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# Evidence for Individual Differences in Regulatory Focus in Rats, *Rattus norvegicus*

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Regulatory focus (Higgins, 1997) builds on the classic approach-avoidance distinction by identifying two important approach orientations: the promotion focus (approaching gains and attainment) and the prevention focus (approaching nonlosses and safety). Though individual differences in regulatory focus have been widely studied in human psychology, it is unknown if such differences exist in other species. To explore this possibility, we designed a series of tests for laboratory rats, paralleling human regulatory focus research on risk taking. In home-cage tests, rats ( $N = 23$ ) were given an opportunity to prevent a loss by burying a noxious novel object. In solitary tests in a novel enclosure, the same rats had the opportunity to pursue gains (food rewards) and/or safety (darkness). Rats demonstrated stable individual differences on both tests ( $p$ 's  $< .001$ ). Complementing the human research, duration of time spent with the noxious novel object was predicted by an individual's tendency to pursue safety ( $p < .01$ ) and not by the tendency to pursue gains ( $p > .8$ ). Some aspects of these results were compatible with alternative approaches, such as the bold-shy axis and "if-then" personality profiles (Mischel & Shoda, 1995). Regulatory focus theory, however, was uniquely able to predict the overall pattern, which may be an indication that it could contribute to future research in animal personality, motivation, and welfare.

*Keywords:* regulatory focus, animal personality, behavioral syndromes, temperament, bold-shy

Central features of any environment are its potential gains and losses. The strength of an animal's behavioral response to a potential gain or a potential loss may vary by time (e.g., midday vs. dusk, migration vs. breeding season), context (e.g., being surrounded by kin vs. rivals), species (e.g., predator vs. prey), and individual. Stable individual differences are well-documented in nonhuman animals (see Gosling, 2001) and are a useful paradigm for exploring a range of scientific questions, from the spread of invasive species (Cote, Fogarty, Weinersmith, Brodin, & Sih, 2010), to the molecular mechanisms underlying the inheritance of behavior (Champagne & Curley, 2009). In this paper, we present regulatory focus theory (Higgins, 1997), heretofore examined only in humans, as a new approach to understanding individual differences in gain-maximization and loss-prevention behaviors in nonhuman animals.

Regulatory focus theory arose from developmental psychology research seeking to understand the fundamental ways in which people achieve self-regulation (Higgins, 1987). The hedonic principle, the ancient maxim that people approach pleasure and avoid pain, is a

powerful predictor of behavior (e.g., Kahneman & Tversky, 1979), but beyond this principle, Higgins (1997) has suggested that an individual's regulatory focus also determines behavior. Unlike the hedonic principle, which is a unitary construct (approaching pleasure at one pole and avoiding pain at the other), regulatory focus identifies two distinct methods of approach: the motivation to approach gains, that is, the *promotion focus*, and the motivation to approach nonlosses, that is, the *prevention focus* (Higgins, 1998). More specifically, within promotion focus, advancement and better-than-neutral states are approached while nongains are avoided; within prevention focus, safety, security, and the status quo (satisfactory current conditions) are approached or actively maintained while losses are avoided (Higgins & Spiegel, 2004). Since its introduction, the deeper implications of this framework have been explored in social psychology (e.g., Higgins, 2000; Higgins et al., 2001). Additionally, its predictive utility has been demonstrated in a range of fields, including behavioral neuroscience (Cunningham, Raye, & Johnson, 2005), health psychology (Strauman, Coe, McCrudden, Vieth, & Kwapil, 2008; Uskul, Keller, & Oyserman, 2008), decision making (Appelt, Zou, Arora, & Higgins, 2009; Crowe & Higgins, 1997), and communication science (Cesario & Higgins, 2008; De Boer, 2010).

Despite its growing influence on human research, regulatory focus has yet to be studied in other animals. To discover if it could be a useful model for understanding nonhuman behavior, we tested whether regulatory focus theory would be able to explain patterns of individual differences in laboratory rats. Human research has shown that an individual has a chronic promotion strength (his or her tendency to approach gains) and a chronic prevention strength (his or her tendency to approach nonlosses; Higgins et al., 2001; Higgins, Shah, & Friedman, 1997). Promotion strength and prevention strength are theoretically and empirically orthogonal con-

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structs: people can be high on both, low on both, or high on one and low on the other (Higgins & Spiegel, 2004).

It is interesting to note that differences in promotion and prevention strength sometimes lead to counterintuitive behavioral patterns. For instance, and in parallel with the current program of research, recent studies on risk taking have shown that under specific conditions, prevention-focused individuals, that is, those people who place a high value on safety and security, can be the riskiest individuals (Scholer, Stroessner, & Higgins, 2008). On the surface, it may seem that an advancement, gain-oriented motivation (promotion motivation) and not a safety, security motivation (prevention motivation) should always be more predictive of risk taking (Crowe & Higgins, 1997). However, when an individual is in a state of loss and taking a risk is the only way to return to a satisfactory status quo, regulatory focus theory predicts that risk taking will be determined by prevention motivation (the motivation to approach safety) and *not* promotion motivation (the motivation to approach gains). A series of independent social psychology studies have supported this reasoning, demonstrating that participants' prevention motivation—either measured as individual differences or induced by writing about times when they were focused on preventing losses—predicted risky behavior in a stock investment scenario (Scholer, Zou, Fujita, Stroessner, & Higgins, 2010). Specifically, a strong prevention motivation predicted risk taking when 1) participants were already in a state of loss, that is, had lost money relative to the start of the experiment, and 2) the risky investment could return them to a nonloss state, that is, the amount of money with which they began the experiment. These results follow logically from a regulatory focus perspective: When a behavior is the only way to return to the status quo or a safe state, individuals who are particularly concerned with safety and security—that is, prevention individuals—should be the most likely to engage in that behavior, even if it is risky.

Following a similar line of argument, we hypothesized that when a behavior will return a nonhuman animal to a satisfactory status quo or a safe state, the animal's loss-prevention motivation will predict the likelihood of engaging in that behavior, even if it is risky or unpleasant. Additionally, as was shown in human research (Scholer et al., 2008; Scholer et al., 2010), we hypothesized that gain-maximization motivation will not predict the likelihood of engaging in that behavior. To test these hypotheses, we designed two experiments to examine individual differences in the behavior of laboratory rats, *Rattus norvegicus*.

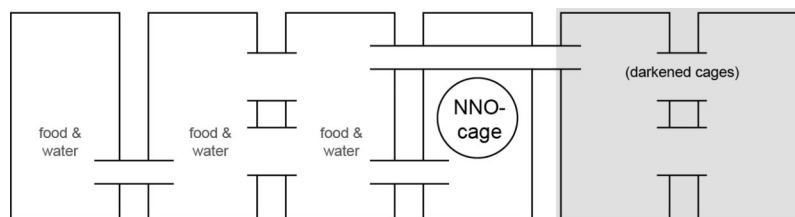
In the first experiment, we gave rats the opportunity to engage in a behavior that could restore their satisfactory status quo by

reducing a current loss: burying a noxious novel object (NNO). In a separate experiment, six months later, we measured their motivational strength to pursue gains (acquire food rewards) or safety (maintain darkness, which is a presumably safe state for a nocturnal animal). The behaviors in this experiment were somewhat exclusive, but because the darkness affected the entire apparatus at once, animals could feasibly engage in both goal pursuits at once. Moreover, the experiment was not designed to be a forced-choice paradigm; animals could engage in alternative behaviors instead (e.g., exploration or grooming). Consequently, our experimental design afforded an additional hypothesis: *Overall regulatory-focus* approach motivation, that is, the motivation to pursue gains or nonlosses (promotion + prevention), would predict latency to approach the NNO. Approaching the NNO should have been motivating for both orientations, because before inspection, whether the NNO cage contained a gain or a preventable loss was unknown. As such, we predicted that individuals with the highest overall regulatory-focus motivation should have the fastest approach. Unlike our first two hypotheses, which have been unexplored in nonhuman animals but directly parallel human research (Scholer et al., 2008; Scholer et al., 2010), this final prediction would, to our knowledge, be a unique contribution to regulatory focus research in general. Together, support for our hypotheses could indicate that regulatory focus may be a useful model for understanding animal motivation, and thereby suggest new avenues of research comparing the patterns of regulatory focus found in humans with the behavior of other species.

## Method

### Animals and Husbandry

Long-Evans rats ( $N = 23$ ) used for this study were bred (descendants from rats bought from Charles River Laboratories, Frederick, MD) and housed in our facility at the Department of Psychology at Columbia University in accordance with Institutional Animal Care and Use Committee regulations. The rats were kept in complex cage systems consisting of 6 polycarbonate, steel-wire lidded cages ( $20 \times 23 \times 46$  cm) interconnected by a series of transparent tubes (see Figure 1). Male and female rats were housed in separate cage systems (12 males in one cage system and 11 females in another). Animals were maintained on a reverse 12D:12L light cycle under constant temperature ( $21^\circ\text{C}$ ) and humidity (55%) with ad lib food and water. The cage systems were enriched with toys, darkened cages, and food treats several times a week



*Figure 1.* Overhead illustration of a home cage consisting of six interconnected cages: three food-and-water cages, two darkened cages, and one marginal cage that contained the noxious novel object during testing (NNO) cage. The NNO cage was connected to the cage on its left with a transparent tube, but was otherwise self-contained. The tube at the back of the NNO cage provided a bypass between the food-and-water cages and the darkened cages.

(see Figure 1). All behavioral observations and tests took place during the dark period of the light cycle.

## Materials and Procedures

**Home-cage tests.** At approximately five months of age, the rats in each cage system were tested twice, several days apart. Just prior to the start of the test, all animals were removed from the NNO cage, but remained in the home-cage with access to the other five cages (see Figure 1) while the experimenter arranged the NNO cage for testing. The NNOs were constructed from a store-bought metallic teabag wired to a carabiner and filled with a cotton ball soaked in either fantastik or bleach. Fresh bedding was added to the NNO cage and the carabiner was secured to the lid so that the NNO rested on the floor at the front of the NNO cage. The connecting tube, which only permitted access by one rat at a time, was then unblocked so that the rats could enter the NNO cage to inspect or bury the NNO. It is noteworthy to mention here, that to minimize extraneous reasons to approach and remain in proximity to the object, the NNO cage was designed to be as marginal as possible: It did not provide passage to other cages and was barren of all necessities—that is, it did not contain food, water, or dark shelter. We observed that NNOs were buried after two hours when we returned to dismantle the experimental materials, but that they were never completely buried within the experimental session, the first 10 min of the test. As such, during the period of time analyzed for this paper, all individuals would have encountered an unburied object. All tests were video recorded.

To enter the NNO cage, a rat passed through the transparent connecting tube, the diameter of which permitted only one animal at a time. As each animal passed through the tube, its unique back pattern was clearly visible, allowing observers to record the times when it entered and exited the NNO cage. On nontest videos, two observers were trained to greater than 90% reliability so that the duration scores they reported for each rat were highly correlated ( $r = .97, p < .0001$ ). On the test videos, the observers, who were blind to the study predictions, coded the entrances and exits for each animal for the first 10 min after the threat cage was unblocked. Based on these codings, the duration each animal spent within the threat cage was calculated as a percentage of total test time and each animal was assigned an entry-order ranking such that lower numbers indicated faster entries.

**Solitary tests.** At approximately 11 months of age, the rats were first trained (2 days in duration) and then tested (2 days in duration) in an opaque Plexiglas enclosure ( $94 \times 94 \times 61$  cm). The enclosure was located in a small room close to the colony room and was illuminated under white light with a 60-W overhead lamp. At the midpoint of adjacent sides of the enclosure, two small boxes (10-cm cubes) were fixed to the floor. At one of these locations, the *treat location*, the small box contained a mixture of high-fat and/or high-sugar familiar food treats (e.g., almonds, sugary cereal, Peanut M&M'S, etc.), providing a gain-maximization opportunity. At the other location, the *dark location*, the small box was empty, but when the rat was within one body length of it, the overhead light turned off for 30 s or until the animal moved away from the box, whichever took longer (manually executed by the experimenter).

On each test day, a rat was removed from its home cage, placed in a corner of the enclosure (equidistant from the two small boxes)

and allowed to move freely throughout the space. Behavior was video recorded from overhead for 10 min, at which point the rat was returned to its home cage. The number of treats eaten was then determined and the number of fecal boli produced during the 10-min session were counted as a physiological indicator of anxiety-like response (e.g., Lund, Rovis, Chung, & Handa, 2005). The enclosure was cleaned with 70% ethanol solution prior to testing each animal. Videos were analyzed with Noldus Observer software (Noldus, Spink, & Tegelenbosch, 2001). The duration of time each animal spent within 20 cm of the treat box (treat location) and dark box (dark location) was calculated as a percent of total test time. Animals were weighed one month after testing.

**Statistical analysis.** All analyses were conducted with Stata v11.1 (College Station, TX). In both test types, stability of individual behaviors (duration, ranking, dark location, and treat location) were assessed with Pearson's correlations. All other associations were investigated using a multilevel model (a.k.a. a mixed, random-effects, or hierarchical model). In a multilevel model, the random effects (i.e., level-two effects, in this case, random intercepts) are estimated to account for the correlated errors that may arise when sampling repeatedly from a single individual or group. By allowing the intercept of the statistical model to vary by rat ID, we can account for this type of repeated sampling while we test for the relationship between the outcome and the fixed effects (treat number, weight, boli, or behavior, depending on the specific relationship being examined; Gelman & Hill, 2006; Rabe-Hesketh & Skrondal, 2008). Because of its flexibility and power, multilevel modeling is becoming an increasingly popular method of statistical analysis in animal personality research (e.g., Martin & Réale, 2008; Wray, Mattila, & Seeley, 2011) and animal behavior in general (see Van de Pol & Wright, 2009). Unless otherwise noted, controlling for gender did not affect the nature of the results.

## Results

### Home-Cage Tests

Rats spent an average duration of 18.42% of the test time in the NNO cage, 95% confidence interval (CI) = 11.88, 24.96 (all subsequent CIs refer to 95% coverage), which was equivalent to nearly 2 min. Duration did not differ by object filling (bleach vs. fantastik,  $p > .6$ ), but did vary by rat,  $r = .75, p < .001, CI = .48, .89$ . Individual rats were also consistent in their ranking,  $r = .64, p < .001, CI = .31, .83$ .

### Solitary Test

Treat location was positively related to the total number of treats consumed;  $t(21) = 7.79, p < .0001$ , but was not related to weight,  $p > .3$ , indicating that treat location was a measure of gain-maximization behavior and not general food-consumption behavior. By design, dark location was yoked to darkness time and was not related to the number of fecal boli produced,  $p > .3$ , indicating that dark location was a measure of loss-prevention behavior and not general anxiety. On average, dark location was 16.48% of test time and treat location was 34.27% of test time. Though there were no significant sex differences in dark location,  $p > .3$ , females had significantly higher treat location than the males,  $t(21) = 5.76, p < .001; CI = 23.52, 47.79$ , which corresponded to eating an average

of 4.14 more treats per session,  $t(21) = 3.16, p < .005$ ;  $CI = 1.57, 6.71$ .

Though there was a negative relationship between treat location and dark location,  $t(21) = 3.18, p < .01$ , most animals did not divide their time exclusively between the two goals. Indeed, combining treat location and dark location, we found percentages ranging from 0.60% to 94.91% with a mean of 50.75%, standard deviation = 27.16. We used this combined score as a measure of *overall regulatory focus*, that is, an individual's overall motivation to approach gains or nonlosses. Across the two test days, an individual's behavior was stable on all three measures: treat location,  $r = .78, p < .0001, CI = .54, .90$ ; dark location,  $r = .62, p = .001, CI = .28, .82$ ; overall regulatory focus,  $r = .81, p < .0001, CI = .60, .92$ .

### Overall Pattern

Using the behavior on the fourth day of solitary testing to give the rats a maximum amount of time to learn the test contingencies, we found that time in the NNO cage was unrelated to treat location,  $p > .8$ , but was positively predicted by dark location,  $t(21) = 2.95, p = .008$ . Moreover, when both variables (treat and dark location) were included as predictors in the multilevel model, only dark location was significantly related to time in the NNO cage: dark location,  $t(20) = 2.99, p = .007$ ; treat location,  $p > .6$ . It is interestingly to note that the dark-location slope was also significantly greater than the treat-location slope,  $t(20) = 2.17, p = .04$ .<sup>1</sup> Finally, on their own, treat location and dark location were unrelated to ranking, that is, entry order on the NNO tests,  $p$ 's  $> .2$ , but higher overall regulatory focus corresponded to marginally faster rankings,  $t(21) = 1.99, p < .06$ .

To explore these patterns in more depth, we classified individuals as being *low* (bottom third) *mid* (middle third) or *high* (top third) on each of the solitary-test behaviors (treat location, dark location, and overall regulatory focus). The treat location grouping did not reveal new insights; treat location remained unrelated to both NNO behaviors. The dark location grouping, however, revealed that high dark-location individuals drove the positive relationship with duration (high compared to low and mid,  $t(21) = 2.30, p = .03$ ) and that there was no evidence of a difference between the low and mid individuals,  $p > .6$ . On average, an individual with high dark location had a duration of 30.48% ( $CI = 17.77, 43.19$ ), compared with 11.98% ( $CI = 2.70, 21.27$ ) for the other individuals (see Figure 2). Similarly, individuals with high overall regulatory focus drove the negative relationship with NNO ranking (high compared to low and mid,  $t(21) = 2.32, p = .03$ ) and there was no evidence of a difference between the low and mid individuals,  $p > .8$ . On average, an individual high on overall regulatory focus entered fourth ( $CI = 3.25, 6.25$ ), compared with eighth ( $CI = 6.72, 9.82$ ) for the other individuals (see Figure 3).

### Discussion

We investigated the ability of regulatory focus theory (Higgins, 1997) to account for individual differences in the behavior of a nonhuman animal, the Long-Evans rat, and sought to compare these individual differences to the patterns found in humans (Higgins & Spiegel, 2004). Specifically, we were interested in discovering if two distinct approach motivations—promotion and pre-

vention—could provide a framework for understanding how an animal engages in risky/unpleasant behaviors that may serve to restore a satisfactory status quo. In humans, the prevention (non-loss) motivation and not the promotion (gain) motivation predicts the probability of engaging in such behaviors (Scholer et al., 2008; Scholer et al., 2010). In laboratory rats, we found evidence of a similar pattern. Individual rats who demonstrated a stable tendency to pursue darkness (safety) in an open enclosure, were the same individuals who remained longest with the NNO. As in the human research (Scholer et al., 2010), a rat's tendency to pursue gains (treat location) was not predictive of remaining with the NNO. Though neither loss-prevention nor gain-maximization behavior predicted approach latencies on their own, their combination did, which may suggest that both facets of regulatory focus are important in determining latencies to approach unknown, novel objects. Furthermore, these tests were separated by six months, which is a substantial portion of a laboratory rat's 2–3 year life span (Lipman, Smith, & Bronson, 1995), possibility indicating that, like humans (Higgins, 1997), the stability of these motivational differences is strong in rats.

Human research has indicated that regulatory focus is a useful elaboration of the hedonic principle, in which approaching pleasure is simply and unitarily contrasted with avoiding pain (Lieberman, Molden, Idson, & Higgins, 2001; Molden & Finkel, 2010; Molden, Lucas, Gardner, Dean, & Knowles, 2009). Similarly, the present research cannot be attributed to a single approach-avoidance dimension. The rats' gain-maximization behaviors, which are ostensibly most similar to approach behaviors, were insufficient to predict approach latencies. The rats' loss-prevention behaviors, which are ostensibly most similar to avoidance behaviors, related positively to durations with an NNO and contributed to overall regulatory focus associations with approach latencies. Neither of these behaviors can be construed as avoidance behaviors and are, instead, more analogous to approach behaviors. As such, the present framework builds on the hedonic principle by identifying, for the first time in a nonhuman animal, two approach orientations: the promotion focus and the prevention focus.

Likewise, this research resonates with nonhuman animal research documenting individual differences along a bold–shy axis (e.g., Jones & Godin, 2010; Reaney & Backwell, 2007; Sinn, Gosling, & Moltchanivskyj, 2008; Wilson, Coleman, Clark, & Biederman, 1993). The bold–shy dimension is most often defined as a propensity to take risks (Wilson, Clark, Coleman, & Dearstyne, 1994) and, importantly, has been shown to have fitness-related consequences (e.g., Bergvall, Schapers, Kjellander, & Weiss, 2011; Reaney & Backwell, 2007; Sinn, Apiolaza, & Moltchanivskyj, 2006; Smith & Blumstein, 2010). To the extent that the behaviors in each test can be related to boldness or risk taking—the riskiness of approaching a NNO and the riskiness of maximizing gains at the potential expense of incurring losses—the

<sup>1</sup> To test for a difference in slopes between the dark location variable and the treat location variables, we generated a new variable that was the difference between the two, that is, dark location minus treat location. We then ran a second multilevel model including the treat location variable and the difference variable. The significance of the treat location variable in this second model is the significance test for a difference in slopes (see Van de Pol & Wright, 2009).



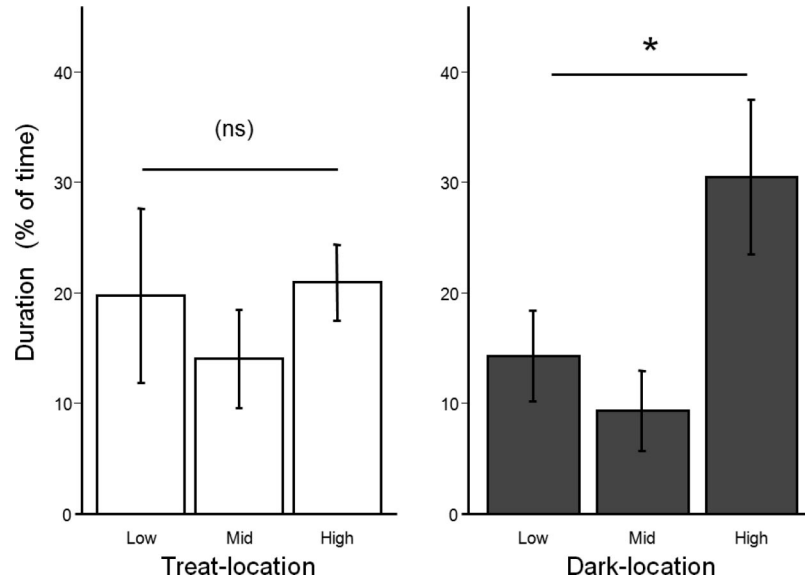


Figure 2. Mean home-cage duration (expressed as a percentage of total test time) spent in the cage with the NNO displayed as a function of the solitary-test behaviors (error bars represent standard error of the mean). Individuals were categorized as *low*, *mid*, or *high* on the solitary-test behaviors, treat location and dark location. There was no evidence of an association between duration and treat location, but there was between duration and dark location: Individuals classified as having a high dark location spent significantly more time with the NNO than other individuals (*ns*,  $p > .8$ ; \*  $p = .03$ ).

behavioral consistency within each test complements research on the stability of individual differences in bold–shy behaviors.

Comparing across tests, however, a pattern of situational inconsistency emerges. Boldness in one environment (treat location in

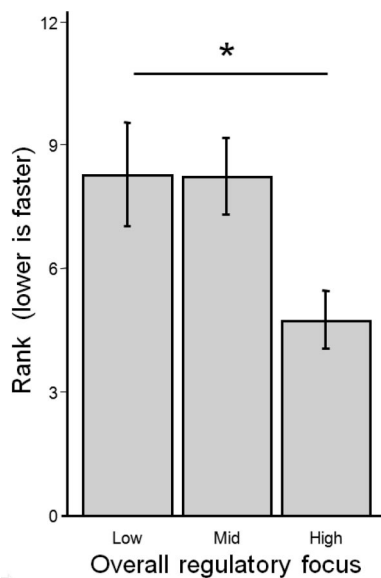


Figure 3. Mean rank approaching the NNO displayed as a function of solitary test overall regulatory focus classification: *low*, *mid*, or *high* (error bars represent standard error of the mean). Individuals classified as having a high overall regulatory focus approached the NNO significantly faster than other individuals (\*  $p = .03$ ).

the solitary tests) did not correspond to boldness in another environment (duration and rankings in the NNO tests). In this way, our results support an “if-then” approach to personality (Mischel & Shoda, 1995), which describes personality as a propensity to behave consistently within certain similar contexts but not across all situations, producing an “if situation X, then behavior Y” pattern of behavior. The “if-then” paradigm has been a powerful concept in human personality research (see Mischel, 2004; Mischel, Shoda, & Mendoza-Denton, 2002) and has been applied to nonhuman animal personality research as well (Uher, Asendorpf, & Call, 2008). Beyond a descriptive “if-then” framework, however, regulatory focus lends an a priori predictive model for understanding cross-situational patterns of behavior. In other words, regulatory focus predicted the specific “if-then” patterns of behavior observed in these experiments. For highly prevention-oriented individuals, the contingencies were: “If boldness/riskiness reduced loss (duration in NNO tests), then high bold/risky behaviors,” but “if boldness/riskiness could not reduce loss (solitary tests, treat location), then no bold/risky behaviors.” Conversely, for highly promotion-oriented individuals, the contingencies were: “If boldness/riskiness could maximize gains (solitary test, treat location), then high bold/risky behaviors,” but if “boldness/riskiness could not maximize gains (duration in NNO tests), then no bold/risky behaviors.”

Thus, we relied on a motivational model to predict behavior, which, for animal research, is perhaps more common in behavioral neuroendocrinology (e.g., Baldo, Daniel, Berridge, & Kelley, 2003; Zhang, Balmadrid, & Kelley, 2003) and addiction research (e.g., Ahmed, Walker, & Koob, 2000) than it is in the animal personality literature. Early animal behavior research, particularly that of Clark Hull and E.C. Tolman, who both sought to understand

the fundamental principles that guide behavior (e.g., Hull, 1931; Tolman & Gleitman, 1949), also used motivational models to understand behavior. Expanding on these various traditions, we use a motivational model to predict individual differences in rat behavior across contexts. Describing individual differences in motivation has been a generative approach within the human personality literature (e.g., Cacioppo & Petty, 1982; Dweck & Leggett, 1988; Higgins, 1997; Kruglanski et al., 2000). Though much work remains to be done, the studies presented here provide evidence in favor of its potential utility in the study of animal personality.

Among the work that remains to be done, one aspect that is particularly relevant to animal research in general is to test whether regulatory focus theory is predictive of behavior in settings less restrictive than a laboratory environment. Though we attempted to leverage ecologically relevant rat behavior—for example, burying threats, preferring darkness, omnivorous foraging—more research will be required to determine the scope of regulatory focus applicability. To begin to explore its range, observational research of noncaptive or zoo-living animals could test for patterns predicted by regulatory focus theory. Prevention-related behaviors should be highly correlated (Higgins, 1997; Higgins, 1998); they could include a propensity to spend time in safety-related locations—such as shelters, places with the least exposure and maximal distance from predators/threats, and so forth—and a propensity to engage in loss-prevention activities—for example, patrolling the territory and vigilantly checking any changes to the status quo. Promotion-related behaviors should also be highly correlated (Higgins, 1997; Higgins, 1998); they could include a propensity to spend time in gain-related locations—such as feeding sites, places that offer trade-off between a gain and a loss, and so forth—and a propensity to engage in gain-maximization activities—for example, eagerly investigating novel food sources and working harder to achieve a gain. It would be especially interesting to discover if these individual differences impact fitness, as has been found in other animal personality research (Smith & Blumstein, 2008).

The present research also raises the question of why female rats engaged in more gain-maximization behaviors than the males (treat location in the solitary tests). Differences in promotion strength are not found between human females and males (Higgins et al., 2001; Higgins et al., 1997), so exploring the roots of this potential species difference could be revealing. Barring the possibility that it was a statistical anomaly, research should first address whether the sex difference extends to all promotion-related behaviors or whether it is an idiosyncratic consequence of the experimental design, perhaps a confound with some other sexually dimorphic phenomenon (Beatty, 1979; Fernandes, Gonzalez, Wilson, & File, 1999; Johnston & File, 1991). If the difference is found to extend to other promotion-related behaviors, exploring the potential relationship between gender differences in regulatory focus and the sexual dimorphism of the species could be an intriguing line of research.

Finally, the present research explores only a small facet of regulatory focus theory. Much of the human literature has been devoted to understanding the types of conditions that are most engaging, that is, the best “fit,” for strongly promotion- versus prevention-oriented individuals (e.g., Cesario, Grant, & Higgins, 2004; Higgins, 2000; Spiegel, Grant-Pillow, & Higgins, 2004; Uskul et al., 2008). This body of literature may serve as a potentially useful comparative framework for researchers studying the

intersection between animal personality and animal welfare (Fox & Millam, 2007; Izzo, Bashaw, & Campbell, 2011; Powell & Svoke, 2008; Watters & Meehan, 2007), though much more research is required to determine the extent to which regulatory focus patterns in humans contain corollaries in rats and other species. The results presented here provide evidence that such an approach is feasible and potentially fruitful.

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