



Development of a One Week Delay Discounting Procedure for use in the Nonhuman Laboratory

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INTRODUCTION

Choice outcomes are discounted by imposed delays. This effect, termed *delay discounting*, is often demonstrated by a higher choice preference for a smaller reinforcer amount delivered sooner, rather than a larger amount delivered after a longer delay.

Degree of delay discounting has been correlated with behaviors exhibited by traditionally impulsive populations, including substance abusers and problem gamblers. Additionally, neural mechanisms involved in choices between delayed outcomes has attracted much attention in recent years.

One limiting factor in assessing discounting is that quantitative determinations of an individual's degree of impulsivity can be quite time consuming. Despite this, few studies have investigated new procedures that could attain a reliable discounting measure in a shorter period of time.

The current study tested and compared results from three variations of delay discounting procedures – one that is widely reported in the literature, and two novel variations. The novel procedures were designed to assess choice behavior in 1-2 weeks. If these methods produce orderly and reliable results, then it could be beneficial to use these procedures in future delay discounting research.

METHODOLOGY

Naïve adolescent Sprague Dawley rats (n = 18) served as subjects beginning on post-natal day 22; sessions were conducted in standard operant chambers containing nose-poke response keys, stimulus lights, and pellet dispensers. Sessions were conducted 7 days per week at approximately the same time day. Subjects were exposed to the discounting procedures in counterbalanced order. For each procedure, subjects were always choosing between having one food pellet delivered immediately (smaller-sooner - "SS") or several food pellets (2, 4, or 8, manipulated across conditions) delivered after some delay (larger-later - "LL").

The main variables of interest are: (a) the number of sessions required to complete each procedure; (b) whether the procedures produce orderly and systematic data across delays and (c) whether the procedures produce orderly and systematic data across amounts.

Within-Session Increasing Delay Procedure (Evenden & Ryan, 1996)

Sessions were split into 8 blocks of trials; each block consisting of **different** LL delays. Stability of behavioral data was analyzed at 30 days.

Across-Session Increasing Delay Procedure

Within each session, subjects made repeated choices between the SS and the LL, with the LL delay **fixed** at either 0, 6, 12, 18, 24, 30, 36, or 42s. This delay incremented either daily ("ID 8" day procedure) or every two days ("ID 16" day procedure).

RESULTS

Figures 1-3: Adolescent rat's individual-subject choices for the LL outcome in 5-trial blocks, as a function of the LL delay. Lines represent the different LL pellet amounts across conditions: 2 (gray), 4 (black) and 8 (burgundy)

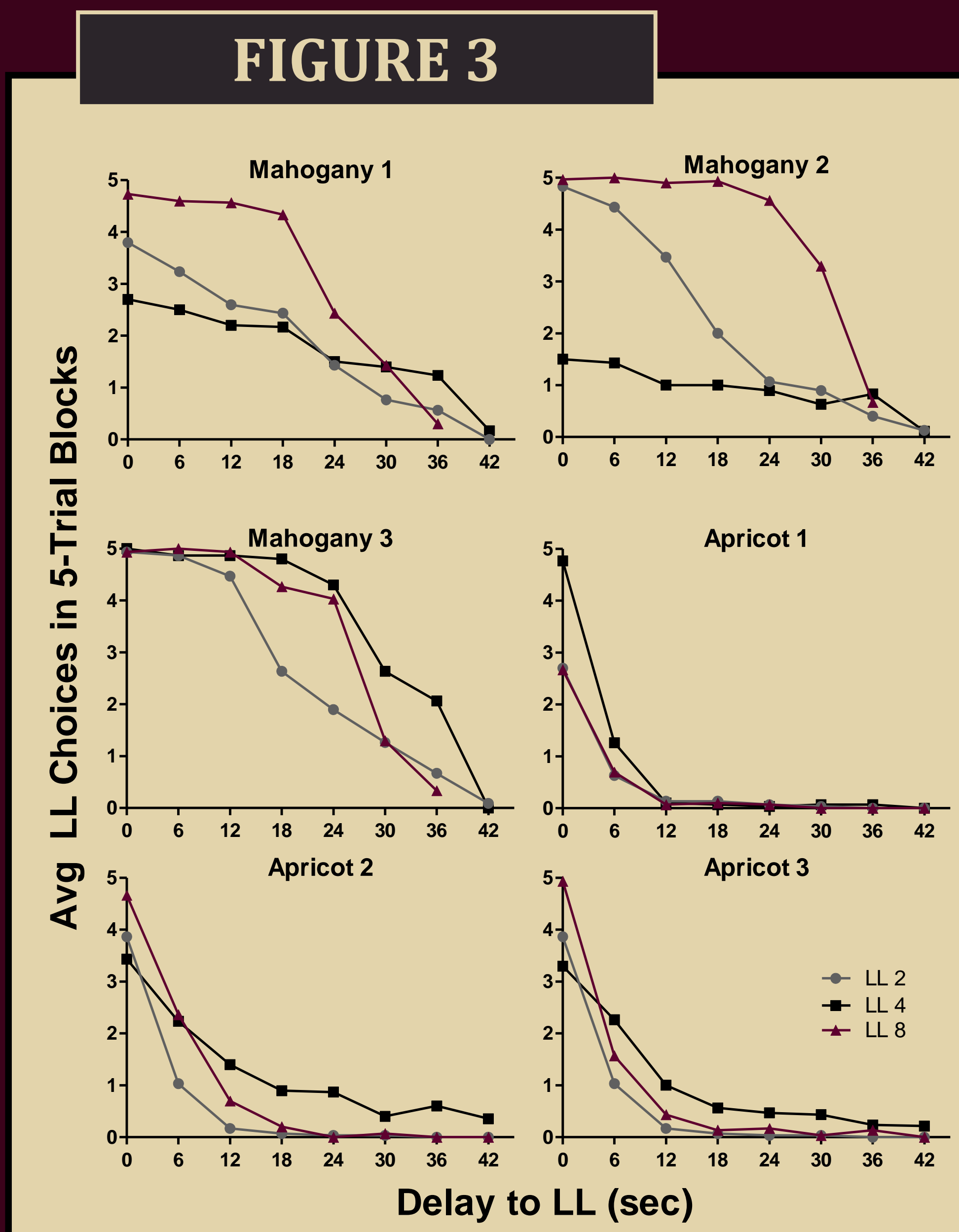
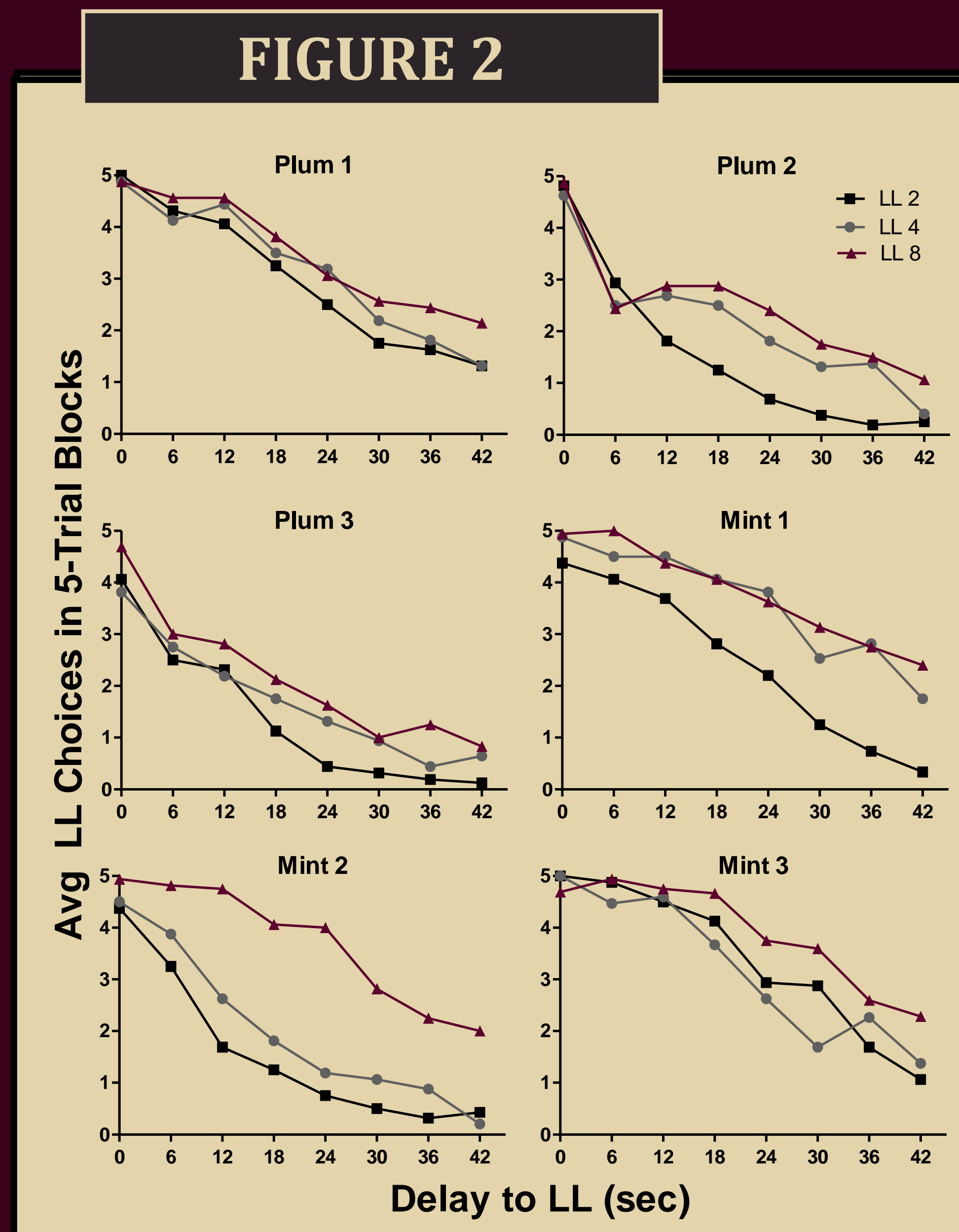
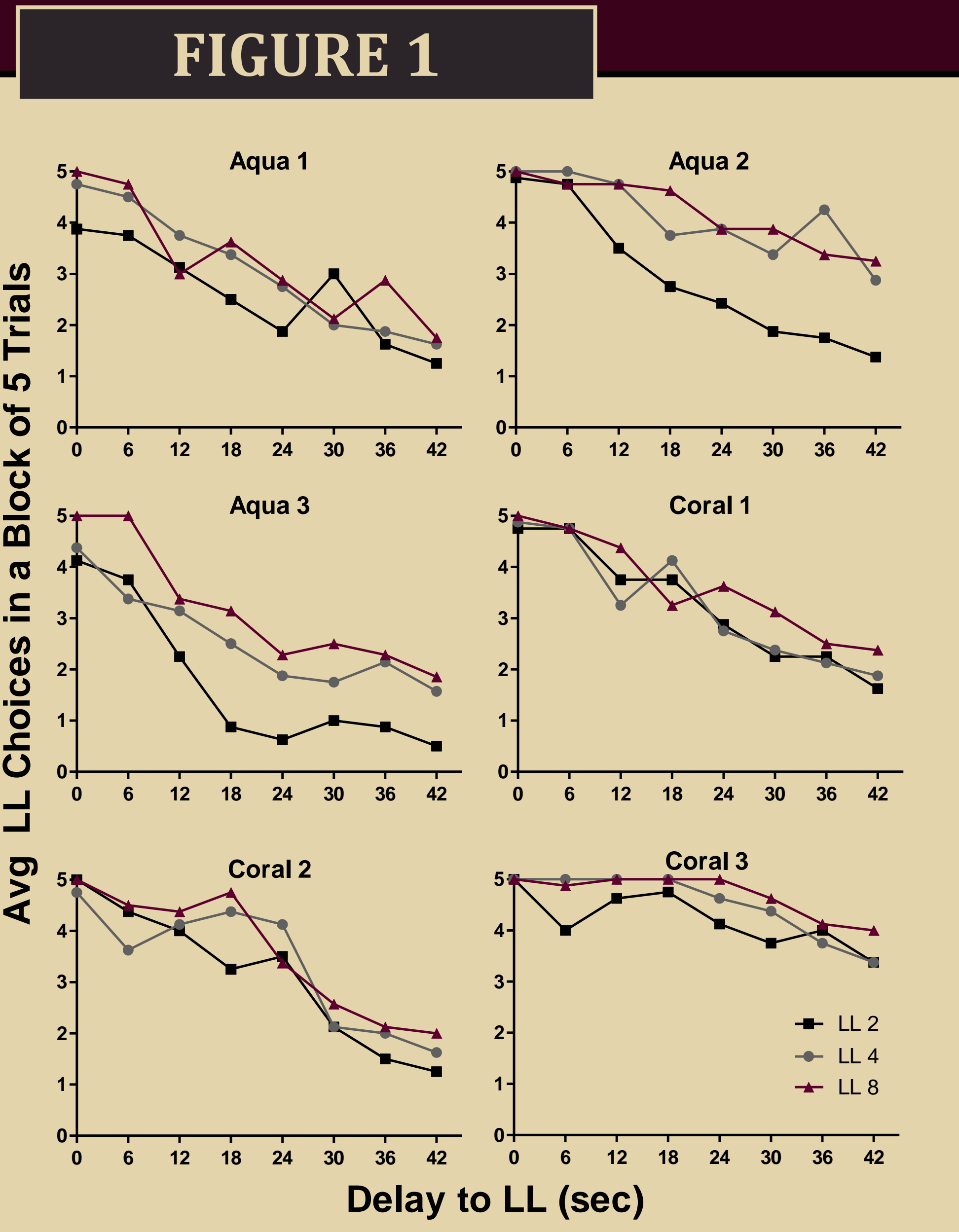
Figure 1: Results from the novel 8 day procedure, where each delay was experienced across sessions – one delay per day.

Figure 2: Results from the novel 16 day procedure, where each delay was experienced across sessions – one delay for two days.

Figure 3: Results from the Evenden & Ryan (1996) procedure, where each subject experienced all delays in every session. Some subjects generated lower points of subjective equality for larger reinforcer amounts.

DISCUSSION

The widely-utilized Evenden and Ryan (ER) procedure historically takes 30 days for data to stabilize. However, the novel procedures allowed researchers to develop orderly curves in one to two weeks. These results indicate that the novel across-session increasing delay task holds promise for shortening the time to achieve an individual discounting measure to only one week, and may actually produce more systematic data than the ER procedure. The ER procedure periodically generated lower Point of Subjective Equality values in higher reinforcer amount conditions (i.e., subjects would wait longer for 2 pellets than 4 or 8), whereas the procedures incrementing delays across sessions produced systematic results. This has clear implications for researchers who utilize delay discounting procedures, and may be particularly valuable for those examining potential correlates with other time-sensitive variables in behavioral, pharmacological, or aging research.



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