A surrogate for rearing infant squirrel monkeys*

JOEL KAPLAN and MICHAEL RUSSELL

Life Sciences Division, Stanford Research Institute
Menlo Park, California 94025

The surrogate "mother" has become a valuable tool in studying primate development. It provides not only the basic needs of an infant taken from its natural mother, but also a means for investigating variables that affect early behavior (Harlow, 1958; Harlow & Suomi, 1970; Rosenblum & Harlow, 1963). In light of its proven usefulness, it is surprising that most of the systematic research involving surrogate-reared animals has been with rhesus monkeys (*Macaca mulatta*). This limitation, along with the growing interest in hand-rearing smaller primates that are easier to maintain in the laboratory

(Ausman, Hayes, Lage, & Hegsted, 1970; Hampton & Hampton, 1967; Hinkle & Session, 1972; Kaplan, 1970), prompted us to develop a surrogate for the infant squirrel monkey (*Saimiri sciureus*).

This paper describes a surrogate on which several infants have been raised successfully for a period of 6 months (Kaplan, 1973). The surrogate allows ad lib nursing, provides warmth and a fur-like surface to which the infant can cling, records contact time, and contains a small speaker for presenting sounds. One of its major advantages is that the surrogate is easily adapted to suit different needs and situations. Simpler versions can be obtained by eliminating components, e.g., the clock circuitry used to measure contact time.

MATERIALS AND METHODS

The surrogate and its components are depicted in Fig. 1. Not shown in the diagram is a form-fitting "sock" made of soft acrylic fur that is used to cover the surrogate. An opening in the fur material, covered by a removable patch, provides access to the nursing bottle.

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Fig. 1. Surrogate for the infant squirrel monkey.

Most of the parts can be purchased or made easily. A few of the more unique items are: (1) narrow-mouth bottle, Nalge 2, 30 ml; (2) nipple, N-30 "Nip," Poly Nurser Products, Brooklyn, New York; (3) thermal switch, Fenwal, 3000-0; (4) heating tape, B-41, Brisco Mfg., Columbus, Ohio; (5) clock, Haydon elapsed-time indicator in minutes; and (6) connectors, Amphenol 126 series, 5-pin hexagonal, male and female.

The surrogate consists of a Plexiglas cylinder (5 cm in diam and 25 cm long) that attaches to the side of the animal's home cage. The angle of the cylinder, with respect to the floor, can be adjusted by means of a pivot. A small plastic bottle with a miniature nipple fits in a hole in the cylinder, and a Plexiglas tube in the hole keeps the bottle in place and prevents leakage into the cylinder. Heat is provided by a flexible heating tape fastened to the inside of the cylinder and attached to a thermal switch. Tape temperature is controlled by an adjustment screw on the switch and, in our studies, was kept at 34°C, as measured under the fur cover.

The amount of time that the infant spends on the surrogate is recorded automatically. The animal's weight on the cylinder moves the pivot, which closes a switch and starts a clock. The different parts of the unit (cylinder, pivot, clock) are connected by pieces of metal tubing that also contain wires connecting the different electrical components to appropriate power sources.

One convenient feature of the surrogate is that it can easily be

removed for cleaning or repairs. This is accomplished by a sleeve and connector arrangement, shown in Fig. 1, which can be used to separate the surrogate from the pivot and clock.

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A Multifunction Multirange Interval Timer*

R. FRANK WALLACE

*University of California, San Diego
La Jolla, California 92037*

One of the most expensive items in electro-mechanical programming has traditionally been interval timers, both in terms of individual unit cost and the number of units required to offer a broad span of time ranges. With the advent of interval timers that utilize gearing systems to allow the selection of one of several time ranges, the need to stockpile timers of different ranges is eliminated. The Tenor Timer (Model 625-5-H) uses a 0-6 scale on the front panel with six multipliers via internal gear trains. By the rotation of an external knob, one can convert instantly the basic unit into a 0-6 sec, 0-60 sec, 0-6 min, 0-6 h, or 0-60 h timer with continuous time settings between the extremes on each range.

The schematic presented here (Fig. 1) offers an extremely versatile circuit for the adaptation of the Tenor Timer for use with snap lead or other electro-mechanical equipment. The completed module can function in the following modes: (1) Pulse-Operate—A negative pulse to the "operate" stud starts the timing interval which continues until the

timer reaches zero or a negative pulse is applied to the "reset" stud; (2) Power-On Operate—The interval times out while power is supplied to the "operate" stud and returns to its setting when power is removed; and (3) Auto-Restart—Once a negative pulse is supplied to the "operate" stud, the timer continues to time-out, reset, and restart itself until interrupted. Table 1 lists the external operation of toggle switches and studs to select the mode of operation.

The timer operates as follows.¹ Relays 1 and 2 (Ry 1, Ry 2) function as a typical lock-up circuit when Toggle Switch 1 (TS 1) is in the closed position. When a pulse is supplied, Ry 1 locks up, holding power on the motor and clutch of the timer until it has timed out or a reset has been received. One set of Ry 1 contacts supply external switching during the timing interval. At the end of the timing interval, Relay 3 (Ry 3) is operated via contacts in the timer and in turn operates Ry 2 to release the lock-up. A set of contacts on Ry 3 provides external switching at the end of the timing interval.

With TS 1 open, Ry 1 cannot lock and will operate only as long as negative is supplied to the "operate" stud. If negative is supplied long enough for the timer to time out, ac power to the motor is cut off though contacts in the timer, taking strain off the motor and the gears. External switching contacts operate in a similar manner to the "pulse-operate" mode, except that they return to their normal state only when negative is removed from the operate stud.

When TS 1 is closed, and the "auto-restart" stud is connected to the negative, Capacitor C1 charges during

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