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# Desire for Social Contact Drives Behavior in the Rat Empathy Device

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Bartal et al. (Science Magazine 334:1427-1430, 2011) showed that when rats are given the opportunity to exhibit empathetic behavior toward another rat, they would do so. By placing a rat in an arena unconstrained (free rat) with a cagemate constrained in another space (trapped rat), the experimenters observed that the free rat had learned to seemingly *deliberately* open the restrainer to free its partner. The free rat would have to touch the front panel of a contained tunnel in order to trigger the opening of the tunnel's back door. This would allow the trapped rat to escape the tunnel into a separate open arena than the one its partner was in. The initially trapped rat would end up farther from the originally free rat. They interpreted these results as strong biologically rooted evidence that non-primate like mammals, such as rodents, behave with pro-social tendencies toward a conspecific's distress, much as do human beings. Bartal et al. determined that since the free rat continued to open the tunnel's rear door even after several sessions, therefore freeing the trapped rat and putting more distance between the two rats, this meant that the pro-social behavior exhibited by the free rat could not be driven by its interest in social contact. Rather, the free rat was motivated by empathetic intentions, striving to reduce the amount of distress felt by its constrained partner. In two experiments, we re-evaluated Bartal et al.'s study and tested female rats to determine whether empathy is, in fact, innately present in these animals. We showed that, in the first condition, the free rat does not learn to trigger the mechanism that opens the rear door to free the trapped rat. Further, after a successive amount of trials, a trapped rat that has escaped will tend to return to the presumably aversive tunnel. Lastly, we observed that a free rat that has experienced triggering the door mechanism would continue to do so despite this behavior, and not free its partner. We attributed these results and those of Bartal et al.'s to two ideas: neophobia and gregariousness. During the initial sessions, neophobia drives the trapped rat to quickly leave the container. However, after many sessions and neophobia dissipates, both rats exhibit gregariousness and empathetic behavior becomes less evident as the prevailing intention.

## Introduction

Pro-social behavior is often associated with intentions from one individual to deliberately benefit another. In human behavior, empathy is a strong motivator of pro-social tendencies. Decety & Jackson (Behavioral and Cognitive Neuroscience Reviews 3:71-100, 2004) explain that empathy includes developing an affective emotional response toward another individual without disconnecting what emotions belong to which individual. Empathetic emotional states are inherent and usually lead to the expression of compassionate intentions meant to alleviate the distress of a similar identity.

Bartal et al. (2011) reported that a "free" rat that is unconstrained in an arena demonstrates pro-social intentions toward its partner rat (trapped rat in a constrained tube) when the trapped rat is in a presumed state of distress. They argue that the free rat has innately empathetic behavior because it continued to trigger the opening mechanism for the rear door of the tunnel, releasing its partner despite putting a larger distance between them. The present experiment replicates Bartal et al.'s study to determine whether empathy is actually the driving factor behind the free rat's perceived pro-social actions. We constructed two different conditions to conduct this experiment. The first observed how a free rat would react in response to releasing its partner into a

separate and more distant arena than the constrained tunnel. The second tested the reaction of the free rat after allowing its partner to escape into the same space that it was in.

## Methods

Animals, setting, and apparatus

Twelve female Sprague Dawley rats were used in this experiment. Rats were kept in pairs during the two-week pre-testing sessions, during the experimenter handling sessions, and during the experimental conditions as well. One rat of each pair was designated the "free rat" and the other was labeled the "trapped rat". Individual rat identification was possible by color-marking the tail of each trapped rat. Thus, six rats were deemed the free rats and six rats with red tail markings were deemed the trapped rats.

In the pre-training sessions, the rats were simply allowed to acclimate to their home environments in an effort to develop familiarity with their partner rats. In the handling sessions experimenters handled each pair of rats for 5, 10, 15, and again 15 minutes on days 1, 2, 3, and 4 respectively. After the rats are handled the pair was placed together in the unconstrained arena for 1 hour and left to roam and explore the space.

The space that the trapped rat would occupy during both conditions of this study was a tubular restrained area that connected the two open areas. The first open space would be the enclosure for the free rat and was attached to the front door of the tunnel container carrying the trapped rat. The second area was also an open space, but it was attached to the rear door of the tunnel and did not hold any animals (unless the trapped rat was released into the space by its already free partner). See Figure 1 for visual illustration of the apparatus. The triggering mechanism was connected to a panel on the front door of the tunnel. This would trigger the back door to open (in the first condition) and the front door to open (in the second condition) whenever the free rats made contact with a platform on the floor in front of the tunnel and with the panel on the front door of the tunnel.

## Procedure

In the first condition, the free rats were put into arena 1 and the trapped rats were put into the tunnel. Each pair of rats was left in the apparatus for 30 minutes (1800 seconds). Whenever the free rats would make contact with the triggering

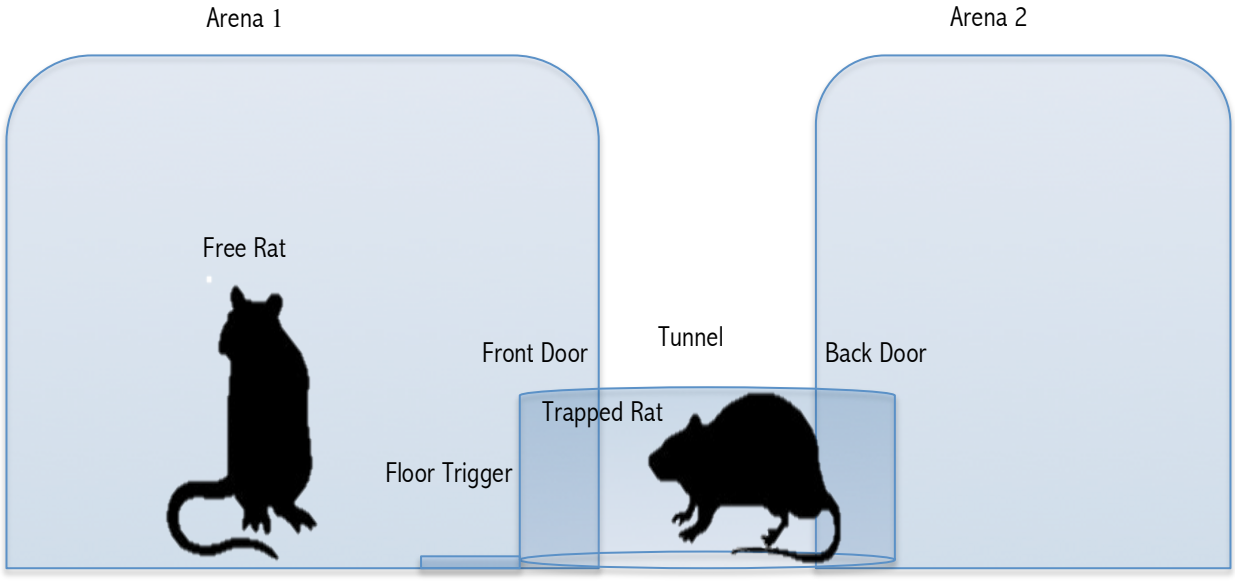



**Figure 1.** Side view of apparatus for free and trapped rats, including arena 1, tunnel space, and arena 2

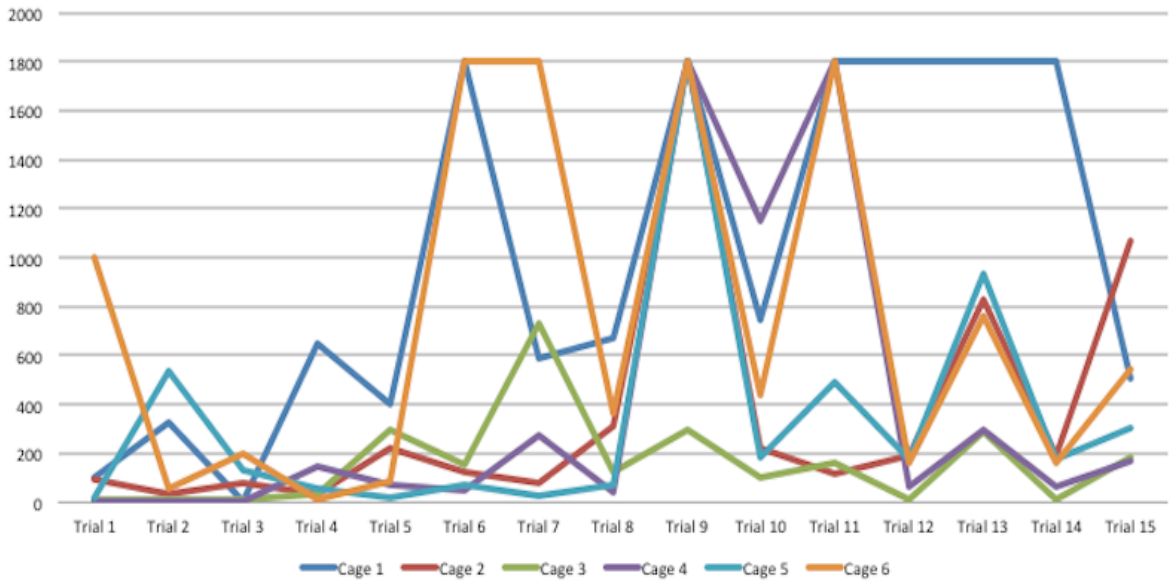
mechanism (touch both the floor panel and the front door panel at the same time), the rear door of the tunnel would automatically open for the trapped rats to escape. Once this had taken place the rats were left to explore their arenas until the half hour had been exhausted. If the free rat never made contact with the triggering mechanism, then this was recorded and the half hour was left to run out with the trapped rat constrained the entire time. Fifteen trials were run in the first condition.

In the first several trials of the first condition (trials 1-5), the free rats responded to the trapped rats' containment fairly quickly and freed their partners in less than 1000 seconds. Trial 3 had the lowest mean first response time with 71 seconds. This indicates that, on average between all six pairs of rats, it took about 71 seconds for the freed rats to trigger the floor and door mechanisms to allow the trapped rats to escape into arena 2. The highest first response time mean was trial 9 at about 1550 seconds (see Table 1). Response times were graphed in an effort to illustrate the differences between each cage of paired rats and each trial run in the first condition (see Graph 1).

In the second condition the free rats were, once again, placed in arena 1 and the trapped rats were put into the restraining tube. Twelve

**Table 1.**
This table illustrates the times (in seconds) that it took each freed rat to release its partner. The table also shows the median and average scores by trial for all 15 trials of the first condition.

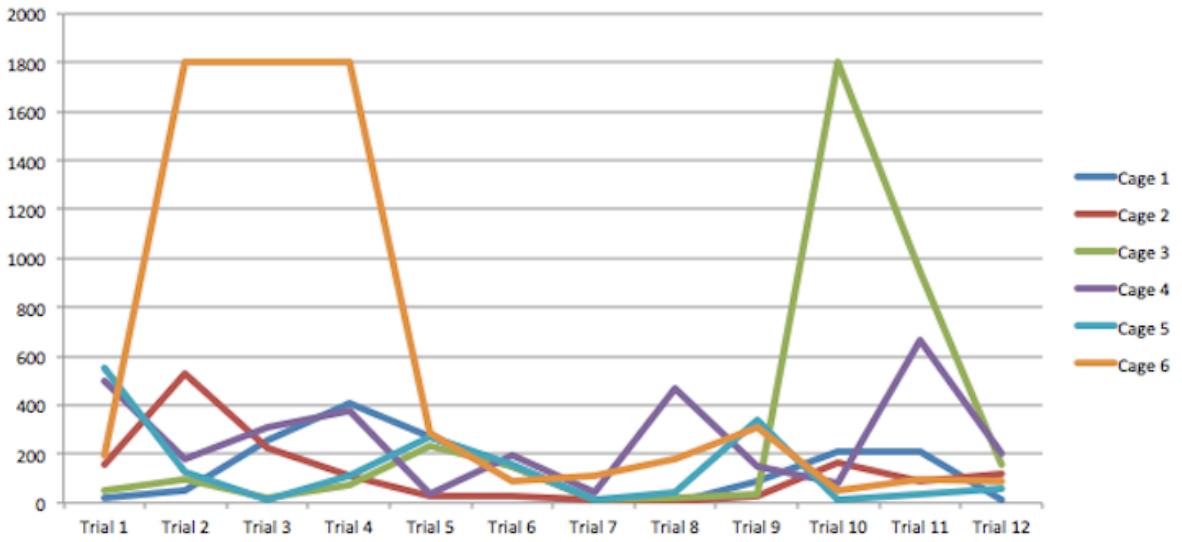
| | Cage 1 | Cage 2 | Cage 3 | Cage 4 | Cage 5 | Cage 6 | Median by Trial | Mean by Trial |
|---|---|---|---|---|---|---|---|---|
| Trial 1 | 102 | 93 | 13 | 3 | 18 | 1001 | 55.5 | 205 |
| Trial 2 | 323 | 31 | 12 | 1 | 535 | 56 | 45.5 | 159.6666667 |
| Trial 3 | 4 | 78 | 10 | 3 | 131 | 200 | 44 | 71 |
| Trial 4 | 647 | 31 | 32 | 148 | 55 | 10 | 43.5 | 153.8333333 |
| Trial 5 | 404 | 218 | 300 | 74 | 20 | 84 | 151 | 183.3333333 |
| Trial 6 | 1800 | 127 | 152 | 52 | 75 | 1800 | 151 | 667.6666667 |
| Trial 7 | 592 | 80 | 732 | 273 | 28 | 1800 | 432.5 | 584.1666667 |
| Trial 8 | 673 | 314 | 127 | 45 | 75 | 364 | 220.5 | 266.3333333 |
| Trial 9 | 1800 | 1800 | 299 | 1800 | 1800 | 1800 | 1800 | 1549.833333 |
| Trial 10 | 748 | 222 | 103 | 1149 | 183 | 442 | 332 | 474.5 |
| Trial 11 | 1800 | 118 | 163 | 1800 | 494 | 1800 | 1147 | 1029.166667 |
| Trial 12 | 1800 | 194 | 12 | 62 | 179 | 160 | 169.5 | 401.1666667 |
| Trial 13 | 1800 | 829 | 291 | 297 | 930 | 764 | 796.5 | 818.5 |
| Trial 14 | 1800 | 194 | 12 | 62 | 179 | 160 | 169.5 | 401.1666667 |
| Trial 15 | 508 | 1070 | 182 | 168 | 301 | 545 | 404.5 | 462.3333333 |




**Graph 1.**
This graph demonstrates each pairs' first response time in the first condition's 15 trials. The graph shows comparison between cages and between trials, showing that as time progressed, the freed rats took less and less haste to aid their cagemate.

**Table 2.**
This table illustrates the first response times it took for the free rats to release their cagemates during the second condition of the experiment (when the trapped rats were released into arena 1 with the free rats). The table also shows the average time by trial for all 12 trials in condition 2.

| | Cage 1 | Cage 2 | Cage 3 | Cage 4 | Cage 5 | Cage 6 | Mean by Trial |
|---|---|---|---|---|---|---|---|
| Trial 1 | 21 | 157 | 52 | 496 | 553 | 195 | 245.6666667 |
| Trial 2 | 49 | 529 | 99 | 176 | 125 | 1800 | 463 |
| Trial 3 | 253 | 228 | 18 | 306 | 9 | 1800 | 435.6666667 |
| Trial 4 | 404 | 114 | 76 | 379 | 114 | 1800 | 481.1666667 |
| Trial 5 | 272 | 29 | 236 | 36 | 268 | 282 | 187.1666667 |
| Trial 6 | 150 | 29 | 147 | 193 | 156 | 92 | 127.8333333 |
| Trial 7 | 16 | 11 | 13 | 43 | 13 | 110 | 34.33333333 |
| Trial 8 | 1 | 6 | 19 | 468 | 43 | 178 | 119.1666667 |
| Trial 9 | 92 | 29 | 32 | 152 | 337 | 306 | 158 |
| Trial 10 | 210 | 168 | 1800 | 78 | 10 | 50 | 386 |
| Trial 11 | 210 | 88 | 949 | 668 | 34 | 96 | 340.8333333 |
| Trial 12 | 15 | 122 | 153 | 199 | 55 | 86 | 105 |




**Graph 2.**
This graph shows each pairs' initial response time in the second condition's 12 trials. The graph illustrates the data for each cage and each trial, demonstrating that as more sessions passed the freed rats' response times, on average, tended to stay consistent.

trials were run in the second condition of this study. In this condition the pairs were still run for half an hour (or 1800 seconds) but if the free rats triggered the apparatus, instead of releasing the trapped rats into arena 2, the trapped rats were released into arena 1 with the free rats. As in the first condition, if the free rats never released the trapped rats, the trial ran until the time of half an hour was over. Table 2 shows the first response times each free rat demonstrated in releasing their cagemates.

**Results**

Beginning with the first condition, when the free rats triggered the mechanism and allowed for the escape of their cagemates, the cagemates at first quickly took flight from the tunnel and begun exploring arena 2. Most of the free rats in the first trials of condition 1 released their partners with very short response times (see Table 1).

As can be analyzed from Table 1, only after trial 5 did the free rats begin to lower their response times. Cage 3 seemed to consistently respond at higher rates compared to the other pairs. Cage 6 responded significantly slower, on average, than the five other pairs.

Conditon 2 showed less of a demarcation between the first several trials and the last trials. On average the free rats released the trapped rats at about 245 seconds, 463 seconds, and 435 seconds for trials 1, 2, and 3 respectively (see Table 2). The pairs took about 386 seconds, 341 seconds, and 105 seconds for trials 10, 11, and 12 respectively. This does not show a major shift in response rates from trial 1 to trial 12.

As can be seen in Graph 2, apart from four outliers (cage 6, trial 2, 3, and 4; cage 3, trial 10), the freed rats tended to behave fairly consistently in terms of how long they took to release their trapped cagemates. Cage 6 seemed to respond significantly slower in trials 2, 3, and 4 than the other pairs did. Trial 7 proved to have considerably quicker responses to triggering the mechanism than in any other trial.

**Discussion**

In analyzing these results it can become clear that two specific processes are at work. Rather than attributing the freed rats' responses to empathetic affective states, we have found that these resuts can be explained by neophobia and rat gregariousness.

Neophobia is evidenced in the first several trials of condition 1. As illustrated by Table 1, the response rates of the freed rats were much quicker in the first five trials than in the remaining ten. This is because the rats were introduced to a novel environment and therefore, inevitably explored, and possibly unintentionally triggered, the door opening mechanism. As more sessions passed, the freed rats lost interest in the now old environment and were observed staying in one corner of arena 1 or staying atop the restraining tube. The trapped rats, in the first several trials of condition 1, also exhibited this neophobia, as they quickly retreated from the tunnel as soon as they were released and begun to investigate arena 2. After trial 4 or 5, the trapped rats, once freed, would return to the tunnel, after only a short amount of time having been released, and remain in the confined space for the remiander of the time. This proved that the supposedly aversive restraining container was actually a familiar spot for the rats to return to once the neophobia had been diminished (seemingly after approximately five trials).

Furthermore, these rats also showed a heightened intention toward sociability rather than empathetic behavior. As is explained by Latané (Journal of Experimental Social Psychology 5:61-69, 1969) rats that have cohabitated with others seem inclined to show signs of gregariousness as compared to rats that have been confined to living alone. Since the rats that we have tested were living in pairs, they were, in fact, potentially more inclined to showing increased signs of sociability (as would the rats used in Bartal et al.'s experiment). The free rats, during condition 1, would release their partners and then spend much time around the tunnel's front door. If empathetic regard were the main driver of these rats' actions, then it can be assumed that they would be satisfied having released their cagemates and would not have continued to attempt to trigger the door mechanism. Instead, the free rats hovered at the tunnel's front door in an effort to remain as close as possible to their cagemates (showing signs of gregariousness). This gregariousness may explain why the initial response times in the free rats got slower as sessions continued. While the rats did not stop releasing their partners, they did do so with much lower response rates.

Furthermore, in the second condition, the rats' response rates seemed to be consistently fast as compared to those in the last trials of the first condition. This may be attributed to the gregariousness the rats exhibited but can also be accounted for by empathetic intention. Eckman et al. (Journal of Personality and Social Psychology 11:107-114, 1969) suggests that rats who are exposed to a new environment are curious and potentially afraid of this unfaniliar setting and therefore exhibit less social interactions. This is what was observed in the first condition. However, once the neophobia begins to dissapear, the rats are no longer plagued by uncertainity and begin to develop increased gregariousness (Eckman 1969). Once the free rats had released their cagemates into arena 1 with them, during the first several trials both rats explored the space and then began socializing. After the third or fourth trials, however, the rats could be observed returning to the tunnel container and both entering and staying in the conatiner until the thirty minutes of the trial had elapsed. This is strong evidence for rat sociability. There is also evidence for

empathetic regard in terms of the free rats. By consistently releasing the trapped rats at a relatively constant rate and not returning to the panels to attempt to re-trigger the mechanism once the trapped rats had been released, the free rats may have been acting with empathatic initiative. This however, is fairly inconclusive because both rats were released in arena 1 which made socializing a possibility and may have therefore affected why the free rats didn't continue attempting to trigger the door mechanism.

In concluding this experiment, it was therefore found that Bartal et al.'s observations that rats display pro-social behavior may not actually be due to an inherent empathetic expression. Instead, this behavior may be directly related to the neophobia that comes with being emerged in an unfamiliar environment and the gregariousness that rats tend to exhibit as primarily social creatures once that neophobia has been dissolved over time.

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