colorado). One of the distinct advantages of this basic process is the very rapid development of color (a vivid pink) when the nickel sulfate (slightly ammoniacal) is applied to the areas pre-treated with the dimethyl-glyoxime. However, because the nickle sulfate is colorless, only one color results. Adding 3-½ parts of $NiSO_4$ to 1 part of a washable black ink will give a record of "incorrect" responses. The color is greenish black on untreated paper and reddish brown on the section of paper on which dimethyl-glyoxime has been pre-applied. This process is relatively inexpensive and easy to use. Exploratory experimentation indicates that it can be used with regular 20 lb. bond mimeo or ditto paper.

The General Printing Ink Co. (750 Third Avenue, N. Y., N. Y.) markets a black ink incorporating a dye that bleeds out into color when it is dampened with water. The ink is printed with an open screen so that it appears as a cluster of black dots. The ink is available with dyes colored red, blue, green, or yellow. This is the process used in printing children's "paint-with-water" books. However, because of the expense in letter press set-up, it is probably better suited for volume production than for most experimental purposes.

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