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Inhibition of Maladaptive Behavior in Pigeons, Analogous with Human Gambling

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Research has shown that pigeons, much like humans, will gamble for a larger payout that occurs less frequently rather than a smaller payout that occurs more often, even if the small payout has a greater net value. Zentall & Stagner (2010) gave pigeons a choice between one alternative that 20% of the time provided a stimulus that always predicted food and 80% of the time, a stimulus that always predicted the absence of food and a second alternative that provided a stimulus that predicted food 50% of the time. They found that pigeons had a strong preference for the alternative that predicted food 20% of the time. A study using this same concept, except where reinforcement was provided in magnitude (number of pellets), had similar results. In this case, pigeons chose to receive 10 pellets 20% of the time (2 pellets on average) over 3 pellets all of the time (Zentall & Stagner, 2011). Thus, much like human gamblers, pigeons choose less food over time in order to receive the stimulus that predicts the larger outcome. Using this finding as a foundation, we asked if observation of a demonstrator gambling or not gambling would inform an observer's decision to gamble. That is, would pigeons tend to imitate the choice of another pigeon?

For this experiment an operant chamber was constructed with two sections – a section containing the pecking panel, and directly behind, a section containing the observing pigeon. These areas were separated by a grate that allowed observers to watch demonstrators perform. Four pigeons, two per condition, were randomly assigned as demonstrators and were trained to peck at each of two colored response keys. The demonstrators were then trained to peck the keys with another bird watching, to ensure that they would not be disturbed by being observed. The demonstrators were trained to either gamble or not gamble, that is, they were forced to respond to only one alternative, the sub-optimal alternative (obtaining 20% reinforcement) or the optimal alternative (obtaining 50% reinforcement) for xx, xx trial sessions. Then, eight observer pigeons were randomly assigned to a demonstrator, two per demonstrator, four birds per condition. After being habituated to the operant chamber in the same way as the demonstrators (trained to peck at colored response keys), the observers watched the demonstrators perform their conditions.

The first 12 sessions were pure observation sessions in which the observers watched their demonstrators. Starting at Session 13, after an observer watched its demonstrator, the demonstrator was removed from the chamber and the observer moved into the performance section. The pigeon was presented with a choice between the 20% (gambling) and 50% (non-gambling) alternative. Sessions 13 through 16 consisted of 40 choice trials only, thus, serving as a pure measure of observational learning. Starting at Session 17, 20 force trials were introduced; force trials are trials in which only one of the alternatives is presented, with 10 trials per alternative. This allows us to make sure that the birds understand the contingencies associated with each stimulus. The number of choice trials was reduced from 40 to 20.

The results indicate that the observers did not imitate the specific responses made by the demonstrators. No matter what pigeons observed, gambling or non-gambling demonstrators, all pigeons showed the same pattern of acquisition. After starting at close to chance, the pigeons in both groups began to choose the optimal alternative and then gradually developed a preference to

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gamble, which by Session 40 reached 82% (Figure 1). Given the complexity of the procedure observed, it may have been too difficult for the observers to learn observationally.

In the acquisition functions for both conditions, as well as in a function of the two conditions averaged together (see Figure 2), there is a pronounced dip in the graph where initial choice to gamble is around 30%, well below chance. In Figure 2, one can see that choice by the observers on Sessions 17, 18, and 19 is significantly below 50%. This effect has been observed in previous studies concerning the sub-optimal choice of pigeons, but in the present results, this dip is much larger. Previously, it was unclear as to why this dip occurred, as it suggests that the pigeons learn the overall contingencies first and then gradually develop the preference to gamble with more exposure to the 20% reinforcement alternative. At that point, the saliency and value attributed to the 20% alternative began to outweigh the 50% reinforcement alternative. In an earlier study with the same contingencies but in the absence of a period of observation of another pigeon (Stagner & Zentall, 2010), no initial dip in the choice of the 20% reinforcement alternative was found. In the present experiment, the initial choice of the 20% reinforcement alternative could be attributed to the social enrichment provided by observation of the mere presence of the demonstrator. However, it is just as likely that the act of the demonstrator pecking or being reinforced is what caused the observers to be influenced initially to prefer the high reinforcement alternative.

The function presented in Figure 2 provides a way of describing addiction overall. When one engages in gambling behavior that is initially aversive, subjects may choose not to partake (30% choice to gamble). But as the attraction to the high payoff but low frequency alternative increases, one gradually starts to partake more in gambling behavior and overtime the actual value and reward associated with gambling will cause one to prefer the sub-optimal choice (in the present case an 82% preference to gamble) versus the optimal choice. Viewing addiction from that perspective, it is possible that more research focused on investigating the initial propensity to make optimal decisions, could lead to therapies that focus on keeping the sub-optimal choice aversive as opposed to preferred.

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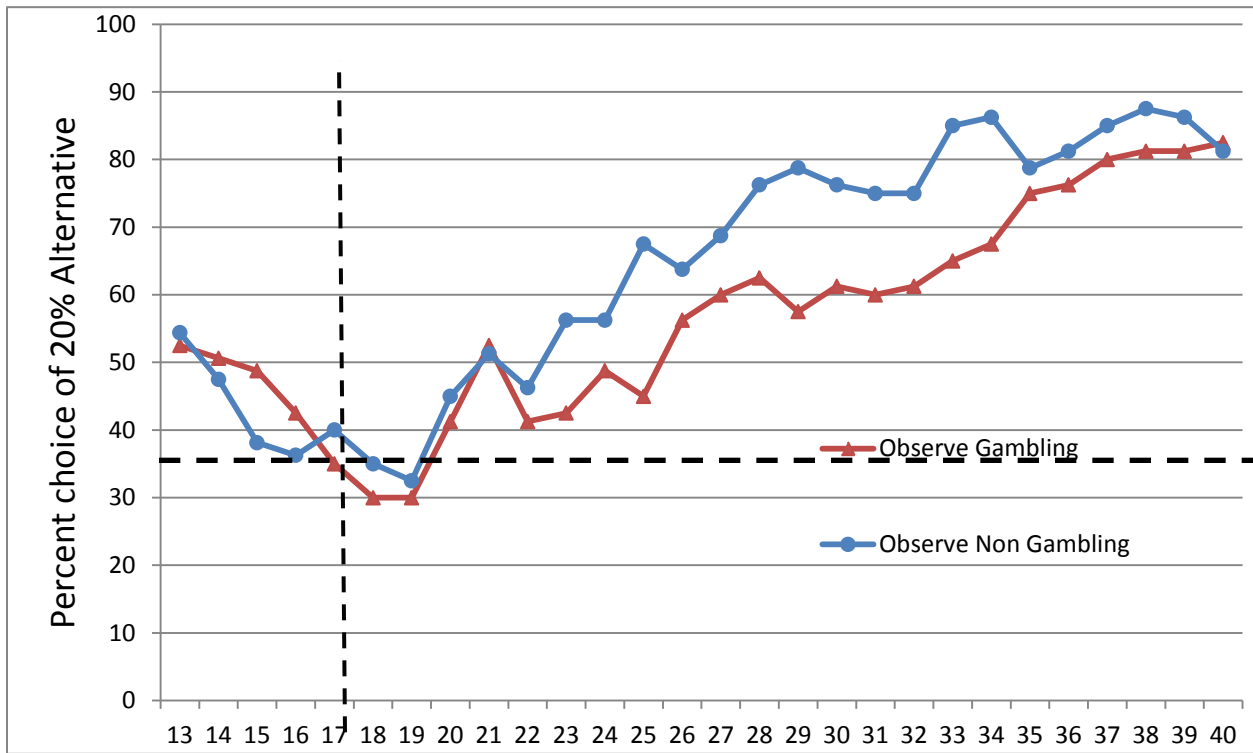


Figure 1. shows percent choice of 20% alternative between groups. The vertical line separates Sessions 13-16 from Sessions 17-40 because 13-16 are choice to gamble out of 40 trials and 17-40 are choice to gamble out of 20 trials, with 20 force trials.

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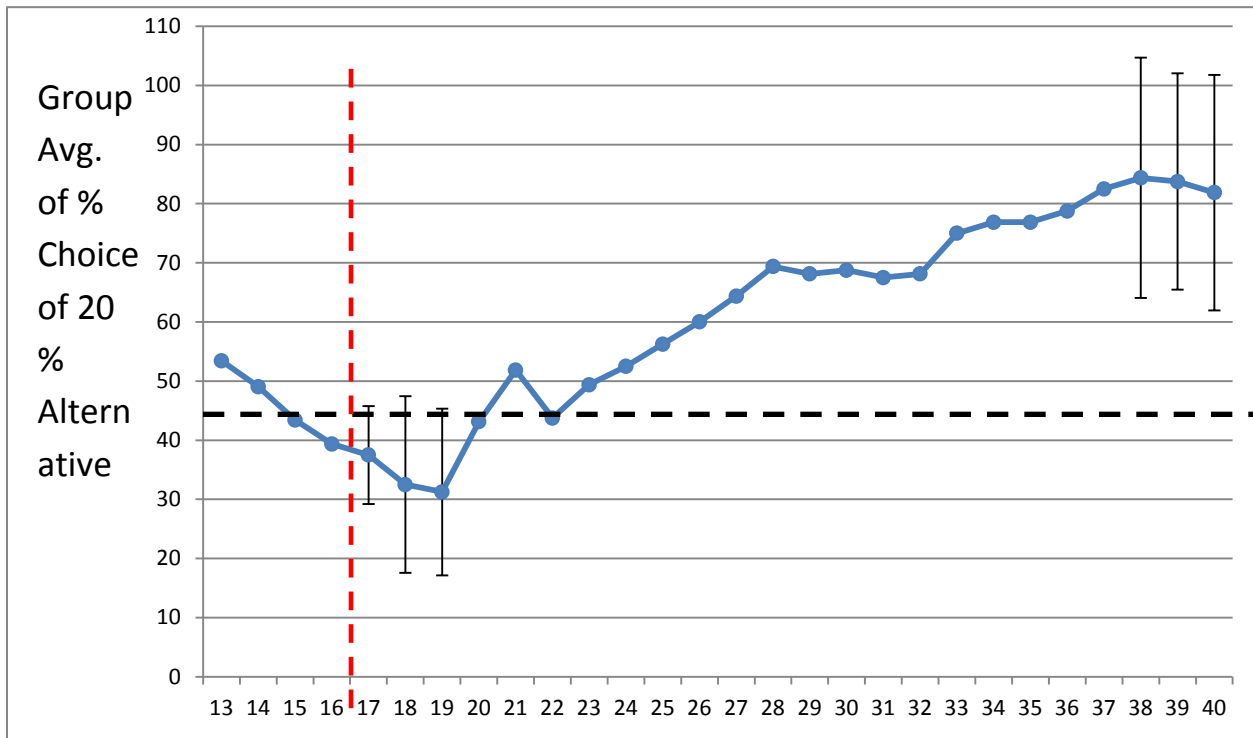


Figure 2. shows the percent choice of the 20 % alternative of both groups averaged together. The red-dotted line separates Sessions 13-16 (40 choice trials) from 17-40 (20 force trials, 20 choice trials). Sessions 17-19 have “error” bars that indicate the upper and lower limits of their respective confidence intervals (CIs). In this case the CIs do not include 50 %, and the lower limits are below 50 % making the “dip” significant. CIs are also indicated on Sessions 38-40. Again, the CIs do not include 50 %, and the upper limits are well above 50 %, making the preference to gamble (82%) significant.