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Within-session patterns in variable-interval schedule performance: Variation with deprivation level

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Abstract

Previous research has shown that patterns in operant responding may change within the course of individual experimental sessions. The proper interpretation of such changes is controversial. At least one source of this controversy may lie in unstated experimental practices across laboratories, as published reports often have failed to detail important particulars of deprivation operations. The present study was aimed at gathering descriptive data on the contribution of deprivation operations to the observation of within-session changes. In two experiments, four food deprived pigeons were exposed to a multiple variable-interval 30-s variable-interval 30-s schedule of grain presentation, wherein each grain presentation was kept constant at 5 s. In Condition I, a session-entry criterion was in place that permitted the pigeon access to the daily session only if its body weight fell within controlled limits. Within-session rates of responding were generally stable. In Condition II, the entry criterion was removed and experimental sessions were conducted 6 days per week. The effect of removing the session-entry criterion was to increase body weight for all birds and decrease food intake across conditions. With no session entry criterion, robust within-session changes were observed for three of the four pigeons. The results suggest that rich schedules of reinforcement often used in the analysis of within-session changes can produce substantial reductions in deprivation levels that require up to several days to reverse. Future experiments in this area should take precautions to insure that deprivation is tightly controlled and report such measures to eliminate potential errors in replication.
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Keywords: Within-session patterns; Variable-interval schedules; Weight gain; Deprivation; Pigeon; Key peck

1. Introduction

Free-operant responding may increase and then decrease within experimental sessions. For example, McSweeney and Hinson (1992) found that responding of rats and pigeons under variable-interval (VI) schedules first increased and then decreased during sessions. Steeper decreases were observed as the density of programmed reinforcement increased. Similar findings were also shown in other experiments, suggesting that this effect is a robust and general finding (McSweeney, 1992; McSweeney and Hinson, 1992; McSweeney and Murphy, 2000). Other research, however, has questioned the generality and interpretation of the effects (e.g. Bizo et al., 1998; DeMarse et al., 1999; Hinson and Tennison, 1999; Palya and Walter, 1997; Schaal, 1996). One interpretation of the effects is that the late-session decreases in operant behavior reflect habituation to the reinforcing stimulus, or perhaps to the context of that stimulus; this interpretation will be hereafter be referred to as the habituation hypothesis (cf. McSweeney and Murphy, 2000). A competing interpretation is that the observed decreases are related to changes in the deprivation conditions of the animals, specifically that such changes are due to satiation to the reinforcing stimulus (cf. Bizo et al., 1998; DeMarse et al., 1999; Palya and Walter, 1997).

We originally began a set of experiments aimed at assessing sensitivity to explicit changes in reinforcer magnitude and how such variables may relate to within-session effects. As a first step, we studied pigeons' key pecking on a multiple VI 30-s VI 30-s schedule providing 5-s access to grain. We consistently encountered difficulties in maintaining our pigeons' weights over several weeks of experimentation, and looked to literature to examine if any such gain was present in earlier reports. Table 1 reviews the majority of data gathered on within-session changes with pigeons. As shown in the table, although several procedures have been used, our procedure was certainly not out of the range of general practice. In order to examine more

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Table 1
Summary of work reporting within-session changes using pigeons

Publication	Procedural details	Reinforcer type	Reinforcer duration	Sessions per week	Body weight	Consistent with habituation?
Bizo et al. (1998)	Simple schedule, VI 60 s	Milo popcorn	1.5–4.5 s	N/A	85% ± 10 g	N
Cannon and McSweeney (1995)	Simple schedule, VI 30 s and VI 60 s	Mixed grain	2–20 s	5	85%	Y/N
DeMarse et al. (1999)	Simple schedule, VI 30 s	Mixed grain milo	3–5 s	N/A	85% ± 5 g	N
Hinson and Tennison (1999)	Multiple schedule, VI and FI 30 s	Mixed grain	3 s	7	80%	N
McSweeney and Hinson (1992)	Concurrent schedule, VI 30 s–VI 240 s	Mixed grain	3 s	N/A	85%	Y
McSweeney et al. (2003)	Concurrent chains, VI 30 s (initial) VI 5 s–225 s (terminal)	Mixed grain	5 s	5–6	85%	Y
McSweeney et al. (2001)	Concurrent schedule, VI 30 s–240 s, VR 15 s–240 s	Mixed grain	5 s	5–6	85%	Y
McSweeney et al. (2004a)	Multiple/mixed schedules, extinction VI 60 s	Mixed grain	5 s	5–6	85%	Y
McSweeney et al. (2004b)	Multiple schedule, VI 30 s, VI 240 s	Mixed grain	1–9 s	5–6	85 ± 5%	Y
McSweeney et al. (1994)	Multiple schedule, VI 15 s–VI 240 s	Mixed grain	5 s	5–6	85%	Y
McSweeney, Swindell et al. (2004)	Multiple schedule, extinction–VI 30 s	Mixed grain	5 s	N/A	75–95 ± 2%	Y/N
McSweeney, Swindell et al (1996)	Autoshaping, VT 30 s–VT 240 s (US–US interval)	Mixed grain	5 s	5–6	85%	Y
McSweeney et al. (1999)	Simple schedule, ext, VI and VT 15 s–240 s	Mixed grain	5 s	5–6	85%	Y
McSweeney et al. (1995a)	Simple schedule, VI 7.5 s–VI 240 s	Mixed grain	5 s	5–6	85%	Y
McSweeney et al. (1995b)	Mixed schedule, VI 30 s–VI 240 s	Mixed grain	5 s	6–7	85%	Y
McSweeney, Weatherly et al. (1996)	Simple schedule, VI 15 s–VI 240 s	Mixed grain wheat	5 s	N/A	85%	Y
Palya and Walter (1997)	Simple schedule, VI 15 s–VI 240 s	Laying pellets	1–3 s	N/A	85 ± 5%	N
Schaal (1996)	Simple schedule, VI 60 s	Mixed grain	4 s	N/A	80%	N
Weatherly et al. (1996)	Conjoint schedule, VI 15 s–VI 480 s + VT 15 s–VT 480 s	Mixed grain	5 s	5–6	85%	Y

closely the range of procedures, we provide a brief description of the procedures used throughout each report, focusing mainly on the range of inter-food intervals, the reinforcing stimulus (if multiple stimuli were used, say for example milo alone as well as mixed grain, both are reported), the duration provided to the reinforcer, number of sessions conducted per week (where applicable), the deprivation level stated in the procedure, as well as any body-weight limits specified for session entry (indicated by the symbol ± and the specific limits; absence of the symbol indicates that the precise criteria were not used, or at least not reported). Finally, we note which experiments have reported results inconsistent with the habituation hypothesis; inconsistencies have taken the form of either failing to find robust within-session patterns, or finding limiting conditions on the occurrence of such patterns.

An interesting correlation emerges in that the studies that imposed strict criteria on entry into the experimental sessions were generally those that produced results inconsistent with the habituation hypothesis. McSweeney and Murphy (2000) identified four main studies that were inconsistent with the habituation hypothesis in their examination of the literature (Bizo et al., 1998; DeMarse et al., 1999; Hinson and Tennison, 1999; Palya and Walter, 1997). In searching the literature more recently, we found three additional publications that reported some data incompatible with an explanation by habituation. Two of those studies we have classified as partially consistent and partially inconsistent with the habituation hypothesis (denoted by "Y/N" in the last column of the table). First, Cannon and McSweeney (1995) reported that variables related to satiety factors could influence late session decreases in responding, but only when grain access times were very large, for example, 20-s per access, making that report partially consistent with accounts by both habituation and satiation. Second, McSweeney, Swindell et al. (2004) examined pigeons responding in manipulations designed to examine behavioral contrast. Interestingly, changes in the deprivation operation altered within-session changes in a negative contrast, but not a positive contrast, condition.

Of the seven studies that provided some data inconsistent with the habituation hypothesis, four of those studies reported the use of strict limits to determine a bird's entry into daily sessions. In contrast, there were 12 studies that used pigeons and reported data consistent with an explanation via habituation processes, and of those only one (McSweeney et al., 2004b) reported the use of strict criteria to grant pigeons access into daily sessions. In summary, a review of the literature reveals a correlation between explicitly described body-weight criteria and data that are inconsistent with the habituation hypothesis. We speculated that variations in weight control and deprivation levels across laboratories may have contributed to different experimental outcomes and decided to gather descriptive data on entry criteria and the development of within-session changes. Two conditions were conducted, one in which weight gain across sessions was tightly controlled and a second experiment where such control was minimal.

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