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SOBRE POMBOS E GENTE: ALGUMAS OBSERVAÇÕES SOBRE DIFERENÇAS ENTRE ESPÉCIES EM ESCOLHA E AUTOCONTROLE

OF PIGEONS AND PEOPLE: SOME OBSERVATIONS ON SPECIES DIFFERENCES IN CHOICE AND SELF-CONTROL

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RESUMO

A continuidade no comportamento entre espécies tem sido amplamente assumida na análise do comportamento, embora pesquisas recentes pareçam desafiar uma versão forte do pressuposto da continuidade. Este artigo apresenta uma revisão de fontes potenciais para a descontinuidade humano-não humano em escolha e auto-controle. Ênfase especial é colocada nas diferenças nos procedimentos empregados para estudar humanos e outros animais, que dificultam comparações entre espécies. Modificações nos procedimentos empregados com não-humanos (por meio do uso de sistemas de reforço do tipo fichas) e com humanos (por meio do emprego de sistemas de reforço do tipo consumatório) mostram maior acordo nos padrões de escolha de humanos e outros animais. Isto sugere que pelo menos algumas das diferenças relatadas sobre escolhas em procedimentos de auto-controle em humanos e outros animais refletem diferenças de procedimento, mais do que diferenças mais fundamentais em processos comportamentais. Ao estreitar as lacunas metodológicas que separam procedimentos empregados com humanos e não humanos, esta pesquisa aponta estratégias mais efetivas para avaliar a continuidade no comportamento entre espécies.

Palavras-chave: escolha, autocontrole, reforçamento por fichas, reforço consumatório, continuidade entre espécies.

ABSTRACT

Cross-species continuity in behavior is widely assumed in behavior analysis, and yet some recent research appears to challenge a strong version of the continuity assumption. This paper reviews potential sources of human-nonhuman discontinuity in the area of choice and self-control. Special emphasis is given to differences in the procedures used to study humans and other animals, which hinder cross-species comparisons. Modifying the procedures used with nonhumans (through the use of token-type reinforcement systems) and with humans (through the use of consumable-type reinforcement systems) brings the choice patterns of humans and other animals into better accord. This suggests that at least some of the reported differences in self-control choices in humans and other animals reflect procedural differences rather than more fundamental differences in behavioral process. By narrowing the methodological chasm separating human and nonhuman procedures, this research points to more effective strategies for assessing cross-species continuity in behavior.

Key words: choice, self-control, token reinforcement, consumable reinforcement, species continuity.

What does it mean to be human? Do humans have special qualities that distinguish them from other animals? What, if anything, do humans share with other animals? Such questions about the place of humans in nature extend far back in recorded history. According to the Bible, humans have dominion over other animals:

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And God said, Let us make mankind in our image, after our likeness, so they may rule over the fish of the sea, and the birds of the air, over the cattle, and over all the earth, and over all the creatures that move on the earth.

Genesis 1:26

This theme—of humans remaining separate from and superior to other animals—remained a central part of philosophy for many centuries. Descartes saw the fundamental difference as one involving the rational soul:

...there is nothing that leads weak minds further astray from the path of virtue than to imagine that the souls of animals are of the same nature as ours, and that, after this life, we have nothing to fear, and nothing to hope, any more than flies and ants. (Descartes, 1637/1960, p. 82)

This view remained dominant, in science as well as in the culture at large, until Darwin's time. In a notebook written some 20 years prior to the publication of *On the Origin of Species*, Darwin wrote:

Man in his arrogance thinks himself a great work worthy the interposition of a deity. More humble and I think truer to consider him created from animals. (cited in Rachels, 1990, p. 1)

Darwin's ideas were predicated on the notion of species continuity—of general principles that were applicable to all species, including humans. This idea of species continuity radically overturned the conventional wisdom that humans were separate from the rest of nature, occupying some privileged position on a ladder of progress.

After Darwin, it became more difficult (at least within scientific circles) to regard humans as distinct from animals on the grounds that humans possessed a soul, but it remained

possible to hold to the facts of evolution and yet retain the idea that humans are fundamentally different than other animals; that is, to acknowledge some continuity between species but to retain the belief in a “ladder of progress” or “Great Chain of Being”—an ordered sequence of steps that leads progressively and inevitably to humans. According to this view, human beings possess special qualities—if not a “soul,” as Descartes had suggested, then something else, e.g., mind, consciousness or rationality—that forever keeps humans distinct from other animals. (Incidentally, this was the view adopted by Spencer, a contemporary of Darwin who formulated an independent theory of natural selection.)

To counteract such an anthropocentric view, Darwin and his followers adopted a viewpoint that was equally extreme in the opposite direction—a kind of naive anthropomorphism, which, among other things, attributed complex reasoning skills to worms:

If worms have the power of acquiring some notion, however rude, of the shape of an object and of their burrows, as seems to be the case, they deserve to be called intelligent; for they then act in nearly the same manner as would a man under similar circumstances. (Darwin, 1881/1985, p. 97)

Statements such as this were based more on anecdotes than on systematic observations or experiments, and as such were equally beyond the facts of the time. But Darwin's approach carried with it the important implication that we should use the same standards in evaluating human and nonhuman intelligence, a practice that was taken up in earnest by comparative psychologists in the

early part of this century (Wasserman, 1981).

Today we no longer need to rely on anecdotal evidence or whimsical tales. Based on decades of comparative research, we now have a wealth of systematic data on the relative capabilities of a wide range of animals on a variety of tasks. On the whole, such evidence reveals impressive generalities across species. The concept of reinforcement, for example, has broad applicability across the animal kingdom. This kind of cross-species generality helps to justify the practice of using “representative” animals to study behavioral laws presumed to operate for other species, including humans (Harrison, 1994; Wasserman, 1994). It also helps justify the extension of procedures and findings from the animal laboratory to real-life human affairs (Branch & Hackenberg, 1998).

Some research, however, has also revealed some apparent differences between humans and other animals. A growing body of evidence gathered over the past few decades appears to challenge a strict version of the species continuity idea by showing, for instance, that humans behave differently than other animals exposed to analogous conditions.

What accounts for such differences between humans and other animals? Are differences best regarded as qualitative (difference in kind) or quantitative (difference in degree)? Do such differences undermine the cross-species continuity of behavioral laws? Are special principles needed to account for human behavior?

These are important questions. Unfortunately, clear answers to such questions are hampered by procedural differences. Humans and other animals are studied with different procedures, and it is quite possible

that at least some of the reported species differences in performance are a product of these procedural differences. Until such methodological problems are resolved, it is not possible to determine whether, or to what extent, genuine species differences exist.

In the present paper, I review research bearing on this problem, using some recent studies in the area of self-control and choice to illustrate an analytic strategy for minimizing procedural differences that have hampered past attempts at species comparisons. I will place special emphasis on differences in the reinforcement procedures typically used with humans and other animals and on whether these procedures can be brought into better alignment in ways that yield more balanced species comparisons. I will then consider some general implications of this research for cross-species continuity of behavioral processes.

SPECIES DIFFERENCES IN CHOICE AND SELF-CONTROL

In laboratory studies of self-control, subjects are given repeated choices between a smaller more immediate reinforcer and a larger delayed reinforcer (Ainslie, 1974; Mischel, 1966; Rachlin & Green, 1972). Selecting the smaller reinforcer is said to reflect sensitivity to reinforcer immediacy (“impulsivity”) whereas selecting the larger reinforcer is said to reflect sensitivity to reinforcer magnitude (“self-control”). Nonhuman animals (mostly pigeons) tend to prefer the smaller sooner reinforcer. There are exceptions—as when both outcomes are sufficiently delayed by adding a constant preinforcer delay to each alternative (Green, Fisher, Perlow, & Sherman, 1981; Rachlin & Green, 1972), or as when an extensive fading history is established (Mazur

& Logue, 1978)—but as a general rule nonhumans show clear delay sensitivity. Adult humans, on the other hand, tend to exhibit considerably less delay sensitivity than nonhuman animals on such procedures (see Logue, 1988, for a review). Across a range of different conditions, humans tend to behave in ways that maximize the overall density of reinforcement. As Logue, Pena-Correal, Rodriguez, and Kabela (1986) put it:

...adult humans, unlike pigeons, are sensitive to events as integrated over whole sessions and tend to maximize total reinforcement over whole sessions (p. 172).

Several interpretations have been proposed to account for such species differences in self-control, most of which appeal to qualitative human-specific adaptations such as verbally governed behavior (e.g., Horne & Lowe, 1993). By this view, laboratory tasks generate verbal behavior that interacts with and determines the nonverbal choice patterns. Others view the differences in more quantitative terms, by treating them as arising from different rates of temporal discounting (Green, Fry, & Myerson, 1994). As plausible as these interpretations may be, they cannot be adequately evaluated until critical differences in the procedures used to study choice in humans and other animals are reconciled.

A key procedural difference separating human from nonhuman studies of self-control concerns the nature of the reinforcement system. In studies with nonhuman subjects, reinforcers are typically unconditioned reinforcers such as food, which is consumed soon after it is presented. In studies with adult human subjects, on the other hand, reinforcers typically consist of conditioned reinforcers such

as points exchangeable for money some time after the experimental session. Because points cannot be exchanged or consumed immediately, and because delays to the periods during which they can be exchanged typically are held constant (normally at the end of the session or at the end of the experiment), there is no particular advantage to obtaining points quickly. Indeed, equalizing delays to both reinforcers gives a special advantage to reinforcer amount, which with these procedures strongly favors selecting the large-reinforcer option.

TOKEN REINFORCEMENT SYSTEMS

It may be useful to conceptualize the typical experimental arrangement used with human subjects (where points earned at Time A are exchanged for reinforcers at Time B) as a kind of token reinforcement system (Hackenberg & Vaidya, 2003; Hyten, Field, & Madden, 1994; Jackson & Hackenberg, 1996). Token reinforcers are usually physically manipulable objects (such as coins, poker chips, or marbles), but they can be defined more generally as conditioned reinforcers “that the organism may accumulate and later exchange for other reinforcers” (Catania, 1998). This more general definition would include events like points exchangeable for money, as well as other nonmanipulable tokens (e.g., checkmarks, stickers etc.).

By this view, a token reinforcement system is a kind of extended chain schedule in relation to which a coordinated pattern of behavior develops. A token reinforcement schedule consists of a series of three interrelated component schedules: (a) the *token-production schedule*, the schedule by which a response produces delivery of tokens; (b) the *token-*

exchange schedule, the schedule by which exchange opportunities are made available; and (c) the *terminal-reinforcer schedule*, the schedule by which tokens produce the terminal reinforcer. In laboratory research with humans, self-control and impulsivity are typically defined in relation to the first schedule—the delays to token delivery and number of tokens earned (points). Previous research on token reinforcement procedures, however, indicates that (a) the token-production schedule is less critical than either (b) or (c)—the schedules governing how and when tokens are exchanged for other reinforcers (Foster, Hackenberg, & Vaidya, 2001; Webbe & Malagodi, 1978).

The pervasiveness of self-control reported in studies with humans and the species differences in self-control may both be derivatives of holding constant the delays to the exchange periods during which the points are exchangeable for the terminal (monetary) reinforcers. Such contingencies virtually guarantee insensitivity to token delays, and yet self-control is typically defined with respect to these token delays. In a sense, the findings with humans do not represent self-control at all—at least not with respect to the critical reinforcers in the terminal link of the chain (money). Instead, they merely indicate sensitivity to amount of monetary reinforcement with delays to monetary reinforcement held constant. In this sense, the results are perfectly consistent with the results of experiments with pigeons showing preference for larger over smaller food amounts with equal delays (Grace, 1995; Logue, Rodriguez, Peña-Correal, & Mauro, 1984; Snyderman, 1983).

This has important implications for cross-species analysis of choice. If differences in

performance stem in part from differences in the reinforcement systems used with humans and other animals, then bringing procedures into better alignment should also bring the cross-species choice patterns into better alignment. There are two main ways this can be accomplished. First, the procedures used with nonhumans can be made more “human-like” through the use of token reinforcement systems modeled after the types of systems normally used with humans. Second, the procedures used with humans can be made more “animal-like” through the use of consumable-type reinforcers more like those normally used in research with nonhumans. These will be discussed in turn.

MAKING ANIMAL PROCEDURES MORE “HUMAN-LIKE”: TOKEN-TYPE REINFORCERS WITH PIGEONS

To better approximate procedures typically used with humans, Jackson and Hackenberg (1996) studied pigeons’ choices in a self-control arrangement with token-like reinforcers. Instead of points, tokens consisted of small stimulus lights mounted in a horizontal array above the response keys in an otherwise standard conditioning chamber; and instead of money, the terminal reinforcers consisted of food. Choices on the side keys illuminated either 1 token (small reinforcer) or 3 tokens (large reinforcer). When lit, each token was “worth” 2-s of food in that it was exchangeable for 2-s of food during scheduled exchange periods (signaled by a red center key).

The exchange period remained in effect until all earned tokens had been exchanged for food. A variable-duration intertrial interval (ITI) separated successive trials so that choices were temporally spaced evenly, 60 s apart. Two forced-choice trials at the outset of each session,

designed to bring behavior into contact with the consequences arranged for each alternative, were followed by ten choice trials. Initially, an exchange period was scheduled each trial. The ratio of choice trials to exchange periods was increased systematically across conditions, eventually reaching a ratio of 10:1 (one exchange following a 10-trial session). This condition was seen as most closely analogous to a typical session with human subjects, in which tokens (points) accumulate across trials for a post-session exchange.

In the first condition of Experiment 2, the delays to tokens and the delays to the exchange period were equal for both options, and an exchange period occurred every trial; that is, token presentation was immediate and exchange periods were scheduled 1.5 s from either choice. All 6 pigeons showed strong (nearly exclusive) preference for the large reinforcer under these conditions. That choices show characteristic sensitivity to reinforcer amount with reinforcer delays held constant is important in functionally calibrating these procedures against more conventional procedures. In subsequent self-control conditions, the delays to tokens differed for the two options: choosing the small-reinforcer (1 token) option produced the token immediately, whereas choosing the large-reinforcer (3 token) option produced 3 tokens after a 6-s delay. In most of these conditions, the delays to the exchange period were equal following either choice, as they typically are in studies with human subjects and point/money reinforcers.

Four of the 6 pigeons consistently preferred the larger reinforcer (i.e., showed self-control) under these conditions. This tentatively supports the view presented above,

namely, that studying pigeons under conditions more characteristic of human research gives rise to performance that is more characteristically human. Still, a few questions remained unanswered. To begin with, 2 of the 6 subjects failed to show self-control. Second, 2 of the 4 who did show self-control were sometimes insensitive to the exchange-delay manipulation (i.e., they sometimes preferred the large reinforcer even on trials when the small-reinforcer option produced quicker access to the exchange period). Perhaps as a result of a long history of selecting the larger reinforcer with equal delays, a general preference for that alternative developed even under conditions when it was delayed (Mazur & Logue, 1978).

To test this notion, and to evaluate the effects of the exchange-delay manipulation in a more direct fashion, Jackson and Hackenberg (Experiment 4) ran an additional sequence of conditions similar to, but much simpler than, some conditions of the prior experiment. The critical manipulation involved the delay to the exchange period. In some conditions, termed *Equal Exchange Delay*, the delay to the exchange period was equal for either choice, as in the final conditions from the earlier experiment. In other conditions, termed *Unequal Exchange Delay*, exchange periods occurred directly following token presentation, and were thus shorter after small-reinforcer choices (owing to the shorter token delays) than after large-reinforcer choices. Thus, in the former but not the latter conditions exchange periods and food were differentially correlated with choice patterns. If the critical delays are those between choices and exchange periods/food and not between choices and tokens (as self-control has conventionally been defined), then one would predict preference for the large reinforcer under

Equal Exchange Delay, when the delays to the exchange period are equal, and preference for the small reinforcer under *Unequal Exchange Delay*, when the exchange delays favor the small-reinforcer option. If, on the other hand, a general insensitivity to delay had developed, then choice patterns should be the same under both Equal Exchange and Unequal Exchange delays.

Three pigeons participated in the experiment, including the two whose responding was insensitive to the exchange-delay manipulations in the earlier experiment. As before, choice of the small reinforcer produced 1 token immediately, whereas choice of the large reinforcer produced 3 tokens after a 6-s delay. Exchange periods were scheduled each trial, either 10 s from either choice (*Equal Exchange Delay*) or 0.1 s after small-reinforcer choices and 10 s after large-reinforcers choices (*Unequal Exchange Delay*). All 3 subjects strongly preferred the larger reinforcer when the delays to the exchange period were equal (*Equal Exchange Delay*). When choosing the smaller reinforcer also resulted in quicker access to exchange periods (*Unequal Exchange Delay*), preferences reversed in favor of the small reinforcer, and then reversed back when the exchange delays were again made equal (*Equal Exchange Delay*). The results provided no evidence of generalized insensitivity to delay. Instead, they provided clear evidence that choices were governed not by token delays (as self-control is normally defined in studies with humans), but by exchange delays (which are usually held constant in experiments with humans).

Subsequent research has provided even more conclusive evidence in support of the exchange-delay effect—the finding that self-

control choices are governed by exchange delays as opposed to token delays (Hackenberg & Vaidya, 2003). This suggests that previously reported differences between pigeons and people may have more to do with how self-control has been defined than with genuine species differences in self-control. When the procedures used to study self-control in pigeons and humans are brought into closer alignment, pigeons' choices come to more closely resemble those normally seen in humans: they show less delay sensitivity and a greater degree of "self-control". Would the converse also hold? That is, would making the procedures used with humans more "animal-like" (by using consumable-type reinforcers vs. token-type reinforcers) yield performances more like those seen in pigeons?

MAKING HUMAN PROCEDURES MORE "ANIMAL-LIKE": CONSUMABLE-TYPE REINFORCERS WITH HUMANS

A second approach to the problem of assessing cross-species continuity in self-control is to use reinforcers more typical of nonhuman research with humans, or, in other words, reinforcers of more immediate consummatory value. A variety of consumable-type reinforcers have been used successfully in laboratory research with humans (Mazur, 1998; Pilgrim, 1998), but additional work with reinforcers of this general sort are sorely needed in the area of self-control.

The most systematic exploration of food/liquid reinforcers in a self-control context was conducted by Logue and colleagues (Forzano & Logue, 1992, 1994, 1995; Logue & King, 1991). Logue and King (1991), for example, gave adult humans repeated choices between smaller and larger reinforcers (3-s vs. 6-s access

to preferred juice) available following different delays (1 s vs. 60 s, respectively). Unlike previous results with humans, in which strong preference for the larger reinforcer was typically seen, Logue and King reported a lower proportion of self-control choice patterns (8 of 19 subjects preferred the larger reinforcer on at least 2/3 of choice trials). Only 4 of the remaining 11 subjects, however, clearly preferred the smaller reinforcer (the remaining 7 were roughly indifferent)—not exactly what is to be expected if the consequences are serving as potent reinforcers (as food does for food-deprived nonhumans).

The main difficulties appear to be motivational: establishing and maintaining conditions under which the food retains its effectiveness as a reinforcer. To enhance the effectiveness of the liquid reinforcers, Logue and King asked subjects to abstain from eating or drinking for 4 hrs prior to the session. No procedures were in place, however, to verify compliance. Moreover, even if food intake was restricted over this period, this level of restriction is far less than that used routinely in studies with nonhuman subjects.

Additional research is needed along these lines, including techniques for enhancing the effectiveness of food reinforcers (e.g., Forzano & Logue, 1995). In finding reinforcers suitable for cross-species comparisons it is first important to demonstrate that the putative reinforcer has effects comparable to other more commonly used reinforcers. Only then can the performances engendered by different reinforcers be compared in functional terms. In the case of self-control choices, for example, it would be important to demonstrate sensitivity to reinforcer immediacy in isolation, prior to pitting it against reinforcer magnitu-

de in a self-control arrangement (Navarick, 1988). Unless the reinforcer produces characteristic delay sensitivity—that is, a decrease in reinforcer value with increases in delay—then it is not functionally the same type of reinforcer as used with other animals. Only after determining that the putative reinforcers are in fact functional reinforcers does it make sense to pit reinforcer delay and amount against each other in a self-control procedure.

A promising approach to this problem was developed by Navarick (1996) with prerecorded TV segments as reinforcers in a choice context with adult humans. Eleven of the 15 subjects tested showed some sensitivity to reinforcer immediacy, defined as preference for the more immediate of two delayed video segments of equal duration. This suggests that video segments for humans, like food reinforcers with animals, are devalued by delay.

In a later study, Navarick (1998) placed reinforcer immediacy and reinforcer amount in opposition. Subjects chose between a 15-s video segment presented immediately and a 25-s video segment delayed by 55 s. Trials lasted 90 s, so that the rate of trial onset remained constant irrespective of which choice had been made. Subjects were studied for 2 sessions (20 choice trials per session) separated by an average of 11 days. The overall pattern of results can be summarized briefly: Despite strong stability of within-subject choice patterns across the 2 sessions, there was considerable between-subject variability: 6 subjects preferred the smaller more immediate video segment, 8 subjects the longer delayed segment, and 1 subject was roughly indifferent. Thus, on the whole, the results are somewhat mixed. On one hand, delay sensitivity was seen in approximately 40% of the subjects,

suggesting that these reinforcers were more comparable to consumable-type reinforcers used with other animals than to the token-type reinforcers typically used with humans. On the other hand, the between-subject variability—due perhaps to the relatively brief exposure to the contingencies—urges caution in the interpretation of such findings.

Also using video reinforcers, Hackenberg and Pietras (2000) gave adult humans repeated choices between a smaller sooner video segment and a longer later video segment. Unlike Navarick's (1998) study, conditions were in effect until choice patterns were stable. Also unlike Navarick's study, the videos were embedded within a token-reinforcement procedure, which permitted a direct within-subject comparison of the two reinforcement systems: token vs. consumable.

Tokens consisted of stimulus lights mounted in an array above the choice keys. In a discrete-trial procedure, subjects chose between a small reinforcer (1 light) available immediately and a large reinforcer (3 lights) after a delay (either 60 s or 120 s, depending on the condition). Each light could be exchanged for 15-s access to a video during scheduled exchange periods at the end of each choice trial. To hold the rate of trial onset constant, a variable-duration ITI was interspersed between exchange periods and subsequent choice trials. Sessions consisted of 14 trials: 4 forced-choice trials (during which only one option was available) and 10 choice trials.

Subjects were initially exposed to two conditions designed to assess sensitivity to reinforcer amount and reinforcer delay separately. In the amount-sensitivity conditions, subjects chose between different

reinforcer amounts (long vs. short video segments) with equal delays; in the delay-sensitivity conditions, subjects chose between different reinforcer delays with equal reinforcer amounts. In both conditions, subjects preferred sooner to later videos of equal duration and longer to shorter video access with equal delays. These results are significant in showing that the video clips produced characteristic delay and amount sensitivity, an important step in functionally calibrating video reinforcers against other reinforcer types, as described above (Navarick, 1988, 1996).

Subjects were then exposed to choices between video segments of differing delays and durations. As in prior token-based self-control studies with pigeons (Jackson & Hackenberg, 1996), the main independent variable was the delay to the exchange period. In some conditions, the exchange periods were scheduled just after token presentation, and were thus shorter for small-reinforcer choices than for large-reinforcer choices. These *Unequal Exchange Delay* conditions alternated with *Equal Exchange Delay* conditions with exchange periods scheduled at the end of each trial.

When the videos could be viewed as they were earned (*Unequal Exchange Delay*), both subjects preferred the smaller sooner video clip. When video time earned could not be exchanged until the end of the trial (*Equal Exchange Delay*), preference reversed in favor of the larger reinforcer. When conditions were changed back to *Unequal Exchange Delay*, preferences reversed again in favor of the smaller reinforcer. In showing sensitivity to exchange-delay manipulations, these results with humans are in striking agreement with those obtained with pigeons on token-based self-control

procedures (Hackenberg & Vaidya, 2003; Jackson & Hackenberg, 1996).

Forzano and Logue (1994) reported effects similar to Hackenberg and Pietras (2000) but with juice reinforcers. In their experiment, adult humans were given choices between smaller and larger reinforcers that differed in their quality (juice vs. money) and in their exchange delays. When the reinforcers consisted of juice available after each choice (Experiment 1) subjects showed greater sensitivity to reinforcer immediacy than when the reinforcers consisted of points exchangeable for money after the session (Experiment 2). This finding is consistent with others mentioned above showing that qualitatively different reinforcers may engender different degrees of self-control.

The most novel manipulation was carried out in Experiment 3, in which subjects were given choices between points exchangeable for juice at the end of the session. Because the delays to points differed but the delays to the period during which they were exchangeable for juice did not, this experiment permitted a sharper specification of the controlling variables. That is, if choices were governed merely by differences in reinforcer quality (juice vs. money), then choice patterns here should have been more similar to those obtained in Experiment 1 in which choices produced juice. On the other hand, if choices were governed by delays to exchange periods, then choice patterns should have been more similar to those obtained in Experiment 2 in which choices produced points exchangeable for money. The results were consistent with those of Experiment 2, suggesting that the delay to the terminal reinforcer was more critical than the quality of the reinforcer per se.

When delays to the exchange period differed, permitting more immediate consumption of the smaller reinforcer, the smaller reinforcer was preferred; when delays to the exchange period were equal, the larger reinforcer was preferred. Thus, along with Hackenberg and Pietras (2000), the results of Forzano and Logue (1994) suggest that the nature of the reinforcers (consumable vs. token) is less important than the nature of the contingencies governing the consumption of those reinforcers.

CONCLUSIONS

Taken together, the studies described here lend support to the main thesis, that procedures can be modified to bring the results of experiments on human and nonhuman behavior into better alignment. By studying pigeon and human behavior under closely analogous experimental conditions, we are in a better position to distinguish genuine species differences in psychological process from mere differences in procedure. With respect to self-control choices, the available evidence suggests that at least some of the differences in the performances of humans and other animals reflect differences in procedure.

This is not to imply that *all* differences in pigeon and human behavior studied in the laboratory are procedural artifacts, or that people are just like pigeons. Important differences certainly exist (as in the realm of verbal behavior). The main point is methodological—only by studying different species under circumstances as similar as possible do we put ourselves in a position to discover the nature and extent of those differences that may exist.

But even similarities should be viewed with caution. In terms of a distinction advocated by Hodos and Campbell (1969), a nonhuman behavior pattern may be analogous to but not homologous to a human behavior pattern. For example, the parallel (convergent) evolution of wings in birds and bats produced anatomical patterns that were analogous but not homologous; despite their similarity, they were the outcome of different historical pathways. So too, with similarities in the choice patterns of humans and other animals may be the result of different behavioral histories (Shimoff & Catania, 1988).

In determining whether similarities are homologous (have similar origins, or occur for similar reasons) or analogous (different historical pathways leading to similar ends), it is important to use procedures that are as similar as possible, and to obtain detailed measures of performance at several values of the independent variable. As Sidman (1960) writes:

Our problem is not one of analogizing, but of obtaining sufficient understanding of both rats and men to be able to recognize resemblances in behavioral *processes*. We must be able to classify our variables in such a manner that we can recognize similarities in their *principles of operation*, in spite of the fact that their physical specifications may be quite different. (p. 27)

To understand how humans differ from other animals we must first understand how we are similar to other animals. And this can be done only by, in a sense, stepping outside of humankind, for it is by comparisons to things that are not human does the nature and provenance of human behavior come into focus. This point was long ago recognized by Skinner:

Although it is sometimes said that research on lower animals makes it impossible to discover what is uniquely human, it is only by studying the behavior of lower animals that we can tell what *is* distinctly human. The range of what has seemed to be human has been progressively reduced as lower organisms have come to be better understood. What survives, of course, is of the greatest importance. (Skinner, 1969, p. 101)

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