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The Effects of Bromocriptine Treatment During Early Pregnancy on Postpartum Maternal Behaviors in Rats

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Abstract

Prolactin, a hormone of the anterior pituitary, is involved in initiating maternal behavior, alleviating postpartum anxiety, and stimulating lactogenesis. Bromocriptine, a dopamine D2 receptor agonist, inhibits prolactin secretion. Bromocriptine administration represses postpartum maternal behaviors (pup retrieval) in mice, and causes elevated anxiety in the elevated plus maze [Larsen & Grattan (2010). Endocrinology 151(8): 3805–3814]. Whether similar effects exist in other species is unknown. The present study examined the possible involvement of prolactin during early gestation on maternal behavior and anxiety in rats. Bromocriptine given on days 2–4 of pregnancy resulted in impaired postpartum maternal behaviors in a novel environment during early lactation. However, compared to controls, bromocriptine-treated subjects did not exhibit increased postpartum anxiety in the elevated plus maze. These findings support work in mice that bromocriptine treatment during early gestation impedes postpartum maternal care, and indicate that early gestational hormonal status affects postpartum behavior more broadly in other mammals.

Keywords

postpartum maternal behavior; anxiety; rats; dopamine agonist

INTRODUCTION

Prolactin (PRL) is an anterior protein hormone found to stimulate a range of reproductive behavior across classes of animals. In birds, the hormone stimulates incubation behavior (Horseman & Buntin, 1995; Lehrman and Brody, 1964; Wang & Buntin, 1999), while in fish it stimulates fin fanning behavior to increase water flow over their eggs (Pall, Liljander, & Borg, 2004). In rats, PRL stimulates the onset of maternal behavior (Bridges, DiBiase, Loundes, & Doherty, 1985; Bridges, Numan, Ronsheim, Mann, & Lupini, 1990) as well as maintaining corpora lutea functions and stimulating lactogenesis (Grattan & Bridges, 2009).

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In the pregnant rat, prolactin is released twice daily in surges from the anterior pituitary during the first half of gestation (Butcher, Fugo, & Collins, 1972). These diurnal and nocturnal surges are stimulated by cervical stimulation during copulation, and persist for 8–10 days of gestation, supporting corpora lutea progesterone production and the maintenance of pregnancy (Knobil & Neill, 1988). Maternal behavior in rats at parturition is stimulated by prolactin's central actions. Prolactin acts directly on the medial preoptic area to stimulate the onset of maternal behaviors; for example, pup retrieval and crouching (Bridges et al., 1990). Inhibition of prolactin secretion with the dopamine agonist, bromocriptine, delays the expression of maternal behavior in hormone-primed, virgin female rats (Bridges & Ronsheim, 1990). In addition to prolactin's actions on maternal care, prolactin also stimulates neurogenesis in the subventricular zone of the lateral ventricle of pregnant mice (Shingo et al., 2003).

Based upon these findings, Larsen and Grattan (2010) examined the role of prolactin during early pregnancy in mice on both postpartum maternal care and anxiety. They found that mice treated with bromocriptine from days 1 to 3 of pregnancy experienced attenuated PRL secretion and exhibited delays in postpartum maternal behaviors in a novel, and potentially anxiogenic, environment, but not in a familiar home cage. Given that the postpartum period is characterized by reductions in anxiety in rats as well as women (Lonstein, 2007), that prolactin is anxiolytic in lactating rats (Torner et al., 2004), and the established relationship between neurogenesis and depression (Hansen, Owens, & Nemerhoff, 2011), these investigators also examined the effects of prolactin, acting through a neurogenesis mechanism, in regulating postpartum anxiety. Bromocriptine-treated pregnant mice displayed reduced neurogenesis and increased levels of anxiety as measured on an elevated plus maze. Concurrent prolactin treatment reinstated neurogenesis and reduced anxiety (Larsen & Grattan, 2010). In the present study, we use a rat model to assess the effects of suppression of prolactin by bromocriptine during early pregnancy (days 2–4) on both maternal care and anxiety. This approach allows us to determine whether prolactin exposure during early pregnancy affects postpartum behaviors in rats as reported in mice (Larsen & Grattan, 2010). Applying a research design similar to that employed by Larsen and Grattan (2010), maternal behavior is measured postpartum in both the mother's home cage and in a novel environment, while postpartum anxiety is measured using an elevated plus maze (EPM). It is hypothesized that rats, like mice (Larsen & Grattan, 2010), given bromocriptine during early pregnancy will exhibit impairments in maternal behaviors, especially in a novel test environment. Furthermore, it is hypothesized that rats will exhibit an increase in anxiety postpartum following the suppression of prolactin secretion by bromocriptine during early pregnancy.

METHODS

Animals

Twenty-eight adult female Sprague–Dawley (Crl:CD[SD]BR) rats (175–200 g) were purchased from Charles River Laboratories (Wilmington, MA) and housed on a 14:10 light:dark cycle (lights on at 0500 hr) with food and water given *ad libitum*. After 1 week of acclimation post-arrival, rats were smeared daily (vaginal lavage) between 0800 and 1000 hr

to determine estrus cyclicity. Females were paired with a breeder male on the day of proestrus. The next day a vaginal lavage determined the presence of sperm in the vagina, and a sperm-positive smear indicated Day 1 of pregnancy. Females were pairhoused after pregnancy was confirmed until day 18 of gestation, at which point they were individually housed in cages (16 in. × 10 in. × 8 in.). Twenty-six rats carried litters to term, and litter sizes ranged from 9 to 17 pups. Two rats in the study did not become pregnant.

Animals in this study were maintained in accordance with the guidelines of the Committee of the Care and use of Laboratory Animal Resources, National Research Council. The research protocol was approved by the Tufts Institutional Animal Care and Use Committee.

Bromocriptine Treatment

Pregnant rats were given subcutaneous injections of bromocriptine (Sigma–Aldrich, St. Louis, MO) to reduce early gestational prolactin levels. Bromocriptine mesylate was dissolved in a minimal amount of ethanol and diluted to the appropriate concentration (10% ethanol) in sterile water. All injections were given between 1700 and 1730 hr, to avoid disrupting the postcoital diurnal prolactin surges in early gestation which occur around 1600 hr (Bridges, Felicio, Pellerin, Stuer, & Mann, 1993; Larsen & Grattan, 2010).

On Day 2 of gestation, pregnant rats received one of three treatments: a subcutaneous injection of bromocriptine at a dose of .05 mg/kg, bromocriptine at a dose of .2 mg/kg or the vehicle of 10% ethanol in sterile water. Subjects received the same treatments on Days 3 and 4 of gestation. These doses were selected because a preliminary study using higher doses of bromocriptine (.5 or 2 mg/kg) resulted in a consistent termination of pregnancy (data not shown). Pregnant rats were assigned randomly to the treatments to yield a treatment group of bromocriptine at .05 mg/kg of $n = 10$, a treatment group of bromocriptine at .2 mg/kg of $n = 8$, and a vehicle group of $n = 8$.

The day that litters were found was noted as Day 1 postpartum. The day after giving birth (Day 2 postpartum), litters were culled to 8 pups, with equal numbers of male and female pups given to the dams, if possible.

Maternal Behavior: Home Cage

On Day 3 postpartum, maternal behavior in the dams was assessed in their home cages between 0900 and 1100 hr. All eight pups were first removed from subjects and placed in a separate cage for 1 hr, then re-introduced into the home cage with the dam, opposite from the nest site, initiating the test session. A digital video camera (Panasonic PV-GS180) recorded each subject's behavior for subsequent unbiased, blind analysis. Behaviors were video-recorded for 30min. Latencies to pup retrieval to the nest site, nursing, pup grooming, self-grooming, and tail chasing activity were scored using ODLog software (Macropod, Inc., Australia). The durations of pup retrieval and nursing were also recorded. The duration of pup retrieval was defined as the time point at which all eight pups were retrieved to the nest site, and duration of nursing was defined as the total time that the dam spent nursing her pups.

Elevated Plus Maze (EPM)

On Day 4 postpartum, dams were tested for anxiety in the elevated plus maze between 1100 and 1330 hr. The elevated plus maze (Kinder Scientific, Poway, CA) had two opposing enclosed arms (19.75 in. × 4.25 in.), two opposing open arms (19.75 in. × 4.25 in.), and a square uncovered platform (4.25 in. × 4.25 in.). Each dam was placed in the center square platform of the plus-shaped maze, and her movements were tracked for 5 min. The maze was wiped down with 70% ethanol between tests to remove residual odors from prior testing. The EPM MotorMonitor software (Kinder Scientific, CA) recorded entries into the open and closed arms, general locomotor activity, and time spent in the open and closed arms. Increased time spent in the open arms and numbers of entries into the open arms of the maze are characteristic of decreased anxiety (Braun, Skelton, Vorhees, & Williams, 2010).

Maternal Behavior: Novel Cage

On Day 5 postpartum, maternal behaviors in the dams were assessed in novel cages, with dimensions two times wider than the home cages (16 in. × 20 in. × 8 in.), between 1000 and 1200 hr. All eight of the dam's pups were removed from the dam and placed in a separate cage for 1 hr while the dam remained in her home cage. Fifty minutes after pup separation, the dam was introduced into the novel cage, and after an additional 10 min the pups were introduced into the same novel cage opposite the nest site. A digital camera (Panasonic PV-GS180) was used to record each subject's behavior for subsequent unbiased, blind analysis. Behaviors were video-recorded for 30 min, and latencies to pup retrieval to the nest site, nursing, pup grooming, self-grooming, and general locomotor activity were recorded using ODLog software (Macropod, Inc., Australia). The durations of pup retrieval and nursing were also recorded.

STATISTICS

Data are expressed as mean±SEM. Maternal behavior scores and elevated plus maze results were analyzed using SigmaStat software, version 3.0 (SPSS Inc., Armonk, NY, USA) A one-way ANOVA was used to assess the differences between the vehicle group (n = 8), the .05 mg/kg bromocriptine treatment group (n = 10), and the .2 mg/kg bromocriptine treatment group (n = 8). Since the two bromocriptine groups did not differ statistically in any behavioral measure, data from these groups were then combined, and independent t-tests were used to assess the differences between the vehicle group (n = 8) and the combined treatment groups (n = 18). To compare changes in maternal behavior of the treatment groups between the home cage and novel cage, a paired t-test with repeated measures was used. For data not normally distributed (latency to pup retrieval), a signed rank test was used. $p < .05$ was used as the level of significance.

RESULTS

Pregnancy Yield

Twenty-six out of the 28 rats in the present study carried a litter to term, for a 93% pregnancy yield. This was a higher yield than the preliminary study using higher doses of bromocriptine at 2 and .5 mg/kg, in which none of the rats (n = 10/group) carried litters to

term (data not shown). In the present study there were no differences in the number of pups born or sex ratios among the treatment groups.

Maternal Behavior: Home Cage

As shown in Table 1, there were no significant differences in maternal behaviors (latency to pup retrieval, duration of pup retrieval, time spent on nest, latency to nurse, and duration of nursing) in the home cage among the rats receiving vehicle injections, bromocriptine at .05 mg/kg, or bromocriptine at .2 mg/kg. There were also no significant differences in maternal behaviors comparing the rats receiving vehicle injections (n = 8) with the combined group of rats treated with both doses of bromocriptine (n = 18) using independent t-tests.

Maternal Behavior: Novel Cage

There was a significant difference in the duration of nursing in the novel cage between the vehicle group and the combined treatment groups (t = 2.39, p = .025). The bromocriptine-treated rats spent significantly less time nursing in the novel cage than the rats that received a vehicle injection.

Pup Retrieval—Rats given bromocriptine injections showed a significant change in the duration of pup retrieval from home cage (113.3 ± 16 s) to novel cage (285.3 ± 54 s), measured as the time point at which the dam retrieved the last pup to the nest site. The bromocriptine-treated rats took a significantly longer time to retrieve all eight pups to the nesting site (t = 3.56, p = .002). Rats given vehicle injections did not exhibit any significant change in the duration of pup retrieval from the home cage (143 ± 41.5 s) to the novel cage (157.5 ± 42.5 s; Fig. 1).

Bromocriptine treatment did not affect the latency to pup retrieval in the home cage or novel cage. A similar lack of difference in retrieval latency was also seen in the rats given vehicle injections. Latency to pup retrieval was measured as the time point at which the dam retrieved the first pup. Although there was no significant difference in the latency to retrieve pups among the three treatment groups, it is noted that the five longest latencies to retrieve were recorded in rats treated with bromocriptine.

Self-Grooming—There were no significant differences in self-grooming behavior in the home cage versus the novel cage among the three treatment groups (see Table 1).

Latency to Nurse—Rats given vehicle injections did not display any significant change in latency to nurse from their home cage to the novel cage (870 ± 171 s vs. 910.9 ± 147.7 s). Rats treated with bromocriptine showed a significant increase in their latency to nurse from the home cage to the novel cage (925 ± 102.5 s vs. 1195 ± 115.5 s). In the novel cage, the bromocriptine rats took significantly longer to begin nursing than in the home cage (t = 2.113, p = .049).

Duration of Nursing—Rats treated with bromocriptine displayed a significant reduction in nursing duration between their home cage and novel cage tests (552 ± 109.7 s vs. 224.15 ± 54.7 s). In the novel cage, the bromocriptine-treated rats showed a significant decrease in

time spent nursing their pups ($t = 2.86$, $p = .01$). Rats given vehicle injections did not have any significant change in duration of nursing from their home cage to the novel cage.

Time on Nest—Rats treated with bromocriptine showed a significant decline in time spent on the nest between their home cage and the novel cage (615.7 ± 68.1 s vs. 502.4 ± 34.7 s). Rats given bromocriptine spent significantly less time on their nest in their novel cage compared to their home cage (paired one-tailed *t*-test; $t = 2.07$, $p = .027$). Rats given vehicle injections did not display a significant change in time spent on the nest between home cage and novel cage tests.

Elevated Plus Maze

There were no significant differences among any of the experimental groups on the EPM regarding basic movements, distance traveled in the open arms, distance traveled in the closed arms, time spent in the open arms, time spent in the closed arms, entry into the open arms, or entry into the closed arms. Data are shown in Table 2.

DISCUSSION

The present study demonstrated that bromocriptine treatment during early pregnancy alters postpartum maternal care in a novel test condition. When separated from their pups and reintroduced, rats in their home cages did not show significant differences in maternal behavior based on their treatment. However, similar to findings by Larsen and Grattan (2010), significant differences in maternal behavior emerged in a novel environment. Rats treated with bromocriptine displayed significant shifts in maternal behaviors when their performance in a home cage was compared to their performance in a novel cage. Maternal behaviors, represented by retrieval of pups, latency of nursing, duration of nursing, and time spent on the nest, were reduced when the bromocriptine-treated rats were tested in a novel cage. Whereas bromocriptine treatment detrimentally affected maternal behaviors in the novel cage, it did not increase behaviors associated with anxiety, such as increased self-grooming or more time spend in the open arms of the EPM.

The lack of significant differences in maternal behaviors in the home cage was similar to the findings of Larsen and Grattan (2010), who found that mice with suppressed prolactin levels during early pregnancy did not exhibit significantly different maternal behavior in their home cages compared with that of postpartum control mice. The bromocriptine-treated mice were more likely to leave their nest if disturbed, indicating that maternal behavior differences emerged more readily under conditions of stress (Larsen & Grattan, 2010). Similar to the study in mice, the most significant results in the present study were seen in potentially anxiogenic situations, when testing was conducted in a novel cage.

In the present study, however, when tested for anxiety on day 4 postpartum, no significant changes in behavior, measured in time spent in the different arms, were detected in the EPM. This departure from the EPM findings of Larsen and Grattan (2010) may be due to the fact that rats in the present study were run in the EPM on Day 4 postpartum, with no other behavior testing taking place that same day. The lactating mice (Larsen & Grattan, 2010) experienced separation from their pups in a home and/or novel cage environment (although

the order in which the behavior tests were performed is not clear), so it is likely that they may have been exposed to a stressful environment prior to experiencing the EPM, thus further stimulating the anxiolytic effects of PRL suppression.

The results of the present study reveal similar results as the findings of Larsen and Grattan (2010) in regards to possible separate mechanisms for the impairment of maternal behavior and the attenuation of postpartum anxiety. Research by Larsen and Grattan (2010), as noted above, suggested that there may be two separate mechanisms regulating postpartum maternal behavior: a mechanism for attenuating anxiety, which has a critical period in early gestation, and a mechanism for initiating maternal behaviors. The present study supports the notion that suppression of maternal behavior may not always occur in conjunction with behaviors associated with high anxiety. The rats in the present study experienced changes in maternal behavior without experiencing altered behaviors among treatment groups in the elevated plus maze. Additionally, there was no difference in self-grooming behaviors among treatment groups in the present study, indicating a distinction between maternal behavior suppression and anxiety-related behaviors. Social stress can lead to increased self-grooming behaviors in rats (Nephew & Bridges, 2011), but there was no increased self-grooming response found here among the treatment groups.

There are many factors that may have affected the responses of the mother, including testing schedules, validation of the actions of bromocriptine, and the bromocriptine dosing. First, it is noted that in the home cage testing the pups were separated from the dams for 60 min, and this may have been too long to elicit a difference in behavior. The pups were separated to stimulate maternal drive, but a shorter separation time, or an immediate introduction to foster pups similar to the study by Larsen and Grattan (2010) may have been more effective in demonstrating a suppressed maternal response in the treated dams.

Next, in the present study, the effects of the bromocriptine treatment on PRL were not measured. However, our choice of doses of bromocriptine and injection times indicates that the bromocriptine treatments likely attenuated the PRL secretion as is well documented (Ben-Jonathan & Hnasko, 2001). While bromocriptine-induced pregnancy termination was avoided in the present study, a more precise measurement of the PRL levels would be useful for validating effects of bromocriptine on PRL secretion in light of the maternal behavior results.

Finally, the doses of bromocriptine in the present study were diluted 10-fold from the doses used in our preliminary studies (2 mg/kg and .5 mg/kg) and the injections given later in the afternoon to avoid disrupting the diurnal prolactin surge and rescue of the corpus luteum (Grattan & Bridges, 2009). It is possible that a dose of bromocriptine between .2 and .5 mg/kg could bring about results similar to the studies in mice, which both inhibited maternal behaviors and increased anxiety, while still maintaining pregnancy. The study by Larsen and Grattan (2010) used a dose of 50 mg per mouse—roughly equivalent to the dose received by a 250 g rat in the high dose bromocriptine group.

In summary, the present study demonstrated that bromocriptine treatment during early pregnancy in rats disrupted postpartum maternal behavior in a novel environment but did not

manifest with behavioral changes indicative of anxiety in the elevated plus maze. That an apparent disruption of normal endocrine activity during very early pregnancy affects the subsequent expression of postpartum maternal care is of interest both from a developmental perspective as well as from a behavioral health viewpoint. Since stress can affect prolactin secretions, both acutely by elevating hormone levels, and chronically by suppressing prolactin release (Gala, 1990), it is conceivable that exposure to an ethological stress during early gestation, for example, could result in longer term effects on maternal mental health and on offspring well-being.

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REFERENCES

Ben-Jonathan N, Hnasko R. Dopamine as a prolactin inhibitor. Endocrine Reviews. 2001; 22(6):724–763. [PubMed: 11739329]

Braun A, Skelton M, Vorhees C, Williams M. Comparison of the elevated plus and elevated zero mazes in treated and untreated male Sprague–Dawley rats: Effects of anxiolytic and anxiogenic agents. Pharmacology Biochemistry and Behavior. 2010; 97(3):406–415.

Bridges RS, DiBiase R, Loundes DD, Doherty PC. Prolactin stimulation of maternal behavior in female rats. Science. 1985; 227(4688):782–784. [PubMed: 3969568]

Bridges RS, Felicio LF, Pellerin LJ, Stuer AM, Mann PE. Prior parity reduces post-coital diurnal and nocturnal prolactin surges in rats. Life Sciences. 1993; 53:439–445. [PubMed: 8336523]

Bridges RS, Numan M, Ronsheim PM, Mann PE, Lupini CE. Central prolactin infusions stimulate maternal behavior in steroid-treated, nulliparous female rats. Proceedings of the National Academy of Sciences of the United States of America. 1990; 87(20):8003–8007. [PubMed: 2236014]

Bridges RS, Ronsheim PM. Prolactin (PRL) regulation of maternal behavior in rats: Bromocriptine treatment delays and PRL promotes the rapid onset of behavior. Endocrinology. 1990; 126(2):837–848. [PubMed: 2298174]

Butcher RL, Fugo NW, Collins WE. Semicircadian rhythm in plasma levels of prolactin during early gestation in the rat. Endocrinology. 1972; 90(4):1125–1127. [PubMed: 5011056]

Gala RR. The physiology and mechanisms of the stress-induced changes in prolactin secretion in the rat. Life Sciences. 1990; 46(20):1407–1420. [PubMed: 2189051]

Grattan DR, Bridges RS. Prolactin actions in the brain. Hormones, Brain and Behavior. 2009; 4:2471–2503.

Hansen ND, Owens MJ, Nemerhoff CB. Depression, antidepressants and neurogenesis: A critical reappraisal. Neuropsychopharmacology. 2011; 36(13):2589–2602. [PubMed: 21937982]

Horseman ND, Buntin JD. Regulation of pigeon milk crop secretion and parental behavior by prolactin. Annual Review of Nutrition. 1995; 15:213–238.

Knobil, E.; Neill, JD. The physiology of reproduction. Vol. 2. New York, NY: Raven Press Ltd.; 1988.

Larsen C, Grattan D. Prolactin-induced mitogenesis in the subventricular zone of the maternal brain during early pregnancy is essential for normal postpartum behavioral responses in the mother. Endocrinology. 2010; 151(8):3805–3814. [PubMed: 20484459]

Lehrman DS, Brody PN. Effect of prolactin on established incubation behavior in the ring dove. Journal of Comparative and Physiological Psychology. 1964; 57:161–165. [PubMed: 14168637]

Lonstein JS. Regulation of anxiety during the postpartum period. Frontiers in Neuroendocrinology. 2007; 28:115–141. [PubMed: 17604088]

Nephew BC, Bridges RS. Effects of social stress during lactation on maternal behavior and growth in rats. Stress. 2011; 14(6):677–684. [PubMed: 21875305]

Pall MK, Liljander M, Borg B. Prolactin diminishes courtship behaviour and stimulates fanning in nesting male three-spined sticklebacks, *Gasterosteus aculeatus*. Behavior. 2004; 141:1511–1519.

Shingo T, Gregg C, Enwere E, Fujikawa H, Hassam R, Geary C, Weiss S. Pregnancy-stimualted neurogenesis in the adult female forebrain mediated by prolactin. Science. 2003; 299(5603):117–120. [PubMed: 12511652]

Torner L, Maloumby R, Nava G, Aranda J, Clapp C, Neumann ID. In vivo release and gene regulation of brain prolactin in response to physiological stimuli. The European Journal of Neuroscience. 2004; 19(6):1601–1608. [PubMed: 15066156]

Wang Q, Buntin JD. The roles of stimuli from young, previous breeding experience, and prolactin in regulating parental behavior in ring doves. Hormones and Behavior. 1999; 35:241–253. [PubMed: 10373336]

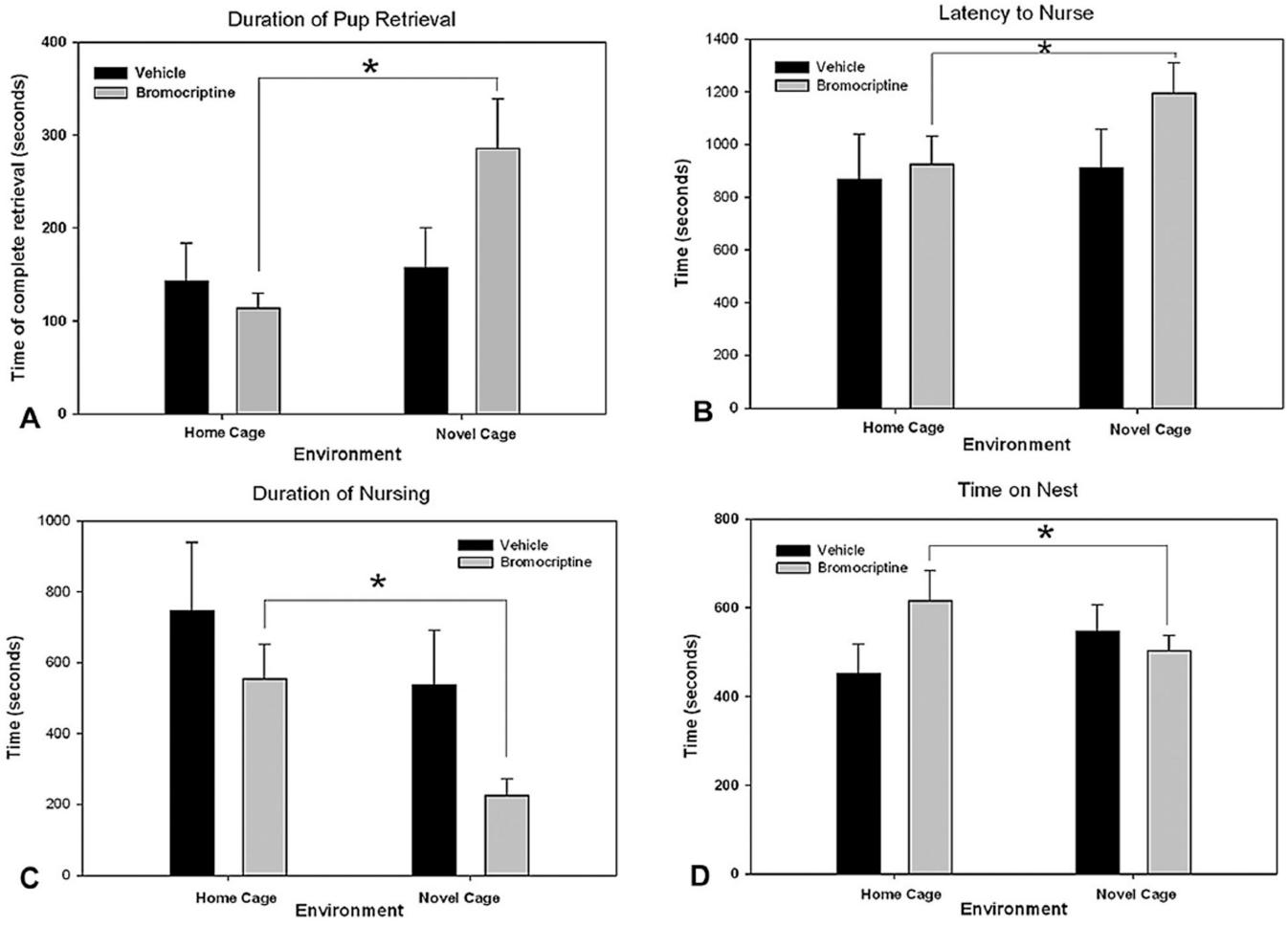

FIGURE 1.

The effect of bromocriptine treatment on total duration of pup retrieval (A), latency to nurse (B), duration of nursing (C), and time on nest (D). Values shown are means + SEM. (A) Combined groups of dams treated with bromocriptine (10 rats at a dose of .05 mg/kg, 8 rats at a dose of .2 mg/kg) took significantly longer to retrieve all eight of their pups in a novel cage compared to a home cage ($t = 3.56$, $^{*}p = .002$). Rats treated with the vehicle did not differ in home and novel cage pup retrieval latencies. (B) Dams treated with bromocriptine took significantly longer to initiate nursing in a novel cage compared to a home cage ($t = 2.11$, $^{*}p < .001$). Rats treated with the vehicle did not differ in latency of nursing between the home and novel cages. (C) Dams treated with bromocriptine spent a significantly shorter amount of time nursing their pups in a novel cage compared to a home cage ($t = 2.86$, $^{*}p = .01$). Rats treated with the vehicle and tested in the home and novel cages did not differ in nursing duration. (D) Dams treated with bromocriptine spent a significantly shorter time on the nest in a novel cage compared to a home cage ($t = 2.07$, $^{*}p = .027$). Rats treated with the vehicle did not differ in time spent on the nest in the home and novel cages.

Table 1

Mean Maternal Behavior Scores (±SEM) in Home Cage and Novel Cage

	Vehicle (*n* = 8)		Combined Bromocriptine Doses (*n* = 18)	
Behavior	**Home Cage**	**Novel Cage**	**Home Cage**	**Novel Cage**
Latency of pup retrieval	17 ± 6.6	23.8 ± 9.2	23.6 ± 4.5	86.7 ± 32.4
Duration of pup retrieval	143 ± 41.5	157.5 ± 42.5	113.3 ± 16	285.3 ± 54*
Self-grooming	103 ± 31.4	90.4 ± 16.1	93.8 ± 21.5	162.3 ± 38.9
Time spent on nest	451.6 ± 66.1	546.5 ± 59.7	615.7 ± 68.1	507.4 ± 34.7*
Latency of nursing	870 ± 171	910.9 ± 147.7	925 ± 106	1195 ± 115.5*
Duration of nursing	747.6 ± 193.5	536 ± 155.3	552.8 ± 102.7	224.2 ± 52.7*

Mean times of behavior scores (in seconds) for the treatment groups: vehicle and combined bromocriptine doses of .05 and .2 mg/kg.

Significant changes between home and novel cages are indicated by *.

See text for statistical details.

Table 2

Mean Scores (±SEM) for Activity in the Elevated Plus Maze (EPM) for Three Treatment Groups: Vehicle, Bromocriptine at .05 mg/kg, and Bromocriptine at .2 mg/kg

Behavior	Vehicle	Bromocriptine—.05 mg/kg	Bromocriptine—.2 mg/kg
Time spent in open arms (s)	40.4 ± 10.7	51 ± 14.5	64.6 ± 17.9
Time spent in closed arms (s)	226.9 ± 13.3	208 ± 25.5	170 ± 31.3
Entries into open arms	10.1 ± 3.1	16.8 ± 4.7	14.4 ± 3.6
Entries into closed arms	20.6 ± 1.5	16.7 ± 3.5	15.5 ± 2.8

Test session lasted for 300 s.