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Handler Attitude and Chick Development

Brenda Cramton

INTRODUCTION

Avian Companions and the Human-Animal Bond

Human relationships with companion animals have existed for thousands of years (Lorenz 1953). Artifacts from ancient civilizations attest to our long-standing relationships with birds (Vnend 1984). Our relationships with birds continue to flourish. Today, there are millions of pet birds in the United States (Harris 1989).

Empirical studies have demonstrated conclusively that relationships with companion animals provide humans with valuable physical and psychosocial benefits (see, e.g., Mugford & M'Comisky, 1975; Beck & Katcher, 1989; Loughlin & Dowrick, 1993). Likewise, humans have been shown to influence the behavior of birds. Imprinting studies conducted early in this century by Lorenz are probably the most widely known experiments on the reactions of domestic avian species to interaction with human beings (Duncan 1992). Imprinting has been defined as a preprogrammed learned behavior (Alcock 1993). It allows the rapid establishment of a behavioral bond between an offspring and its parent. Lorenz (1952) found that baby Mallard ducks and Greylag goslings that he reared from hatching formed an immediate attachment to him either by sight (Greylags) or vocal expression (Mallards) and would maintain close proximity to him rather than their mother, another adult female of the same species, or another human.

Handling

More recently, studies have begun to focus on the long-term effects of other types of early experience on the human-animal bond. It has been shown that an animal's fear of humans can be reduced by habituation. One habituation technique is called "handling" (Duncan 1992). Although it is difficult to modify relationships between adult animals and humans (Murphy & Duncan 1978), young animals are responsive to learning experiences that include the formation of social attachments during a sensitive or critical period (Jones & Waddington 1993). Neonatal, or postnatal, handling has been shown to produce psychophysiological effects such as decreased fearfulness, decreased emotionality in open field tests (Denenberg & Zarrow 1971), and decreased novelty-induced fear (Bodnoff et al. 1987), as well as increased resistance to stress (Levine 1957, 1962). Many studies on mammals have shown that handled animals, such as puppies (Scott & Fuller 1965) and kittens (Karsh 1983), become closely attached to humans. Likewise, several studies have found similar effects in domestic poultry species (see, e.g., Jones & Faure 1981; Jones & Waddington 1993; Gross & Siegel 1979; Nicol 1992). Most neonatal handling studies have been conducted using mammals, primarily rats and mice. Levine initiated the classical infant-handling studies using rats to examine the effects of early experience on neural development and function under stress conditions (Smythe et al. 1994). He hypothesized from his results that "handling constitutes a stressful situation for the infant organism and that early experience with stress results in a greater ability of the organism to adapt to psychological and physiological stress in adulthood" (1957, p. 405). Meaney and his colleagues undertook studies to identify the mecha-
nism that enables this adaptation to occur. Their findings suggest that the hypothalamic-pituitary-adrenal (HPA) axis is altered by early experiences such as postnatal handling.

The HPA Axis

The HPA axis is highly responsive to stress (Selye 1950). Any type of stress stimulates the neurons in the paraventricular nucleus of the hypothalamus to secrete corticotropin-releasing hormone (CRH) into the portal system, which drains into the anterior lobe of the pituitary. CRH results in an increase in the release of adrenocorticotropic hormone (ACTH) from the pituitary. The elevated level of ACTH stimulates an increase in the output of glucocorticoids from the adrenals. Elevated concentrations of glucocorticoids inhibit subsequent secretion of CRH from the hypothalamus and ACTH from the pituitary (Meaney et al. 1988). This negative feedback mechanism involves the interaction of the hormones ACTH and CRH and a cytosolic glucocorticoid receptor in neural tissue (Meaney et al. 1985b).

Although glucocorticoids assist the organism under stressful conditions by increasing the availability of energy substrates, continued exposure to glucocorticoids may be detrimental to the organism after the termination of the stressor. Elevated glucocorticoid levels may lead to suppression of anabolic processes, muscle atrophy, hypertension, hyperlipidemia, arterial disease, impairment of growth and tissue repair, and immunosuppression (Meaney et al. 1996). Therefore, the capacity to effectively cope with these stimuli is adaptive. Gross and Siegel (1979) found that male Shaver Starcross chickens that were adapted to their habitat produced more antibody to sheep, horse, or human erythrocytes; had more blood protein; gained more weight; and were more resistant to a Mycoplasma gallisepticum challenge than unadapted birds that were allowed minimal human contact.

Effect of Early Experience on the Maturation of the HPA Axis

In the rat, the pituitary-adrenal stress response and the stress-related, negative feedback system do not mature until after birth; therefore, the development of these systems is under way during the period when an animal is exposed to early environmental stimulation (Meaney et al. 1985b). Meaney and his colleagues (1985a) suggest that the mechanism by which handling influences the development of the stress response involves the regulation of glucocorticoid receptor concentrations in the hippocampus and, perhaps, transcorin receptors in the pituitary. They found that handled rats showed an increase in hippocampal glucocorticoid receptor concentrations and a decrease in pituitary transcorin binding compared to non-handled animals. Since transcorin receptors bind circulating corticosterone, it is not able to inhibit the release of ACTH; therefore, higher transcorin levels in non-handled animals would lead to greater adrenocortical activity. The researchers hypothesize that early handling increases hippocampal glucocorticoid receptor concentration in one of two ways: (1) by increasing the number of receptor sites per cell, or (2) by stimulating postnatal neurogenesis in the hippocampus, which leads to an overall higher concentration of receptor sites. Their work also suggests that thyroid hormones have some role in the mediation of the development of glucocorticoid receptor concentrations in the hippocampus because their levels are known to be low from birth until about day 4, when they begin to increase, and peak at adult levels at the end of the second week of life; this pattern is identical to the developmental increase in glucocorticoid receptor concentrations in some brain regions (Meaney et al. 1987). Also, it is known that thyroid hormones are released during hypothermia, and handling is known to result in a transient period of mild hypothermia (Mitchell et al. 1990).

Increases in serotonin activity may also mediate the developmental changes in hippocampal glucocorticoid receptors and influence the effects of environmental events such as neonatal handling (Mitchell et al. 1990). Hippocampal concentrations of serotonin increase over the first two weeks of life and peak on day 14, which is similar to the developmental changes in hippocampal glucocorticoid receptor binding (Mitchell et al. 1990). Mitchell and his colleagues (1990) found that adult animals treated with a neonatal neurotoxin (5,7-dihydroxytryptamine) in the first few days of life had reduced hippocampal glucocorticoid receptor binding. In contrast, treatments that increased receptor binding capacity, such as neonatal handling or exogenous thyroid hormone treatment, increased hippocampal serotonin turnover.

Postnatal Handling

Since the interest in the use of neonatal handling (such as a reduction in the stress of handling and handling during a developmental period) as an intervention to alleviate collection-related stress has increased, many species have been used, such as rats, mice, and birds (e.g. hatched chicks). The opposite effect of neonatal handling is that of postnatal handling when birds are already hatched. Captive breeding is commonly employed to meet the demand for birds in the pet trade market.

While many of the species that are handled with neonatal techniques also exhibit postnatal handling (such as a reduced rate of capture or handling in captivity), the developmental period in which the handling occurs is opposite of the opposite of the experimental period in which the handling occurs. For example, the opposite end of the neonatal period is the hatched chicks are still in the nest with the parent birds and handling is not allowed. This form of handling introduces several stressors, including changes in diet and thermal environment and changes in social interaction of food intake and social contact rates of hatched chicks. Further, many of these species may lose their capacity for group living or social interaction and may lose their capacity for group living or social interaction. Interfaces of human-animal interactions prompted Davis and Millam (1997) to question whether a combination of these factors may have a positive effect on the health of the species. Davis and Millam (1997) found that when animals were exposed to repeated handling by humans, they showed decreased aggression rates and increased rates of tameness tests. Further, Millam (1997) revealed that animals handled later in life (age) were more tame.
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Postnatal Handling in Parrots

Since the interest in parrots as pets has grown in recent years, many species have become threatened due to capture for the pet trade. Habitat destruction and hunting for food have also contributed to the reduction in wild populations (Toft 1993). Every effort, therefore, must be made to alleviate collection from wild populations. Captive breeding is an alternative that can be employed to meet the demand for parrots for the pet trade market.

While many of the postnatal handling studies with rats and mice involve minimal amounts of handling (such as simple removal from the cage and placement in a container), the traditional aviculturalist's approach to taming chicks is at the opposite end of the handling spectrum: newly hatched chicks are permanently separated from parent birds and hand-fed by humans until weaning. This form of hand-raising may, however, introduce several sources of error. Inappropriate diets and thermal environments as well as the aspiration of food into the lungs may increase mortality rates of hand-raised chicks (Davis & Millam 1997). Furthermore, hand-raised chicks may lose their capacity to reproduce if they imprint on the humans that hand-rear them. These issues prompted Davis and Millam (1997) to ask whether a combination of hand-rearing and parent-rearing might alleviate some of these problems while at the same time producing tame parrots. A shared method of rearing tamed chicks would not only decrease the risk of chick mortality but also significantly decrease the amount of human labor necessary to produce tame birds. Davis and Millam demonstrated that tamed parrots could be produced by short, regular periods of handling by humans while parent birds provided the primary care for the chicks. In their study, chicks were handled daily for 15 to 30 minutes from day 12 until fledging. The researchers found that handled chicks scored high on a series of tameness tests. A follow-up study (Davis & Millam 1997) revealed that chicks that were handled later in life (handling began at 35 days of age) were more tame than the early handled birds and the experimenters judged the birds to be as tame as hand-raised birds.

Collette et al. (2000) confirmed and extended Davis and Millam's findings. They found that postnatally handled chicks were more tame on all behavioral tests than non-handled chicks. They also examined the influence of taming on immune status. After fledging, birds were physically restrained for a period of ten minutes. For handled birds, the restraint consisted only of perching on a human hand; however, non-handled birds were not perched on a human hand so they were instead wrapped in a towel. After the period of restraint, immune status was assessed by responses to (1) humoral response to a killed Newcastle disease virus; (2) serum corticosterone levels; (3) heterophil:lymphocyte ratios; and (4) delayed-type hypersensitivity (DTH) test to a foreign protein (phytohemagglutinin). DTH responses are antigen-specific, cell-mediated immune reactions (Dhabhar 1998). Experiments have shown that acute stress administered immediately before the introduction of an antigenic challenge significantly enhances a cutaneous DTH response, whereas chronic stress suppresses cutaneous DTH (Dhabhar 1998). Collette found that handled chicks had a significantly greater humoral response to Newcastle disease virus and a significantly lower DTH response to a foreign protein than did non-handled chicks. According to current immunologic theory, antibody response is inversely related to DTH response (Hassig et al. 1996). Corticosterone levels were also lower in handled chicks, but the difference between the two groups was not statistically significant. Handled and non-handled chicks were indistinguishable with respect to heterophil:lymphocyte ratios.

Although Davis and Millam (1997) and Collette et al. (2000) found that postnatal handling resulted in tame chicks, both studies reported a considerable variation in degree of tameness. Since a high degree of tameness may be valued by individuals seeking parrots as companion animals, and tameness may reduce the degree of stress parrots experience in captive environments, it is important to consider what factors, or factors, may have led to the observed degrees of tameness in these studies.

Handler personality is one possibility. Seabrook (1972) examined the influence of the
herdsman's personality on milk yields of dairy cows. He found that "good" herders' cows produced as much as 20% more milk than cows under the care of other herders at similar facilities under the same ownership. Seabrook defined a good herder as one with "knowledge of the behavior of the individual cows in the herd and the ability to notice deviations from normal behavior" (p. 376). He found that patient herdsmen that behaved consistently and showed consideration for their cows' needs had cows with the best milk yield. Other traits of the good herdsmen included confidence, self-reliance, and introverted personalities. Other studies have found that pigs that are fearful of humans after intentional aversive handling experiences had depressed growth rates and reproductive performance (see, e.g., Hemsworth et al. 1981, 1986). This is probably due to a chronic stress response, since even after aversive handling ceased, and humans were no longer present, pigs continued to exhibit elevated levels of plasma-free corticosteroids.

Empathy

Although it is difficult to predict what factor, or factors, of human personality may influence an animal's fear response to a human, the ability to empathize might be one important trait. People who experience sympathy or empathy "are more likely to help, comfort, or share with other people or animals" (Eisenberg 1988, p. 16). Conversely, cruelty toward other people or animals is considered, by mental health professionals, to be the result of a distortion in the development of empathy (Ascione 1993).

Definitions of empathy are varied but similar. For example, it has been defined as "the capacity to feel what another is feeling" (Zahn-Waxler et al. 1985, p. 22), or "the power of understanding and imaginatively entering into another's feelings" (Fox 1985, p. 61), or "a vicariously induced emotional reaction based on the apprehension of another's state or condition that is similar to the other's emotional state or consistent with the other's situation" (Eisenberg 1988, p. 15).

Darwin described the empathy that developed between himself and his dog as an interaction whereby an animal and a human intuit the other's state from behavioral cues (cited in Buck and Ginsburg 1997). In animal handling, an empathic handler presumably makes accurate assessments of an animal's fearfulness or timidity in certain situations. The empathic handler would then make adjustments in his or her behavior or the environment in order to lessen the animal's experience of fear or apprehension. In contrast, a handler that fails to take an animal's perspective and to recognize and correctly interpret the animal's cues may handle the animal inappropriately in relation to its internal state; if handled regularly by the same individual, the animal may become conditioned to fear humans and to experience them as stressful stimuli.

Purpose

This study was undertaken to address an aspect of emerging societal concern: human-animal interaction. The purpose of this study was to examine the relationship between the level of empathy of the handler, the attitude of the handler toward pets, and the degree of tameness and immune competence in handled parrots. It was hypothesized that parrots handled by more empathic handlers would exhibit a higher level of tameness and an increased ability to cope with stress than birds handled by less empathic handlers. Since genetic factors and quality of parrot parenting may also play a role in tameness and immune competence, these variables were also examined.

A better understanding of the human factors that increase tameness and the ability to respond effectively to stress is expected to (1) benefit aviculturists who wish to rear highly marketable parrots for the pet bird trade, (2) contribute to the overall welfare of parrots that must co-exist with humans in their captive environments, and (3) increase the knowledge of the effects that people have on the behavior of captive parrots.

PARTICIPANTS, ANIMALS, MATERIALS, AND METHODS

Human Participants

In order to examine the effect of handler empathy on parrot tameness, volunteer handlers that scored either high or low on the construct of empathy were solicited from the student population of the University of California, Davis. Potential participants were contacted by U.S. mail, electronic mail, posters, and classroom solicitations. In order to avoid any confounding sex differences, only female students were selected to par-
participants in the study. The average age of the participants in this study was 21 years.

Procedure

Students interested in participating in the handling study were asked to call or e-mail the experimenter to request a personality test. Ninety-two students requested personality tests. Sixty-eight students returned completed personality tests. Seven students were selected to participate in the handling study. The number of participants selected was based on the number of chicks available to be handled. The ratio of handlers to chicks was 1:3.

Personality test scores were not revealed to any students. As compensation for the time required to complete the questionnaire, each student who returned a questionnaire was provided with a list of occupations engaged in by individuals with profiles similar to their own. These occupational profiles are often used by professionals in career counseling.

Selected participants were required to complete a health surveillance questionnaire and to discuss their responses with a nurse at Employee Health Services, University of California, Davis. Participants were also required by the Office of the Campus Veterinarian, University of California, Davis, to obtain tuberculosis clearance (via a tuberculin skin test) and to have a serum sample drawn for archival purposes. Both procedures were conducted by personnel at Employee Health Services. There was no cost to the participants for these medical procedures.

Instruments

16PF

The Sixteen Personality Factor Questionnaire (Institute for Personality and Ability Testing, Inc., Champaign, Illinois) is a psychological assessment instrument designed by Raymond B. Cattell. In the 1940s, Cattell used factor analysis to reduce 45 categories of words, commonly used in the English language to describe human personality, to 15 dimensions of personality (Karson & O’Dell 1976). Later, three less replicable factors were discarded and four factors that were considered important were added (Karson & O’Dell 1976). Currently, the test measures 16 normal dimensions of adult personality: warmth, reasoning ability, emotional stability, dominance, impulsivity, conformity, social boldness, sensitivity, vigilance, imagination, privateness, apprehension, openness to change, self-reliance, perfectionism, and tension. Since the first-order factors are correlated, or oblique factors, Cattell was able to conduct a second factor analysis and arrive at second-order factors. These factors summarize the relationships found among the 16 first-order factors. The test measures five second-order factors: extraversion, anxiety, tough-mindedness, independence, and self-control. The 16PF consists of a total of 187 questions.

The 16PF was employed in this study to measure the level of one second-order personality factor: tough-mindedness, a measure of empathy. An individual who scores high on tough-mindedness has low scores on four first-order factors: warmth, emotional sensitivity, imagination, and openness to change (Karson and O’Dell 1976). Karzon and O’Dell (1976) explain that these people are much less likely to be controlled by their feelings than by their intellect. In contrast, a low tough-mindedness score is associated with high scores on the first-order factors of warmth, emotional sensitivity, imagination, and openness to change.

All tests were hand-scored. Females who scored high (7.7–10) or low (1.0–2.0) on tough-mindedness were selected to handle parrot chicks. Due to the fact that very few female test-takers scored on the high end of the tough-mindedness scale, a larger point spread was allowed in the high tough-mindedness handlers’ scores than in the low tough-mindedness handlers’ scores (2.3 versus 1.0 point spread).

Pet Attitude Scale

Prior to the start of handling, the Pet Attitude Scale (PAS; Templer et al. 1981; see Appendix 12A) was administered to participants to measure favorableness of attitudes toward pets. The PAS was selected because it is one of few published scales with reliability information: Cronbach’s alpha coefficient is 0.93, and two-week test-retest stability is 0.92 (Lago et al. 1988). The PAS consists of 18 7-point Likert format questions; therefore, 126 points are possible. A higher score represents a more favorable attitude toward pets. The items on the PAS represent three factorially derived scales: love and interaction, pets in the home, and joy of pet ownership.
Animals and Housing

The animals in this study were the offspring of wild-caught Orange-winged Amazon Parrots (Amazona amazonica). All chicks hatched in the animal colony at the University of California, Davis. Sixteen breeding pairs were housed in two adjacent rooms, one pair per cage, eight pairs per room. Pairs were housed in 2m x 2m x 2m suspended, wire welded cages. Each cage had two 2m x 2m x 2m wooden perches mounted with metal brackets to the 2m lengths of the cage. One perch was mounted near the front of the cage (the cage door end) and the other near the rear (the nest box end) of the cage. Birds were maintained in accordance with the University of California, Davis, Animal Use and Care Provisions.

Breeding Conditions

Sixteen pairs of Orange-winged Amazons were stimulated to breed by exposure to long day-lengths and the provision of nest boxes. Nest boxes were presented to breeding pairs on May 21, 1997. Stainless steel sheet metal “grandfather clock” type (40 cm x 20 cm x 20 cm) nest boxes were installed at the rear of each cage on its exterior surface. A 14 cm x 18 cm opening in the wire of the cage provided access to the nest box hole. The nest box hole was surrounded with a wooden insert with a 9 cm diameter hole in it. The wooden insert enabled the birds to enlarge the hole and, in a sense, chew their way into the nest box. The nest box floors were lined with 8–12 cm of autoclaved, premium-grade pine shavings.

On the same day that nest boxes were presented, light schedules began to be increased from 10 hours light and 14 hours dark (10:14D) to 14:10D. Light was increased by 30-minute increments each day (15 minutes in the A.M. and 15 minutes in the P.M.) over a period of eight days.

Diet was changed from Roudybush maintenance pellets (provided during non-breeding periods) to Roudybush breeder pellets (Roudybush Inc., Sacramento, California) during breeding, laying, and rearing stages. Water was available ad libitum from nipple waterers.

Chick Fostering

Due to the cannibalistic behavior of two breeding pairs (sire band #693 & dam band #458, and sire #187 & dam #338) in previous breeding seasons, all fertile eggs were removed from the nest boxes of these pairs. The eggs were placed either with another suitable breeding pair during the late incubation stage or in an incubator (RX2T, serial no. MM, cat. no. 910-063, Lyon Electric Co., Chula Vista, California) during the early incubation stage and then transferred to another breeding pair during the late incubation stage.

Incubator conditions were as follows: (1) average wet and dry bulb temperatures were 87 and 99 degrees Fahrenheit (30.6 and 37.2 Celsius), respectively; (2) relative humidity ranged from 60 to 65%; and (3) eggs were rotated by automatic turner once per hour.

Handling Procedure

Handling of chicks began between 28 and 35 days post-hatch. Each handler was assigned three chicks to handle for the duration of the study. Clutchmates were not assigned to the same handler. Within each clutch, chicks were randomly assigned to either a high or low-tough-mindedness handler. When clutches consisted of an even number of chicks, equal numbers of chicks were assigned to high and low-tough-mindedness handlers. A total of 20 chicks were included in the handling study: 11 chicks were assigned to low-empathy handlers and nine chicks were assigned to high-empathy handlers.

To allow for freedom of interaction between handlers and chicks, handlers were provided only basic instructions about the handling procedure. They were shown how to isolate the parent birds from the nest box by insertion of a metal plate between the lower one-third and upper two-thirds of the grandfather style next box, and how to remove the chicks from the nest box and place them in a shallow, towel-lined plastic tub. The handlers were instructed to handle each chick individually and to interact with the chick in any way they chose. Each chick was handled three times per week and handling sessions lasted for a period of 20 minutes. Handling continued until the time of testing.

All chicks were also handled briefly by the principal investigator during leg band placement, weekly weight measurements, and twice-weekly nest box cleaning. During nest box cleaning, the chicks in a clutch were placed in a towel-lined, plastic tub while the soiled pine shavings were replaced with clean shavings.

Tameness Tests

Chicks

After fledging (e.g., 45 days post-hatch), a series of tests were conducted on each chick (see Appendix 12B). The behavioral and physiological measures included: (1) wing stretch, (2) response to finger/hand, (3) response to back, (4) response to a brand breakfast object (a 4 cm length of corn or wood), and (5) proximity of the chick to the test administrator (closeness with a hand of the same species?).

Two indirect measures of chick behavior were also assessed. These measures were (1) non-agitation, measured by the number of times a handler put chicks in the test perch and (2) the test administrator’s ability to handle chicks without further interaction. A test was limited to three attempts, after which the chick was assigned to the remaining tester. These tests showed that the chicks exceeded 300 seconds of handling before becoming agitated.

Five tameness tests were conducted on each chick. The first trial was conducted by the handler. Two successively paired trials were conducted by each of the two other test administrators. Handlers were always the same individual who had interacted with the chick during that trial. Each trial consisted of a test to the bird and the handler’s reaction to the chick. The latter also made the final determination of whether a chick was tamable or not. Test administrators were blind to the results of the test. When a chick did not pass the test, the chick was handled by the principal investigator for a behavioral and latency to defecate test.

Parent Birds

Behavioral and physical differences were also measured between the parent birds in order to assess...
from the nest boxes and placed either with their parents during the late incubation period or in an incubator (RX2TT, serial number 651, Lyon Electric Co., Plattsburg, N.Y.) during the early incubation stage (see Appendix 1A) and to another breeding box at the incubation stage. The hatchers were removed at 23 days of age and assigned to the same handling treatments as chicks. They were randomly assigned to each handling treatment in an even number of experimental units. Ten chicks were assigned to each treatment. In the first week, half of the chicks were assigned to the tough-mindedness handling treatments and the other half to the normal handling treatments. Half of these chicks were assigned to low-density treatment and the other half to the high-density treatment. 

Two indirect measures of fear were used: respiration and latency to defecation. These measures were selected because they are not affected by the bird's weight or the amount of light that it is exposed to. Respiration was measured by placing the bird on a perch at a distance of 1 m from the experimenter and then measuring the number of breaths taken in 30 seconds. Latency to defecation was measured by placing the bird on a perch at a distance of 1 m from the experimenter and measuring the amount of time it took for the bird to defecate. These measures were used to assess the birds' reaction to the handling treatments.

The chicks were handled three times a week in two sessions of 30 minutes each. The first session was done at 8:00 a.m. and the second session was done at 3:00 p.m. Each session consisted of 10 minutes of handling and 20 minutes of rest. The chicks were handled in groups of five in a small room. Each group was handled for 10 minutes and then rotated to a new group. The birds were handled in this manner for a period of 4 weeks.

The chicks were weighed on a weekly basis to assess their growth. The weight gain was measured by subtracting the initial weight at hatch from the final weight at the end of the experiment. The chicks were placed in a controlled environment at 35°C and 60% relative humidity. The chicks were placed in a nest box lined with soft wooden shavings. The nest box was provided with food and water at all times. The chicks were handled three times a week and were weighed weekly to assess their growth.

**Tameness Tests**

**CHICKS**

After fledging (approximately 56 days post-hatch), a series of tameness measures was made on each chick (see Chick Tameness Score Sheet, Appendix 1A). The tests consisted of both behavioral and physiological measures. The behavioral measures included: (1) response to a novel object (a 4 cm length of plastic drinking straw); (2) response to a novel object (a 4 cm length of plastic drinking straw); (3) response to a novel object (a 4 cm length of plastic drinking straw); (4) response to a novel object (a 4 cm length of plastic drinking straw); and (5) response to a novel object (a 4 cm length of plastic drinking straw).

Two indirect measures of fear were made: respirations per minute and period of latency to defecation. These measures were selected because they were not affected by the bird's weight or the amount of light that it was exposed to. Respiration was measured by placing the bird on a perch at a distance of 1 m from the experimenter and then measuring the number of breaths taken in 30 seconds. Latency to defecation was measured by placing the bird on a perch at a distance of 1 m from the experimenter and measuring the amount of time it took for the bird to defecate.

**Quality of Parenting Measures**

Two variables were selected to represent measures of quality of parenting: (1) chick rate of weight gain, and (2) chick plumage condition. Each chick was weighed every seven days beginning on day 7 post-hatch. Weekly rate of absolute weight gain over the first four weeks of life was averaged.

Since some breeding pairs had a history in prior breeding seasons of pulling out their chicks' feathers, this behavior was also recorded as a measure of quality of parenting. Chick plumage condition was scored either as feather-plucked or non-plucked.

**Immunoresponse Test**

Immune status was assessed by response to a DTH test to a foreign protein, phytohemagglutinin-M (USB Specialty Biochemicals, Cleveland, Ohio). This test was selected because Collette et al. (2000) found a significant DTH response in handled versus non-handled Amazon chicks. Following the completion of tameness measures, each chick was placed in an animal carrier (26 cm x 8 cm x 40 cm) to produce a condition of novel environment and mild immobilization stress. Chicks were retained in the carrier for a period of five minutes. Placement in an animal carrier was selected as a stressor because most captive animals will be transported in carriers during their life.
times; therefore, it allowed the inducement of a stress that would occur under normal conditions in captivity.

Twenty-four hours after initial placement in the carrier (at 7 A.M.), each chick was again retained in the carrier for five minutes. After this, wing web thickness was measured with a micrometer and marked with a black marker dot. Phytohemagglutinin-M (0.25 mg dissolved in 0.05 ml sterile saline) was then injected subcutaneously to the marker dot in the wing web. After 12 hours (7 P.M.), the area was measured again for change in tissue thickness.

Statistics
SAS (1990) was employed to conduct all statistical analyses. The procedure used was PROC REG, version 6.12. Stepwise regression analysis was utilized to analyze the data. Regression analysis allowed the development of an equation that enabled the prediction of one variable from the knowledge of another variable.

At each stage in the stepwise regression procedure, the algorithm began with the calculation of F-statistics for each of the predictors that were currently selected for the regression model. If a predictor did not meet a specified significance level (0.100 in this study), it was removed from the equation. Next, an attempt was made to add a new predictor by calculating an F-statistic for each variable not currently in the equation. At each step in the model-building procedure, at most, one term was removed from or added to the model. If one or more terms were eligible to be removed, the one with the largest significance level (p-value) was removed. If one or more terms were eligible to be added to the model, the one with the smallest significance level was added. The stepwise regression procedure stopped when predictors were no longer added or deleted.

The procedure used to analyze the data in this study differed in that handler tough-mindedness was forced to be included in all regression models. This was done because the purpose of the study was to determine whether handler tough-mindedness had an impact on tameness; therefore, p-values were being sought regardless of whether they were or were not significant. Other predictors that were examined included handler attitude toward pets, whether or not chicks were feather-plucked, average rate of weight gain over the first four weeks of life, and behavioral and physiological measures of tameness in parent birds.

RESULTS
Reproductive Response
Fourteen breeding pairs produced a total of 77 eggs. At least 44 of the 77 eggs were fertile. Thirty-four eggs hatch ( hatch rate = 77%). The average number of chicks reared by a breeding pair was 2.3 chicks. This number includes foster chicks (see the following section on chick fostering). Six fertile eggs suffered damage inflicted by the parent birds: one female (#352) fractured her five eggs by pecking them when the nest box door was opened; another pair (#369 and #172) punctured the shell of one of their eggs with a toenail. Although the holes and fractures were patched with tape, all of the damaged eggs failed to hatch.

Candling revealed that 27 eggs were infertile. The fertility status of six other artificially incubated eggs was indeterminable; either the embryos died early or the eggs were infertile.

Twelve chicks that hatched later died. Five hatchings and one three-month-old chick (band #97-29) were killed by parent birds (sire #540 & dam #389, sire #436 & dam #602, and sire #183 & dam #374). Three hatchings died due to parental neglect (sire #519 & dam #350, and sire #513 & dam #352). One six-week-old chick died from a respiratory infection (band #97-22). The cause of death of two remaining hatchlings was unknown.

Six breeding pairs that experienced the loss of their first clutch produced a second clutch. Average size of second clutches was four eggs. Only one pair (sire #436 & dam #602) had a surviving chick from the first clutch. One pair (sire #433 & dam #504) failed to produce any fertile eggs in either the first or second clutch. Two pairs had the eggs in their first clutches removed to an incubator due to cannibalistic behavior by the parent (sire #693 & dam #458, and sire #187 & dam #338). One pair (sire #540 & dam #389) killed all of the chicks in the first clutch. Another pair (sire #513 & dam #352) fractured all of the eggs in the first clutch and, as a result, the embryos died.

One breeding pair failed to produce any eggs, although a bowl with eggs was present. Another pair was separated to consist of two fertile and one infertile egg. Two pairs failed to produce any infertile eggs.

Of the surviving eggs, the low-empathy group produced 10% more chicks than the high-empathy group (13% and 23%, respectively). This study because the aviary infection took place twice-a-day injection of drugs was used. Therefore, it was believed that additional infertile eggs would be controllable under the conditions of this study.

Chick Fostering
Due to the cannibalistic behavior of the parents in previous studies, eggs were set in an incubator and chicks were fostered to replace them. A third pair had all of the chicks in one egg killed by the chick in their second breeding season. They were treated for a respiratory infection of their first hatch. Eggs were incubated in the second breeding season.

Four pairs were used in the late incubation. In some eggs, the parents and others were used. Incubation in an incubator provided an environment for the development of embryos. Developing chicks were placed in various stages of development to adult. Embryos were used to incubate chicks were successfull.

A total of 13 fertile artificially incubated eggs were fostered on the expected date of hatch. Six chicks survived. They completed the incubation period and were successfully hatched and weaned into these pairs (sire #3-
although a bowl was created in the nest box shavings. Another pair, later determined by genetic sexing to consist of two females, laid a total of five infertile eggs. Three other pairs produced only infertile eggs.

Of the surviving 23 chicks, 11 were assigned to low-empathy handlers and nine were assigned to the high-empathy handlers. Three chicks (#97-22, #97-23, and #97-24) were excluded from the study because they suffered from a chronic respiratory infection that required administration of twice-daily injectable oral antibiotics; therefore, it was believed that tameness outcomes would be confounded by the frequent and aversive handling of these chicks.

Chick Fostering

Due to the cannibalistic behavior of two breeding pairs in previous breeding seasons (sire #187 & dam #338, and sire #693 & dam #458), their eggs were fostered to other possibly more suitable pairs. A third pair (sire #540 & dam #389) killed all of the chicks in their first clutch and the first chick in their second clutch during the current breeding season. The female of this pair had been treated for a respiratory infection during the incubation of her first clutch. The three remaining eggs in her second clutch were fostered to other pairs.

Four pairs were selected to foster eggs from the late incubation stage. During early incubation, some eggs remained with the biological parents and others were artificially incubated. Incubation in an incubator served a dual purpose: it provided an environment for the growth and development of embryos, and it also allowed the developing chicks to be photographed during the various stages of development without any disturbance to adult birds. The photographs of the embryos were used in another study. Four of ten artificially incubated eggs hatched. Two of these chicks were successfully reared by foster parent birds.

A total of 13 fertile eggs were fostered (four artificially incubated and nine naturally incubated). Eggs were fostered one week prior to the expected date of hatch. Ten chicks hatched and eight chicks survived. Two pairs successfully completed the incubation of foster eggs: chicks hatched and were successfully reared. One of these pairs (sire #368 & dam #407) completed the incubation of two eggs from the incubator. The other pair (sire #495 & dam #545) successfully completed the late incubation stage of three eggs that were previously incubated by the biological dam (#458). Neither foster pair had produced any fertile eggs of their own. Their infertile eggs were replaced with an equal number of fertile foster eggs.

Two other pairs successfully incubated foster eggs and chicks hatched; however, some chicks were killed or neglected (which resulted in death). One of these foster pairs (#379 & #646) produced no fertile eggs because both birds were later determined by genetic sexing to be females. The first hatching in their care was found dead on day 2 post-hatch: therefore, the two remaining foster eggs were fostered to another pair (sire #183 & dam #374). The latter pair completed the incubation of the eggs and successfully reared the two chicks for three months before killing the younger chick. Another foster pair (sire #513 & dam #352) produced one hatching of their own, but it was found dead on the same day that the first foster chick hatched. A second foster hatching in their care survived only one week.

One chick hatched in the incubator five days prior to the expected date of hatch. This chick was fostered to a pair that was successfully raising four of their own chicks (sire #317 & dam #111). The pair's youngest chick was close in age to the fostered chick. The foster chick failed to thrive and expired after seven days. Whether this was due to a biological anomaly that may have been associated with the chick's early hatching or whether it was due to the possibly overworked parents' ability to provide for one additional chick is unknown.

Tameness

Empathy

The global factor "tough-mindedness" was utilized as a measure of handler empathy. The tough-mindedness scale ranges from 1 to 10. A lower tough-mindedness score is associated with a higher degree of empathy. Handler scores were 1.6, 1.9, 2.0, 7.7 (two handlers with this score), 8.7, and 9.3.

According to the stepwise regression models, handler tough-mindedness significantly predicted both physiological measures of tameness. Tough-mindedness predicted chick respiration rate.
$p = 0.002$, and inversely predicted latency to defecation, $p = 0.070$ (Figures 12.1 and 12.2, respectively).

In contrast, handler tough-mindedness did not significantly predict the behavioral measure of tameness, $p = 0.947$. Birds handled either by high- or low-empathy handlers did not demonstrate appreciable differences in behavioral tameness. They perched on experimenters' hands, permitted human touch, and accepted food items and novel objects from experimenters.

**ATTITUDE**

Templer's PAS was employed to measure handler attitude toward pets. A higher score is associated with a more positive attitude toward pets. A total of 126 points are possible. Pet attitude scores of the handlers in this study were 108, 111, 112, 113, 117 (two handlers with this score), and 123.

According to the stepwise regression models, handler attitude did not significantly predict behavioral tameness, $p = 0.190$, latency to defecation, $p = 0.500$, or respiration rate, $p = 0.883$. The correlation between pet attitude and tough-mindedness was weak, $r = 0.101$.

**PARENTING VARIABLES**

Quality of parenting was assessed by measures of two variables: (1) chick average rate of weekly weight gain over the first four weeks of life, and (2) chick plumage condition. Three breeding pairs (sire #513 & dam #352, sire #519 & dam #350, and sire #436 & dam #602) were responsible for feather plucking 25% of the chicks in the study.

A feather-plucked condition significantly predicted both physiological measures of tameness: respiration rate, $p = 0.005$, and latency to defecation, $p = 0.048$ (Figures 12.3 and 12.4, respectively). However, according to the sums of squares, handler tough-mindedness was a stronger predictor of respiration rate ($F = 238.5$, respectively) than feather-plucked condition ($F = 44.3$). The predictor of latency to defecation was 1,863 versus 18,632, respectively.

In contrast to the situation with tough-mindedness on behavioral measures, feather-plucked condition did not predict behavioral tameness.

Rate of weight gain did not predict any measure of chick weight gain over time ($r = 0.19$, $p = 0.13$).
squares, handler tough-mindedness was a better predictor of respiration rate than was a feather-plucked condition (sum of squares = 329.7 versus 238.5, respectively). In contrast, a feather-plucked condition was a somewhat better predictor of latency to defecation than was handler tough-mindedness (sum of squares = 22,667 versus 18,632, respectively).

In contrast to the effect of handler tough-mindedness on behavioral tameness, a feather-plucked condition significantly and inversely predicted behavioral tameness, $p = 0.042$ (Figure 12.5).

Rate of weight gain did not significantly predict any measure of tameness. Mean weekly chick weight gain over the first four weeks of life was 84.55 grams/week ± 2.78 grams/week (mean ± SE).

**PARENTAL TAMENESS**

Paternal respiration rate inversely and significantly predicted latency to defecation in chicks, $p = 0.013$ (Figure 12.6). It was a more significant predictor of latency to defecation than either feather-plucked condition or handler tough-mindedness (sum of squares = 38,950 versus 22,667 and 18,632, respectively).

Maternal behavioral tameness inversely and significantly predicted chick tameness, $p = 0.007$ (Figure 12.7). Interestingly, the correlation between foster chick tameness and biological dam tameness was greater than the correlation between foster chick tameness and foster dam tameness, $r = -0.400$ versus $r = -0.249$, respectively.

**Cell-Mediated Immunity**

According to the stepwise regression model, handler empathy did not predict immune response, $p = 0.761$. Birds handled either by high- or low-empathy handlers did not demonstrate any dis-
cernible difference in change in wing thickness after the administration of PhA-M. Mean wing thickness change in birds handled by low-empathy handlers was 0.592 mm ± 0.169 mm (n = 11) versus 0.579 mm ± 0.261 mm (n = 7) in birds handled by empathic handlers. Two birds handled by empathic handlers were omitted from the computations because one chick died before the test was conducted and an improper measuring technique led to an erroneous measure on a second chick.

**DISCUSSION**

**Tameness**

**Handler Empathy**

The results of this study support, in part, the hypothesis that degree of handler empathy affects parrot chick tameness. Level of handler empathy was found to significantly influence both physiological measures of fear examined in this study: respiration rate and period of latency to defecation. In the presence of humans, chicks that had been handled by individuals with lower levels of empathy exhibited higher rates of respiration and shorter periods of latency to defecation than chicks that had been handled by high-empathy handlers.

The surprising finding in this study is that birds handled either by high- or low-empathy handlers exhibited overtly tame behaviors such as a willingness to perch on a human hand and permit human touch. However, although birds handled by low-empathy handlers exhibited tame behaviors, the results of this study suggest that these birds continued to experience fear on a physiological level when in the presence of humans. This outcome is consistent with Hennessy and Levine's (1979) finding that "some physiological responses may habituate more slowly than overt behavioral reactions" (qtd. in Levine et al. 1989, p. 344). Habituation is the process by which new stimuli or situations are compared with representations in the CNS of previous events (Sokolov, cited in Levine et al. 1989).

The results of this study may contribute to the knowledge of the factors, or factors, in the bird handlers led to the physiological level, to the results stated earlier. Because bird owners had to use interaction in order to train birds. Perhaps the low-empathy handlers failed to reduce the fear in their behaviors while handled birds' interaction in birds may have contributed to maternal conflict, anxiety, and stress of any human. A limitation in Seabrook's (1979) study of empathy handlers' behaviors is that therefore, these birds may have human encounters and/or uncertain s
Handler Attitude

Handler attitude toward pets did not correlate with parrot chick tameness. Presumably, this is due to the fact that there was a cluster of high handler attitude scores. The small handler sample size ($n = 7$) may also have led to this negative result. It is not surprising that the participants scored high on a scale designed to measure attitude toward pets, since the sample was self-selected to participate in a research project involving the handling of neonatal parrots. Perhaps behavioral tameness, which was not predicted by tough-mindedness in this study, is more easily affected by handler attitude than handler tough-mindedness.

Quality of Parenting

At least one factor of parenting is an important predictor of chick tameness. Feather plucking of chicks by parent birds significantly predicted both measures of physiological tameness, but to a lesser degree than handler empathy.

Normal preening, or feather grooming, of chicks is a necessary parental bird behavior. In preening, each feather is drawn individually through the bird's beak; this process smooths the feather and removes debris. Hence, normal preening maintains good feather condition and is, therefore, essential to chick survival, especially in the wild.

Suchecki and her colleagues (1993) have found that some maternal behaviors in rats are necessary not only for the survival of the young but also for the regulation of the development of some physiological systems. The researchers found that maternal behaviors exert dual control over HPA axis regulation: (1) feeding keeps the adrenal glands insensitive to ACTH during the stress hyporesponsive period (SHRP) in the first two weeks of life, and (2) licking of the anogenital region to induce urination and defecation plays a role in inhibiting ACTH secretion. It is possible, therefore, that excessive parental behaviors, such as preening to the extent that it results in the removal of feathers, may perturb the normal ontogeny of the HPA axis and result in an oversensitization of the system to novel and/or stressful stimuli.
adaptive and selected against. The basis of feather plucking or “overgrooming” in captivity is not understood, but repeated human handling may be one contributing factor. It is interesting that the chicks in one feather-plucked clutch (not included in the study) required excessive, and intrinsically ungentle, human handling for treatment of a chronic respiratory infection. The chicks were frequently returned to the nest box or home cage with their plumage in disarray. If parental grooming of chicks is a response to soiled and/or malaligned feathers, overgrooming could conceivably develop from repeated human handling.

It is not surprising that parenting factors influence tameness. Since, in this study, chicks spent more than 99% of their time in the care of their parents, the opportunity for chick tameness to be influenced by parental factors was great. It is likely that numerous other parenting factors exist that may also affect chick tameness. The potential exists to select breeding pairs that exhibit specific parenting qualities that increase chick tameness. Work to identify important parenting variables has recently begun with the analysis of videotapes made during the course of the present study, of parent and chick interaction in the nest box.

**Parental Tameness**

One counternintuitive finding from this study is that maternal behavioral tameness inversely and significantly predicted chick behavioral tameness. This result may be due to either post-hatch environmental factors or genetic factors or some combination of the two. Perhaps an as-yet-unnamed difference in the maternal behaviors of more and less tame mothers accounts for the inverse relationship of maternal and chick behavioral tameness. These results indicate that may be a genetic component, since foster chick tameness was more strongly correlated with biological dam tameness than with foster dam tameness.

Paternal respiration rate also significantly and inversely predicted chick latency to defection: male parents with low respiration rates in the presence of humans had chicks with long periods of latency to defection when humans were present. This outcome suggests that there may also be a genetic component to fearfulness. Taken together, these results suggest that chicks may inherit very different factors of tameness from each parent.

**Immune Status**

Neither degree of handler empathy nor attitude toward pets significantly predicted cell-mediated response to a foreign protein challenge. Chicks handled either by high- or low-empathy handlers showed similar changes in wing thickness. As stated earlier, Collette et al. (2000) found that handled parrot chicks had a lower cell-mediated response and a higher antibody response to a Newcastle disease virus challenge than did non-handled chicks. This inverse relationship between the two immune responses would be predicted if the birds had experienced handling as a stressful stimulus (Hassig et al. 1996). The results of the present study support Collette’s finding that human handling is interpreted as stressful and activates the neuroendocrine system; however, the results here show that handling and human presence are interpreted as stressful only when postnatal handling has been carried out by a human handler with a low level of empathy.

**CONCLUSION**

Differences in empathy of humans providing neonatal handling of Amazon chicks produced differences in physiologic indices of stress, although no difference was detected in chick behavioral tameness or DTH response. Parental feather picking predicted differences in both physiologic and behavioral responses to handling but not DTH response to a foreign protein challenge. The results suggest that adaptability of wild animals to captivity might be improved by a better understanding of the basis for differences in the effects of quality of parenting and human handler personality on behavioral development of parrots.

**REFERENCES**


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Appendix 12A

Pet Attitude Scale

1. I really like seeing pets enjoy their food. (+)
2. My pet means more to me than any of my friends. (+)
3. I would like a pet in my home. (+)
4. Having pets is a waste of money. (−)
5. Housepets add happiness to my life (or would if I had one). (+)
6. I feel that pets should always be kept outside. (−)
7. I spend time every day playing with my pet (or I would if I had one). (+)
8. I have occasionally communicated with a pet and understood what it was trying to express. (+)
9. The world would be a better place if people would stop spending so much time caring for their pets and started caring more for other human beings instead. (−)
10. I like to feed animals out of my hand. (+)
11. I love pets. (+)
12. Animals belong in the wild or in zoos, but not in the home. (−)
13. If you keep pets in the house you can expect a lot of damage to furniture. (−)
14. I like housepets. (+)
15. Pets are fun but it’s not worth the trouble of owning one. (−)
16. I frequently talk to my pet. (+)
17. I hate animals. (−)
18. You should treat your housepets with as much respect as you would a human member of your family. (+)

Plus and minus signs denote the direction in which the question is to be scored.

Appendix 12B

Chick Tameness Score Sheet

Chick Band # ________________/Cage # ________________

Test Administrator __________________/

Date ________________

I. Behavioral Data

A. Response to extended finger/hand
   ____ approach/perch: ____ latency in seconds
   ____ no response
   ____ withdraws/aggressive display/bites: ____ latency in seconds

B. Response to touch on head (check or back)
   ____ permits
   ____ permits with flinch or vocalization
   ____ withdraws/aggressive display/bites

C. Response to food offering (Cheerios cereal)
   ____ accepts: ____ latency in seconds
   ____ no response/turns away: ____ latency in seconds
   ____ withdraws/aggressive display/bites: ____ latency in seconds

D. Response to novel object (piece of a drinking straw)
   ____ accepts: ____ latency in seconds
   ____ no response/turns head away: ____ latency in seconds
   ____ withdraws/aggressive display/bites: ____ latency in seconds

E. Proximity seeking to
   administrator____ parrot ____ ambivalent____ no response____

II. Physiological Data

A. Respiration rate
   ____ rpm

B. Latency to defecation
   ____ seconds

III. Physiological Data

A. Respiration
   ____ rpm

B. Latency to defecation
   ____ seconds
Appendix 12C

Parent Tameness Score Sheet

Bird Band #: ________________
Sex: ____________________________
Cage #: ________________
Test Administrator: _______________________
Test Trial #: ________________

I. Behavioral Data
   A. Response to person in front of cage
      ______ approach (non-aggressive)
      ______ no response
      ______ aggressive display
      ______ withdrawal
   B. Response to opening of cage door
      ______ approach (non-aggressive)
      ______ no response
      ______ aggressive display
      ______ withdrawal
   C. Response to extended (empty) hand
      ______ approach (non-aggressive)
      ______ no response
      ______ aggressive display
      ______ withdrawal
   D. Response to food offering (fruit)
      ______ acceptance
      ______ no response
      ______ aggressive display
      ______ withdrawal

II. Physiological Data
   A. Respiration rate
      ______ rpm
   B. Latency to defecation
      ______ seconds