AN ASSESSMENT OF MULTIPLE MEASURES OF HONEY BEE (*APIS MELLIFERA LIGUSTICA*) AND HORSE (*EQUUS FERUS CABALLUS*) RESPONDING ON FIXED INTERVAL SCHEDULES: AN INDIVIDUAL VERSUS AGGREGATE ANALYSIS

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Abstract: We compared different measures of temporal control of two species' responding when reinforced on fixed interval schedules of reinforcement. The measures that were evaluated are: cumulative response curves, response bin tallies, quarter life, index of curvature, post-reinforcement pause, inter-response times, trial duration, and response duration. Honey bee (*Apis mellifera ligustica*) and horse (*Equus ferus caballus*) responding was exposed to fixed interval schedules of reinforcement because the former species has not demonstrated evidence of temporally control responding (Grossmann, 1973) while the latter has demonstrated evidence of temporally control responding (Myers and Mesker, 1960); comparing response patterns from temporally controlled versus non-temporally controlled fixed interval performances revealed what measures do, or do not, convincingly operationalize temporal control. To contrast the effectiveness of an individual versus aggregate analyses of these measures of temporal control, both Observation Oriented Modeling and null hypothesis significance testing analysis methods were employed and compared. For most measures and assessments, horses demonstrated consistent evidence of responding coming under temporal control while honey bees demonstrated inconsistent evidence of responding coming under temporal control of the fixed interval schedules.

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INTRODUCTION

Fixed interval schedules of reinforcement are one of the most basic assessments of temporal control and arbitrary timing. In the fixed interval protocol, responding is not reinforced until a prescribed interval of time has elapsed, and the first response after the interval elapses is reinforced (Skinner, 1938; Ferster and Skinner, 1957). When reinforced on fixed interval schedules of reinforcement, responses occurring later in the interval are more likely to be reinforced and thus occur in higher numbers whereas responses early in the fixed interval are less likely to be reinforced and thus occur in smaller numbers. Assuming fixed intervals that are longer than continuously reinforced inter-response times are utilized, after extensive exposure to the fixed interval, responding can be characterized by positively accelerating response levels (a “scallop” in the cumulative curve response record) or by a period of no responding followed by a period of steady responding (a “break-and-run” cumulative curve response record).

Following Skinner's example, an assumption that all organisms produce similar patterns became firmly rooted in early behavioral investigation even though fixed intervals had only been investigated with rats and pigeons. Myers and Mesker (1960) produced one of the first comparative fixed interval investigations that supported a conclusion that responding came under temporal control and displayed a single horse's final fixed interval session's "scalloped" cumulative response curve. In contrast, Grossmann's (1973) honey bees produced the first comparative fixed interval response patterns that did not provide evidence of temporal control as displayed by cumulative response records. Gonzalez, Eskin, and Bitterman (1962) did not produce evidence of temporal control in Tilapia, but Lejeune and Wearden (1991) did find response levels were higher later in the fixed interval for their Tilapia subjects. A recent investigation of honey bee responding (Craig, Varnon, Sokolowski, Wells, & Abramson, 2014) confirmed Grossmann's (1973) initial findings; thus, honey bees are the first species that have been investigated that have consistently failed to produce evidence of temporally controlled responses. While many species have since been investigated, the present investigation re-evaluates these first species beyond rats or pigeons to produce evidence for, and against, temporal control.

While the fixed interval schedule is a basic protocol, at least eleven distinct variables must be considered in comparative fixed interval analyses beyond the initial species difference that draws the majority of comparative psychologists' interest. Failure to properly control these variables renders direct species comparisons difficult at best, and impossible at worst. The comparative psychologists' core interest in species differences requires consideration of these eleven distinct variables, and by association, three distinct hypotheses which could account for observed differences in operant behavior as reported by Richelle and Lejeune (1980; 1984). While more than three hypotheses may exist, the distinctiveness of these hypotheses should allow an abductive inference of the best explanatory hypothesis.

First, the Evolutionary Hypothesis posits that higher-order phyla are more likely to emit temporally controlled responses than lower-order phyla due to evolved emergence in time; the general points of this hypothesis require a focus on ordinal relations of the animal kingdom (largely *chordata*) based on fossil records. In support of the evolutionary hypothesis, Lowe and Harzem (1977) and Lejeune and Wearden (1991) found rats' responding came under greater temporal control than pigeons' responding on a variety of measures including cumulative curves, average post-reinforcement pause, running rate, a 10 bin response tally assessment, and Gaussian curve fit analyses (termed *coefficient of variation*).

Evidence has been produced for almost all mammals and birds that have been investigated that allegedly support the conclusion of responding coming under temporal control of fixed interval schedules. Other than turtle doves (which, curiously, are closely related to pigeons), at least one measure has been observed to support temporal control in "higher-order" animals. In contrast, "lower-order" animals (e.g. reptiles, fish, and invertebrates) have not consistently demonstrated evidence of temporally controlled responses. Laurent and Lejeune's (1985) failure to find evidence of temporal control in turtles, and Kleinginna and Currie's (1979) failure to find evidence of temporal control in kingsnakes renders reptiles as the poorest fixed interval *chordata* performers (this contrasts with the Evolutionary Hypothesis which would predict fish to be the poorest *chordata* performers). While Rozin (1965) and Higa and Simm (2004) have respectively demonstrated temporal control of goldfish and beta Siamese fighting fish responding, unfortunately, no amphibian species have been investigated. Future research with amphibian species may help clarify the difference between fish and reptile performances and refine the Evolutionary

Hypothesis; at present, the Evolutionary Hypothesis is only supported with mammal and bird models.

Second, the Ecological Hypothesis posits selective pressures determine which species may, or may not, come under temporal control of fixed interval schedules. For instance, Boisvert and Sherry (2006) posit the advanced circadian rhythms of bumble bees, and the importance of temporal regulations on bee behavior makes the bumble bee an ideal animal model for timing. Boisvert and Sherry (2006) allude to the Ecological Hypothesis with this statement. While similar to the Evolutionary Hypothesis, the Ecological Hypothesis considers greater subtleties of natural selection such as brain complexity, environmental pressures, and life histories while the Evolutionary Hypothesis only considers evolved emergence via the fossil record. A major issue surrounding the Ecological Hypothesis is the tendency to infer circadian rhythms influence arbitrary timing; however, these processes may be two distinct behaviors (Hills, 2003) that should not be fused together as a single process to avoid the pitfalls equivocation may have on operationalism.

Third, the Reductionist Hypothesis posits that all animals are equally capable of coming under temporal control and the reason species differences are observed is due to instrumental (viz. procedural) considerations that, at present, have largely been neglected in the literature. The Reductionist Hypothesis is a result of Skinnerian and Radical Behaviorism focuses on refinement of instrumentation. At its core, the Reductionist Hypothesis posits that the ability of responses to come under temporal control is a primitive behavior shared by all organisms. However, it is important to mention that the Radical Behaviorists were not *true* comparative psychologists; the vast majority of their hypotheses were supported with only pigeon or rat data (Ferster and Skinner, 1957); thus, the Reductionist Hypothesis may be an artifact of investigating only two species. Moreover, the Radical Behaviorist tendency to over-generalize learning principles without comparative evidence seems written into the Reductionist Hypothesis. In a sense, the Reductionist Hypothesis is the Null Hypothesis of comparative investigations: no differences are observed with ideal instrumentation. Throughout this manuscript, the term “instrumental” should not be confused with instrumental conditioning; our use of the term is limited to procedural methods and measurement.

When considering all of the learning literature, most investigations do support the reductionist hypothesis; however, this is because the Reductionist Hypothesis is difficult to falsify (as are the majority of behaviorist hypotheses). If species differences are not observed, the Reductionist Hypothesis is supported. If species differences are observed, the Reductionist Hypothesis posits instrumentation modifications will result in no species differences. No matter the empiricism, the Reductionist Hypothesis will be supported. This is not the definition of a good hypothesis, but Skinner’s radical behaviorism developed just before Popper’s falsification began to influence hypothesis testing theory; reevaluating the Reductionist Hypothesis seems critical for radical behaviorists and comparative psychologists.

In addition to facilitating species comparisons, understanding the effects and interactions of these instrumental concerns is important from a traditional behaviorist paradigm. Inter-trial response variability when responding is reinforced on fixed interval schedules of reinforcement has been discussed in detail since the schedule’s invention, and Hoyert (1992) posits temporally controlled responding functions under a chaotic (i.e. deterministic) system. Thus, understanding the initial conditions and refining instrumentative or procedural control must be a major focus for not only comparative temporal investigators, but also for behaviorists investigating traditional animal models. Without having a complete understanding of the initial conditions and utilized instrumentation for each subject, temporal control researchers will be unable to account for the response variability within and between trials of fixed interval schedules of reinforcement.

Richelle and Lejeune (1980; 1984) recommend three strategies to assess these three comparative hypotheses. First, comparative psychologists must investigate a greater number of species. Prior to 1960, only rat and pigeon responding was investigated on fixed interval schedules. It was not until Myers and Mesker (1960) exposed a horse and Ginsburg (1960) exposed budgerigars to fixed interval schedules of reinforcement that comparative psychologists began assessing a wider range of species. During the 1960's, a series of comparative fixed interval investigations were conducted in a variety of animals; during the 1970's, interest in drug research motivated primate research; however, by the mid-1980's, comparative fixed interval investigations were neglected. The following investigators were the first to contribute to the comparative temporal control literature for each species: Waller (1961) investigated beagle dogs; Gonazlez, Eskin, and Bitterman (1962) investigated African mouthbreeders; Ferster and Zimmerman (1963) investigated rhesus monkeys; Rozin (1965) investigated goldfish; Cloar and Melvin (1968) investigated quail; Rubin and Brown (1969) investigated rabbits; Haney, Bedford, and Berryman (1971) investigated ravens; Powell (1972) investigated crows; Grossmann (1973) investigated honey bees; Byrd (1973; 1975) investigated chimpanzees and baboons, Barrett (1976) investigated squirrel monkeys Wenger and Dews (1976) investigated mice; Anderson and Shettleworth (1977) investigated golden hamsters; Todd and Cogan (1978) investigated black-tailed prairie dogs; Kleinginna, and

Currie (1979) investigated kingsnakes; Sanger (1979) investigated Mongolian gerbils; Lejeune and Richelle (1982) investigated turtle doves; Laurent and Lejeune (1985) investigated freshwater turtles; Taylor, Haskell, Appleby, and Waran (2002) investigated domestic hens; Higa and Simm (2004) investigated beta Siamese fighting fish; Bosivert and Sherry (2006) investigated bumble bees; and Toelch and Winter (2013) investigated long-tongued bats. Of these investigated species, only turtles, turtle doves, kingsnakes, honey bees, and Gonzalez, Eskin, and Bitterman's (1962) African mouthbreeders have not provided response records that were used to support temporal control.

Second, Richelle and Lejeune (1980; 1984) recommend comparing closely related species rather than a wide variety of unrelated species. With this strategy, instrumental concerns are reduced as similar procedures and automated apparati can but utilized. For example, Cloar and Melvin (1968) compared two species of quail (Bob white quail and Japanese quail) and observed similar performances between species using the same apparatus. Moreover, Lejeune and Wearden (1991) report comparisons between pigeons and turtle doves as well as comparisons between woodmice and rats. Lejeune and Wearden's (1991) coefficient of variation measure indicated pigeon responding came under greater temporal control of the fixed interval schedules than turtle dove responding and revealed striking similarities between woodmice, rats, and cats (the latter species has only been investigated by Lejeune (1971)). As analyzing similar species facilitates similar instrumental protocols, direct comparisons are easier to make compared to the first strategy of comparing multiple, unrelated species.

Evidence to support an additional distinction between the training of radical behaviorists and true comparative psychologists is that, of the wide range of pigeon and rat breeds that have been investigated by behaviorists, no direct comparisons between breeds have been made in either species. Often, fixed interval researchers will simply identify that "rats" or "pigeons" were the models of the investigation and not identify which breed of rat or pigeon was used. If breed differences are observed via Richelle and Lejeune's (1980; 1984) second strategy, archival researchers will be unable to properly evaluate several notable fixed interval publications due to lax descriptions of the animal models.

Third, Richelle and Lejeune (1980; 1984) recommend refining instrumentation to make direct species comparisons more possible. This strategy is a continuation of the radical behaviorist's Reductionist Hypothesis. The refinement of the utilized instrumentation in the comparative fixed interval literature has been discussed by previous authors, but no publications discuss more than a few possible instrumental concerns. Laurent and Lejeune (1985) and Higa and Simm (2004) identified five separate considerations comparative psychologists must address.

First, the **response** under investigation must be considered; the assumption that operant responding is similar across responses is likely false and serves to undermine parsimony concerns. When considering the traditional animal models, a key-press in a pigeon is a fundamentally different operant behavior than a lever-press in a rat, yet direct comparisons have been attempted (e.g. Lowe and Harzem, 1977). For example, within the invertebrate fixed interval literature, three responses have been assessed within two species. In bumblebees (Boisvert and Sherry, 2006), a proboscis extension response was assessed whereas in honey bees (Grossmann, 1973; Craig et al., 2014), a head-enter response and a full-body-enter response were assessed, respectively. Immediately, even when considering the similarity of the investigated species, a direct comparison of operant learning becomes impossible. For comparative psychologists, considering the operant response under investigation is an assessment of the Ecological Hypothesis. Craig et al. (2014) utilized a full-body-enter response into an automated flower for honey bee subjects; subjects had to enter a hole similarly to how honey bees enter a flower.

Within the vertebrate literature, many responses have been investigated. Key-presses dominate the fish literature, lever-presses dominate the mammal literature, and key-presses dominate the bird literature. Perhaps one of the most interesting responses that have been investigated by temporal control researchers is the vocalization response used by Ginsburg (1960) with budgerigars wherein subjects had to vocalize to receive seeds as reinforcement. Selecting a response that the subject has been naturally selected to emit is a difficult task in practice while selecting a comparable response across species is a theoretically difficulty task. As the Reductionist Hypothesis suggests *some* response can be used to demonstrate temporal control, simply claiming no timing was observed when investigating only one response may contribute a false conclusion to the literature.

A second instrumental concern identified by Laurent and Lejeune (1985) and Higa and Simm (2004) is the utilized **reinforcer**. All invertebrate fixed interval behaviors have been investigated by reinforcing responding with a sucrose solution, so within this subset of the temporal control literature, sufficient control has been established for this variable, but a reinforcer artifact may be present. In the vertebrate fixed interval literature, many reinforcers (and shock as a punisher) have been used, but the majority of reinforcers have been consummatory (e.g. grain, pellets, milk). Higa and Simm (2004) offer the largest departure from the traditional forms of consummatory reinforcement by providing mirror exposure to beta Siamese fighting fish. The betas would reliably swim through a hoop for exposure to a “social reinforcer” (i.e. seeing themselves in a mirror), and this hoop-swimming response came under temporal control of fixed interval schedules.

A third instrumental concern is the **number of trials**, or reinforcers, per session and per individual. The main concern Richelle and Lejeune (1980; 1984) voice regarding their third strategy of refinement of instrumentation was that the speed of acquisition of temporal control may vary greatly between species; thus, selecting an appropriate number of trials and thus exposures to the fixed interval schedules is paramount. Relatedly, the number of hours of exposure to the schedule (a combination of number of sessions and number of trials) is an important instrumental concern. Unfortunately, substantial exposure to fixed interval may be difficult for some comparative investigations. For example, a subject’s lifespan or sleep/wake cycle could limit extensive exposure to fixed interval schedules.

A fourth instrumental concern is the number of investigated fixed intervals, and **the schedule durations** utilized by the researcher. Throughout the fixed interval literature, FI 30-sec, FI 60-sec, FI 120-sec, and FI 180-sec appear the most commonly investigated schedule durations; however, FI 300-sec, FI 600-sec schedules are also common. Schedules over 15 minutes are less common, but sparsely appear throughout the literature (e.g. Cumming and Schoenfeld, 1958). Direct comparisons wherein a species’ response patterns are directly compared with a second species’ response patterns are obviously impossible at different schedule durations; comparing response patterns of a turtle on an FI 30-sec with those for a turtle on an FI 60-sec is inappropriate, let alone with a kingsnake on an FI 60-sec. Consistent FI durations must be utilized by comparative psychologists. An important interactive effect between schedule duration and species (from an Ecological Hypothesis perspective) is that a species’ metabolism or circadian rhythms may impact its ability to come under shorter or longer schedule durations. For example, consider kingsnakes which evolved a metabolism around weekly meals (Secor and Diamond, 2000). Perhaps, Kleinginna, and Currie (1979) inappropriately dismissed kingsnakes as a potential model of temporal control because of the relatively short schedule durations that were selected to compare with performances of high-metabolizers such as a rat or pigeon. Perhaps kingsnake responding can come under temporal control of longer schedules, but not shorter schedules. Hence, a greater variety of fixed interval schedules must be investigated.

The final instrumental consideration identified by Laurent and Lejeune (1985) and Higa and Simm (2004) is the drive-level, or **motivating operation** of the procedure. This instrumental consideration is obviously related to the utilized reinforcer. The typical motivating operation is to deprive subjects of food to 80% of their free-feeding body weight. To date, no fixed interval investigations have systematically manipulated free-feeding body weight percentages, so direct comparisons of the effects of varying percentages of free-feeding body weight have not been made; however, most investigations vary between 75% – 90% free-feeding body weight, so between publication comparisons may be possible. However, Weiss and Moore (1956) investigated food deprivation as defined by time since last feeding and observed longer food deprivation intervals produced higher response rates on fixed interval schedules. Thus, the motivating operation is an important consideration that has not been assessed in fixed intervals in over half a century.

While Laurent and Lejeune (1985) and Higa and Simm (2004) provide separate, but overlapping, lists of important instrumental concerns for comparative psychologists; these lists are not exhaustive and many other instrumental considerations must be made. As mentioned previously, the number of trials is an important consideration, but the **number of**

sessions is also an important consideration for the same reasons as considering the number of trials (viz. total exposure to the schedule). The primary concern regarding the number of sessions involves data analyses; "warm up" effects are often disregarded in favor of analyses of stable-state responding. Hence, it is important to consider which sessions will make up the data analyses and thus how many sessions are required to assess temporal control. Moreover, the inter-session interval must be addressed, and while Neuringer and Schneider (1968) manipulated inter-trial intervals via blackouts (i.e. lights in the operant chamber were turned off), only one systematic manipulation of inter-session interval has been conducted; Gleitman and Bernheim (1963) manipulated a test inter-session interval to either 24 hours or 24 days under a neo-behaviorist attempt to assess retention and long term memory. Longer inter-session intervals resulted in more responding early in the interval thus reducing temporal control.

Laurent and Lejeune (1985) and Higa and Simm (2004) discuss the importance of considering the utilized reinforcer but do not discuss the impact of the **amount of each reinforcer**. Unfortunately, the fixed interval literature is punctuated with investigations that do not precisely measure the amount of reinforcement; rather than define their reinforcer as a weight, a time of exposure to reinforcement will be provided (this is an indirect measure of consumed reinforcement). However, assessing the effect of the amount of each reinforcer is difficult, for doubling the size of the reinforcer between conditions adds confounds related to increasing the size of a consumable (e.g. more time required to consume the reinforcement, different stimulus properties associated with size). For these reasons, Guttman (1953) recommends assessing the impact of the amount of each reinforcer via systematic manipulations of reinforcer concentration. Thus, the stimuli properties related to size are not affected by the manipulation, and the amount of time to consume the reinforcement is not impacted by the manipulation. Lowe, Davey, and Harzem (1974) also assessed reinforcement concentration and found higher concentrations increase post-reinforcement pause, but not average response rate; thus, higher concentrations improve temporal control.

An additional concern is that **multiple protocols** are inconsistently utilized within the fixed interval literature. The most basic protocol difference is the utilization of between-subject or within-subject protocols and condition assessments. The within-subject protocol incrementally increases the fixed interval schedule duration (e.g. condition 1 is an FI 0-sec, condition 2 is an FI 3-sec, condition 3 is an FI 30-sec, condition 4 is an FI 90-sec). The between-subject protocol tends to assess the immediate shift from a baseline performance to a specific fixed interval schedule (e.g. group one is tested on an FI 30-sec and group two is tested on an FI 90-s). While Dermer and Hoch (1999) make excellent arguments discrediting objections to within-subject protocols, the criticism of order effects is especially difficult for schedule assessments where previous reinforcement history is the object of investigation; hence, between-subject or mixed-design protocols may be preferable. Dermer and Hoch (1999) make three recommendations to assess order effects, but these recommendations may be difficult to utilize during fixed interval investigations. First, randomizing or counterbalancing conditions and averaging performance is inappropriate given the goal of incrementally increasing schedule duration. Second, reducing carryover effects or history confounds by increasing inter-session intervals is also inappropriate given Gleitman and Bernheim's (1963) demonstration of the negative effect of longer inter-session intervals on temporal control. This leaves the third recommendation; measuring or assessing multiple treatment interactions via independent verification such that a treatment is assessed alone and in combination is the only way to assess the impact of order effects for fixed interval investigations. However, in order to do this, a between-subject protocol must be used (mixed-design). Thus, in order to contend with protocol differences in between-subject and within-subject designs, a culture of mixed-designs may be beneficial if adopted by fixed-interval investigators (and psychologists in general).

A second protocol difference is the onset of the fixed interval schedule within a session. Traditionally (Ferster and Skinner, 1957), reinforcement delivery restarted the fixed interval schedule. This provides a clear stimulus for the subject as reinforcement delivery is marked/signaled via mechanical sounds as reinforcement is delivered. However, Mechner, Guevrekian, and Mechner (1963) and Shull (1970) utilized a response-initiated protocol wherein subjects reentered a fixed interval schedule after consuming the reinforcement and making a response. This protocol essentially subtracts the amount of time required to consume reinforcement from a post-reinforcement pause measure (more appropriately labeled as "latency" in a response-initiated protocol). Surprisingly, few subsequent investigations using a response-initiated protocol have been conducted.

A third protocol difference is the departure from the fixed interval procedure in favor of Scalar Expectancy Theory related protocols such as Church and Gibbon's (1982) temporal generalization protocol, Stubbs (1976) temporal bisection task, or Catania's (1970) peak procedure. These protocols are extensions of the fixed interval, but a comprehensive comparison between methods has not been established. Comparative investigators face a major challenge when attempting to compare animal and human timing performances, for most modern human investigations utilize temporal bisection or temporal generalization tasks while modern animal investigations utilize peak procedures (e.g. Toelch and Winter, 2013).

An additional instrumental concern is the **marking stimuli** used in the protocol. Multiple types of signals, or secondary reinforcers, have been used in fixed interval investigations to indicate a variety of procedural events. Reinforcement signaling is fairly common; when reinforcement becomes available, a light or sound will signal reinforcement delivery. This type of signal reduces reinforcement delays, and should improve temporal control without impacting the fixed interval schedule with stimuli confounds. However, some investigations have marked the fixed interval schedule; a signal will be made when the interval is initiated and/or has terminated. This type of marking stimuli is theoretically problematic for temporal control researchers, for the subject can simply use the signals to discriminate when responding will be reinforced; the protocol no longer assesses temporal control but is merely a discrimination assessment. Ferster and Zimmerman (1963) extended Ferster and Skinner's (1957) investigations with signals for the remainder of the fixed interval (essentially physical clocks); both investigations found signals improved temporal control, but teasing apart the effect of physical discrimination with temporal discrimination is not possible with a marking procedure. Clearly, carefully selecting marking stimuli is an important task for comparative researchers.

Unfortunately, comparative psychologists have not performed **replications** to improve their inductive processes for the majority of species exposed to fixed intervals. Myers and Mesker (1960) are the only publication assessing horse timing, and they used a single horse before concluding horse responding can come under temporal control. Lejeune and Richelle (1982) only assessed four turtle doves before concluding turtle doves do not come under temporal control. Comparative psychologists must consider that representative samples for all but two of the investigated species (i.e. rats and pigeons) have not been established; previous indirect species comparisons will not hold if a replication counters the original publication. Most temporal control investigations use limited sample sizes, and if an individual analysis is employed, each subject can be considered a replication. However, if aggregate or group analyses are employed, increasing group sizes does not address replication concerns. Replications of some form must be conducted for comparative psychology to gain an understanding of temporal control before generalizations (like the Reductionist Hypothesis) can be made.

The final instrumental consideration concerns protocol **dependent variables** and their analyses. In order for comparative temporal control investigators to make claims about species' differences, standardizing the operationalism of "temporal control" is paramount. Zeiler and Powell (1994) attempted, as have others, to establish an operational definition of "temporal control," but these attempts at standardization have largely been ignored in favor of an unsystematic utilization of a variety of dependent variables across research teams. The fact remains that many different dependent variables and data analyses have inconsistently been used to infer, or reject, temporal control. Rather than limit which dependent variables should be used to infer temporal control, we recommend comparative investigators conduct multiple assessments of each of the common operationalisms of temporal control; the most common measures are described below.

Traditional Fixed Interval Measures

<u>Cumulative Curves</u>

Ferster and Skinner (1957) established the fixed interval tradition of including individual's cumulative response records as well as the trend of plotting cumulative response records to describe behavior; these depictions presented time throughout the interval on the abscissa and discrete response tallies on the ordinate. Technological limitations of Skinner's cumulative responder visually connected each response and created a tradition of conceptualizing discrete responses as occurring continuously throughout the interval despite the departure from realism this practice required; responding either occurs or does not occur, but Skinner's description of response rates implies continuous responding throughout the interval. Responding is discrete and thus cannot produce a continuous rate; there is no continuous change in space-time of a response as a lever-press is not constantly in flux; using the term "rate" inappropriately draws from relations of distance and time. Responding is not comparable to a vehicle speeding along a road as implied from a term like "rate." In practice, the drawn line between responses likely cultivated a culture within radical behaviorism that focused on response rates rather than conceptualizing responding as discrete occurrences; plotting each response's occurrence within the fixed interval without connecting each response with a horizontal line would have been a more appropriate practice that may have avoided construing responding as occurring continuously throughout the interval. The use of the term response "rate" rather "levels," and the development of a later measure, the index of curvature, provide evidence to substantiate the claim that early fixed interval researchers may have inappropriately considered responding as a continuous process.

Skinner's cumulative curves were qualitative in nature and could only depict individual response patterns of a series of trials; visual inspections offered the only means of analysis and aggregate cumulative curves were impossible to create. After quantitative measures of inter-response time allowed cumulative curves to be reconstructed post-hoc, aggregate cumulative curves could be created to combine inter- or intra-individual trials and sessions. An important consideration is if the cumulative curves (and binned response tallies) are of individual's trials, or are averages of individuals' or groups' responding. Branch and Gollub (1974) famously cautioned against the use of aggregates for response rate analyses, for individuals exposed to extensive numbers of fixed interval trials tend to exhibit "break-and-run" patterns of responding (Cumming and Schoenfeld, 1958; Schneider, 1969) but aggregating response rate distributions produced artifact "scalloped" cumulative curves. Surprisingly, after Gollub (1964), few temporal control publications have displayed individual cumulative response curves. For these reasons, we recommend assessing and reporting individuals' cumulative curves as a qualitative indicator of temporal control.

If conforming to the quantitative imperative is judged as a worthwhile endeavor, plotting cumulative response duration rather than cumulative response tallies on the ordinate may bring temporal control researchers' classic assessment to a truly quantitative depiction of responding in the fixed interval. While response tallies are a discrete, non-continuous measure, response duration is a truly continuous measure that conforms to additivity as well as density requirements for a measure to be considered continuous (Michell, 1997). By plotting cumulative response duration on the ordinate, the abscissa and ordinate will depict the same unit to create meaningful operationalizes with clear units. Additionally, the recommended modified cumulative response record may provide a more detailed visual analysis of responding within the fixed interval, for the ordinate can depict response duration patterns rather than only displaying response tallies. Thus, in addition to presenting traditional cumulative curves with cumulative response tallies on the ordinate, we also recommend displaying modified cumulative curves with cumulative response duration tallies on the ordinate.

Binned Response Tally

The most common measure in the fixed interval literature is a *binned response tally* wherein the interval is divided into a number of bins (i.e. equal divisions), and response tallies for each bin are calculated. Higher response tallies in later bins within the interval produces evidence of temporal control. Weiss and Moore (1956) were the first to publish a binned analysis of fixed interval responding, and the measure continued to be utilized into the 1990's (Lejeune and Wearden, 1991). The most apparent issue with binned response tallies is the determination of an appropriate number of bins. Should the analysis use two bins and divide the interval in halves, and simply assess if more responses occur in the last half of the interval compared to the first half of the interval, or should the experiment use 10 bins or even 20 bins for a more detailed analysis?

For species that have not yet emitted temporally controlled responses in the literature, assessing response distributions using only two bins is an appropriate, albeit crude, method of determining if a greater number of responses occur later in the interval, for assessing response tally ordinal differences between the first half and the second half of the interval answers the most basic question: do more responses occur later in the interval compared to the first half of the interval? If a two bin response tally comparison reveals more responses occur later in the fixed interval, an appropriate follow-up assessment would be to divide the interval into a greater amount of bins to create a finer depiction of responding across the interval. As reinforcement probability increases as the interval approaches completion, a monotonic ordinal increase in response tallies across bins would support a conclusion of temporal control; however, dividing the interval into too many bins will inevitably create empty bins that will disrupt the monotonically increasing ordinal response pattern; hence, the researcher must cautiously select the number of bins to divide the interval. Dividing the interval into 10 bins under the expectation that response tallies will monotonically increase across the bins within the interval is the most common method. However, investigating the monotonically increasing ordinal pattern is the only ordinal prediction that is usually made; responding may be better characterized by other ordinal predictions.

We believe comparative fixed interval investigations may benefit from chucking responses into four bins in addition to using two and 10 bins. A four bin analysis provides the researcher with a manageable number of other predictions that may more appropriately fit the data. If responding fits a qualitative “break-and-run” pattern rather than a “scalloped” pattern, predicting the first two (or three bins) contain the same number of responses while the final fourth bin contains the greatest number of responses may be a better ordinal prediction to compare with the observed data instead of a monotonically increasing pattern prediction. In using four bins, the researcher may posit a manageable number of different ordinal predictions accounting for the four bins’ response tallies and can compare each ordinal prediction with the observed data to determine which ordinal prediction best fits the observed data. Four of these ordinal predictions may be most useful in determining if the response patterns can be characterized as coming under temporal control. Examples of these predictions are depicted in Figure 1.

Assessing a four bin analysis from an individual paradigm generalizes from the two-order ordinal response bin prediction described in Craig et al. (2014). If response bins were inappropriately taken to contain continuous scales of measurement, as is the trend in the fixed interval literature, an analogous null hypothesis significance testing assessment for a two-bin comparison would be a dependent t-test while the proposed four-bin comparison would be comparable to a repeated measures ANOVA. However, for the temporal control researcher that remains mindful of the continuity assumption of all general linear model assessments, Wilcoxon Signed-Rank and Friedman tests would be the most appropriate non-parametric null hypothesis significance testing assessment.

Figure 1: *Four Bin Ordinal Predictions*

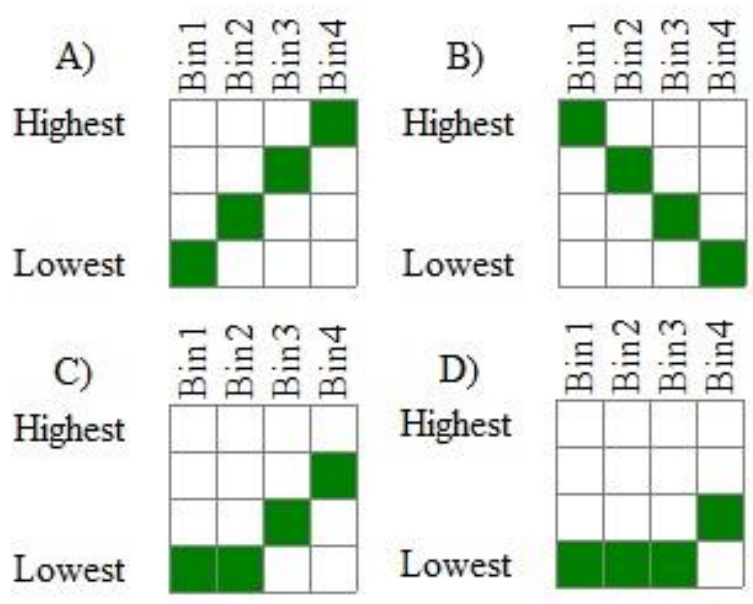


Figure 1 shows examples of ordinal predictions using four bins; A) demonstrates a "scalloped" pattern assessment; B) demonstrates a "break-through" pattern assessment; and C) and D) demonstrate possible "break-and-run" pattern assessments.

Quarter Life

Herrnstein and Morse (1957) defined the *quarter life* measure as the interval of time in which the first quarter of total responses made during the fixed interval occurs. Herrnstein and Morse (1957) found pigeon's quarter lives typically occur within ¾ to ⅘ of the fixed interval; this means ¾ of the total responses emitted in each trial tend to be clustered during the final fraction of the fixed interval. Quarter life was investigated up until the 1970's; future investigations may consider returning to this measure. Quarter life offers a simple assessment of a single trial's responding prior to reinforcement delivery and provides an interesting quantitative summary of responding within the interval. The major limitation of quarter life is that four responses must be emitted in order for a quarter life to be calculated; perfect fixed interval responding wherein the subject emits a single response as soon as the interval elapses cannot be captured by quarter life. However, quarter life may be especially useful for comparative investigators as the assessment offers an indirect species comparison that may determine when multiple responses begin to be emitted.

Direct quarter life comparisons can be made between and within species under ideal conditions. Combinations of one session's trials' quarter lives can be compared against a second (or more) session's trials' quarter lives. As quarter life is a truly continuous measurement (e.g. milliseconds), null hypothesis significance testing alternatives may appropriately involve either t-tests or ANOVAs.

Index of Curvature

Fry, Kellehler, and Cook (1960) defined the *index of curvature* measure. We contend the index of curvature may be an artifact of Skinner's method of treating responses as a continuous, rather than a Poisson, process. The index of curvature compares responding in the fixed interval with a steady-state of responding. Integrals of "scalloped" performances are subtracted from integrals of a steady-state response slope; higher indices of curvature indicate better temporal control. A criticism of the index of curvature is that subjects emitting break-through patterns (i.e. extinction bursts) may produce indices lower than subjects with “scallops;” hence, individual trials must be assessed. However, Gollub (1964) observed that the index of curvature is highly correlated with quarter life, and that response rate is only moderately correlated with quarter life and index of curvature. An important criticism surrounding the index of curvature returns to the same criticisms of Skinner’s cumulative response curve; responding is not continuous throughout the fixed interval, and taking integrals of cumulative response curves further departs from the reality of discrete responding.

Conceptually, an index of curvature can be modified to accommodate a realist perspective using a similar strategy previously presented to contend with traditional cumulative response curves via a few simple modifications. The temporal control researcher can depict response duration on the ordinate rather than response tallies to create a Cartesian system around a single unit (e.g. milliseconds). Clearly, a response duration cannot be positively accelerating, and because the abscissa and ordinate are of the same unit, a 45° line with a slope of 1 can be drawn from the initiation of the response to the completion of the response.

Using simple geometry, the duration of the each response in the trial can be used to calculate the area under each response duration’s line. As the abscissa depicts the time within the interval and the ordinate depicts the cumulative response duration, the trial’s first response’s duration can be squared and divided by two to calculate the response duration’s area under the response duration’s line. As the ordinate depicts the trial’s cumulative response duration, the area of the subsequent response durations can be calculated by squaring a subsequent response’s duration and dividing by two (i.e. to calculate the area of the new response duration) and adding this value with the current cumulative response duration multiplied by the interval of time between the current response's termination and last response's termination. For the final response of a trial, the initiation of the final cumulative response duration can be multiplied by the final inter-response time. This means the subsequent trial incorporates the area of the final response duration of the last trial, so short final responses favor the subsequent trial's index of curvature.

Finally, the temporal control researcher can calculate the inter-response time areas by multiplying an inter-response time with the current cumulative response duration as determined by the previous response's termination. Summing all response duration areas and inter-response time areas produces the area under a modified cumulative response curve. In order to calculate a modified index of curvature for each trial, the temporal control researcher can draw a uniform line between (0, 0) and (trial duration, final cumulative response duration) and subtract the area under the modified cumulative response curve from the area under the uniform response line (calculated by multiplying the trial duration by the terminal cumulative response duration and dividing this value by two). To treat our indices of curvature as realistically as possible, we did not perform the final limit transformations to the observed indices of curvature as reported in Fry, Kelleher, and Cook (1960)

For a direct species comparison under appropriate conditions, combinations of trials' indices of curvature can be compared across species following an *a priori* ordinal prediction that would ideally be based in the evolutionary or ecological hypotheses. Alternatively, direct species comparison using aggregate analyses could be accomplished by utilizing an independent t-test or one-way ANOVA.

Breakpoint

Schneider (1969) revolutionized fixed interval investigations by measuring inter-response time instead of merely tallying responses in bins and their approximate time of occurrence. With precise measures of inter-response time, response rates would no longer need to be binned; precision of instrumentation had finally been achieved. Most importantly, Schneider (1969) brought the fixed interval literature to a true measurement of continuous, additive, and quantitative variables (i.e. time). Responses no longer had to he simply tallied; the amount of time between each response could be measured. Schneider (1969), with his newly utilized inter-response times, sought to identify the *time of breakpoint*, or the time when responding shifts from low response rates (with long inter-response times) to high response rates (with short inter-response times). However, Schneider straddled both a bin paradigm and continuous responding paradigm despite the developments his inter-response time measurement allowed. Schneider conceptualized responding as occurring continuously throughout the fixed interval, but used binning methods to calculate breakpoint. Breakpoint was estimated by performing regressions to estimate the average breakpoint; however, this method contrasts with the discrete bins that were regressed (Schneider, 1969).

Conceptually, an identification of breakpoint may be modified to accommodate a realist perspective using a similar strategy previously presented to contend with traditional cumulative response curves and indices of curvature. For a breakpoint assessment, the temporal control researcher is provided an option of plotting the response tally or response duration on the ordinate; however, the present explanation will concern itself with response tallies as this was Scheider's focus. Generalizing the present explanation of response tallies to response durations follows the same methods as described when discussing modified cumulative cures and indices of curvature.

Rather than estimate the time of breakpoint via Schneider's tracing method, or mathematically performing two regressions using least squares methods to find the intersection point of these lines, a modification of a breakpoint may seek to identify the time of the response that initiates the second response pattern state (i.e. when responding shifts to a high rate) via comparing the slope of a hypothetical uniform response pattern identified as the line between (0, 0) and (trial duration, final cumulative response tally) with the slope of a response (time from initiation of the fixed interval, response tally) to the terminal response of the trial (trial duration, final cumulative response tally). To calculate the breakpoint, the slope of each response to the terminal response can be calculated and compared to identify which response resulted in the largest change in slopes compared to adjacent response slopes. Under ideal response patterns, breakpoint may be calculable via these methods. However, imperfect response patterns may not provide slopes that clearly shift towards being consistently high, so breakpoint is likely difficulty to identify via these methods.

To infer temporal control at varying fixed interval durations, combinations of each interval's breakpoints can be compared under an ordinal prediction that longer fixed intervals will produce longer breakpoints. Independent t-tests or oneway ANOVAS of breakpoints could be used as an aggregate analysis analogue utilizing null hypothesis significance testing methods if response durations are compared; if response tallies are used, Kruskal-Wallis or Mann-Whitney U assessments may be more appropriate for a breakpoint analysis.

Post-reinforcement pause

With the refinement of instrumentation that allowed precise measurement of inter-response time, the *post-reinforcement pause* (PRP) began to garner attention by temporal control researchers. One method of assessing post-reinforcement pause is to simply compare PRPs across schedule durations (Duckich and Lee, 1973). Unsurprisingly, Duckich and Lee (1973) observed PRP correlates highly with quarter life, and thus with an index of curvature; longer schedules produced longer PRPs. However, Duckich and Lee (1973) posited other measures that were related to PRP such as time to the fourth response of the trial.

PRP has been observed to be highly variable, so attempts were made to decrease the inter-trial variability of PRP within individuals, conditions, and groups. Duckich and Lee (1973) also posited a *running rate* measure which was designed to assess response rates without the influence of the PRP. Duckich and Lee (1973) defined running rate as the number of responses divided by the fixed interval minus the PRP. Other investigators weighed in to the issues surrounding separating response rate from PRP. Lowe and Harzem (1977) redefined running rate as the inter-response time between the first and second response. Hanson and Killeen (1981) defined *pause length* as the mean and standard deviation of the midpoint of the first and second consecutive bins with responses. Shull (1971) performed a series of *autocorrelations* of PRP to assess inter-trial variability. Autocorrelations approaching -1 indicate the PRP varies widely between trials whereas an autocorrelation approaching +1 indicate the PRP is consistent between trials. However, Wearden and Lowe (1983) have posited autocorrelations do not capture all of the dynamics of temporal control (in assessing PRP, only the first response was being assessed), and as a correlation is dependent on aggregate least squares methods, no realist modifications can be ventured for autocorrelation assessments.

Single trial PRPs easily lend themselves towards individual analyses methods. Combinations of control continuous reinforcement trial PRPs can be compared with combinations of fixed interval PRPs under a two-order ordinal comparison under the prediction fixed interval PRPs will be longer than continuous reinforcement as reported in Craig et al. (2014). The null hypothesis significance testing analogue to this method would be an independent t-test. Moreover, like the generalization from a t-test to a one-way ANOVA, the proposed method could also be used to make three-order (or more) ordinal comparisons comparing multiple fixed interval durations (e.g. CRF < FI 60-sec < FI 90-sec < FI 180-sec).

With the advent of inter-response time measurement, *Gaussian curve fitting* became possible. Essentially, the cumulative response curve of each trial, or averages of cumulative response curves, are fit to a Gaussian curve while holding the peaks constant. Via this method, "scalloped" cumulative response curves (rather than "break-and-run" cumulative curves) could be assessed. Cheng, Westwood, and Crystal (1993) were able to easily fit aggregate data with Gaussian curves, but individuals' response curves did not fit the Gaussian curves. Rather than discuss this finding similarly to Branch and Gollub (1974), Cheng, Westwood, and Crystal (1993) ignored this critical observation. Out of the Gaussian curve fit measure, Lejeune and Wearden (1991) developed their *coefficient of variation* wherein the standard deviation of the Gaussian curve is divided by the fixed interval duration. Higher coefficients of variation imply lower levels of temporal control. The advantage of the coefficient of variation is its standardizations; hence, direct species comparisons are appealing. However, both of these dependent variables remain entrenched in a continuous responding paradigm, and comparing a discrete response assessment with a continuous curve is a fundamentally flawed endeavor, and no modifications to these assessments are possible from a paradigm that does not conceptualize positively accelerating curves.

Alternative Fixed Interval Measures

Inter-response time

Clearly, an all-encompassing measure that assess response patterns throughout the entire fixed interval needs to be adopted by temporal control investigators and relying on *inter-response time* (IRT) seems to theoretically be the best measure to remain grounded in the quantitative imperative. Conceptualizing behavior as a discrete Poisson process, or as continuous response durations/forces is one side of the coin; focusing on the time between responses is equally important. Gentry, Weiss, and Laties (1983) proposed an ordinal analysis of IRT within the fixed interval, but other than this assessment, ordinal analyses of IRTs have been largely neglected by fixed interval investigators. Under the prediction that monotonically decreasing IRTs will occur within the fixed interval, fixed interval researchers can use a clear model to assess observations' fit; we recommend returning to Gentry, Weiss, and Laties's (1983) measure, for this method would eschew aggregate analyses and would provide a detailed analysis of individual trials, subjects, and pooled conditions.

However, Gentry, Weiss, and Laties (1983) report only aggregates, not individual trials, fit the ordinal prediction. If individual trial IRTs across the fixed interval do not fit a monotonically decreasing ordinal prediction, the revered "scalloped" response pattern would have to be reevaluated. For this reason, comparing the individual ordinal analyses with a repeated measures ANOVA may be particularly enlightening for an inter-response time analyses; however, these assessments would be complicated due to varying numbers of responses per trial.

Trial duration

Rather than focus on the beginning of the response pattern via an assessment of PRP, *trial duration* may be the simplest assessment of responding towards the end of the fixed interval. Ideally, a subject's temporally controlled responding would not be characterized by a "scalloped" or "break-and-run" response pattern, but by the emission of a single response as soon as the interval elapses; non-contingent responding (i.e. the responses that make-up a "scalloped" of "break-and-run" cumulative response record) demonstrates imperfect temporal control. Hence, all of the previously discussed dependent variables are utilized to investigate a relatively liberal operational definition of temporal control. Assessing trial duration focuses on the temporal location of the contingent response. Trial duration can be used to assess temporal control improvement between trials or sessions. An individual analysis could compare combinations of the first session's trial durations with later sessions' trial durations, and aggregate methods could employ t-tests or ANOVAs.

Response duration

An additional recommended dependent variable that has received little attention by temporal control researchers is a *response duration* assessment. This assessment is a continuation of the substitution of discrete response tallies in favor of continuous response durations as previously described regarding the recommended modified cumulative response record. Like the ordinal IRT analyses, the temporal control researcher can predict monotonically decreasing (or increasing) response durations across the fixed interval. As an abductive method requires evidence before positing a hypothesis, and as no response duration assessments have been reported in the fixed interval literature, no hypo-deductive model can be posited at this time. Indeed, two patterns may exist, and both seem viable from a timing perspective; hence, both ordinal predictions may be helpful to further describe temporally controlled responding.

Present goals

The present investigation compared horse responding with honey bee responding and provides the first comparison between invertebrates and vertebrates in the fixed interval literature. Myers and Mesker (1960) produced qualitative evidence with a single equine subject (*Equus ferus caballus*) that has not since been replicated. As no replications of Myers and Mesker (1960) have been published, the present horse experiment replicated the conditions, manipulations, and number of sessions reported in Myers and Mesker (1960) while also extending this protocol to include a more modern peak procedure wherein longer, unreinforced trials are interspersed within normal, shorter fixed intervals (Roberts, 1981). The present experiment is the first assessment of equine responding on a peak procedure and is also the first quantitative analysis of horse responding when reinforced on fixed interval schedule of reinforcement.

Previously, two fixed interval investigations have been performed in invertebrates (Grossmann 1973; Boisvert and Sherry, 2006), and these investigations produced contrasting findings that were subsequently explained in Craig et al. 2014. Grossmann (1973) did not observe temporally controlled behaviors in honey bees (*Apis mellifera*) when considering qualitative response cumulative curves whereas Boisvert and Sherry (2006) claimed to have observed temporally controlled behaviors in bumble bees. However, Boisvert and Sherry (2006) used a series of compound schedules that assume timing processes on simpler fixed interval schedules and only analyzed one dependent variable (i.e. PRP); PRP has been identified to be a highly variable and inconclusive measure when attempting to assess temporal control without considering response levels within the fixed interval (Elsmore, 1971; Hienz, and Eckerman, 1974).

Boisvert and Sherry (2006) used a series of aggregate analyses that may have assessed unrealistic and unrepresentative averages of individual's responding; learning and timing occurs in an individual, not in an abstract aggregate. Clearly, assessing learning in individuals is paramount, so the presented data was analyzed using a data analyses method that remains grounded in observed individual data and does not rely on aggregate analyses, for many of the assumptions required to perform traditional null hypothesis significance testing are not met by behavioral data (Laurent, and Lejeune, 1985; Craig, Grice, Varnon, Gibson, Sokolowski, and Abramson, 2012; Craig et al., 2014). To eschew the methodological difficulties associated with relying on null hypothesis significance testing, the collected data was assessed by using a series of ordinal analyses from an Observation Oriented Modeling paradigm (Grice, 2011; Craig et al., 2012; Dinges et al., 2013; Craig et al., 2014) and compared, when permissible, with traditional null hypothesis significance testing methods. Using Observation Oriented Modeling, the individual's observed data was compared to an ordinal prediction and a series of randomizations of the observed data were compared to the ordinal prediction to determine if the observed data differed from the randomized data sets. To facilitate comparisons with previous fixed interval research, both null hypothesis significance testing as well as a qualitative analyses of individual's response cumulative curves were performed and compared with the data analysis provided in Observation Oriented Modeling.

CHAPTER II

METHODOLOGY

Horses

Subjects

Subjects were domesticated horses *Equus fears caballus* (n = 16) of varying breeds from an off-campus ranch outside of Stillwater, Oklahoma; Table 1 displays each subjects' respective group assignment, breed, age, sex (all males were geldings), and number of shaping sessions. Of these 16 subjects, 13 completed the experiment. Subjects were stabled at night, fed grain twice a day, turned out to pasture in the morning, and had free access to water; thus, subjects did not undergo any deprivation procedures. All subjects were experimentally naïve, and responding had to be shaped. Prior to each daily session, each subject was collected from the pasture and led to the apparatus. All of the equine study procedures were approved by Oklahoma State University's Animal Use and Care Committee (ACUP: AS-14-11).

Table 1: Horse subject demographic information

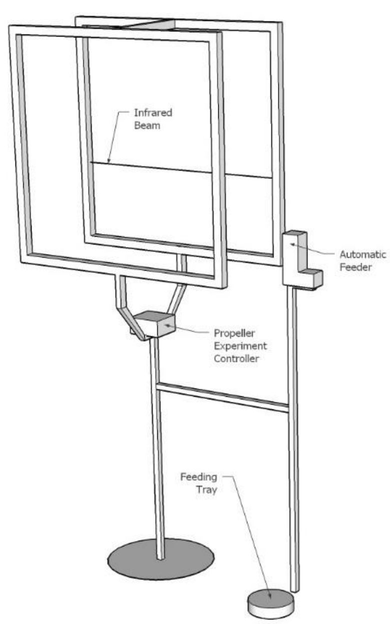
Subject Number	Group	Sex	Breed	Age (Years)	Number of Shaping Sessions	Final Condition
1	0-90-P	Male	American Quarter Horse	5	1	Peak Procedure
2	0-60-90-180-P	Male	American Paint Horse	18	1	Peak Procedure
3	0-180-P	Male	American Quarter Horse	5	2	Peak Procedure
4	0-60/90/180-P	Male	Grade Quarter Horse	7	2	Peak Procedure
5	0-60-90-180-P	Female	American Quarter Horse	9	2	Peak Procedure
6	0-60-P	Female	American Quarter Horse	12	2	Peak Procedure
7	0-60-90-180-P	Female	Arabian	15	3	Peak Procedure
8	0-60-90-180-P	Female	American Quarter Horse	6	2	Peak Procedure
9	0-60-P	Female	American Quarter Horse	5	2	Peak Procedure
10	0-90-P	Female	Appendix Quarter Horse	10	2	Peak Procedure
11	0-60/90/180-P	Male	American Quarter Horse	10	2	Peak Procedure
12	0-180-P	Female	American Quarter Horse	8	3	Continuous Reinforcement
13	0-90-P	Male	American Paint Horse	15	4	Peak Procedure
14	0-60-P	Male	Pony	8	2	Peak Procedure
15	0-60/90/180-P	Female	Grade Paint Horse	13	5	Shaping
16	0-180-P	Male	American Quarter Horse	12	2	Continuous Reinforcement

Apparatus

We utilized a propeller-controlled apparatus (Varnon and Abramson, 2013) that delivered bite-size Apple Flavored Nuggets purchased from MannaPro (St. Louis, MO), hereafter known as horse treats. The apparatus was located in an unused wash stall (224 cm x 350 cm x 246 cm) in a non-air-conditioned and non-noise free barn. A successful response required the subject insert its head through two parallel rectangular hoops (79 cm x 81 cm) to break a horizontal infrared beam located 28 cm from the bottom of the hoop furthest from the subject. The two hoops were 35 cm apart so that the subject would be required to make an exaggerated, deliberate head-extension response. The response was considered complete once the subject ceased breaking the infrared beam. To signal a successful response, a 330 Hz 75% duty cycle square wave tone was emitted from the propeller which was located 24 cm below and midway between the response hoops. The hoops were tall enough for subjects to move their head above or below the infrared beam, so the subject could make numerous responses without having to remove its head entirely from the apparatus. The hoops were made from 1 inch PVC pipe; this material was selected for its lightweight properties and flexibility so that if a subject forcibly pushed or hit the apparatus, neither the subject nor the apparatus would be damaged. The hoops were raised 114 cm from the floor by a 1.5 inch PVC pipe which was held in place by an outdoor umbrella stand. To prevent flies from breaking the infrared beam, we positioned a raised box fan opposite the subject (behind the apparatus) that assured flies would not fly between the response hoops and create invalid "responses."

When reinforcement contingencies were met, approximately 10 grams of apple-flavored nuggets were released via a propeller-controlled automatic feeder located 35 cm to the right of the response hoops. In addition to activating the automatic feeder when reinforcement contingencies were met, a 523 Hz 50% duty cycle square wave tone was emitted from the propeller to single reinforcement delivery. The automatic feeder activated for .5 sec and produced a slight variation in the amount of reinforcement; however, this minimal range of amount of reinforcement occurred randomly and was thus not systematic between conditions. The automatic feeder was placed 114 cm above a circular feeding tray (diameter: 16 cm) that was located on the floor; reinforcement delivery produced a distinct marking stimulus as the reinforcement fell from the automatic feeder and hit the feeding tray. The feeding tray was not attached to the apparatus because some subjects would forcibly push or pull on the feeding tray while consuming the treats; attaching the feeding tray to the apparatus would have potentially resulted in the apparatus being damaged. One experimenter was thus obliged to reset the feeding tray once the subject lifted its head from the feeding tray and began to insert its head into the response hoops. A second experimenter was stationed to the left of the response hoops and held the subject's lead rope. Figure 2 displays the apparatus used with the horse subjects.

Figure 2: Horse apparatus



Shapina

As all subjects were experimentally naïve prior to data collection, responding had to be shaped. During shaping, the subject was led to the apparatus and the subject's lead rope was placed through both response hoops and held by an experimenter with enough slack for the subject to insert or retract its head from the response hoops. The subject was then allowed to explore and habituate to the apparatus and wash stall. After the subject habituated to the apparatus, a second experimenter stood behind the apparatus and offered the subject a hand-fed treat after each movement that brought the subject closer to the apparatus, first response hoop, and eventually second response hoop containing the infrared emitter and sensor and furthest from the subject. Once the subject emitted a head-poke through both response hoops and broke the infrared beam, the experimenter dropped the hand-held treat into the feeding tray. Most subjects readily consumed the treats from the feeding tray when it was located on the floor, but some subjects did not initially consume treats from the feeding tray.

To train the subject to consume treats from the feeding tray when it was located on the floor, an experimenter held the feeding tray close to the subject's height, and slowly lowered the feeding tray after each successful response until the subject was trained to consume treats from the feeding tray from the floor. Each shaping session lasted for approximately 50 trials of continuous reinforcement, and shaping was considered complete if the subject freely emitted a response and consumed the treat from the feeding tray during the first trial of a session. If a subject did not freely emit a response during the first trial, shaping continued for another session. Most subjects reliably responded within two shaping sessions; however, a few subjects required three shaping sessions.

Sessions

Sessions were run daily for each subject, and each session contained 50 test trials. Prior to each session, subjects were collected from the pasture and led to the apparatus. For every session, regardless of the condition, the first response was reinforced to signal the apparatus was working properly. The initiation of the first response initiated the session, and the next trial was initiated after .5 sec of reinforcement delivery; subsequent trials were all initiated .5 sec after the initiation of a response meeting the condition's contingencies. The subject did not have to cease its response for reinforcement delivery to occur. For continuous reinforcement (CRF) contingency sessions, 51 trials were administered to control for the added first CRF trial during fixed interval (FI) contingency sessions. Thus, during FI sessions, the first response under CRF was considered trial zero and was not recorded or analyzed. The session ended after the completion of the final response that satisfied the reinforcement contingency; the subject was allowed to consume the treat in the feeding tray and was then led back out to pasture.

Each day, two or three subjects experienced 50 test trials apiece, and these sessions were run back-to-back after the experimenters cleaned the apparatus of saliva and treat crumbs as well as cleaning the floor of the wash stall of feces or treat crumbs that may have accumulated during the previous session. In some cases, subjects did not complete 50 test trials because responding was not maintained at longer FI durations. If subjects did not respond after 12 minutes (four times the duration of the longest FI schedule) or attempted to leave the wash stall and exit the barn, the session was terminated. We recorded responses per trial, response duration, and inter-response time (IRT).

Baseline

Following at least one shaping session, if a subject freely responded (i.e. did not have to be prompted to respond) after being led to the apparatus, that session was considered the first of three baseline sessions of continuous reinforcement. Thus, as each session contained 50 trials, all subjects experienced 150 trials of continuous reinforcement.

During baseline sessions, every response produced reinforcement delivery, but the subject was free to make multiple responses before consuming the treats in the feeding tray. Because of this, some experienced subjects would make multiple responses during later baseline sessions to increase the amount of treats in the feeding tray before consuming the treats. Thus, some IRTs during baseline trials cannot be considered pure PRPs.

Fixed Interval Schedules

After three sessions of baseline CRF were completed, subjects entered the FI condition wherein responding was reinforced on either an FI 60-sec, FI 90-sec, or FI 180-sec schedule of reinforcement. We selected these intervals to remain consistent with the only published fixed interval investigation using a horse model (Myers and Mesker, 1960). Depending on a subject's group assignment, a subject's responding was reinforced on an FI schedule for either one or three sessions. Myers and Mesker (1960) reinforced their subject's responding for three sessions of 30 trials apiece for the shorter FI 60-sec and FI 90-sec conditions (90 trials) and reinforced their subject's responding for 5 sessions of 30 trials apiece for the longer FI 180-sec conditions (150 trials). Myers and Mesker (1960) reported the last FI 180-sec session's cumulative response pattern, so to compare our data with Myers and Mesker (1960), we exposed our subject's responding to 150 trials across three sessions for all FI conditions for all but one group of subjects' responding which received 50 trials of each FI condition across three sessions.

The first response of each FI session was reinforced to demonstrate to the subject that the apparatus was working properly. Once the fixed interval was initiated .5 sec after the last contingency-meeting response, subjects were free to respond during the fixed interval and these responses did not re-set the fixed interval. The present method of reinforcing the first response of the session was necessary to establish subject responding during fixed interval sessions.

Peak Procedure

Following the fixed interval conditions, each subject entered a single session peak procedure condition wherein a subject's responding was reinforced on the same FI schedule duration as the subject's last FI session for 40 out of 50 of the test trials. The peak procedure is an adaption of the classic FI schedule of reinforcement (Roberts, 1981). During each batch of five trials, one of the five trials was a peak trial that was randomly selected by the propeller-controller. Peak trials were twice the duration of the other four normal FI trials and were not reinforced. Like the baseline and FI sessions, the first response initiated the peak procedure session and delivered reinforcement but was not considered a test trial. The first test trial of a session was always a fixed interval, and one of the next four trials was randomly selected as a peak trial. Peak trials were always separated by at least one FI trial. The completion of a peak trial was signaled by the same stimulus used to signal reinforcement delivery (523 Hz 50% duty cycle square wave tone), but the lack of the treats hitting the feeding tray made this marked stimulus distinct.

Groups

Subjects were randomly assigned to 5 groups of differing FI schedules and numbers of sessions. All groups experienced at least three conditions. For all groups, responding was continually reinforced for the first three sessions so that each individual could serve as its own control. We used three baseline CRF sessions as pilot investigations revealed consistent IRTs after about 100 trials. Following the three baseline CRF sessions, subjects entered the fixed interval condition for either three or nine sessions depending on group assignment. After either three or nine FI sessions, all subjects' final session (either session seven or thirteen) contained peak trials for ten out of the fifty trials. This inconsistency in the number of FI sessions between groups was designed to assess the effect of incrementally increasing the FI duration as reported in Myers and Mesker (1960) versus suddenly increasing the schedule of reinforcement from CRF to the longer FI schedules. Thus, we analyzed the immediate shift from CRF to each FI schedule (either 60-sec, 90-sec, or 180-sec) for three sessions at each schedule. We also incrementally increased the schedules after either one or three sessions at each FI schedule.

The groups were named according to their conditions and serve to indicate the utilized ABC within-subject design: 0-60-P, 0-90-P, 0-180-P, 0-60/90/180-P, 0-60-90-180-P. The first number represents the CRF baseline condition (FI 0-sec), and the final symbol (P) represents the peak procedure condition. During the peak procedure, 40 out of 50 trials were FI trials of the same duration as the last FI condition the subject experienced. The middle numbers represent the FI schedule as well as the number of sessions for each FI schedule; for the numerical representations, hyphens separate three sessions while forward slashes separate one session. Hence, the 0-60/90/180-P group incrementally increased the FI schedule durations with just one session for each FI schedule whereas the 0-60-90-180-P group incrementally increased the FI schedule durations after three sessions for each FI schedule.

Honey Bees

The protocol utilized here is extensively explained in Craig et al. (2014); we have summarized the important aspects of the protocol in the following section.

<u>Subjects</u>

Subjects were wild free-flying *Apis mellifera* L. (n = 50) from the Oklahoma State University Comparative Psychology and Behavioral Biology Laboratory apiary. During the experiment, subjects flew from their hive to forage in an operant chamber (Sokolowski and Abramson, 2010). All subjects were experimentally naïve prior to the experiment.

Apparatus

We utilized two adjoined computer-controlled clear acrylic operant chambers (24 cm × 26 cm × 38 cm) that provided 50% sucrose solution. The operant chambers were located approximately 3 m from the 10% sucrose solution feeding station. The top of an operant chamber served as a door the experimenter opened and closed once the subject attempted to enter or leave the apparatus. Once inside the operant chamber, subjects orientated themselves towards the response hole (diameter: 5 mm) located in the center of the side of the apparatus opposite of the adjoining wall separating each operant chamber. A response was recorded when the subject entered the response hole in the operant chamber and broke an infrared beam located 1 cm within the response hole. The response was considered complete when the subject exited the response hole. To make multiple responses, the subject was required to repeatedly enter and exit the response hole. When reinforcement contingencies were met, 5μl of 50% sucrose solution was released via a computer-controlled stepper motor into a cup attached to the end of the response hole located in front of the subject's head while she was still inside the response hole. The stepper motor served as a consistent marking stimulus, for the motor lightly sounded and vibrated the apparatus upon reinforcement delivery.

Shaping

Subjects were randomly collected from the 10% sucrose solution feeding station and were brought to the operant chamber where hole-entering responses were shaped. During shaping, drops of sucrose solution were placed near the response hole, and then inside the response hole. Shaping was considered complete once the subject consistently returned to the operant chamber directly from the hive. After shaping, each subject was tagged so the subjects could be distinguished. We used a Queen Marking Tube (QMT1) to immobilize the subject while a colored, numbered tag was attached with a non-toxic adhesive; these materials were purchased from Betterbee (Greenwich, NY).

Sessions

We utilized the cyclical foraging patterns of our free-flying honey bees to separate sessions; we collected all session data for each subject in a single day. Each visit to the apparatus after returning from the hive was considered a separate session. Throughout the experiment, a session was initiated by a subject's first response in the operant chamber after returning from the hive. Each session ended as the subject completed its final response prior to returning to the hive; we waited until the subject returned to the hive before considering a session complete. As each session's duration was determined by the subject's behavior, session durations were not identical. In addition to variable session durations, we did not control the number of trials per session. Honey bees can hold between 50 µl to 80µl of solution and return to the hive to unload after filling their social crop; hence, each session could offer anywhere between 10 to 16 reinforcers, though many sessions contained fewer than 10 trials. This variability in the number of reinforcers per session is an inherent aspect of working with unconfined and wild subjects in a naturalistic setting.

If a subject left the operant chamber during a session, we visually followed the subject to determine if she returned to the hive or the nearby 10% sucrose solution feeding station. If the subject returned to the hive, the session was considered complete, and another session began when the subject returned to the operant chamber. However, if the subject returned to the 10% sucrose solution feeding station and extended its proboscis or did not return to the operant chamber after 30 minutes, data collection was terminated for that subject.

Sessions began after hole-entering responding was shaped and subjects directly returned to the operant chamber after leaving the hive. All subjects completed the 27 sessions in one day. We did not collect data over multiple days because we were unable to confine our subjects to assure subjects were not foraging at different locations and thus experiencing different reinforcement contingencies between days. However, we were able to ensure subjects were only foraging at the operant chamber throughout the experiment, for we visually followed subjects to be sure they returned to the operant chamber immediately after leaving the hive.

We recorded responses per session, response duration, reinforcers per session, inter-response time (IRT), and intersession intervals while also recording environmental temperature. Adding response duration and IRT intervals together for each session produced session durations and dividing this value by the number of responses made during a session produced an average response rate per session for each bee.

Baseline

Six baseline sessions of continuous reinforcement (CRF) were administered so that each bee could serve as her own control. During baseline sessions, subjects were allowed to freely enter the operant chamber, respond, and exit the operant chamber to avoid potential post-reinforcement delay effects (Craig et al., 2012).

Fixed Interval Schedules

After six sessions of baseline CRF were completed, subjects entered the experimental condition for 20 sessions wherein responding was reinforced on either an FI 0-sec (CRF), FI 15-sec, FI 30-sec, FI 60-sec, or FI 120-sec schedule of reinforcement. We selected these intervals to remain consistent with the intervals used in Lowe and Harzem (1977) and Higa and Simm (2004). We added a shorter FI 15-sec schedule as Higa and Simm (2004) recommended utilizing a greater number of schedules.

Groups

Subjects were randomly assigned to five groups of differing FI schedules with 10 subjects in each group. The first six sessions were baseline continuous reinforcement sessions. Following the six baseline sessions, 20 FI sessions were administered; FI schedule duration served as the only manipulated difference between groups. The groups were named according to the conditions and FI schedule to which subjects were assigned and serve to indicate the utilized ABC repeated measures design: 0-0-X, 0-15-X, 0-30-X, 0-60-X, and 0-120-X. The first number represents the CRF baseline (an FI 0-sec schedule), the second number represents the FI schedule of the experimental condition (i.e. the group assignment), and the X represents an extinction session which lasted for 10 minutes.

We only assessed subject responding if the subject initiated the final fixed interval session. Only eight subjects in the 0-15-X group initiated the final fixed interval session while only five subjects in the 0-30-X group initiated the final fixed interval session; no subjects in the 0-60-X and 0-120-X groups completed the experiment, and these subjects' response records were not analyzed.

Data Analysis

The focus of science on particulars (i.e. individuals) versus universals (e.g. aggregates) is a long-standing philosophical discussion (Franck, 1986). Radical behaviorists initially seemed to value focusing on individuals; indeed Mace and Kratochwill (1986) single out behaviorists as the only psychology researchers with a rich history in individual subject analyses. However, this individual focus may have been a result of practical instrumental limitations due to qualitative analyses surrounding response cumulative curves rather than theoretical reasons; following Schneider's (1969) quantitative measurement of inter-response times, aggregating individual subject's data and focusing on group aggregates became common for behaviorists. Now, temporal control researchers are hard-pressed to find FI publications containing individual analyses despite Branch and Gollub's (1974) and Dews' (1978) well-known cautioning of the utilization of aggregates due to artifact concerns related to aggregates not accurately representing individuals' performances. While focusing on aggregates may be an important scientific endeavor for temporal control researchers, small subject sizes and few replications in most investigated species render focusing on individuals and particulars to be preferable compared to analyzing aggregate representations of universals as current practices severely limit generalizing to universals. The current temporal control literature suffers from using inter-individual methods to describe learning and temporal control even though these attributes can only occur within individuals as aggregates do not exist in reality. This disconnect between behavior methods and theory must be addressed.

In an attempt to return temporal control investigations to concerns of particulars rather than universals, we used Observation Oriented Modeling (Grice, 2011; 2014) which is a data analysis technique that permitted us to compare our observed results to expected patterns of outcomes for each subject and then to evaluate the differences with an accuracy index and a randomization test. Observation Oriented Modeling (OOM) assesses individual observations and does not rely on traditional summaries of data such as measures of central tendency or variability. By using these methods, we were able to eschew the assumptions of null hypothesis significance testing (e.g. homogeneity, normality) as well as avoid construing temporal control as an abstract population parameter such as a mean or variance to be estimated from our data.

Within OOM, we performed a series of ordinal analyses which produce a percent correct classification (PCC) value and a chance-value (a probability statistic). For each analysis, an observed PCC value was computed by comparing an *a priori* ordinal prediction with the observed data. The resulting PCC value ranges from 0 to 100 and is the percent of the observed data that matches the expected ordinal pattern. Higher PCC values indicate more observations were correctly classified by the prediction. The PCC value is a two-order assessment; when more than two orders are assessed, OOM also provides a complete percent correct classification (CPCC) value which indicates the extent the full prediction is met. The CPCC value becomes an increasingly conservative assessment as more orders are used for an analysis. We did not utilize imprecision values for any of the conducted OOM analyses.

Next, a randomization process wherein the observed data were randomly shuffled between groups/conditions was repeated 1,000 times (unless otherwise stated) for each ordinal analysis; these randomized data sets were each compared to the original ordinal prediction to create a range of randomized PCC values. To facilitate interpretation of the PCC value, the minimum and maximum randomization PCC values are reported. The randomization ranges are especially helpful when considering assessments of three or more orders; increasing the number of orders produces smaller randomization ranges with maximum randomization PCC values that are rarely larger than zero for 10 or 20 order ordinal assessments.

The observed PCC values were then compared to the randomized range of PCC values to compute a chance value (c-value). The c-value ranges from 0 to 1 and displays the proportion of randomized versions of the observed data that yielded PCC values greater than or equal to the observed data's PCC value. For example, a c-value of .01 indicates the observed PCC value was larger than 99 of the PCC values obtained from 100 randomized versions of the data. As c-values are calculated from randomizations of the observed data points, each PCC value is assessed on an adaptable distribution that is based on observed data rather than a hypothetical distribution (e.g. the standard normal curve).

The major criticism against employing an individual analysis rather than reporting aggregate analyses is the incongruence of an individual analysis with the majority of the temporal control literature; comparing the present individual's findings with the literature's findings is impossible because of the different employed paradigms to analyze the fixed interval data. For this reason, we also performed a series of aggregate assessments from a null hypothesis significance testing paradigm and compared our individual assessments with our aggregate assessments. While conducting these assessments, various assumptions (e.g. homogeneity, sphericity) were assessed, and all popular corrections were employed when these assumptions were observed to have been violated. For null hypothesis significance testing and Observation Oriented Modeling, p-values and c-values that were below 0.05 were evaluated as producing evidence supporting the rejection of the null hypothesis or matching the ordinal prediction. However, as the PCC value indicates how well the observed data fit an ordinal prediction, this value is more important in determining model fit using Observation Oriented Modeling compared to the c-value.

CHAPTER III

RESULTS

Of the 16 original horse subjects, 13 completed all of the fixed interval sessions, and we analyzed responding for these 13 subjects. Subject 12 (0-180-P) ceased responding during the second CRF session and would not approach the apparatus or allow the researchers to approach or harness her for subsequent sessions. Subject 15 (0-60/90/180-P) ceased responding during shaping sessions; the subject would insert her head into the apparatus, but the sound of the horse treats falling from the automatic feeder and hitting the feeding tray startled the subject. Subject 15 would slowly approach the apparatus, insert her head into the response hoops, but avoided breaking the infrared beam. We paired a recorded sound of the treats hitting the feeding tray with immediate hand-delivery of the treats, but Subject 15 still avoided breaking the infrared beam for later shaping attempts. Due to these reasons, we did not initiate the CRF sessions with Subject 15. Finally, Subject 16 (0-180-P) maintained responding throughout the CRF sessions, but the subject’s owner relocated the horse from the ranch without informing the researchers; thus, there were no fixed interval performance data to analyze for Subject 16.

Of the 50 original honey bee subjects, 10 did not encounter any fixed interval sessions (0-0-X), and no subjects in the 0-60-X and 0-120-X groups initiated the final fixed interval session. Two subjects in the 0-15-X group did not complete the experiment while five subjects in the 0-30-X group did not complete the experiment. This left a total of 13 honey bees that were analyzed. Honey bees dropped out of the experiment by either not returning to the operant chamber, or by visiting the near-by feeding station.

Previously, we and others (Dukich and Lee, 1973) have recommended that temporal control researchers may benefit from assessing multiple measures of temporal control. In the following sections, we report the analyses of horse and honey bee performances on these different measures. The full results of all of the performed assessments are contained in a series of appendices; throughout the following sections, we will highlight the general trends for individuals, groups, and schedules, and we discuss exceptions to these trends as well as address inconsistencies between the performed analyses.

Cumulative Response Curve Analysis

A positively accelerating (i.e. "scalloped") cumulative response curve and a two-state cumulative response curve wherein responding is inhibited during the beginning of the fixed interval, and suddenly increases at a terminal response rate (i.e. "brake-and-run") have been traditionally utilized to infer temporal control of responding on fixed interval schedules of reinforcement. In Appendix 1: Traditional Cumulative Curve, we present traditional cumulative response curves (i.e. time on the abscissa and cumulative discrete responses on the ordinate) for each subject's final session at each fixed interval schedule.

We also present our recommended modified cumulative response records with time on the abscissa and cumulative response duration on the ordinate for each subject's final session at each fixed interval schedule in Appendix 2: Modified Cumulative Curve. Both cumulative curves display reinforced responses in orange while unreinforced responses are depicted in blue. As these visual depictions of responding are qualitative in nature, no assessments utilizing either OOM or NHST were performed.

Horses

For both types of cumulative curves, horse response records did indicate responding came under temporal control for most subjects. Towards the end of most subjects' final fixed interval sessions, trials tend to resemble "break-and-run" response patterns; indeed, response patterns for most subjects are better characterized as "break-and-run" rather than "scalloped." The horse subjects that did not emit "scalloped" or "break-and-run" cumulative response patterns by the end of their final fixed interval session were assigned to either the 0-180-P group or 0-60/90/180-P group; the immediate shift from CRF to an FI 180-sec seems to have been too abrupt for Subject 3 (0-180-P) while Subjects 4 and 11 (0-60/90/180-P) likely did not experience each schedule for a sufficient number of trials in order for their responding to come under temporal control. For the 0-60-90-180-P group, Subject 5 and 8 did produce temporally controlled cumulative plots on the FI 60-sec and FI 90-sec conditions, but did not produce clear "break-and-run" cumulative curves towards the end of their final FI 180-sec session (though Subject 5 did shift its response pattern approximately half-way through the session, and a distinction between responding during the initiation of the session versus responding towards the termination of the session is observable). Of the remaining subjects, Subject 1 (0-90-X) seems to have produced the poorest cumulative response performance as revealed by the relatively small latencies to the first response of a trial and rather “steady-state” response record.

Honey Bees

In contrast, for both types of cumulative curves, no honey bee subjects that initiated the final fixed interval session (i.e. session 26) displayed cumulative response records that indicated responding came under temporal control. Instead, honey bee subject responding is better characterized as either a “steady-state” or "break-through" response pattern; neither pattern is indicative of temporally controlled responding. Only the tenth subject in the 0-15-X group emitted a trial on the traditional cumulative curve plot that resembles a “scalloped” response pattern.

Response Bin Analysis

An increase in response levels as reinforcement availability approaches has been suggested to indicate temporal control. To perform our response bin analysis, we divided each fixed interval into bins for each trial for subjects that completed their final fixed interval condition. We divided each trial's fixed interval into two bins, four bins, 10 bins, and 20 bins under the *a priori* prediction that response tallies would monotonically increase across bins from the initiation of the fixed interval to the end of the trial and thus interval. For example, for a two bin analysis, an FI 60-sec trial would be divided into two 30-sec bins; the contingent response was always placed in the final bin.

Response Bin Analysis - OOM

We performed a series of ordinal analyses to assess if response levels “scalloped” across the fixed interval by comparing the observed data to a monotonically increasing ordinal prediction. To further assess the response patterns of our observed data, we also performed ordinal assessments opposite of what would be expected if subject responding came under temporal control (i.e. we also predicted a monotonic decrease across bins). However, for the four bin analysis, we performed additional ordinal assessments to clarify the observed response patterns. For the four bin analysis, in addition to predicting monotonically increasing and decreasing response patterns, we also predicted response tallies would be equal during the first and second bin, but then monotonically increase during the third and fourth bin (this prediction was performed to assess "break-and-run" response patterns); we also predicted the first, second, and third bin would be equal while the fourth bin would contain a greater number of responses than the first, second, and third bins. This final ordinal analysis of the four bin response tallies is the most conservative assessment of temporal control as operationalized by a response bin analysis. Finally, we also predicted each bin would contain an equal number of responses.

In order to compare individual response rates between the bins within each interval, we used Observation Oriented Modeling (OOM) to compute an observed percent correct classification (PCC) value between our observed data and a two-, four- 10-, or 20-order *a priori* prediction. For this response bin analysis, we only analyzed the final fixed interval session for individuals; we also pooled data between individuals for our ordinal assessment for group and condition assessments. Appendix 3: Response Bin OOM displays each ordinal assessment's PCC value, randomization range, and c-value for the final fixed interval session for each individual subject and group; different tables are presented for different species and group assignments. To assist the interpretability of Appendix 3: Response Bin OOM, the best fits for each series of ordinal predictions for each individual and condition are bolded to indicate which ordinal prediction was best matched by the observed data for each series of analyses when considering PCC, CPCC, and c-values.

Horses

Horse responding tended to follow a monotonically increasing pattern across bins, and thus could be taken to infer temporal control. For the two bin ordinal analysis, the best ordinal prediction match was a monotonic increase across bins; every horse subject emitted more responses in the second half of the fixed interval compared to the first half of the fixed interval other than the final FI 180-sec session for Subject 3 (0-180-P) and Subject 4 (0-60/90/180-P). This finding corroborates the horse subjects' cumulative curves, for Subjects 3 and 4 did not emit "break-and-run" or "scalloped" response patterns. PCC values were very high for almost all subjects under the prediction that more responses occur in the second half of the fixed interval; PCC values for individuals in the 0-60-P and 0-90-P groups ranged from 94 to 100; the 0-60/90/180-P group's individuals' PCC values ranged from 88 to 96; and the 0-60-90-180-P group's individuals' PCC values ranged from 90 to 100.

For the four bin analysis, the horse subjects tended to produce response patterns that were best fit by ordinal predictions with the first two or three bins being equal followed by a monotonic increase for bins three and/or four. Only Subject 1 (0-90-P) and Subject 3 (0-180-P) emitted responses that were better fit with a monotonically increasing ordinal prediction; again, this corroborates these horses' cumulative curve response patterns. The FI 180-sec session for Subject 4 (0-60/90/180-P) almost fit a "steady-state" response tally prediction (1=2=3=4). An interesting observation comes from the 0-60-90-180-P group; Subject 5 and Subject 7's final FI 60-sec and FI 90-sec session resembled a "break-and-run" ordinal pattern but changed to a monotonic increasing pattern for the final FI 180-sec session; this may likely be an effect of the duration changes for each bin as schedule duration increases. The observed PCC values that best described the individuals' response patterns for these "break-and-run" four bin analysis (1=2<3<4 and 1=2=3<4) ranged from 62.30 to 87.33 other than for Subjects 3 and 4's final FI 180-sec session. An important consideration is the observed CPCC values which are relatively high (ranging from 14.00 to 72.00) for most horse subjects for the 1=2<3<4 and 1=2=3<4 ordinal predictions; the CPCC value indicates the extent of a full pattern match rather than just pair-wise comparisons as identified in the PCC value; considering these values is important when assessing OOM bin comparisons between more than two orders.

For the 10 bin analysis, all horse subjects better fit the increasing ordinal prediction other than Subject 3 (0-180-P) and Subject 4's (0-60/90/180-P) final FI 180-sec session; again, this corroborates the horses' cumulative response curves. The 0-60-P group produced PCC values ranging from 35.64 to 44.04 while the 0-90-P group produced PCC values ranging from 36.00 to 54.44. In the 0-60/90/180-P group, Subject 4 did not emit responses that matched an increasing monotonic pattern for the final FI 180-sec session and had smaller PCC values (32.93, and 33.91) for the final FI 60-sec and FI 90-sec sessions compared to Subject 11 which produced larger PCC values ranging from 47.02 to 50.71. The 0-60-90-180-P group produced PCC values ranging from 31.47 to 63.07. An additional observation for the 0-60-90-180-P group is that each individual subject produced larger PCC values at higher schedule durations; this may be an effect of extended experience with fixed interval schedules. While the CPCC values for all subjects was zero, the randomization ranges do not produce CPCC values over zero either; a complete pattern match is a very strict assessment for these data.

For the 20 bin analysis, all horse subjects better fit the increasing ordinal prediction other than Subject 3 (0-180-P) and Subject 4's (0-60/90/180-P) final FI 180-sec session. Individuals in the 0-60-P group produced PCC values ranging from 21.24 to 27.52 while individuals in the 0-90-P group produced PCC values ranging from 21.44 to 37.59. Subject 3's (0-180-P) responding did produce a small c-value, but the observed PCC value was not impressive (PCC value: 26.74; randomization range: 12.74 – 30.42; c-value = .02). In the 0-60/90/180-P group, Subject 4 did not emit responses that matched an increasing monotonic pattern for the final FI 180-sec session (PCC value: 17.05; randomization range: 9.05 – 25.26; c-value = .45) and had smaller PCC values (19.62 and 19.20, respectively) for the final FI 60-sec and FI 90-sec sessions compared to Subject 11 which produced larger PCC values ranging from 31.03 to 32.20. Individuals in the 0-60-90-180-P group produced PCC values ranging from 19.87 to 51.36. Again, while the CPCC values for all subjects was zero, the randomization ranges did not produce CPCC values over zero either; a complete pattern match is a very strict assessment for these data.

For horse subjects, when pooling across groups to create a pooled condition assessment, subjects tended to emit monotonically increasing response patterns. For the two bin assessment, a monotonic increase was observed for the FI 60-sec condition (PCC value: 96.57; randomization range: 41.43 – 56.86; c-value < .001), the FI 90-sec condition (PCC value: 97.68; randomization range: 40.00 – 57.68; c-value < .001), and the FI 180-sec condition (PCC value: 92.55; randomization range: 36.02 – 60.84; c-value < .001). For the four bin assessment, different patterns were better fit by different schedule durations. The FI 60-sec condition best matched the most conservative timing prediction wherein responding was equal for the first three bins, and then increased for the final bin (PCC value: 73.82; randomization range: 28.27 – 36.90; c-value < .001). The FI 90-sec condition best matched the prediction that responding was equal for the first two bins, and then monotonically increased for the final two bins (PCC value: 75.51; randomization range: 29.95 – 40.14; c-value < .001). These findings corroborate the "break-and-run" cumulative response patterns observed for horse subjects. The FI 180-sec condition best matched the prediction that responding monotonically increased throughout the fixed interval (PCC value: 74.84; randomization range: 36.44 – 48.45; c-value < .001). For the 10 bin assessment, a monotonic increase was observed for the FI 60-sec condition (PCC value: 47.73; randomization range: 21.80 – 24.79; c-value < .001), the FI 90-sec condition (PCC value: 48.58; randomization range: 25.01 – 28.85; c-value < .001), and the FI 180-sec condition (PCC value: 55.21; randomization range: 30.03 – 35.75; c-value < .001). This monotonically increasing pattern match was also observed for the 20 bin assessment for the FI 60-sec condition (PCC value: 27.45; randomization range: 15.02 – 16.51; c-value < .001), the FI 90-sec condition (PCC value: 34.15; randomization range: 19.01 – 20.74; c-value < .001), and the FI 180-sec condition (PCC value: 42.20; randomization range: 24.54 – 27.84; c-value < .001). For the 10 and 20 bin assessments, longer schedule durations produced responding that better fit the monotonically increasing ordinal prediction.

Honey Bees

Honey bee responding tended to follow a monotonically increasing pattern across two bins; however, a few subjects did not emit responses that approximated the ordinal predations that are consistent with the hypothesis of responding coming under temporal control. Of the three ordinal predictions that were made for the two bin analysis (1=2; 1>2; 1<2), most honey bee subjects matched the prediction that more responses were emitted at the end of the fixed interval. Only Subjects 3 and 6 (0-15-X) did not fit a monotonically increasing ordinal prediction. However, when compared to the PCC values observed for horses for this ordinal prediction, the PCC values for the honey bees were not as impressive; PCC values for individuals in the 0-15-X group ranged from 30 to 100; PCC values for individuals in the 0-30-X group ranged from 50 to 100. While this upper range of observed PCC values seems impressive, most PCC values ranged between the 40's and 80's. Thus, many PCC values were not convincing (especially compared to the observed horse PCC values) for the two bin assessment; in some cases, the more liberal combination assessment for the two bins was the only assessment to produce c-values below an arbitrary .05 value which was selected based on common NHST conventions. Indeed, a PCC value of 50.00 was observed when pooling all 0-15-X subjects' response data while the pooled 0-30-X group produced a PCC value of 74.36; these are not impressive PCC values for a two order prediction, especially when compared with the observed pooled PCC values for the horse subjects. Responding did not, as predicted, resemble a monotonic decrease for most honey bee subjects; however, responding was not clearly observed to be monotonically increasing for the two bin analysis for all honey bee subjects.

For the four bin analysis, honey bees also produced responses that were best fit by ordinal predictions with the first three bins being equal followed by an increase for the fourth bin. These PCC values for this ordinal pattern ranged from 33.33 to 75.93 for honey bees; these values are substantially lower than those observed for the horse subjects. Only Subjects 6 and 10 (0-15-X) and Subject 7 (0-30-X) did not fit any of the three ordinal predictions that may indicate responding was temporally controlled. While these PCC values may seem impressive, it is important to note that the CPCC values for these four-order assessments were very low for the honey bee subjects (none were greater than 33.00). Thus, while the PCC values may seem impressive for this ordinal predictions, these subjects did not emit these “break-and-run” predicted patterns because of the low observed CPCC values. A four bin analysis of responses that are temporally controlled should produce CPCC values above what was observed for these honey bee subjects. The reason these PCC values are high is likely due to the pair-wise comparisons between the first two or three bins; the “steady-state” response record prediction (1=2=3=4) contained PCC values as high as 52.08.

For the 10 bin analysis, most honey bees better matched the monotonically increasing ordinal prediction; however, these observed PCC values were generally smaller than those observed for the horses. Only Subjects 2 and 6 (0-15-X) and Subject 1 (0-30-X) did not fit the ordinal prediction that may indicate if responding was temporally controlled. Individuals in the 0-15-X group produced PCC values ranging from 24.69 to 40.83 while the individuals in the 0-30-X group produced PCC values ranging from 27.78 to 51.72. Again, while the CPCC values for all subjects were zero, the randomization ranges do not produce CPCC values over zero either; a complete pattern match is a very strict assessment for these data.

For the 20 bin analysis, honey bees better matched the monotonically increasing ordinal prediction; however, these observed PCC values were generally smaller than those observed for the horses. Only Subjects 2 and 6 (0-15-X) and Subject 1 (0-30-X) did not fit the ordinal prediction that may indicate if responding was temporally controlled. Individuals in the 0-15-X group produced PCC values ranging from 12.87 to 24.79 while individuals in the 0-30-X group produced PCC values ranging from 15.72 to 39.14. Again, while the CPCC values for all subjects were zero, the randomization ranges do not produce CPCC values over zero either; a complete pattern match is a very strict assessment for these data.

Taken together, OOM revealed most horse subjects consistently produced evidence of temporal control with the exception of Subject 3 (0-180-P) and Subject 4 (0-60/90/180-P). The honey bee subjects' performances varied between individuals and produced inconsistent evidence of temporal control for this reason; PCC values were generally lower for honey bees compared to horses. Six out of eight of the 0-15-X honey bee subjects while four of five of the 0-30-X honey bee subjects fit ordinal predictions supporting temporal control. Thus, while inconsistent, the majority of honey bees' responding fit the ordinal predictions designed to indicate responding came under temporal control.

<u>Response Bin Analysis - NHST</u>

To demonstrate the differences between OOM and NHST data analysis methods, we also performed a series of Wilcoxon Signed-Rank tests (for our 2 bin analysis) and Friedman tests (for our 4 bin, 10 bin, and 20 bin assessments). To remain consistent with the fixed interval literature, we also inappropriately conceptualized our response tally data as occurring on a continuous scale, and thus performed a series of dependent t-tests (for our 2 bin analysis) and repeated measures ANOVAs (for our 4 bin, 10 bin, and 20 bin assessments). The results of these assessments are presented in Appendix 4: Response Bin NHST Non-Parametric for assessments not assuming continuity and in Appendix 5: Response Bin NHST Parametric for assessments assuming continuity; bolded results indicate analyses that were not significant. These NHST assessments were performed as similarly to our OOM analyses as possible; we performed individual and group assessments without concerns of depleting our alpha-levels.

Horses

For horse subjects, Wilcoxon Sign-Rank and Sign Tests indicated significant differences between two bins for all subjects and groups other than the final FI 180-sec session for Horse 3 (0-180-P) and Horse 4 (0-60/90/180-P). Based on the Sign Test, the proportion of trials with more responses in the second bin compared to the first when divided by the total number of sessions was very high for most horse subjects (ranging from 88% to 100% for individual subjects excluding the final FI 180-sec session for

Horse 3 (0-180-P) and Horse 4 (0-60/90/180-P)). These analyses echo the previously reported OOM assessments. A dependent t-test produced similar results, all subjects and groups had significant differences between the first and second bin other than the final FI 180-sec session for Horse 3 (0-180-P) and Horse 4 (0-60/90/180-P). Cohen's d varied between 1.32 – 2.68 and R^2 varied between .28 – .88 excluding the final FI 180-sec session for Horse 3 (0-180-P) and Horse 4 (0-60/90/180-P); these values constitute a large observed effect for most subjects. An important observation is that for the 0-60-90-180-P group, most subjects produced larger mean differences between the bins at larger schedule durations (or possibly with more experience on fixed interval schedules); indirectly comparing the mean differences between the 0-60-P and 0-90-P groups reveals a potential schedule effect on the variability of these data.

For horse subjects, Friedman assessments for the four and 10 bin analyses found significant differences between bins for all subjects' final fixed interval sessions other than Subject 3 (0-180-P) and Subject 4 (0-60/90/180-P); however, the 20 bin analyses was significant for the final FI 180-sec session for Subject 4 whereas Subject 3's final FI 180-sec session was not significant. Group assessments were significant for the four bin analysis for the 0-60-P group (χ^2_3 = 322.279, p-value < 0.001), the 0-90-P group (χ^2_3 = 277.72, p-value < 0.001), the FI 60-sec session for the 0-60/90/180-P group (χ^2_3 = 205.584, p-value < 0.001), the FI 90-sec session for the 0-60/90/180-P group (χ^2_3 = 173.535, p-value < 0.001), the FI 180-sec session for the 0-60/90/180-P group (χ^2_3 = 73.181, p-value < 0.001), the final FI 60-sec for the 0-60-90-180-P group (χ^2_3 = 401.495, p-value < 0.001), the final FI 90-sec for the 0-60-90-180-P group (χ^2_3 = 448.054, p-value

< 0.001), and the final FI 180-sec for the 0-60-90-180-P group ($\chi^2_3 = 279.769$, p-value $<$ 0.001).

Group assessments were significant for the 10 bin analysis for the 0-60-P group ($\chi^2_9 = 686.148$, p-value < 0.000), the 0-90-P group ($\chi^2_9 = 600.991$, p-value < 0.001), the final FI 60-sec session for the 0-60/90/180-P group ($\chi^2_9 = 407.32$, p-value < 0.001), the final FI 90-sec session for the 0-60/90/180-P group ($\chi^2_9 = 370.124$, p-value < 0.001), the final FI 180-sec session for the 0-60/90/180-P group ($\chi^2_9 = 167.212$, p-value < 0.001), the final FI 60-sec for the 0-60-90-180-P group ($\chi^2_9 = 893.221$, p-value < 0.001), the final FI 90-sec for the 0-60-90-180-P group ($\chi^2_9 = 1036.926$, p-value < 0.001), and the final FI 180-sec for the 0-60-90-180-P group ($\chi^2_9 = 638.934$, p-value < 0.001).

Group assessments were significant for the 20 bin analysis for the 0-60-P group ($\chi^2_{19} = 1068.941$, p-value < 0.000), the 0-90-P group ($\chi^2_{19} = 901.731$, p-value < 0.001), the final FI 60-sec session for the 0-60/90/180-P group ($\chi^2_{19} = 605.094$, p-value < 0.001), the final FI 90-sec session for the 0-60/90/180-P group ($\chi^2_{19} = 598.781$, p-value < 0.001), the final FI 180-sec session for the 0-60/90/180-P group ($\chi^2_{19} = 256.5$, p-value < 0.001), the final FI 60-sec for the 0-60-90-180-P group ($\chi^2_{19} = 1423.913$, p-value < 0.001), the final FI 90-sec for the 0-60-90-180-P group ($\chi^2_{19} = 1644.085$, p-value < 0.001), and the final FI 180-sec for the 0-60-90-180-P group ($\chi^2_{19} = 1006.2$, p-value < 0.001).

The results of these non-parametric assessments were echoed in the repeated measures ANOVA assessments for the horse subjects. Group assessments were significant for the four bin analysis for the 0-60-P group ($F_{3,\,447} = 253.692$, p-value $<$ 0.001, $\eta^2 = 0.630$), the 0-90-P group ($F_{3,\,447} = 165.14$, p-value < 0.001, $\eta^2 = 0.526$), the final FI 60-sec session for the 0-60/90/180-P group (($F_{3, 297}$ = 162.079, p-value < 0.0001 η^2 = 0.621), the final FI 90-sec session for the 0-60/90/180-P ($F_{3, 297}$ = 96.469, p-value < 0.001, η^2 = 0.494), the final FI 180-sec session for the 0-60/90/180-P ($F_{3, 162}$ = 40.012, p-value < 0.001, η^2 = 0.426), the final FI 60-sec for the 0-60-90-180-P group ($F_{3, 597}$ = 147.125, p-value < 0.001, η^2 = 0.428), the final FI 90-sec for the 0-60-90-180-P group ($F_{3, 582}$ = 308.715, p-value < 0.001, η^2 = 0.614), and the final FI 180-sec for the 0-60-90-180-P group ($F_{3, 465}$ = 201.824, p-value < 0.013, η^2 = 0.566). Eta^2 values for the four bin repeated measures ANOVA assessments varied between .481 – .781 for subjects with significantly different response patterns.

Group assessments were significant for the 10 bin analysis for the 0-60-P group ($F_{9, 1341}$ = 151.041, p-value < 0.001, η^2 =0.503), the 0-90-P group ($F_{9, 1341}$ = 94.077, p-value < 0.001, η^2 = 0.387), the final FI 60-sec session for the 0-60/90/180-P group ($F_{9, 891}$ = 98.846, p-value < 0.001, η^2 = 0.467), the final FI 90-sec session for the 0-60/90/180-P ($F_{9, 891}$ = 87.85, p-value < 0.001, η^2 = 0.369), the final FI 180-sec session for the 0-60/90/180-P ($F_{9, 486}$ = 20.966, p-value < 0.001, η^2 = 0.280), the final FI 60-sec for the 0-60-90-180-P group ($F_{9, 1791}$ = 99.993, p-value < 0.001, η^2 = 0.334), the final FI 90-sec for the 0-60-90-180-P group ($F_{9, 1746}$ = 180.165, p-value < 0.001, η^2 = 0.482), and the final FI 180-sec for the 0-60-90-180-P group ($F_{9, 1395}$ = 105.61, p-value < 0.013, η^2 = 0.405). Eta^2 values for the 10 bin repeated measures ANOVA assessments varied between .324 – .650 for subjects with significantly different response patterns.

Group assessments were significant for the 20 bin analysis for the 0-60-P group ($F_{19, 2831}$= 94.441, p-value < 0.001, η^2 = 0.388), the 0-90-P group ($F_{19, 2831}$ = 66.681, p-value < 0.001, η^2 = 0.309), the final FI 60-sec session for the 0-60/90/180-P group (($F_{19,}$

$_{1881}$ = 53.999, p-value < 0.001, η^2 = 0.353), the final FI 90-sec session for the 0-60/90/180-P ($F_{19, 1881}$ = 46.031, p-value < 0.001, η^2 = 0.317), the final FI 180-sec session for the 0-60/90/180-P ($F_{19, 1026}$ = 14.491, p-value < 0.001, η^2 =0.212), the final FI 60-sec for the 0-60-90-180-P group ($F_{19, 3781}$ = 79.657, p-value < 0.001, η^2 = 0.286), the final FI 90-sec for the 0-60-90-180-P group ($F_{19, 3686}$ = 119.818, p-value < 0.001, η^2 = 0.382), and the final FI 180-sec for the 0-60-90-180-P group ($F_{19, 2945}$ = 68.923, p-value < 0.013, η^2 = 0.308). Eta^2 values for the 20 bin repeated measures ANOVA assessments varied between .228 – .523.

Despite the decrease in effect size ranges when comparing a greater number of bins, nearly all observed effects sizes for subjects with significantly different response patterns are interpretable as being large. Probing the repeated measures ANOVA four and 10 bins assessments revealed estimated marginal means monotonically increased across bins when averaging all subjects' final respective fixed interval sessions other than the final FI 180-sec session for Subject 3 (0-180-P) and Subject 4 (0-60/90/180-P); the 20 bin assessments produced imperfect monotonically increasing estimated marginal means that still revealed an interpretable increasing trend across bins.

For the four bin repeated measures ANOVA assessments, all horse subjects violated the sphericity assumption other than for the final FI 180-sec session for Subjects 5, 7, and 8 (0-60-90-180-P). However, for the 10 and 20 bin repeated measures ANOVA assessments, all horse subjects violated the sphericity assumption without exception when Mauchly's *W* could be calculated. Greenhouse-Geisser and Hyunh-Feldt sphericity assumption corrections did not alter whether a subject's sessions were gauged as significantly different in all cases except one. For the 20 bin repeated measures ANOVA assessments, the final FI 180-sec for Subject 4 (0-60/90/180-P) was significant without sphericity corrections ($F_{19, 76} = 2.078$, p-value < 0.013, $\eta^2 = 0.342$); however, a Greenhouse-Geisser correction (ε=0.153) was not significant ($F_{2.907, 11.626} = 2.078$, p-value < 0.159, $\eta^2 = 0.342$) while a Huynh-Feldt correction (ε=0.603) was significant ($F_{11.463, 45.851} = 2.078$, p-value < 0.04, $\eta^2 = 0.342$). This is a clear example of some of the difficulties associated with procedures that modify degrees of freedom; what correction should be reported and used to draw conclusions?

Honey Bees

For honey bee subjects, Wilcoxon Sign-Rank and sign tests did not indicate significant differences between two bins for most subjects. Only Subject 7 (0-15-X), Subject 2 (0-30-X), Subject 8 (0-30-X), and Subject 9 (0-30-X) had significant differences between two bins. For Subject 2 (0-15-X), a Wilcoxon signed-rank test revealed a significant difference between the two bins (Z=-2.121, p-value < 0.034), but a sign test did not reveal a significant differences (p-value < 0.063) despite every second bin being larger than every first bin for this subject's final fixed interval session. Based on the sign test, the proportion of trials with more responses in the second bin compared to the first when divided by the total number of sessions was not as high as observed in the horse subjects; values ranged from 67% to 86% and do not overlap with values observed for the horse subjects which were all larger. A dependent t-test produced similar results; only Subject 7 (0-15-X), Subject 2 (0-30-X), Subject 8 (0-30-X), and Subject 9 (0-30-X) had significant differences between two bins. Of the subjects with significant differences between the two bins, Cohen's d ranged from 1.15 to 2.68 while R^2 ranged from .08 to .81; most R^2 were above .59, so most of the observed effect sizes are large for subjects with significant differences between the two bins. Comparing the dependent t-test and Wilcoxon Sign-Rank tests reveals inconsistencies for Subjects 8, 9 and 10 (0-15-X).

For honey bee subjects, a Friedman assessment for the four, 10, and 20 bin analyses inconstantly found significant differences between bins for subjects' final fixed interval sessions; increasing the number of bins resulted in more subject's response patterns being regarded as significant. For the four bin Friedman test, four of the eight 0-15-X subjects that completed the experiment had significant differences between the four bins while three of the five 0-30-X subjects that completed the experiment had significant differences between the four bins. Group assessments were significant for the four bin analysis for both the 0-15-X group (χ^2_3 = 47.073, p-value < 0.001) and the 0-30-X group (χ^2_3 = 37.047, p-value < 0.001). For the 10 bin Friedman test, seven of the eight 0-15-X subjects that completed the experiment had significant differences between the 10 bins while four of five of the 0-30-X subjects that completed the experiment had significant differences. Group assessments were significant for the 10 bin analysis for both the 0-15-X group (χ^2_9 = 115.952, p-value < 0.001) and the 0-30-X group (χ^2_9 = 82.932, p-value < 0.001). For the 20 bin Friedman test, all of the 0-15-X subjects that completed the experiment had significant differences between the 10 bins while four of five of the 0-30-X subjects that completed the experiment had significant differences. Group assessments were significant for the 20 bin analysis for both the 0-15-X group (χ^2_{19} = 271.07, p-value < 0.001) and the 0-30-X group (χ^2_{19} = 147.247, p-value < 0.001).

These findings were echoed in the repeated measures ANOVA assessments for the honey bee subjects in all but one case. For the four bin analysis, a Friedman test was not significant for Subject 2 in the 0-15-X group (χ^2_3 = 6.538, p-value < 0.088) while a repeated measures ANOVA was significant ($F_{3, 12}$ = 3.826, p-value < 0.039, η^2 = 0.489). In all other cases, the Friedman and repeated measures ANOVA assessments were in agreement. Group assessments were significant for the four bin analysis for the 0-15-X group ($F_{3, 183}$ = 14.955, p-value < 0.001, η^2 = 0.197) and the 0-30-X group ($F_{3, 114}$ = 15.903, p-value < 0.001, η^2 = 0.295). Eta^2 values for the four bin repeated measures ANOVA assessments varied between .401 – .820 for subjects with significantly different response patterns. Group assessments were significant for the 10 bin analysis for the 0-15-X group ($F_{9, 549}$ = 12.693, p-value < 0.001, η^2 = 0.172) and the 0-30-X group ($F_{9,}$ 342 = 9.495, p-value < 0.001, η^2 = 0.200). Eta^2 values for the 10 bin repeated measures ANOVA assessments varied between .257 – .658 for subjects with significantly different response patterns. Group assessments were significant for the 20 bin analysis for the 0-15-X group ($F_{19, 1159}$ = 17.432, p-value < 0.000, η^2 = 0.222) and the 0-30-X group ($F_{19, 722}$ = 7.735, p-value < 0.001, η^2 = 0.169). Eta^2 values for the 20 bin repeated measures ANOVA assessments varied between .190 – .609. Despite the decrease in effect size ranges when comparing a greater number of bins, nearly all observed effects sizes for subjects with significantly different response patterns are interpretable as being large. However, the majority of the observed effect sizes for honey bees are considerably smaller than the effect sizes observed for horses.

In the 0-15-X group, probing the repeated measures ANOVA four bins assessments revealed estimated marginal means monotonically increased across bins for Subjects 2, 7, 8, and 10. For the 10 and 20 bin assessments, estimated marginal means monotonically increased across bins only for Subjects 7 and 8. When averaging the 0-15-

X group, a monotonic increase in estimated marginal means was not observed for the four, ten, and 20 bin analyses. In the 0-30-X group, probing the repeated measures ANOVA four bins assessments revealed estimated marginal means monotonically increased across bins for Subjects 2, 7, and 9. For the 10 bin assessments, estimated marginal means monotonically increased across bins only for Subjects 2 and 8. For the 20 bin assessment, estimated marginal means monotonically increased across bins only for Subject 8. However, when averaging the 0-30-X group, a monotonic increase in estimated marginal means was observed for the four, ten, and 20 bin analyses.

For the four bin repeated measures ANOVA assessments, no individual honey bee subjects violated the sphericity assumption when Mauchly's *W* was calculable. However, the 0-15-X group did violate the sphericity assumption ($W = 0.83$, $\chi^2_5 = 11.145$, p-value < 0.049) as did the 0-30-X group ($W = 0.55$, $\chi^2_5 = 21.647$, p-value < 0.001). Greenhouse-Geisser and Hyunh-Feldt sphericity assumption corrections did not alter whether a group's sessions were gauged as significantly different. For the 10 bin repeated measures ANOVA assessments, no individual honey bee subjects violated the sphericity assumption when Mauchly's *W* was calculable. However, the 0-15-X group did violate the sphericity assumption ($W = 0.244$, $\chi^2_{44} = 81.557$, p-value < 0.001) as did the 0-30-X group ($W = 0.11$, $\chi^2_{44} = 76.782$, p-value < 0.002). Greenhouse-Geisser and Hyunh-Feldt sphericity assumption corrections did not alter whether a group's sessions were gauged as significantly different. For the 20 bin repeated measure ANOVA assessments, no individual subjects' sphericity were calculable. The 0-15-X group did violate the sphericity assumption ($W = 0.04$, $\chi^2_{189} = 304.579$, p-value < 0.001) as did the 0-30-X group ($W = 0$, $\chi^2_{189} = 308.9$, p-value < 0.001).

Taken together, NHST revealed the horse subjects consistently produced evidence of temporal control (on average) with the exception of Subject 3 (0-180-P) and Subject 4 (0-60/90/180-P) while the honey bee subjects varied between individuals and produced inconsistent evidence of temporal control (on average) for this reason. While horses produced estimated marginal means that monotonically increased across four, 10, and 20 bins, only a few honey bees' estimated marginal means followed a monotonically increasing pattern.

Both OOM and NHST methods were in agreement when evaluating which horse subjects demonstrated evidence of temporal control; however, for honey bee subjects, NHST was actually more conservative than OOM at identifying response tally differences between bins. For the two-bin analysis, Subject 5 (0-15-X) did not produce significant results under a Wilcoxon Signed-Rank test, sign test, or dependent t-test, but OOM noted bin two contained more responses than bin one (PCC value: 61.11; randomization range: 11.11 – 55.56; c-value < .001) for Subject 5 (0-15-X). For the four, ten, and 20 bin analyses, OOM and NHST assessed very different properties: OOM assessed the existence of a monotonic increase across the interval whereas NHST assessed if any response tally differences were observed between bins; thus, a comparison between NHST and OOM regarding which subjects emitted "significantly different" response bin tallies is not an entirely fruitful endeavor.

Quarter Life Analysis

Quarter life is defined as the interval of time in which the first quarter of total responses made during the fixed interval occurs. If fewer than four responses were emitted by the subject, we did not include that trial in our quarter life assessments as quarter life requires at least four responses to be calculated. As quarter life is a truly continuous measure (i.e. time), we present descriptive statistics of horse and honey bee subject quarter lives for the final fixed interval session in Appendix 6: Quarter Life Descriptive Statistics; a clear increase in average quarter life across longer fixed interval schedules is readily observable for the horse subjects while a less clear trend was observed for honey bee subjects. For horses, when considering all schedules and subjects, average quarter lives when considering all final session trials at each schedule duration ranged between 41.63% to 68.47% of the fixed interval for horses when excluding the final FI 180-sec session for Subject 4 (0-60/90/180-P) while honey bee subjects' quarter lives ranged between 6.88% 47.60% of the fixed interval.

Quarter Life Analysis - OOM

Horses

To assess differences in horse quarter lives between fixed interval schedule durations, we performed a series of two-way ordinal analysis in OOM. Combinations of each fixed interval schedule duration's final session's trials were compared under the prediction that longer fixed interval schedule durations would produce longer quarter lives. Three two-way ordinal analyses were conducted (i.e. FI 60-sec versus FI 90-sec; FI 60-sec versus FI 180-sec; FI 90-sec versus FI 180-sec) for group and condition comparison analyses using OOM. Unfortunately, we could not perform three-way ordinal comparisons because the required combinations exceeded 1,000,000 ordinal comparisons, and OOM could not draw enough computing power from our computers to complete the analysis. We employed two strategies for our ordinal analyses; one ordinal analysis separated groups while the second ordinal analysis pooled conditions across groups. Following the first strategy, the sixth session's quarter lives of the 0-60-P, 0-90-P, 0-180-P groups were compared; the sixth, ninth, and twelfth session's quarter lives of the 0-60-90-180-P group were compared; and the fourth, fifth, and sixth, session's quarter lives of the 0-60/90/180-P group were compared. Following the second strategy, we pooled all of the final sessions of each fixed interval schedule (excluding the 0-60/90/180-P group as these subjects did not experience three fixed interval sessions and pooling this group with the other subjects would not be an appropriate assessment).

The results of these ordinal assessments are displayed in Appendix 7: Quarter Life OOM. In all cases for all group and condition comparisons for horse subjects, longer fixed interval schedules produced longer quarter lives, and this comparison produced impressive PCC values ranging from 73.87 to 97.30; pooling appropriate fixed interval schedules also produced a clear schedule duration effect on quarter life for the FI 60-sec versus FI 90-sec schedule comparison (PCC value: 86.05; randomization range: 49.35 – 50.65; c-value < .001), the FI 60-sec versus FI 180-sec schedule comparison (PCC value: 95.48; randomization range: 49.00 – 51.00; c-value < .001), and the FI 90-sec versus FI 180-sec schedule comparison (PCC value: 88.16; randomization range: 49.03 – 50.72; c-value < .001).

Honey Bees

To assess differences in honey bee quarter lives between fixed interval schedule durations, we only performed a single two-way ordinal assessment between the FI 15-sec condition and FI 30-sec condition as no subjects in the FI 60-sec and FI 120-sec conditions completed all 20 fixed interval sessions. For subjects that competed the experiment in the 0-15-X and 0-30-X groups, each fixed interval schedule's final session's trials were compared under the prediction that longer fixed interval schedule durations would produce longer quarter lives. When comparing quarter lives of the 0-15-X and 0-30-X groups, larger quarter lives were observed for the 0-30-X group compared to the 0-15-X group (PCC value: 81.14; randomization range: 42.86 – 56.14; c-value < .001). While impressive, this pooled honey bee analysis produced a lower pattern match compared to the horse schedule comparisons.

Quarter Life Analysis - NHST

As quarter life is a continuous measure, we performed a series of independent t-tests to assess mean differences in quarter life for each schedule utilizing NHST methods for both horse and honey bee subjects. For the three way comparisons for the horse subjects, we performed a one-way ANOVA. The results of the independent t-tests and one-way ANOVAs are presented in Appendix 9: Quarter Life NHST Parametric; bolded assessments were not significant. To demonstrate the difficulties in conceptualizing continuous data as non-continuous in NHST, we also performed a series of Wilcoxon Sign-Rank tests, Kruskal-Wallis tests, and Median tests. The results of the Wilcoxon Sign-Rank Tests, Kruskal-Wallis Test, and Median Test are presented in Appendix 8: Quarter Life NHST Non-Parametric; bolded assessments were not significant.

For every comparison other than those involving Subject 3 (0-180-P), both horses and bees produced significant differences according to both a Mann-Whitney U test and independent t-test. It is likely that these assessments involving Subject 3 (0-180-P) were not significant because of the low sample size of quarter lives (N = 4). The Mann-Whitney U test and independent t-test assessments were in agreement for all comparisons other than for one comparison. The Mann-Whitney U did find a significant difference when comparing the quarter lives between the 0-60-P and 0-180-P group ($U = 8$, p-value < 0.002) while an independent t-test was not significant: $t(3.013) = -1.77$, p-value < 0.175, $d = -3.189$. Both assessments were not significant when comparing the 0-90-P and 0-180-P groups ($U = 116$, p-value < 0.106; $t(3.016) = -1.169$, p-value < 0.326, $d = -1.868$).

Levene's tests were significant for every comparison other than when comparing the FI 90-sec and FI 180-sec sessions for the 0-60/90/180-P ($F = 2.938$, p-value < 0.09). A few interesting notes are present when comparing the independent t-tests assessing quarter-life differences between schedules. First, even though the 0-60-P versus 0-180-P comparison was not significant, this comparison produced the largest effect size ($d = -3.189$). Second, other than the horse 0-60-P versus 0-90-P group comparison ($d = -1.229$), the honey bee 0-15-X versus 0-30-X group comparison produced the lowest effect size ($d = -1.367$). Third, when considering the predicted confidence intervals, the honey bee group comparison produced the narrowest confidence interval (-9.035 – -3.639); however, the lower limit of this interval was much closer to zero than any significant confidence interval for horses' fixed interval duration comparisons of quarter life.

The Kruskal-Wallis, Median, and One-Way ANOVA assessments were significant for all three way comparisons; the lowest observed eta^2 (0.427) from comparing the 0-60-P, 0-90-P, and 0-180-P groups was still considered a large effect size; comparing the FI 60-sec, FI 90-sec, and FI 180-sec sessions for the 0-60/90/180-P group produced the largest effect size (1.662).

Simply stated, both horse and honey bee subjects that were exposed to longer fixed interval schedules emitted longer quarter lives; however, the percentage into the fixed intervals in which quarter lives occurred was markedly different between horses and honey bees. NHST observed significant differences in quarter life for all comparisons other than those involving the 0-180-P group. Additionally, all NHST assessments produced similar results as the OOM ordinal predictions with the exception of the analyses involving Subject 3 (0-180-P) which is likely due to the small number of quarter lives this subject emitted, for OOM's assessments are not contingent on N.

Index of Curvature Analysis

Indices of curvature were calculated for each trial based on the previously described general procedure. We calculated three versions of index of curvature based around this general method. The first index of curvature was calculated by plotting response tally on the ordinate and treating responding as occurring discreetly throughout the fixed interval (*Discrete Response Tally Index of Curvature*). For this index of curvature, single lines were not drawn between each response in a triangular manner; only rectangular areas were calculated under each response and IRT. The second index of curvature was calculated again by plotting response tally on the ordinate, but continuous responding was incorrectly assumed (*Continuous Response Tally Index of Curvature*). This method is closest to the traditional form of the index of curvature and draws lines between responses thus incorporating triangular areas on top of the rectangular areas as calculated in the Discrete Response Tally Index of Curvature method. Both of these methods calculate areas under the traditional cumulative curve. Finally, the third index of curvature was calculated by plotting response duration on the ordinate and by drawing lines between responses such that both rectangles and triangles were used to calculate *Response Duration Index of Curvature* as previously described. As index of curvature can be represented as a truly continuous measure (i.e. for index of curvature using response duration on the ordinate, integrals of time are expressed in seconds^2), we present descriptive statistics of subject indices of curvature in Appendix 10: Index of Curvature Descriptive Statistics; negative indices of curvature (indicating responding was not temporally controlled) are bolded.

To assess the similarity between these three methods of calculating index of curvature, we performed correlations between each index separately for both horses and honey bees; these correlations are also presented in Appendix 10: Index of Curvature Descriptive Statistics. Larger indices of curvature are taken to imply higher levels of temporal control; if an index is negative, this may be an indication of poor temporal control. An assessment of positive versus negative indices of curvatures' means and medians reveals indices of curvature are positive for most horse subjects with two exceptions (Subject 3 (0-180-P) and Subject 4 (0-60/90/180-P)). In contrast, honey bee subjects produced more negative indices of curvature indicating poorer levels of temporal control. From this assessment alone, horses could be taken to have emitted responses than came under a higher level of temporal control compared to honey bee responses. When assessing Appendix 10: Index of Curvature Descriptive Statistics, the Discrete Response

Tally Index of Curvature produced the fewest negative subject and group means and medians which may be indicative this measure is the most liberal calculation of index of curvature.

Index of Curvature Analysis – OOM

To assess differences in horse indices of curvature between fixed interval schedule durations, we performed a series of two-way ordinal analysis in OOM; unfortunately, performing three-way ordinal comparisons in OOM was not possible as doing so created over 1,000,000 combinations to be compared. Combinations of each fixed interval schedule's final session's trials were compared under the prediction that longer fixed interval schedule durations would produce larger indices of curvature. Three two-way ordinal analyses were conducted (i.e. FI 60-sec versus FI 90-sec; FI 60-sec versus FI 180-sec; FI 90-sec versus FI 180-sec) for an individual analysis using OOM. We employed two strategies for our ordinal analyses; one ordinal analysis separated groups while the second ordinal analysis pooled conditions across groups. Following the first strategy, the sixth session's indices of curvature of the 0-60-P, 0-90-P, 0-180-P groups were compared; the sixth, ninth, and twelfth session's indices of curvature of the 0-60-90-180-P group were compared; and the fourth, fifth, and sixth, session's indices of curvature of the 0-60/90/180-P group were compared. Following the second strategy, we pooled all of the final sessions of each fixed interval schedule (excluding the 0-60/90/180-P group). The results of these assessments are presented in Appendix 11: Index of Curvature OOM; bolded assessments did not fit the ordinal prediction.

Horses

For the Discrete Response Tally Index of Curvature, horse subjects tended to emit longer indices at longer schedules other than when comparing the 0-90-P and 0-180-P groups' indices (PCC value: 46.17; randomization range: 43.37 – 57.67; c-value < .97). For the more traditional Continuous Response Tally Index of Curvature, a greater number of schedule comparisons did not produce observed differences between the shorter and longer fixed interval schedules when evaluating PCC values or c-values. When comparing the 0-60-P and 0-90-P groups with the 0-180-P group, small PCC values and large c-values were observed (indicating poor pattern matches); when comparing the FI 60-sec, FI 90-sec, and FI 180-sec schedules for the 0-60/90/180-P group, small PCC values and large c-values were also observed; however, the 0-60-90-180-P group's comparisons did produce clear differences between schedule durations. For the recommended Response Duration Index of Curvature, horse subjects again tended to emit longer indices at longer schedules. The only comparisons that did not fit the ordinal prediction was the comparison between the 0-90-P and 0-180-P groups (PCC value: 39.33; randomization range: 42.50 – 56.67; c-value = 1), and the comparison between the FI 60-sec and FI 90-sec conditions of the 0-60/90/180-P group (PCC value: 48.22; randomization range: 48.56 – 51.81; c-value = .1). A comparison between the three different indices of curvature reveals the Continuous Response Tally Index of Curvature measure produced fewer schedule comparisons that fit the ordinal prediction.

Honey Bees

To assess differences in honey bee indices of curvature between fixed interval schedule durations, we only performed a single two-way ordinal assessment between the FI 15-sec condition and FI 30-sec condition as no subjects in the FI 60-sec and FI 120-sec conditions completed all 20 sessions. Each fixed interval schedule durations' final sessions' trials were compared under the prediction that longer fixed interval schedule durations would produce larger indices of curvature.

Honey bees did tend to emit longer Discrete Response Tally Index of Curvature between schedule durations (PCC value: 67.86; randomization range: 46.33 – 52.14; c-value < .001), and this PCC value was comparable to the PCC values observed when comparing horse performances. For the more traditional Continuous Response Tally Index of Curvature, honey bee subjects did fit the prediction (PCC value: 58.22; randomization range: 46.60 – 52.70; c-value < .001) that longer schedules produce larger indices of curvature, but this pattern match was not as strong when compared the Discrete Response Tally Index of Curvature. Moreover, this PCC value was the lower than all horse schedule comparisons when excluding those comparisons that did not produce a pattern match. Finally for the recommended Response Duration Index of Curvature, honey bees emitted smaller indices of curvature at the shorter schedule duration (PCC value: 59.86; randomization range: 46.46 – 53.23; c-value < .001). This PCC value was lower than all horse schedule comparisons when excluding those comparisons that did not match the ordinal prediction.

Simply stated, horses and honey bees did tend to produce higher indices of curvature at longer schedules, but honey bees tended to not fit this pattern as strongly as horses.

Index of Curvature Analysis – NHST

As index of curvature can be calculated as a continuous measure, we performed a series of t-tests to assess mean differences in index of curvature for each schedule utilizing NHST methods for both horses and honey bees. To demonstrate the difficulties associated with conceptualizing continuous data as non-continuous in NHST, we also performed a series of Mann-Whitney U assessments. For the three way comparisons, we performed a series of oneway ANOVAs, Kruskal-Wallis tests and median tests. These assessments were performed for each calculated index of curvature. Mann-Whitney U, Kruskal-Wallis and median assessment results are provided in Appendix 12: Index of Curvature NHST Non-Parametric while independent t-test and oneway ANOVA assessment results are provided in Appendix 13: Index of Curvature NHST Parametric. Levene Tests of homogeneity revealed all quantitative NHST assessments violated homogeneity concerns, for this reason, corrected t-values, degrees of freedom, p-values, and confidence intervals are presented in Appendix 13: Index of Curvature NHST Parametric. For both appendices, bolded assessments were not significant.

Mann-Whitney U assessments revealed horses and honey bees tended to produce larger Discrete Response Tally Indices of Curvature at longer schedule durations other than when comparing the 0-60-P and 0-90-P groups to the 0-180-P group. In contrast, the OOM assessment of Discrete Response Tally Indices of Curvature produced a low c-value when comparing the 0-60-P and 0-180-P groups, but this PCC value was not impressive (PCC value: 54.5; randomization range: 43.50 – 56.50; c-value < .01). Mann-Whitney U assessments of Continuous Response Tally Indices of Curvature revealed honey bee subjects did not emit significantly different Continuous Response Tally Indices of Curvature; this finding was not echoed within OOM or by an independent t-test.

In contrast, Mann-Whitney U assessments of horse Continuous Response Tally Indices of Curvature were in agreement with the OOM assessments; comparisons involving both the 0-180-P and 0-60/90/180-P groups were not significant. However, honey bees did not produce a significant difference in Continuous Response Tally Indices of Curvature when comparing group schedule durations ($U = 943$, p-value < 0.167).

Finally, Mann-Whitney U assessments of Response Duration Indices of Curvature did conform to OOM ordinal analyses for most horse subjects; the 0-90-P versus 0-180-P group comparison was not significant ($U = 236$, p-value < 0.467), nor was the comparison between the FI 60-sec and FI 90-sec session for the 0-60/90/180-P group ($U = 4822$, p-value < 0.664). Additionally, the honey bee group comparison was not significant ($U = 908$, p-value < 0.101).

Kruskal-Wallis assessments were significant for all horse comparisons except when comparing the Continuous Response Tally Indices of Curvature for the 0-60/90/180-P group ($\chi^2(2) = 0.068$, p-value < 0.966). Median tests were also significant for all horse comparisons except when comparing the Continuous Response Tally Indices of Curvature for the 0-60/90/180-P group ($\chi^2(2) = 1.074$, p-value < 0.584).

Taken together, independent t-tests revealed horses and honey bees tended to produce larger Discrete Response Tally Indices of Curvature at longer schedule durations other than when comparing the 0-60-P and 0-90-P groups to the 0-180-P group. Specifically, the 0-60-P versus 0-180-P group comparison was not significant for either NHST assessment, but was when utilizing OOM (PCC value: 54.50; randomization range: 43.50 – 56.50; c-value < .01). An additional inconsistency is that the FI 90-sec versus FI 180-sec session comparison for the 0-60/90/180-P group was not significant with an independent t-test ($t(62.075) = -0.91$, p-value < 0.366, $d = -0.404$) while a Mann-Whitney U assessment was significant ($U = 2068$, p-value < 0.017) and OOM revealed an impressive pattern match (PCC value: 61.70; randomization range: 48.04 – 51.76; c-value < .001). This is an important distinction to note as both categorical analyses were gauged as being significant while treating the Discrete Response Tally Index of Curvature as a continuous measure did not produce significant results for the FI 90-sec versus FI 180-sec session comparison for the 0-60/90/180-P group. Cohen's d effect sizes were generally impressive for horse subject comparisons (ranging from .930 – 4.426) for subjects with identified significant differences; honey bee subjects produced a smaller effect size (.810) that is still considered large by standard conventions. Additionally, honey bee confidence intervals (-43.624 – -10.709) were closer to zero than horse confidence intervals in most cases. A oneway ANOVA was significant for all horse schedule comparisons; the lowest eta^2 was observed for the 0-60/90/180-P group.

For horses, independent t-tests of the Continuous Response Tally Indices of Curvature conformed to both the OOM and Mann-Whitney U assessments; comparisons involving both the 0-180-P and 0-60/90/180-P groups were not significant. In contrast, honey bees did produce a significant difference between the 0-15-X and 0-30-X groups ($t(43.468) = -2.279$, p-value < 0.028, $d = -0.554$) that was not observed for the Mann-Whitney U assessment ($U = 943$, p-value < 0.167). Additionally, honey bees produced the lowest effect size ($d = 0.555$) of the significant comparisons while horses produced generally large effect sizes ranging from 0.623 – 3.322. Finally, honey bees produced confidence intervals (-35.795 – -2.189) that were closer to zero than horses with observed significant differences in Continuous Response Tally Indices of Curvature between schedule durations. Oneway ANOVAs were significant for all schedule comparisons with horses; this contrasts with the findings produced by the Kruskal-Wallis ($\chi^2(2) = 0.068$, p-value < 0.966) and Median ($\chi^2(2) = 1.074$, p-value < 0.584) tests for the 0-60/90/180-P group ($F(2, 251) = 2.367$, p-value < 0.096). The effect size for the 0-60/90/180-P schedule comparisons was smaller ($eta^2 = 0.019$) compared to the other group schedule comparisons for horses which ranged between 0.154 – 0.593.

Independent t-tests of the Response Duration Indices of Curvature conformed to both the OOM and Mann-Whitney U assessments for the 0-90-P versus 0-180-P comparison ($t(3.01) = -0.125$, p-value < 0.909, $d = -0.221$) and for the FI 60-sec and FI 90-sec comparison for the 0-60/90/180-P group comparison ($t(182.741) = -1.341$, p-value < 0.181, $d = -0.318$). However, a few inconsistences between the performed assessments were observed for Response Duration Indices of Curvature. First, the 0-60-P versus 0-180-P comparison was not significant with an independent t-test ($t(3.009) = -1.216$, p-value < 0.331, $d = -2.23$) but was significant for a Mann-Whitney U assessment ($U = 103$, p-value < 0.025) and matched the OOM ordinal prediction (PCC value: 82.83; randomization range: 44.83 – 55.83; c-value < .001).

It is important to note the observed large effect size of the independent t-test indicates this insignificant p-value may be reduced with a larger N for the 0-180-P group, so this inconsistency between assessments may be understandable. Second, the honey bee 0-15-X versus 0-30-X group comparison was not significant with an independent t-test ($t(58.44) = -1.608$, p-value < 0.113, $d = .362$), or a Mann-Whitney U test ($U = 908$, p-value < 0.101) but did match the OOM ordinal prediction (PCC value: 59.86; randomization range: 46.46 – 53.23; c-value < .001); in this case, OOM may be a more liberal assessment method. Compared to the schedule comparisons of the response tally indices of curvature, the Response Duration Indices of Curvature produced large effect sizes and confidence intervals. Cohen’s d was not large for the honey bee comparison ($d = .362$) and was smaller than the effect sizes observed for the schedule comparisons with observed significant differences for horses; these effect sizes ranged from 2.238 – 24.783. A oneway ANOVA was significant for all schedule comparisons for the horses and echoes the Kruskal-Wallis and Median Tests for Response Duration Indices of Curvature.

Simply stated, most NHST comparisons of the three indices of curvature revealed longer schedules produced higher indices of curvature; the effect of this difference for honey bees seems to be lower than the effect for horses, on average, but several issues complicate such a comparison due to the different schedule durations between species. While a few inconsistences were noted between NHST methods, most comparisons produced comparable results.

Breakpoint

We redefined breakpoint as the time since the initiation of the fixed interval to the response that maximized slope differences between the previous and following response. We attempted to identify what response produced both the largest change in slope towards the terminal point (trial duration, response tally) of the trial compared to the previous adjacent response and the smallest change in slopes for the remaining responses in the trial. Unfortunately, while this redefinition may be theoretically sound from a realist perspective under ideal circumstances, attempting to isolate a maximum difference in slopes was not possible with actual horse or honey bee data. Slope variation was not as clean as originally anticipated, and subjects' response variability was such that this new definition of breakpoint was not calculable. Unfortunately, as the only other calculation of breakpoint involves fitting aggregate regression lines through discrete responses, we did not attempt to use this method as utilizing an average is required to calculate and analyze breakpoint; we are interested in individual trial analyses to assess temporal control.

Latency and Post-Reinforcement Pause Analysis

During the fixed interval sessions, some horse subjects did not consume the deposited treats before continuing to respond; hence, for some trials, PRP and latency to the first response of a trial were not synonymous. We were thus obliged to perform slightly different assessments for horse versus honey bee subjects. As honey bees consumed the reinforcement after each delivery, PRP was assessed for honey bees while latency to first response of the trial was assessed for horses. As both latency and PRP measures are truly continuous (i.e. time), Appendix 14: Latency and PRP Descriptive Statistics presents PRP or latency descriptive statistics for each individual's and group's final CRF and FI sessions. A clear increase in average latency when comparing the final CRF and FI sessions was observed for all horse subjects while Subject 6 and Subject 9 from the 0-15-X group did not produce an increase in PRP when comparing the final CRF versus FI sessions. Medians also followed this trend for horses other than for Subject 1 (0-90-P) while honey bee Subjects 3, 6, 9 and 10 (0-15-X) did not emit longer median PRPs when comparing the final CRF versus FI sessions. However, all 0-30-X subjects increased in median PRP when responding was reinforced on fixed interval schedules.

The final FI session also tended to produce higher standard deviations in latency or PRP compared to the final CRF session for most horses and honey bees. We also present the percent into the fixed interval when the average first response is made for horses and honey bees in Appendix 14: Latency and PRP Descriptive Statistics. These percentages are substantially larger for most horse subjects (ranging from 13.13% to 90.45%) compared to most honey bee subjects (ranging from .25% to 85.99%); it is important to note that horse responding was reinforced on longer fixed interval schedules, so this difference in percentages favors an interpretation that horse responding came under more temporal control than honey bee responding; however, concluding species differences in PRP when different schedule durations were utilized may be inappropriate.

Latency / PRP Analysis – OOM

We used two strategies to perform an individual analysis of horse and honey bee latencies and PRPs, respectively. First, two-way ordinal comparisons were made between combinations of the final CRF session and final FI session under the prediction latencies or PRPs would be longer during the final FI session compared to the final CRF session. For this prediction, we assessed individual's sessions and also pooled a group's individuals to perform group assessments; pooled horse groups only underwent 100 randomizations whereas individual subject comparisons underwent 1,000 randomizations because OOM would not complete an analysis with 1,000 randomizations.

Second, a series of two-way ordinal comparisons were made between group schedule durations under the prediction longer fixed interval durations would contain longer latencies to the first response of a trial. Thus, we compared latencies of the 0-60-P group with the latencies of the 0-90-P group, the latencies of the 0-60-P group with the latencies of the 0-180-P group, the latencies of the 0-90-P with the latencies of the 0-180-P group, and the PRPs of the 0-15-X group with the PRPs of the 0-30-X group. For the 0-60/90/180-P and 0-60-90-180-P groups, we also performed within-subject schedule comparisons of the final session at each schedule. We also pooled the final session of each respective FI condition of the 0-60-90-180-P group into the 0-60-P, 0-90-P, and 0-180-P groups and compared these pooled FI latencies across schedule. Unfortunately, we could not perform a three-way ordinal analysis comparing latencies of the FI 60-sec, FI 90-sec, and FI 180-sec schedule durations as doing so would produce combinations of over 1,000,000 orders, and OOM could not complete this assessment. The results of these assessments are presented in Appendix 15: Latency and PRP OOM; bolded analyses did not match the ordinal prediction.

Horses

All horse subjects and pooled groups tended to emit longer latencies during the final FI session compared to the final CRF session; PCC values ranged from 52.60 – 98.44 and all c-values were below .01. Additionally, most fixed interval schedule comparisons revealed horses tended to produce longer latencies at longer fixed interval schedule durations with the exception of the comparisons involving the FI 180-sec session for Subject 4 (0-60/90/180-P) and the FI 90-sec versus FI 180-sec comparison for Subject 7 (0-60-90-180-P).

Honey Bees

In contrast, honey bee individual subjects produced inconsistent results when comparing the final FI session compared to the final CRF session; PCC values ranged from 29.69 – 100. The 0-15-X group had three of eight subjects that matched the ordinal prediction that the final FI session contained longer PRPs compared to the final CRF session while the 0-30-X group had four of five subjects that matched the ordinal prediction. However, both pooled groups did match the ordinal prediction even though some individuals did not fit this prediction; the 0-15-X group matched the prediction (PCC value: 63.76; randomization range: 46.91 – 51.78; c-value < .001) as did the 0-30-X group (PCC value: 73.88; randomization range: 45.80 – 53.55; c-value < .001).

When comparing PRPs between fixed interval schedule durations, honey bees did produce longer PRPs when responding was reinforced on an FI 30-sec compared to an FI

15-sec (PCC value: 60.85; randomization range: 46.88 – 52.87; c-value < .001). The comparison between the 0-15-X and 0-30-X group produced a lower PCC value than all horse fixed interval schedule comparisons with the exception of the 0-60-P versus 0-90-P group (PCC value: 58.59; randomization range: 49.26 – 50.63; c-value < .01), Subject 4's comparisons involving the FI 180-sec session, and Subject 7's FI 90-sec session versus FI 180-sec session comparison (PCC value: 49.56; randomization range: 42.00 – 57.56; c-value < .001).

Simply stated, horses tended to emit longer latencies when responding was reinforced on a fixed interval schedule while honey bees produced inconsistent individual results. The pooled honey bee group comparison revealed a similar, but weaker, trend compared to pooled horse group comparisons. Fixed interval schedule comparisons revealed both honey bees and horses tended to wait longer before emitting the first response of a trial at longer schedule durations.

<u>Latency / PRP Analysis – NHST</u>

As both the latency and PRP measures are continuous, to perform aggregate assessments of these data, we correctly conducted a series of independent t-tests (displayed in Appendix 17: Latency and PRP NHST Parametric) and incorrectly performed a series Mann-Whitney U assessments (displayed in Appendix 16: Latency and PRP NHST Non-Parametric) to demonstrate the importance of the continuity assumption on aggregated data. Both appendices bold comparisons that were not significant. Both NHST assessments were used to compare the final CRF session with the final FI session for individuals and pooled groups as well as for the pair-wise fixed interval schedule comparisons. Levene's homogeneity assessments were significant for some horse and honey bee subjects while other subjects conformed to the homogeneity assumption inherent in Student's t-tests; when corrections were required, we present appropriate modifications to degrees of freedom and accompanying t-values, p-values, and confidence intervals

Mann-Whitney U assessments comparing latencies and PRPs of the final CRF session with the final FI session revealed most horse subjects produced significant differences in latency between the two conditions with the exception of Subject 1 (0-90-P) (*U* = 1185, p-value = 0.654) and the FI 180-sec session for Subject 4 (0-60/90/180-P) (*U* = 66, p-value = 0.084). In contrast, the ordinal analysis within OOM revealed all horse subjects fit the prediction that longer latencies were contained within the final FI session compared to the final CRF session. For honey bees, PRPs were not significantly different when comparing the final FI session compared to the final CRF session for five of the eight subjects in the 0-15-X group; however, pooling the 0-15-X group resulted in a significant difference between the final FI session compared to the final CRF session (*U* = 1475, p-value = 0.049). For the 0-15-X group, both OOM and the Mann-Whitney U assessments identified the same subjects as having sizeable differences between the final FI session compared to the final CRF session. For the 0-30-X group, OOM and the Mann-Whitney U assessments did not identify the same subjects as having sizeable differences between the final FI session compared to the final CRF session; large PCC values and small c-values were observed for Subjects 1 and 2 (0-30-X) using OOM (PCC value: 71.11; randomization range: 32.22 – 67.78; c-value < .001; PCC value: 64.29; randomization range: 29.79 – 67.86; c-value < .01, respectively), but the Mann-Whitney

U assessments were not significant for these subjects (*U* = 26, p-value = 0.133; *U* = 19.5, p-value = 0.336, respectively). Both OOM and the Mann-Whitney U assessments identified Subject 9 (0-30-X) did not emit sizeable differences in PRP between the final FI session compared to the final CRF session (*U* = 51, p-value < 0.562; PCC value: 42.15; randomization range: 35.54 – 64.46; c-value < .96).

Independent t-tests comparing latencies and PRPs of the final CRF session with the final FI session revealed most horse subjects produced significant differences in latency between the two conditions with the exception of Subject 1 (0-90-P) (*t*(89.833) = -0.883, p-value = 0.380, *d* = -0.177), Subject 3 (0-180-P) (*t*(4.147) = -2.586, p-value = 0.059, *d* = -2.364), and the FI 60-sec session for Subject 7 (0-60-90-180-P) (*t*(98) = -1.681, p-value = 0.096, *d* = .352). Thus, the Mann-Whitney U assessments were in agreement with the performed t-tests for all horse subjects with the exclusion of Subject 7 (*U* = 959, p-value = 0.045). For most horse subjects, Cohen's d effect sizes were large and ranged between -0.177 – -3.152, and confidence intervals were generally far from intersecting zero. For honey bee subjects, only two of eight subjects in the 0-15-X group and only two of five subjects in the 0-30-X group produced significant differences between the final CRF session and final FI session. When comparing the Mann-Whitney U assessment to the independent t-tests, only Subject 2 (0-15-X) produced conflicting results (*U* = 5, p-value < 0.048; *t*(10) = -2.052, p-value = 0.067, *d* = -1.201).

Mann-Whitney U assessments comparing horse latencies between fixed interval schedule durations revealed significant differences between the 0-60-P and 0-90-P groups (*U* = 9317, p-value < 0.01), but latencies from the 0-180-P group were not significantly different from those observed in the 0-60-P group (*U* = 194, p-value = 0.067) and 0-90-P group (U = 242, p-value = 0.178); this is likely due to the small sample size of trials during the final FI session for the 0-180-P group (N = 4). In contrast, OOM did observe that the 0-60-P group contained shorter latencies compared to the 0-180-P group (PCC value: 74.16; randomization range: 45.87 – 55.87; c-value < .01), and the 0-90-P group contained shorter latencies compared to the 0-180-P group (PCC value: 67.73; randomization range: 45.47 – 54.93; c-value < .01); this may be due to the fact that OOM's analyses are not directly contingent on N. Subject 4 (0-60/90/180-P) did not produce significant differences in latency when comparing the FI 60-sec session with the FI 180-session (U = 81, p-value < 0.21). While a significant difference was observed when comparing the FI 90-sec session with the FI 180-sec session for Subject 4 (0-60/90/180-P) (U = 23, p-value < 0.001), this difference was in the opposite direction (CRF median = 57.06; FI median = 27.33); thus, we may have observed a type III error for this assessment. This is important to note, for OOM is sensitive to directional concerns and observed a small pattern match under the prediction the FI 180-sec session would contain longer latencies compared to the FI 90-sec (PCC value: 9.20; randomization range: 40.40 – 58.80; c-value < 1.00). Finally, Subject 7 (0-60-90-180-P) did not produce significant differences in latency when comparing the final FI 180-sec session with the final FI 60-sec session (U = 153, p-value = 0.054), or with the final FI 90-sec session (U = 223, p-value = 0.965). All other horse schedule comparisons were significant. Combining the final sessions at each fixed interval of the 0-60-90-180-P group with the 0-60-P, 0-90-P, and 0-180-P groups produced clear differences between schedule durations. In contrast, the PRPs for the 0-15-X versus 0-30-X honey bee fixed interval schedule comparison were not significantly different (U = 946, p-value = 0.065);

note that OOM did observe longer PRPs in the 0-30-X group compared to the 0-15-X group (PCC value: 60.85; randomization range: 46.88 – 52.87; c-value < 0.001).

Independent t-tests comparing horse latencies between fixed interval schedule durations revealed similar findings as the Mann-Whitney U assessments with a few exceptions. First, both OOM and the Mann-Whitney U assessments revealed clear differences between the 0-60-P and 0-90-P groups, but an independent t-test was not significant ($t(298) = -1.91$, p-value = 0.057, $d = -0.221$). Second, when comparing the 0-60-P group versus the 0-90-P group, an independent t-test was significant ($t(153) = -3.2$, p-value < 0.002, $d = -1.455$), but the Mann-Whitney U assessment was not significant ($U = 194$, p-value < 0.067) while OOM did observe a strong pattern match (PCC value: 74.16; randomization range: 45.87 – 55.87; c-value < .01). Third, the independent t-test and Mann-Whitney U were both not significant when comparing the 0-90-P and 0-180-P groups ($U = 242$, p-value < 0.178; $t(153) = -0.856$, p-value < 0.393, $d = -0.389$) while OOM did observe a strong pattern match (PCC value: 67.73; randomization range: 45.47 – 54.93; c-value < .01). In all other cases for the horses, the Mann-Whitney U assessments and independent t-tests were in agreement. The FI 60-sec versus FI 180-sec comparison for Subject 4 (0-60/90/180-P) was not significant ($t(53) = 0.991$, p-value = 0.326, $d = 0.465$), and the FI 90-sec versus FI 180-sec for Subject 4 (0-60/90/180-P) was significant ($t(53) = 3.252$, p-value = 0.002, $d = 1.526$) but made a type three error (FI 90-sec $M = 57.80$; FI 180-sec $M = 23.63$). Fourth, an independent t-test comparing the final FI 60-sec session versus the final FI 90-sec session for Subject 2 (0-60-90-180-P) was not significant ($t(98) = -0.828$, p-value = 0.410, $d = 0.166$) while an Mann-Whitney U assessment was significant ($U = 662$, p-value < 0.001), and an ordinal analysis within

OOM found a clear pattern match (PCC value: 73.52; randomization range: 46.88 – 53.36; c-value < 0.001). Pooling the final sessions at each fixed interval of the 0-60-90-180-P group with the 0-60-P, 0-90-P, and 0-180-P groups produced clear differences between schedule durations. However, for honey bee subjects, an independent t-test rejected the null hypothesis ($t(50.599) = -2.207$, p-value < 0.032, $d = -.509$) while a Mann-Whitney U assessment was not significant ($U = 946$, p-value < 0.065). Comparing Cohen’s d between horses and honey bees reveals the effect size difference between the 0-15-X versus 0-30-X group was smaller than most schedule comparisons for horses; moreover, the confidence interval for this assessment was closer to overlapping zero than any significant schedule comparison with horses.

Simply stated, Mann-Whitney U and independent t-tests were largely in agreement but contradicted one another for some comparisons which highlights the importance of treating continuity as an important consideration for statistical analyses. Horses emitted longer latencies, on average, when comparing the final CRF session with the final FI sessions; honey bees did not display as clear of a tend individually, but pooling honey bee groups did produce significant differences between the final CRF session compared to the final FI session. Additionally, most horse individuals and pooled groups contained significant differences when comparing schedule durations; however, a Mann-Whitney U did not observe a difference in PRP between the 0-15-X and 0-30-X group indicating honey bees may not have emitted temporally controlled responses. Taken together, horses produced latency data that indicates responding came under temporal control while honey bee individuals did not support the conclusion that responding came under temporal control.

An important consideration is the dependence between the final CRF versus final FI session comparison within individuals; simply pairing each trial does not approximate the combination method used in our OOM analysis and presents a difficult question as to whether a dependent or independent assessment should be utilized for these comparisons.

Inter-Response Time Analysis

If positively accelerating response rates (i.e. a "scalloped" cumulative response pattern) are used to operationalize temporal control, then negatively accelerating inter-response times can be used as a measure of temporal control. We performed an ordinal analysis of IRTs within individuals' pooled trials under the prediction that temporally controlled responses would yield monotonically decreasing IRTs across the fixed interval. Appendix 18: Inter-Response Time OOM displays each individual's final FI session's trials' PCC and c-values on each fixed interval schedule; bolded assessments indicate which subjects matched the ordinal prediction. We also pooled individuals into appropriate groups for a pooled group PCC and c-value and also pooled across appropriate schedules for schedule PCC and c-values.

Horses

Seven of the thirteen horses emitted IRT patterns that fit the monotonically decreasing prediction pattern; however PCC values were not impressive when compared to the maximum randomization PCC values; the final FI 60-sec for Subject 11 (0-60/90/180) best matched the ordinal prediction (PCC value: 63.44; randomization range: 41.56 – 58.13; c-value < 0.001). Pooling groups and schedules produced pattern matches for all groups other than the 0-180-P group (PCC value: 40.99; randomization range:

28.38 – 70.72; c-value < 0.93), the FI 60-sec (PCC value: 47.58; randomization range: 40.31 – 58.81; c-value < 0.81), the FI 180-sec (PCC value: 52.42; randomization range: 44.27 – 55.64; c-value < 0.08), and the 0-60/90/180-P group; Subject 4 (0-60/90/180-P) did not match the ordinal predictions for all fixed interval sessions.

Some of the horse subjects that did not match the IRT pattern prediction were unexpected based on previous analyses. Subject 9 (0-60-P) (PCC value: 54.81; randomization range: 34.31 – 62.76; c-value = 0.15) and Subject 10 (0-90-P) (PCC value: 53.61; randomization range: 37.35 – 63.55; c-value = 0.17) unexpectedly did not match the monotonically decreasing IRT pattern prediction. However, when pooling between individuals, the 0-60-P group (PCC value: 56.69; randomization range: 43.79 – 55.37; c-value < 0.001) and the 0-90-P (PCC value: 55.95; randomization range: 45.50 – 55.98; c-value < 0.001) fit the ordinal pattern. Additionally, the final FI 60-sec session for Subject 5 (0-60-90-180) did not fit the ordinal prediction (PCC value: 54.03; randomization range: 40.67 – 57.60; c-value = 0.07) similarly to the final FI 90-sec session (PCC value: 54.53; randomization range: 42.96 – 57.08; c-value = 0.23) and the final FI 180-sec session (PCC value: 51.09; randomization range: 44.24 – 56.14; c-value = 0.26). The final FI 60-sec session for Subject 7 (0-6090-180-P) did not fit the ordinal prediction (PCC value: 56.52; randomization range: 37.39 – 62.61; c-value = 0.08) as did the final FI 180-sec session (PCC value: 48.12; randomization range: 38.71 – 63.91; c-value = 0.67).

Honey Bees

In contrast, only two of the thirteen honey bees fit the monotonically decreasing prediction pattern; the majority of honey bee subjects produced low PCC values ranging as low as 14.29. No subjects in the 0-15-X group matched the decreasing ordinal prediction pattern and pooling the 0-15-X group did not produce a pattern match (PCC value: 46.05; randomization range: 41.27 – 57.36; c-value = 0.88). Only Subject 8 (PCC value: 90.00; randomization range: 0 – 100; c-value = 0.03) and Subject 9 (PCC value: 53.67; randomization range: 41.24 – 54.43; c-value =0.002) matched the ordinal prediction; pooling all subjects in the 0-30-X group produced a pattern match (PCC value: 54.58; randomization range: 42.26 – 57.02; c-value = 0.03).

While most horse responding did tend to produce monotonically decreasing IRTs across intervals, honey bee responding did not fit the ordinal prediction for all but two subjects. To assess if honey bees produced a monotonic increase in IRT across trials, we performed a second ordinal prediction for both horse and honey bee trial IRT patterns under the prediction IRTs would monotonically increase throughout the interval. For horses, the FI 180-sec session for Subject 4 (PCC value: 69.51; randomization range: 25.61 – 81.71; c-value < 0.01) matched a monotonically increasing IRT ordinal prediction. Only three honey bees matched the monotonically increasing IRT ordinal prediction; Subject 6 (PCC value: 64.20; randomization range: 28.40 – 75.31; c-value = 0.03) and Subject 8 (PCC value: 85.71; randomization range: 9.52 – 90.48; c-value = 0.003) from the 0-15-X group matched the pattern while Subject 1 (PCC value: 71.05; randomization range: 28.95 – 71.37; c-value = 0.004) from the 0-30-X group matched the ordinal prediction. An interesting analysis may be to compare PCC values for each prediction to determine whether a monotonically increasing or decreasing was best fit by the observed IRT data. For horse subjects, only Subject 3 (0-180-P), Subject 4 (0-60/90/180-P), and Subject 7 (0-60-90-180-P) emitted IRT patterns that were better characterized by a monotonically increasing pattern. In contrast, seven of eight 0-15-X and two of five 0-30-X honey bees emitted IRT patterns that were better characterized by a monotonically increasing pattern.

Simply stated, most horses produced monotonically decreasing IRTs across trials while only a few honey bees produced monotonically decreasing IRTs across trials. Indeed, most honey bees emitted IRT patterns that better fit a monotonically increasing pattern compared to a monotonically decreasing pattern; however, both pattern fits were low for the majority of honey bee subjects. Unfortunately, an analogous aggregate assessment using NHST is impossible for the IRT ordinal analysis because each trial contained a varying number of IRTs, and thus, could not be analyzed via a repeated measures ANOVA or Friedman assessment due to “missing” data.

Trial Duration Analysis

A relatively simple analysis of temporal control is to assess each trial’s duration for each subject to determine how long after the reinforcement contingencies had been met before the subject emitted the trial’s final response. Ideally, if subject responding came under perfect temporal control, responding would be inhibited for the entire fixed interval, and a single response would be emitted the instant a response would be reinforced. Obviously, this response pattern occurs rarely, under fixed interval schedules, but a focus on the contingent response may be a fruitful endeavor for temporal control researchers. Appendix 19: Trial Duration Descriptive Statistics presents descriptive statistics of the interval of time between reinforcer availability and reinforcement delivery for each subject's and group's first and last fixed interval schedule trial durations. Many honey bee and horse subjects produced smaller aggregates of trial duration during the final fixed interval trial compared to the first fixed interval trial.

Trial Duration Analysis – OOM

We performed an ordinal analysis of the interval between reinforcer availability and reinforcement delivery within individuals' pooled trials under the prediction that combinations of the first fixed interval session's trials would be longer than combinations of the last fixed interval session's trials. Appendix 20: Trial Duration OOM displays each individual's final FI session's trials' PCC and c-values on each fixed interval schedule; we also pooled individuals into appropriate groups for a pooled group PCC and c-value; bolded analyses indicate which subjects matched the ordinal prediction.

Horses

Most horses' final fixed interval sessions had shorter trials compared the first fixed interval session; only Subject 9 (0-60-P), the FI 90-sec session comparisons for Subject 8, and the FI 180-sec session comparisons for Subject 2, 5, and 8 (0-60-90-180-P) did not match the ordinal prediction. Interestingly, Subject 3 (0-180-P) had the highest pattern match (PCC value: 90.00; randomization range: 25.00 – 75.00; c-value < 0.001) even though previous assessments did not demonstrate Subject 3's (0-180-P) responding came under temporal control.

Other than the FI 180-sec session comparison for the 0-60-90-180-P group, all pooled group assessments fit the pattern match. Again, this is interesting because Subject 3 (0-180-P) produced the highest pattern match of any horse subject. The 0-60-P group's PCC value was the closest to the maximum randomization PCC value (PCC value: 55.81; randomization range: 49.07 – 51.00; c-value < 0.001); however, the FI 60-sec session comparison for the 0-60-90-180-P contained the largest deviation between the observed PCC value and the maximum randomization PCC value (with the exclusion of the single subject 0-180-P "group") (PCC value: 64.62; randomization range: 49.29 – 50.82; c-value < 0.001). Finally, comparing the pooled 0-90-P pattern match (PCC value: 63.24; randomization range: 48.80 – 51.00; c-value < 0.001) with the FI 90-sec session comparison for the 0-60-90-180-P group (PCC value: 61.84; randomization range: 49.28 – 50.79; c-value < 0.001) revealed relatively consistent findings. Because of these inconsistences, a clear schedule effect was not observed in changes of trial duration when comparing horse group's first and final fixed interval sessions' trial durations.

Honey Bees

Only two of eight 0-15-X while three of five 0-30-X honey bees matched the ordinal prediction that the final fixed interval session had shorter trials compared to the first fixed interval session. Subject 9 (0-30-X) produced the most convincing pattern match (PCC value: 100; randomization range: 30.68 – 65.91; c-value < 0.001), and the other honey bee subjects that fit the pattern produced PCC values that approximated or exceeded the PCC values observed for horses. With the exception of the FI 180-sec comparison for the 0-60-90-180-P group, the pooled 0-15-X group produced the poorest pattern match (PCC value: 53.56; randomization range: 47.44 – 52.48; c-value < 0.001), and with the exception of the 0-180-P group, the 0-30-X group produced the best pattern match (PCC value: 70.29; randomization range: 46.61 – 53.12; c-value < 0.001).

Simply stated, most horse and honey bee subjects, with the exception of the honey bee 0-15-X group, emitted contingent responses closer to the schedule contingences with increased exposure to the fixed interval sessions.

Response Duration Analysis

No assessments of response duration have been published in the temporal control literature, and thus, two ordinal predictions were posited and compared to the observed data to better facilitate abductive inferences of response duration's relationship with temporal control. The first ordinal analysis predicted a monotonic decrease in response duration across the fixed interval while the second ordinal analysis predicted a monotonic increase in response duration across the fixed interval. Appendix 21: Response Duration OOM displays each individual's final session's trials' PCC and c-values on each fixed interval schedule for each ordinal prediction; bolded assessments fit the ordinal prediction. We also pooled individuals into appropriate groups for a pooled group PCC and c-value, and also pooled across appropriate schedules for schedule PCC and c-values.

Horses

Horses did not convincingly fit a monotonically decreasing ordinal prediction for response duration across trials; the final FI 90-sec session for Subject 7 (PCC value: 65.02; randomization range: 36.77 – 64.57; c-value < 0.001) contained the highest PCC value and most other subjects with low c-values did not produce PCC values that differed widely from the maximum randomization PCC value. Pooling between groups did not provide more consistent results; the 0-90-P group (PCC value: 54.10; randomization range: 45.80 – 54.50; c-value < 0.001) matched the ordinal prediction, but the 0-60-P (PCC value: 52.92; randomization range: 43.22 – 56.21; c-value = 0.08) and 0-180-P (PCC value: 42.67; randomization range: 29.33 – 73.33; c-value = 0.89) groups did not match the monotonically decreasing pattern. However, pooling schedules did produce consistent findings, all pooled schedules matched the ordinal prediction, but these PCC values were modest when compared to the maximum randomization PCC values.

Honey Bees

In contrast, no honey bees matched the ordinal prediction that longer response durations would occur earlier in the fixed interval. While honey bees did not fit the monotonically decreasing ordinal prediction for response duration, five of the eight 0-15-X subjects and one of five 0-30-X subjects fit the monotonically increasing response duration ordinal prediction. Both the 0-15-X (PCC value: 68.84; randomization range: 39.61 – 58.09; c-value < 0.001) and 0-30-X (PCC value: 59.03; randomization range: 40.90 – 56.73; c-value < 0.001) pooled honey bee groups fit the monotonically increasing response duration ordinal prediction. In contrast, only one horse, Subject 14 (0-60-P), fit the monotonically increasing response duration ordinal prediction (PCC value: 58.68; randomization range: 38.62 – 62.28; c-value < 0.01).

Simply stated, horses inconsistently fit the monotonically decreasing ordinal prediction, but did not fit the monotonically increasing ordinal prediction for response duration. In contrast, honey bees did not fit the monotonically decreasing ordinal prediction, but most honey bees did fit the monotonically increasing ordinal prediction for response duration. Based on the inconsistent pattern matches for horses, response duration may not be an effective measure to assess if a subject's responding has come under temporal control; however, response duration may be used as an indicator that subjects are not emitting responses that have come under temporal control if a monotonically increasing prediction is made. Unfortunately, an analogous aggregate assessment using NHST is impossible for the response duration ordinal analysis, for each trial contained a varying number of responses, and thus, could not be analyzed via a repeated measures ANOVA or Friedman assessment due to "missing" data.

Peak Procedure Analysis

Subject 3 (0-180-P) and Subject 4 (0-60/90/180-P) did not maintain responding during the final session of the experiment and did not encounter any peak trials before terminating the session; thus eleven of the thirteen horses encountered peak trials. We performed two assessments to analyze peak trials during each subject's final session. The first assessment was a response bin analysis wherein responses were chucked into 10 and 20 bins (utilizing two or four bins would have been insufficient to assess responding during the peak trials). Appendix 22: Peak Procedure Figures displays summed peak trials' response bin tallies for each subject.

We also performed two ordinal analyses of each half of the peak trial. During the first half of the peak trial, we predicted responding would follow a monotonically increasing pattern; this analysis is conceptually no different than the response bin analysis for a standard fixed interval trial. During the second half of the peak trial, we predicted responding would follow a monotonically decreasing pattern. We also ran the opposite monotonic predictions for each half of the peak trials. Appendix 23: Peak Procedure OOM displays PCC values and c-values for each subject's individual trials as well as pooled PCC values and c-values for each subject and group; bolded assessments indicate which individuals matched the ordinal predictions.

Based on plots of the 10 bin division of the peak trials in Appendix 22: Peak Procedure Figures, six of eleven subjects emitted interpretable peaks approximately half-way through the peak intervals; based on the 20 bin division of the peak trials, seven subjects emitted interpretable peaks approximately half-way through the peak intervals. A higher number of interval divisions identified a peak for Subject 9 (0-60-P) that was not observable with only 10 divisions. Referring to the 20 bin analysis likely provides a better approximation of when responding peaked during the trial; peaks occurred between 45% and 65% of the peak trials for six subjects, and peaked at 35% of the peak trials for Subject 2 (0-60-90-180-P). Subject 14 (0-60-P) and Subject 1 (0-90-P) increased response levels throughout the second half of the peak trials. Subject 11 (0-60/90/180-P) peaked at 80% of the peak trials and had low response levels at 50% and 55% of the peak trial; other than these three points, a near perfect parabolic increase and decrease throughout the peak trial is observed for Subject 11. Subject 5 (0-60-90-180-P) had a slight peak at 50% of the peak trials, but responding nearly scalloped during the final divisions of the peak trials. Interestingly, pooling individuals into groups did not produce clear peaks for all groups. Subject 10 (0-90-P) produced the clearest peak trials by far; most subjects did not display strong decreasing trends during the second half of the peak trials that mirrored the first half of the peak trials.

An ordinal analysis predicting monotonic increases and decreases within the first and second halves of the peak trials revealed a 20 bin analysis (i.e. two 10 bin analyses for the peak trials) was more sensitive to identifying which subjects peaked approximately half way through the interval than a 10 bin analysis (i.e. two five bin analyses for the peak trials). Appendix 23: Peak Procedure OOM displays monotonically increasing and decreasing patterns for both halves of the peak trials. For the 10 bin analysis, a monotonically increasing prediction for bins 1 – 5 matched responses patterns for Subject 6 (0-60-P), Subject 14 (0-60-P), Subject 1 (0-90-P), Subject 13 (0-90-P), Subject 11 (0-60/90/180-P), Subject 2 (0-60-90-180-P), and Subject 8 (0-60-90-180-P).

All pooled group and schedule assessments (as well as individual subjects) were better characterized as monotonically increasing across the first half of the peak trials. For the second half of the peak trials, a monotonically decreasing prediction for bins 6 – 10 was only matched by Subject 10 (0-90-P) (PCC value: 90.00; randomization range: 5.00 – 85.00; c-value < 0.001) and Subject 7 (0-60-90-180-P) (PCC value: 80.00; randomization range: 0.00 – 80.00; c-value = 0.03); however, neither subject fit a monotonically increasing prediction for bins 1-5 (PCC value: 35.00; randomization range: 0.00 – 40.00; c-value = 0.09; PCC value: 60.00; randomization range: 0.00 – 70.00; c-value = 0.16, respectively).

Pooling the 0-60/90/180-P and 0-60-90-180-P groups produced a decreasing monotonic trend across the second half of the peak trials (PCC value: 42.00; randomization range: 25.20 – 48.00; c-value = 0.05). During the first half of the peak trials, bins 1 – 5 matched a monotonically increasing ordinal prediction for this pooled assessment (PCC value: 53.20; randomization range: 20.00 – 44.40; c-value < 0.001). We also pooled all subjects' bin tallies, regardless of schedule duration, and for the 10 bin analysis, this assessment also matched an increasing ordinal prediction during the first half of the peak trials and a decreasing ordinal prediction during the second half of the peak trials. These twice and thrice pooled assessments were the only 10 bin analysis that fit both five bin ordinal predictions in a manner to allow an inference of responding coming under a high degree of temporal control; this is troublesome given no individual subjects matched both ordinal predictions.

For the 20 bin analysis, a monotonically increasing prediction for bins 1 – 10 matched responses patterns for Subject 6 (0-60-P), Subject 14 (0-60-P), Subject 10 (0-90-P), Subject 13 (0-90-P), Subject 11 (0-60/90/180-P), Subject 2 (0-60-90-180-P), Subject 5 (0-60-90-180-P), Subject 7 (0-60-90-180-P), and Subject 8 (0-60-90-180-P). While dividing the first half of the peak trials into 5 bins did not identify Subjects 5 and 7 (0-60-90-180-P) as matching the monotonically increasing ordinal prediction, dividing the first half of the peak trials into 10 bins produced pattern matches. However, the opposite was true for Subject 1 (0-90-P); hence determining the number of bins to use is an important consideration. Additionally, all pooled group and schedule assessments (as well as individual subjects) were better characterized as monotonically increasing across the first half of the peak trials. For the second half of the peak trials Subject 1 (0-90-P) and Subject 5 (0-60-90-180-P) matched a monotonically increasing prediction for bins 11 – 22 which is the opposite of how temporally controlled responses would be clustered. However, a monotonically decreasing prediction for bins 11 – 22 was only matched by Subject 6 (0-60-P), Subject 10 (0-90-P), Subject 11 (0-60/90/180-P), and Subject 7 (0-60-90-180-P). Most importantly, each of these four subjects matched the monotonically increasing pattern for the first half of the peak trials; thus, these four subjects fit the OOM analyses in a manner that allows us to conclude responding came under temporal control as identified by the peak procedure. Pooled groups and schedules did not match a monotonically decreasing prediction for the second half of the peak trials; however pooling all individuals, regardless of group assignment, did produce a monotonically decreasing pattern match (PCC value: 31.43; randomization range: 24.63 – 32.54; c-value = 0.02). This thrice pooled assessment also matched a monotonically increasing ordinal prediction for the first half of the peak trials.

Taken together, OOM revealed four horse subjects demonstrated clear evidence of peaks occurring approximately half-way through the peak trials when the peak trials were divided into 20 bins. Only dividing the peak trials into 10 bins did not produce evidence that individuals fit the ordinal predictions, but pooling between schedules and for all individuals produced pattern matches indicative of temporal control. Qualitative analyses of summed bin response tallies revealed six or seven out of eleven horses' response levels peaked approximately half-way through the peak trials.

Extinction Analysis

Craig et al. (2014) describe differences in response tallies during the 10 minute extinction session for subjects that encountered the fixed interval schedules of reinforcement versus the control 0-0-X group which only received extensive CRF exposure. To assess any potential effects of having responses reinforced on fixed interval schedules of reinforcement, we performed a three-way ordinal analysis prediction under the expectation that subjects that were exposed to longer fixed intervals would be more resistant to extinction and emit a higher number of responses compared to subjects that were exposed to shorter fixed intervals (or none at all). Thus, our ordinal prediction was: 0-0-X < 0-15-X < 0-30-X. In addition to producing a PCC values, this three-way ordinal prediction produced a more conservative CPCC values. We observed longer fixed interval schedules produced higher levels of responding during extinction (PCC value: 68.39; randomization range: 45.74 – 54.52; c-value < 0.001; CPCC value: 36.86; randomization range: 11.14 – 23.17; c-value < 0.001). Hence, subjects exposed to longer schedule durations were more resistant to extinction.

CHAPTER IV

DISCUSSION

We compared multiple measures of horse and honey bee responding when reinforced on varying fixed interval schedules to determine if responding was temporally controlled. While no direct species comparisons were performed due to instrumental differences between the protocols, indirect comparisons reveal, in contrast to horses, the majority of honey bees did not convincingly emit responses that came under temporal control. Our findings confirm and extend Myers and Mesker's (1960) reported "scalloped" cumulative response curves in horses and echo Grossmann's (1973) conclusion that honey bee responding does not come under temporal control. Our findings contrast with Bosivert and Sherry's (2006) claim that the performance of bumble bees can come under temporal control. While the divergence in the invertebrate fixed interval literature could be an indication of species differences, without further replication and a more extensive analyses of bumble bee responding beyond an aggregate PRP analyses, a conclusion of a species difference between honey bees and bumble bees would be premature. However, several instrumentation differences between the present protocols must be addressed before attempting an indirect species comparison between horses and honey bees.

Instrumentation Differences

First, different responses were assessed between species; honey bees inserted their entire bodies into a response hole to break an infrared beam while the horses inserted their heads into a response hoop to break an infrared beam. While these responses are relatively similar compared to other responses such as pressing a lever (Myers and Mesker, 1960), many topographical differences in responding were observed across the horse subjects while honey bee responding was rather consistent across subjects during CRF sessions. For example, some horses moved their heads above or below the infrared beam to make multiple responses, but some horses fully retreated their heads from the response hoops between each response. In contrast, honey bees consistently moved in and out of the response hole by partially retreating their bodies to complete a response. Unfortunately, we could not make the response hoops smaller so that the horses would have to partially retreat their heads out of the apparatus (more similarly to the honey bees) because the horses would not insert their heads into hoops smaller than used here.

Comparative psychologists are hard pressed to select similar responses to investigate species comparisons, and while response differences do exist between the protocols used here, these responses are more consistent than comparisons between other traditional responses such as the lever-press and key-peck. While the lever-press and key-peck are more commonly investigates responses, we recommend investigating responses that can be detected by infrared beams. This type of response can be easily adapted for different species to detect a wide range of behaviors. Doing so would address a point of Richelle and Lejeune’s (1980; 1984) second recommendation of comparing closely related species with similar responses to reduce instrumental differences for species comparisons.

Second, different stimuli served as reinforcers between species; honey bees received 50% sucrose solution while the horses received apple-flavored horse treats. While consumable nourishment was used as reinforcement for both species, many different properties between these reinforcers preclude considering these stimuli equivalent. Direct species comparisons would require equivalency between stimuli. Unfortunately, selecting a consistent reinforcer across species is a difficult task for comparative psychologists that are interested pursuing Richelle and Lejeune's (1980; 1984) first recommendation of comparing a greater variety of non-related species.

Third, we were unable to control the number of trials for the honey bees but were able to control the number of trials for the horses. However, we offered a higher number of sessions to the honey bees, and for some subjects, the honey bees encountered a greater number of fixed interval trials than the horses. For horses, 150 trials of a fixed interval schedule tended to bring responding under temporal control; 50 trials was only sufficient at shorter durations for Subject 11 and was not sufficient for Subject 4 at all schedule durations. In contrast, the number of trials for honey bees was not sufficient to bring responding under temporal control; perhaps administering additional fixed interval trials would have been necessary to observe temporally controlled responding. However, we were unable to administer additional fixed interval trials because doing so would require collecting data from a single subject across multiple days, and we could not be sure that subjects would return and, if they did, would not encounter other schedules of reinforcement with similar stimulus properties between days.

Fourth, we only had one fixed interval schedule (FI 60-sec) that was used for both species. The honey bees' responding was reinforced either on an FI 15-sec, FI 30-sec, FI 60-sec, or FI 120-sec; the horses' responding was reinforced on an FI 60-sec, FI 90-sec, and/or FI 180-sec. Unfortunately, no honey bees in the 0-60-X group completed the experiment; thus, their responding could not be directly compared with horse responding in the 0-60-P group had other instrumental differences been held constant.

Fifth, the motivating operations may have been similar enough between experiments to allow for a direct species comparison. Neither species was food-deprived. Additionally the first response of a session was reinforced in both species to signal the apparatus could still dispense reinforcement. Moreover, neither species satiates; honey bees would unload their crops between sessions, and horses graze for hours a day; none of the horse subjects were disinterested in the apple treats after a session was completed. For these reasons, the motivating operations between these procedures may be comparable. However, honey bees left the operant chamber (i.e. completed their sessions) after filling their social crop while horses would have continued responding had we not limited the sessions to 50 trials. Hence, the filling of the honey bees’ social crops (i.e. the elimination of the motivating operation) ended the honey bees’ sessions while the elimination of the motivating operation did not terminate the horses’ sessions. This difference may affect the motivating operation for the initiation of the following session. Moreover, the assumption that motivating operations are constant within trials or sessions is not substantiated.

Sixth, we did not use the same number of sessions between species. Honey bees were exposed to 20 sessions of a fixed interval schedule of reinforcement while horses were exposed to either one or three sessions of a particular fixed interval schedule of reinforcement. Moreover, the honey bees were exposed to all 20 fixed interval sessions in a single day whereas horses only encountered one session a day. While the number of trials was roughly similar between species, this difference in sessions creates a confound that complicates a direct species comparison.

Seventh, we did not ensure the amount of reinforcement was comparable between species. We precisely delivered a prescribed 5µl of 50% sucrose solution to the honey bees, but the automatic feeder used for horses provided slight differences from trial to trial. This variation was minimal and random and did not covary between conditions, but these inconsistencies likely affect within-session assessments, most notably PRP and latency. Controlling the amount of reinforcement is necessary to control species differences in PRP during CRF sessions. If PRPs during CRF sessions are not approximately equal between species, directly comparing untransformed PRPs during fixed interval sessions between species becomes problematic.

Eighth, we utilized two slightly different protocols between species. First, we assessed honey bee responding on fixed intervals after an immediate shift from CRF. Immediately shifting to FI 15-sec and FI 30-sec durations maintained responding for thirteen subjects, but shifting to longer FI 60-sec and FI 120-sec durations failed to maintain responding for all subjects. For the horses, we followed this immediate shift from CRF to an FI schedule for three groups, and also incrementally increased fixed interval durations for two groups. This immediate shift produced temporally controlled responding for the FI 60-sec and FI 90-sec schedules for horses but did not maintain responding at an FI 180-sec schedule. In contrast, slowly increasing the fixed interval durations maintained temporally controlled responding while quickly increasing the fixed interval durations did not maintain temporally controlled responding for Subject 4; however, Subject 11 did maintain responding with only 50 trials of each fixed interval schedule. Future honey bee fixed interval investigations may find honey bee responding can be maintained at longer fixed interval durations if an incrementally increasing protocol is used similar to the methods used by Grossmann (1973). However, Grossmann (1973) did not observe evidence of temporally controlled responding for his honey bee subjects which does not encourage an expectation that the present honey bees may have emitted temporally controlled responses if we had used a strict within-subject design.

Relatedly, we completed the experiment using different conditions between species; honey bees encountered an extinction session while horses entered into a peak procedure. As honey bees did not demonstrate evidence of temporal control, placing them in a peak procedure was unnecessary. Instead, the extinction phase demonstrated honey bees exposed to the fixed intervals were more resistant to extinction compared to control 0-0-X subjects that were only exposed to continuous reinforcement (Craig *et al.*, 2014). While this is not evidence of temporal control, it is a finding nonetheless that would not have been revealed by a peak procedure.

Ninth, while we signaled reinforcement delivery and a successful response for both species, the stimuli were not the same. The horses were signaled with a tone and the sound of the apple treats hitting the feeding tray whereas the honey bees' were signaled via the apparatus vibrating as the stepper motor provided reinforcement into the response hole. Additionally, unreinforced responses were singled by a tone for horses while honey bee responses were signaled by a slight pulse of the stepper motor (this vibration did not release sucrose into the response hole). Finally, neither species was signaled when the fixed intervals were initiated or completed. Taken together, while these signals were not explicitly the same, they performed the same function.

Tenth, due to the analyses of individual subjects, each subject within a group can be considered a replication; of the groups reported here, the 0-180-P group only contained one subject that completed the experiment, and the 0-60/90/180-P group only contained two subjects. Both of these groups did not produce response patterns that were clearly temporally controlled; assigning more subjects into these groups would strengthen our conclusion that neither group clearly emitted temporally controlled responses. The present manuscript describes the second time honey bee and horse subjects' responding has been reinforced on fixed interval schedules, and aspects of the present protocols were designed around Myers and Mesker (1960) and Grossmann (1973) to approximately replicate these original investigations. However, because of the between-subject design for the present honey bee protocol, individual analyses comparing the impacts of varying fixed interval schedules were not possible for honey bees while these analyses were possible for six horses in the 0-60-90-180-P and 0-60/90/180-P groups.

Of these instrumental concerns, only the motivation operation and protocol signals may allow a direct comparison between species. Had the other instrumental concerns been possible to equate between species, a direct species comparison would have been appropriate**.** The final instrumental concern, the assessed measures, were analyzed for both species, and these measures are compared against one another as well as indirectly compared across species in the following section.

Evidence of Temporal Control

To facilitate a comparison between each measure of temporal control, Appendix 24: Fixed Interval Measures displays the conclusion of each measure for each individual and group (when applicable); bolded cells indicate the assessment did not support a conclusion of responding coming under temporal control. Of these analyzed operationalizations of temporal control, all traditional measures supported the conclusion of that most horses' responding came under temporal control. Only Subject 3 (0-180-P) and the FI 180-sec session for Subject 4 (0-60/90/180-P) consistently failed to produce evidence of temporal control across most measures. In contrast, only bin analysis could be used to support a conclusion of that most honey bee's responding came under temporal control; all other measures inconsistently supported the conclusion that some honey bee individuals' responding came under temporal control.

Individual PRP analyses did not support a conclusion of temporal control for approximately half of the honey bee subjects; however, PRP differences between the final CRF session versus the final fixed interval session were observed for pooled group assessments. This observed PRP effect may be an artifact of a group analysis that does not represent approximately half of the individual's responding. Dukich and Lee (1973) posit multiple measures must be used in temporal control assessments, and as only one measure (i.e. bins) seemed to support a conclusion of temporal control of honey bee responses, we do not conclude this sample of honey bees' responding came under temporal control. To assess specific differences between species response patterns, we indirectly compared honey bees and horses on each measure. To assess the utility of each individual measure, we also assessed which measures did, or did not, produce evidence of temporal control for both horses and honey bees.

Cumulative Curves

Most horse cumulative curves displayed classic "break-and-run" patterns while honey bee cumulative response curves displayed "break-through" and "steady-state" response patterns. From this traditional, qualitative, and indirect comparison, we observed most horses emitted response patterns that have been used to support a conclusion of temporal control while honey bees did not emit responses that support a conclusion that responding came under temporal control. Only Subject 1 (0-90-P), Subject 3 (0-180-P), and Subject 4 (0-60/90/180-P) did not emit response patterns that could be taken to support a conclusion that responding was temporally controlled by the fixed interval schedules in horses. In contrast, honey bees emitted either a response pattern that mirrors a series of minor extinction bursts, or a response pattern that does not widely differ from responding on a CRF schedule of reinforcement. Our findings confirm Myers and Mesker's (1960) only assessment of temporal control in horses and also confirms Grossmann's (1973) conclusion that honey bee responding does not come under temporal control on fixed interval schedules.

An interesting observation regarding the traditional cumulative response curves for the horses is that responding tends to be uniform at the beginning of a session, but then shifts approximately half-way through the session towards a less consistent response pattern. This is especially clear for the final FI 60-sec session for Subjects 4, 6, 7, 8 and 11. Curiously, Subjects 4 and 11 were assigned to the 0-60/90/180-P; thus, the FI 60-sec cumulative plot is the first fixed interval session for these subjects, and their performance is comparable to the final fixed interval session for Subjects 6, 7, and 8 which experienced three sessions of the FI 60-sec schedule. While the FI 180-sec performances for Subject 4 and 11 did not indicate responding came under temporal control of the most extreme fixed interval condition, their FI 60-sec and 90-sec cumulative response curves do contain "break-and-run" patterns. This finding indicates horse responding may come under temporal control of shorter schedules in fewer than 50 trials and is impressive compared to the acquisition speed of other mammalian species that have been investigated; Cumming and Schoenfeld (1958) observed "break-and-run" response patterns begin to develop after 24 sessions (with 50 trials apiece) for White Carneaux hen pigeons.

Our major criticism of Skinner's traditional cumulative response record is the line connecting responses; this line obscures a realistic conceptualization of discrete responses, and discrete analyses of these responses. Two solutions can be recommended. The first would be to cease connecting responses; this method is commendable as new labels do not need to be identified for response patterns, and indirect comparisons can be made with previous fixed interval literature cumulative response curves. We presented both of our cumulative curve types in this manner as doing so is a simple process with modern graphing software. The second solution, and the one advocated for here, would be to replace the ordinate's cumulative response tally with cumulative response durations. We prefer this solution three reasons. First, the abscissa and ordinate are presented in the same scale. Second, by plotting response duration, the ordinate depicts a continuous rather than a discrete measure. Both of these reasons combine into a third strength of this recommended modified cumulative curve: responses can be depicted via a 45° line rather than a small vertical increase in the ordinate if the axis scales are the same. However, because of these factors, cumulative curve standards (i.e. the “scallop”) may need to be relabeled if these patterns are indeed an artifact of traditional methods of plotting cumulative response curves.

Comparing the traditional cumulative curve with the recommended modified cumulative curve produced several interesting findings. First, both plots were very similar for most subjects, but not similar for a few subjects. The clearest departure between both cumulative curves is Subject 11’s (0-60/90/180-P) final FI 180-sec session; the modified cumulative curve depicted long response durations that were not observable in the traditional cumulative curve. Other obvious departures between the types of cumulative curves for the horses are Subject 5, 6, and 7’s final FI 60-sec session and Subject 7 and 10’s final FI 90-sec session. One of the most striking departures between the two types of cumulative curves for the honey bees is Subject 3 of the 0-15-X group; the modified cumulative response record is nearly perfectly linear indicating the subject made very consistent response durations throughout the session.

While differences between these types of cumulative curves was not consistently observed, more information about subject response patterns are offered with the modified cumulative response record. Moreover, “break-and-run” response patterns are still clearly observable with the modified cumulative response record; the two types of cumulative curves are generally very similar, and our recommended cumulative curve can still be used to identify temporally controlled response patterns. An important note is that this modified cumulative record should confirm and be visually correlated with the traditional cumulative record, and each subject’s cumulative curves are largely in accordance with one another.

A final consideration is that the honey bees consumed their reinforcement while still inside of the response hole while horses had to remove their head from the hoops and consume their reinforcement in a tray located on the floor. This protocol difference explains the observed contrasts between the modified cumulative response records for honey bees and horses. For honey bees, the final responses were generally longer compared to horses because the honey bees consumed the delivered sucrose solution before completing the final response of the trial. In contrast, horses removed their heads from the response hoops to consume the released apple treats. Inferring species differences from the cumulative plots would be inappropriate; however, the recommended modified cumulative curve depicts this observed difference while the traditional cumulative does not. Had comparable instrumentations been utilized between species, the traditional cumulative curve would not be able to address potential differences in response duration across the fixed intervals.

Response Tally Bins

No previous horse or honey bee fixed interval investigations have utilized a response tally bin analysis (or any of the following measures of temporal control), so no comparisons of the present findings to those of Myers and Mesker (1960) and Grossmann (1973) can be made. We divided the fixed interval into either two, four, 10, or 20 bins, and multiple ordinal predictions were made for each bin analysis. The first ordinal analysis divided each fixed interval into two bins, and simply compared the number of response tallies in the first half of the interval versus the number of tallies in the last half of the interval under the prediction that temporally controlled response patterns are characterized by higher numbers of responses occurring in the last half of the interval compared to the first half of the interval. During the fixed intervals, all but two honey bee matched this two bin prediction, and all but two horses matched this prediction. To confirm this finding, we also performed an ordinal prediction in the opposite direction (i.e. monotonically decreasing response tallies across the fixed interval for both species) and observed both honey bees and horses did not match this pattern. PCC values for the two bin comparisons indicate honey bees and horses fit the ordinal prediction in a comparable manner. The majority of both species' response patterns appear to be temporally controlled according to the two bin assessments.

For the four bin comparison, we compared our observed data to five ordinal predictions. Two of these patterns were taken to not support the conclusion that responding came under temporal control; we predicted a "steady-state" response record (1=2=3=4), and a "break-through" response record (1>2>3>4). A monotonic increase across bins (1<2<3<4) was taken to be indicative of a "scalloped" response pattern while the remaining two ordinal predictions (1=2<3<4; 1=2=3<4) were taken to be indicative of a "break-and-run' response pattern. Most horses best matched a "break-and-run" ordinal prediction; the majority of horses best fit the 1=2<3<4 pattern, and these CPCC values widely differed from the maximum randomization range and produced low c-values. Again, Subject 3 (0-180-P) and the FI 180-sec for Subject 4 (0-60/90/180-P) did not match the ordinal patterns taken to indicate responding was temporally controlled.

For honey bees, a monotonically decreasing prediction across bins was not matched by the observed data indicating responding did not conform to a "break-through" response pattern. Surprisingly, most honey bees fit the most extreme "break-and-run" ordinal prediction (1=2=3<4) when evaluating PCC values, but CPCC values were much lower than those observed for horses, and c-values were all large for a complete pattern analysis indicating randomizing the observed data produced better pattern matches. It is important to note that the steady state ordinal prediction (1=2=3=4) for honey bees usually produced sizeable PCC values that were not observed for horses, and as the PCC value is a pair-wise comparison assessment, the reason honey bees matched the extreme “break-and-run” ordinal prediction is likely due to the relatively “steady-state” response levels for the first three bins. Referring to the cumulative records for honey bees helps support this explanation. For this reason, the “break-and-run” ordinal predictions must take the CPCC values into account before a conclusion that responding came under temporal control can be made; considering CPCC values indicates horses fit the “break-and-run” ordinal predictions while honey bees did not fit these predictions.

For the 10 and 20 bin analyses, neither species fit the monotonically decreasing ordinal predictions taken to indicate “break-through” responding. Instead, responding in both species was better characterized as monotonically increasing throughout the fixed interval (a “scalloped” ordinal prediction). However, the difference between the PCC values and randomization ranges revealed horses fit the ordinal prediction better than honey bees. Neither species’ CPCC values revealed complete pattern matches; the number of utilized bins produced highly conservative assessments that do not characterize real, observed data. Increasing the number of bins also produces a more conservative assessment; indeed, we observed a decrease in PCC values at a higher number of bins for both species. For an FI 60-sec schedule, a 20 bin comparison would yield bins of only three seconds; multiple responses rarely occurred within just three seconds of one another; hence, many empty bins were observed and compared. Indeed, for Subject 1 (0-30-X), two and four bin temporal control pattern matches were observed, but were not observed for the 10 and 20 bin analyses. Dividing the fixed interval into more than 10 bins may be inappropriate for the relatively small fixed intervals that we utilized. However, an opposite trend was also observed for Subject 3 (0-180-P); the 20 bin assessment matched the pattern, but the two, four, and 10 bin analyses did not match the ordinal prediction. Zeiler and Powell (1994) investigated intervals as long as 480 seconds and employed a 20 bin analysis; a 20 bin analysis may be more appropriate for longer fixed interval schedules than those reported here. Clearly, selecting the number of bins to divide the interval is an important concern.

NHST assessments generally echoed the analyses performed in OOM, but a few discrepancies are observable in Appendix 24: Fixed Interval Measures. OOM was a more liberal assessment for the two bin ordinal assessment compared to the dependent t-test and Wilcoxon signed-rank test, and for the four bin ordinal assessment compared to the repeated measures ANOVA and Friedman assessments. Indeed, for the two and four bin analyses, NHST revealed more honey bees did not have significant differences across bins within fixed intervals. However, for the 10 and 20 bin analysis, OOM was a more conservative assessments compared to the repeated measures ANOVA and Friedman assessments. Indeed, only Subject 4 (0-60/90/180-P) and Subject 7 (0-30-X) did not have significant differences in response levels across the interval when performing a 20 bin analysis. Finally, four inconsistent results were observed when comparing the parametric versus non-parametric NHST assessments; clearly, properly conceptualizing continuity is a worthy endeavor. In order to be considered continuous, properties must satisfy a density (i.e. resolution) requirement such that an infinite number of divisions of a measure can be made; for example, meters are continuous, but responses are not (Michell, 1994).

Based on these bin assessments, horses produced consistent evidence to indicate responding came under temporal control while honey bees produced inconsistent evidence to indicate responding came under temporal control. Horse assessments produced more impressive pattern matches and larger effect sizes compared to the honey bee assessments. From these indirect comparisons, we may be tempted to conclude horse responding came under a greater level of temporal control than honey bees.

A final consideration for the bin analyses is how to divide the bins. Beyond simply selecting a number of bins to use, several methods of dividing the fixed interval trial to calculate bins exist, and the selection of these methods appears to be a rather arbitrary decision. Unfortunately, the literature does not explicitly explain how fixed interval bins are created, and multiple methods have likely been utilized and treated as if they are one in the same.

Three binning methods seem to exist in the literature; to describe the differences between these methods, consider a two bin division of a FI 60-sec session with a contingent response that is made 66 seconds after the initiation of the fixed interval, or six seconds after the contingency has been met. First, the fixed interval can be divided into truly equal bins, and the final response of the trial (which occurs after the final bin) is not included in the final bin. The first bin would be 30-sec while the final bin would be 30-sec; it is possible to have two empty bins if responding is inhibited until the completion of the fixed interval with this method. Second, the fixed interval can be divided into equal bins with the exception of the final bin of the trial which contains the final response of the trial. The first bin would be 30-sec while the final bin would be 36-sec; it is impossible to have two empty bins if responding is inhibited until the completion of the fixed interval with this method. This is the method reported here, and it appears to be the most common within the fixed interval literature. Third, the trial, rather than the fixed interval can be divided into equal duration bins. The first bin would be 33-sec while the final bin would be 33-sec; it is impossible to have two empty bins if responding is inhibited until the completion of the fixed interval with this method. This is the method reported in Craig et al. (2014); identifying different methods to bin responses were utilized by Craig et al. (2014) and the present manuscript, and this explains the contrasting bin analyses between this same samples of honey bees' fixed interval data, for Craig et al. (2014) did not observe bees fit a two bin monotonically increasing ordinal prediction. Clearly, in addition to deciding the appropriate number of bins to divide the fixed interval, researchers must use a standardized method to divide the fixed intervals.

Quarter Life

Honey bee quarter lives typically occurred before or around the first quarter of the fixed interval had elapsed; this finding indicates responding was not uniform and that more responses were emitted towards the beginning of the interval rather than later in the interval. In contrast, horse quarter lives typically occurred between the second and third quarter of the fixed interval. While a quarter life occurring later than a quarter of the interval may be indicative of temporal control, our horses' quarter lives occurred earlier in the interval than Herrnstein and Morse's (1957) pigeons (which occurred into about

80% of the fixed interval) but approximated Zeiler and Powell's (1994) pigeons' quarter lives (which occurred after 50% of the fixed interval had elapsed).

We also compared quarter life durations between schedules and observed longer fixed interval durations produced longer quarter lives. Again, pair-wise assessments were more liberal using OOM; all group and schedule comparisons fit the ordinal prediction taken to indicate responding was temporally controlled while Mann-Whitney U and independent t-tests revealed insignificant differences between the 0-180-P versus 0-60-P and 0-90-P groups. One reason OOM may have detected this difference is because NHST is increasingly conservative with low Ns, and N is not directly used to calculate PCC values in OOM.

Based on these quarter life assessments, a clear difference when quarter lives occurred is observable between species; horses waited longer into their extended fixed intervals to emit the first quarter of their responses compared to honey bees. However, both horses and honey bees produced longer quarter lives when responding was reinforced on longer fixed interval schedules, and this assessment could be used to support the conclusion both species' responding came under temporal control.

We recommend returning to the quarter life measure for four reasons. First, the measure is continuous (i.e. expressed in time). Second, the measure is easily calculable and compared. Third, the measure is conceptually easy to understand. Fourth, the measure facilitates easy species comparisons. Our main concern regarding quarter life is that at least four responses must be emitted in order for quarter life to be calculated; perfectly temporally controlled responding (i.e. a single response being emitted the instant the fixed interval elapses) cannot produced quarter lives. For this reason, only relying on quarter life as an assessment of temporal control is unadvisable.

<u>Index of Curvature</u>

We calculated three indices of curvature: a Discrete Response Tally Index of Curvature, a Continuous Response Tally Index of Curvature, and a Response Duration Index of Curvature. While the two forms of response tally indices of curvature were highly correlated, low correlations were observed when comparing the Response Duration Index of Curvature with the Discrete Response Tally Index of Curvature and Continuous Response Tally Index of Curvature. The index of curvature subtracts the area under the cumulative response (or response duration) curve from a theoretical “steady-state” response line. From this method, “scalloped” and “break-and-run” response patterns would produce highly positive indices of curvature, “steady-state” response patterns would produce indices of curvature that approximate zero, and “break-through” response patterns would produce negative indices of curvature. Observing descriptive statistics of the three indices of curvature reveals most horses produced positive indices; at most, three horses produced negative average indices of curvature while eight honey bees produced negative average indices of curvature. This initial observation indicates the area below honey bee cumulative response curves was greater than the area below a comparable “steady-state” response record; thus, honey bee indices of curvature do not support a conclusion of responding coming under temporal control.

We also compared pooled group and schedules under the prediction that longer fixed interval schedules would produce higher indices of curvature, and we observed both horses and honey bees generally fit this trend using the OOM ordinal analysis for all subjects other than those involving the 0-180-P and 0-60/90/180-P groups; however, honey bees did not significantly differ for the Continuous Response Tally Index of Curvature and Response Duration Index of Curvature according to Mann-Whitney U assessments and independent t-tests. Hence, these three indices of curvature analyses revealed horses emitted response patterns that are taken to be indicative of temporal control while honey bees did not display convincing evidence to infer responding came under temporal control.

As the index of curvature is based on the traditional cumulative curve, our criticisms of the cumulative curve generalize to the index of curvature. Our recommended modification to the cumulative curve solves many of the conceptual issues of the index of curvature. We included response duration, and as such, were able to calculate the area under a response and the area under inter-response times; traditional indices of curvature only captured the area under an inter-response time. Furthermore, we did not estimate the area under the modified cumulative curve via estimating an integral by dividing the fixed interval into quarters or any other number of subdivisions. We calculated the area under each response and inter-response time on an individual response and trial basis.

While the Discrete Response Tally Index of Curvature and Continuous Response Tally Index of Curvature are highly correlated for horses ($r = 0.96$) and honey bees ($r = 0.99$), the correlation between these indices are much lower (ranging between 0.16 – 0.57) when compared to the Response Duration Index of Curvature for both species. This is an important consideration when offering a suggested alteration for a traditional method. In our view, the Response Duration Index of Curvature may be theoretically preferable, for the two indices of curvature calculated with response tally on the ordinate produce a difficult to interpret unit of responses x seconds. However, the Response Duration Index of Curvature's lack of overlap with the more traditional Continuous Response Tally Index of Curvature presents issues when comparing new investigations with the literature. As the Discrete Response Tally Index of Curvature and Continuous Response Tally Index of Curvature measures are highly correlated, we suggest reporting the Continuous Response Tally Index of Curvature and Response Duration Index of Curvature methods if an index of curvature assessment is used as an assessment of temporal control.

Breakpoint

Unfortunately, attempting to isolate a maximum difference in slopes was not possible with actual horse or honey bee data. Slope variation was not as clean as originally anticipated, and subjects' response variability was such that this new definition of breakpoint was not calculable; hence, our redefinition of breakpoint is not useful at this juncture.

Post-reinforcement Pause & Latency

Boisvert and Sherry (2006) is the only invertebrate fixed interval investigation that has assessed PRPs. Boisvert and Sherry (2006) concluded bumble bee subjects had longer average PRPs during longer fixed interval conditions; however, individual subjects were not assessed.

For the present analyses, clear increases in mean and median and PRPs and latencies were observed for most horse and honey bee subjects when comparing the final CRF versus the final fixed interval session. An important observation is that horses generally waited until a greater percentage of the fixed interval had elapsed before emitting the first response compared to honey bees.

We performed two PRP and latency comparisons. The first comparison assessed if the final fixed interval session had longer PRPs or latencies compared to the final CRF session. Using OOM, we observed all individual and pooled horses matched this ordinal prediction. In contrast, the pooled honey bee analyses fit the ordinal prediction, but six of thirteen individual subjects did not fit the ordinal prediction. For horses, a Mann-Whiteney U was not significant for Subject 1 (0-90-P) and Subject 4 (0-60/90/180-P) while an independent t-test was not significant for Subject 1 (0-90-P) and Subject 3 (0-180-P); hence, correctly conceptualizing continuity is an important endeavor. In contrast, a Mann-Whitney U was not significant for eight of thirteen honey bee subjects, and an independent t-test was not significant for nine of thirteen honey bee subjects. Despite the fact that the majority of honey bees did not match the ordinal prediction or have significant differences, pooled and average group analyses were significant for honey bees.

An average PRP analysis in honey bees confirmed Boisvert and Sherry's (2006) findings, but the majority of individual honey bee subjects did not emit longer PRPs during the fixed interval condition compared to continuous reinforcement sessions. In contrast, individual horses did emit longer latencies compared to baseline CRF sessions; moreover, aggregate analysis of latencies conformed to individual subject trends for horses with few exceptions. While groups of honey bees, on average, produced longer PRPs when comparing CRF versus fixed interval sessions, only approximately half of the subjects followed this trend; thus, the conclusion of temporal control in invertebrates according to PRP may be an artifact of aggregate analyses. Clearly, performing individual analyses is critical for temporal control researchers as learning cannot occur in aggregates, but can only occur in individuals.

The second PRP and latency comparison assessed if longer schedule durations had longer PRPs or latencies compared to shorter schedule durations. These assessments were comprised of between-subject comparisons of pooled or averaged groups for the 0-60-P, 0-90-P, 0-180-P, 0-15-X, and 0-30-X groups while the 0-60-90-180-P and 0-60/90/180-P groups underwent within-subject comparisons. OOM revealed most horse subjects fit the ordinal prediction with the exception of Subject 4 (0-60/90/180-P) and Subject 7 (0-60-90-180-P); honey bee subjects also fit the ordinal prediction, but the observed PCC value was closer to the maximum randomization range for every analysis with the exception of the 0-60-P versus 0-90-P comparison. For horses, a Mann-Whitney U assessment also identified Subject 4 (0-60/90/180-P) and Subject 7 (0-60-90-180-P) as not having significant differences between schedules, but also identified the 0-60-P versus 0-180-P and 0-90-P versus 0-180-P comparisons were not significant; interestingly, a Mann-Whitney U assessment failed to reject the null hypothesis when comparing the honey bee 0-15-X and 0-30-X groups' PRPs. In contrast, an independent t-test was significant for honey bees (again, continuity is an important consideration). For horses, independent t-tests were not in agreement with the Mann-Whitney U assessments for the 0-60-P versus 0-90-P comparisons and for Subject 2 (0-60-90-180-P). Thus, comparing schedule durations revealed most horses emitted longer latencies during longer fixed interval schedule durations while honey bees did not convincingly emit longer PRPs during longer fixed interval schedule durations.

We recommend researchers continue to investigate PRP or latency at different schedule durations. These measures are continuous, meaningful, easy to perform, and have been a staple in the temporal control literature for almost half a century. However, simply performing aggregate analyses many not be sufficient to identify if responding came under temporal control; we recommend performing both individual and pooled/aggregate analyses. Finally, because PRP is a highly variable measure, complementing a PRP analysis with other measures that have been taken to indicate temporal control is advisable.

Inter-response Time (IRT)

If a "scalloped" response pattern is taken to indicate responding came under temporal control, then a decrease in IRTs across the session may be indicative of a "scalloped" response pattern. Unfortunately, this ordinal prediction can only be an assessment of "scalloped" response patterns; "break-and-run" response patterns may not fit this ordinal prediction.

We performed two ordinal analyses of IRT; we predicted monotonic increases or decreases in IRTs across trials and compared the fit of each subject's final session's pooled trials to either ordinal prediction. Seven of thirteen horses fit the monotonically decreasing ordinal prediction while no horses other than Subject 4 (0-60/90/180-P) fit the monotonically increasing ordinal prediction. Comparing both patterns revealed Subject 3

(0-180), Subject 4 (0-60/90/180-P), and the final FI-180-sec session for Subject 7 (0-60-90-180-P) fit the monotonically increasing ordinal prediction better than the monotonically decreasing ordinal prediction. In contrast, only two honey bee subjects fit the monotonically decreasing ordinal prediction while three honey bee subjects fit the monotonically increasing ordinal prediction; no pooled honey bee analyses fit either ordinal prediction. While only three honey bee subjects fit the monotonically increasing ordinal prediction, nine of the thirteen honey bee subjects response patterns were better characterized by the monotonically increasing ordinal prediction compared to the monotonically decreasing ordinal prediction. Thus, the majority of honey bees better fit the prediction indicating subjects took longer to emit responses towards the end of the fixed interval; this type of response pattern is the opposite of a "scalloped" response pattern (i.e. "break-through") and does not support the conclusion that honey bee responding came under temporal control. In contrast, most horses better fit the monotonically decreasing response pattern indicating most horses took shorter amounts of time to emit responses towards the end of the fixed interval.

We only reported pooled trial comparisons for subjects; most individual trials did not fit the ordinal predictions. This finding echoes a similar finding by Gentry, Weiss, and Laties (1983), for only aggregates, not individual trials, fit the same ordinal prediction we made here. As stated previously, this may be due to the fact that the monotonically decreasing IRT assessment creates an assessment of whether the observed response patterns were "scalloped;" Branch and Gollub (1974) revealed "scallops" may be an artifact of aggregating "break-and-run" response patterns, so it is possible our horse subjects' individual trials did not fit the present ordinal prediction because they emitted “break-and-run” response patterns (according to the cumulative and four bin analyses measures). Unfortunately, performing NHST analyses to assess within-trial trends was not possible as trials contained varying number of responses; a repeated measures ANOVA would not analyze the majority of the collected data due to concerns surrounding “missing” data. Implementing an NHST assessment of IRT may help address aggregate artifact concerns.

Trial Duration

If responding came under temporal control, it stands to reason that subjects would emit responses closer to the completion of the fixed interval with extensive exposure to the fixed interval schedule. We observed this effect for the majority of horse, and for some honey bee subjects when assessing mean and median comparisons. We made an ordinal prediction to perform an individual analysis of trial duration and observed ten of eleven horses (we could not perform this analysis for the 0-60/90/180-P group) fit the ordinal prediction that shorter trial durations would occur with greater exposure to the fixed interval schedules while only five of thirteen honey bees fit this ordinal prediction. Interestingly, horses in the 0-60-90-180-P group matched the ordinal prediction for the FI 60-sec sessions, but did not for the FI 90-sec and FI 180-sec sessions; this may be because trial durations were reduced after only three fixed interval sessions and increasing the schedule duration did not necessarily produce longer trial durations that could then be further reduced with more experience on the final schedule.

We maintain that an assessment of the temporal location of the contingent response is necessary for an analysis of temporal control, and if a contingent response occurs well after the fixed interval, responding has not come under temporal control. Obviously, the nuances of temporally controlled responding is not assessed via this measure but satisfying this measure is critical in order for responding to be considered as having come under temporal control. Hence, we recommend trial duration be used in conjunction with other measures for this reason.

However, a few points complicate utilizing trial duration as an assessment of temporal control. Taken together, the variability of honey bee trial durations, horse intra-schedule variability (FI 60-sec sessions), and the inconsistency of subjects that fit the present pattern analysis compared to the analyses of other measures complicate the utility of trial duration as an assessment of temporal control despite the theoretical importance of the contingent response. One glaring issue with a trial duration assessment is that instrumentation differences between assessed species greatly influence this measure. We tried to provide horses with the ability to make numerous responses in a short amount of time, but honey bees generally produced shorter aggregate trial durations. Using trial duration to directly compare if different species' responding came under temporal control does not seem to be a fruitful assessment, but indirect comparisons may still be useful.

Response Duration

No previous fixed interval investigations have assessed how response durations change across the fixed interval, so we performed two ordinal predictions; response durations were predicted to monotonically increase or decrease across the fixed interval. We posit that temporally controlled responses should be shorter as the fixed interval nears completion, for the initiation of a response can only produce reinforcement delivery; a long response directly preceding the completion of the fixed interval decreases reinforcement likelihood. Increasing response durations as the interval progresses reduces reinforcement likelihood as the initiation of a contingent response produces reinforcement delivery.

Some horses did decrease their response durations across the fixed interval, but this pattern was not consistently observed; no honey bees decreased their response durations across the interval. In contrast, six of thirteen honey bees fit the monotonically increasing ordinal prediction while only one of thirteen horses fit this pattern. From this assessment, we can conclude honey bees tended not to emit monotonically decreasing response durations across the interval; thus, an inference that honey bee responding came under temporal control is not supported.

Based on the inconsistent pattern matches for horses, response duration may not be an effective measure to assess if a subject's responding came under temporal control; however, it is possible that response duration may be used as an indicator that subjects did not emit responses that came under temporal control. Increasing response durations throughout the fixed interval reduce the likelihood of making a response once reinforcement is available. For this reason, increasing response durations can be taken to indicate responding is not temporally controlled. Future temporal control assessments may benefit from assessing if the observed response durations are better characterized by a monotonically increasing or decreasing response pattern. Additionally, to assess the relation between response duration and temporal control, allowing the contingency to be met while a response is being made may be beneficial.

Peak Procedure

Honey bees did not encounter a peak procedure, so an indirect inter-species comparison of peak procedure performance could not be made. Horse subjects often did not complete all 10 peak procedure sessions; however, those that did produced peak procedure trials with the highest response levels towards the middle of the peak trial (i.e. responding peaked when reinforcement delivery would have occurred for normal fixed interval trials). Thus, the peak procedure provides additional demonstrations of temporal control in horses.

We divided peak trials into either 10 or 20 bins and plotted response levels for these bins. From this qualitative assessment, the response levels for six out of eleven horses were highest approximately half-way through the peak trials. We then performed two sets of ordinal predictions for the peak trials during the peak procedure session. We divided the interval into halves, and predicted response levels would monotonically increase during the first half of the peak trials but would monotonically decrease during the second half of the peak trials. We observed four of eleven horse subjects fit both of these ordinal predictions.

The present manuscript is the first investigation to expose horse responding to a peak procedure. The peak procedure is a simple extension of the fixed interval protocol and further assesses if responding came under temporal control of the fixed intervals. From our analyses, we can conclude many of horses' response patterns during the peak procedures indicate their responding came under temporal control of the fixed intervals.

Behavior Topography

To further describe comparative differences between horse and honey bee behavior when responding is reinforced on fixed intervals, we also made notes of each species' adjunctive behaviors (i.e. non-contingent behaviors). For some honey bee subjects, inter-response behaviors included exiting the response hole, and walking in circles around the response hole. Other subjects would detach from the platform adjacent to the response hole and fly around the operant chamber. To avoid the effects of post-reinforcement delays reported in Craig et *al.* (2012), the experimenters allowed the honey bee subject to leave the operant chamber. Oftentimes, subjects would fly in circles above the operant chamber, reenter the chamber, and continue responding. Other subjects flew in front of the experimenter's face instead of flying in circles. One subject would return to the nearby 10% sucrose station during sessions but did not extend her proboscis to feed.

Likewise, horses tended to emit adjunctive behaviors during the fixed intervals. Some subjects would look behind themselves, rub their nose against the automatic feeder, lick parts of the apparatus that were made out of PVC, and forcibly push against the apparatus. Many subjects emitted adjunctive behaviors that focused on the feeding tray; these behaviors include checking and rechecking the feeding tray, pushing or pulling the feeding tray, and picking up the feeding tray. Other subjects would insert their heads through the first response hoop, but would not extend their necks through the second response hoop to make a response. For both species, none of these adjunctive behaviors seemed to occur in a specific order for individual subjects. Future investigations may benefit from analyzing the order of these adjunctive behaviors similarly to Anderson and Shettleworth (1977).

Observation Oriented Modeling vs Null Hypothesis Significance Testing

To allow comparisons between the present findings and those reported in the literature, we also analyzed our data via null hypothesis significance testing (NHST) in addition to utilizing OOM to demonstrate nine main differences in data analysis methods, philosophies, and results between OOM and NHST.

First, assumptions of **additivity,** and thus continuity, are not made in OOM as values are not added or aggregated. Discriminating between Stevens' (1946) ordinal scale or ratio scale and determining whether a parametric or nonparametric assessment should be performed is not important in OOM; both forms of data are assessed in the same manner in OOM and the ordinal analysis. As such, concerns about continuity and the observed inconsistent results from different NHST assessments using the same data points are avoided in OOM (e.g. a repeated measures ANOVA was significant but a Friedman's test was not significant for several assessments). To demonstrate the difficulties of continuity concerns of parametric assessments in NHST, we performed a series of Friedman's tests and repeated-measures ANOVAs for our response bin analyses and posit responding occurs on an ordinal scale despite responding’s treatment as occurring on a ratio scale of measurement. While a series of responses may be additive, responding does not satisfy the density requirement of continuity as responses are discrete; a ½ of a response is not conceivable. However, the behavioral literature tends to assume responses are additive and continuous in their utilization of response rates and

NHST. Therefore, we performed parametric and nonparametric NHST analogues of our ordinal analysis for our response bin analyses.

The importance of the continuity assumption was observed in a few cases for our analyses. For example, when treating the Discrete Response Tally Index of Curvature as a continuous measure (as it should not be), independent t-tests were not significant, but correctly performing non-parametric assessments revealed differences between the FI 90-sec versus FI 180-sec sessions for the 0-60/90/180-P group. Additionally, when treating the Continuous Response Tally Index of Curvature as a continuous measure (which it is not; our label is designed to highlight the literature's miss-conceptualization of continuity), a significant difference was observed for the 0-15-X versus 0-30-X groups but was not observed when this measure was treated as a discrete measure (as it should be). Finally, when treating the Response Duration Index of Curvature as a continuous scale (as it should be), the 0-60-P versus 0-180-P group comparison was not significant but was significant when this measure was treated as a discrete measure (as it should not be). Claims of robustness, and general negligence regarding scale continuity, may produce inaccurate results in an NHST paradigm. Additionally, several inconsistencies were observed when comparing the results of Mann-Whitney U and independent t-tests for PRP/latency assessments for both species. Treating a continuous variable as discrete (or a discrete variable as continuous) can result in differing conclusions in NHST.

Second, NHST assumptions about sphericity or **homogeneity** are eschewed in OOM because means, variances and sums of squares are not utilized in the ordinal analysis. As such, concerns about corrections and the observed inconsistent results from different corrections are avoided in OOM (e.g. a Greenhouse-Geisser correction was not significant but a Huynh–Feldt correction was significant for a few cases). By using OOM, we were able to avoid complications surrounding homogeneity or sphericity assumption violations. In many cases, we observed inconsistent NHST conclusions based on modifying the degrees of freedom for these assessments. For example, for the 20 bin analysis for FI 180-sec session for Subject 4 (0-60/90/180-P), a repeated measures ANOVA that violated the sphericity assumption was significant without sphericity corrections, but a Greenhouse-Geisser correction was not significant while a Huynh-Feldt correction was significant. In these types of cases, researchers are hard pressed to determine which correction to interpret and report; researchers may error on selecting whichever correction best supports their experimental hypotheses. Complications around inconsistent degrees of freedom corrections are avoided in OOM, and this may increase researcher objectivity.

Third, OOM tests do not utilize critical **alpha-levels**; hence, there are no concerns about alpha-level adjustments following numerous tests. In focusing on the individual observations of the collected data, generalizations to population parameters are not made; rather, uniqueness of the specific observations of the data are assessed. Unfortunately, we would have been severely under-powered if our primary data analysis methods had been conducted under an NHST paradigm. If an *a priori* power assessment had been used to calculate an appropriate N, we would have been discouraged from investigating temporal control of horse responding as these subjects are expensive and difficult to obtain. By using OOM, we could perform any number of *post hoc* analyses of our data as degrees of freedom are eschewed in OOM because OOM does not concern itself with population parameters.

Fourth, testing between-group **dependency** or between-group independency does not involve inherently different methods in the OOM ordinal analysis. The researcher may perform combinations for independent or dependent data without assumptions of dependency complication these analyses. Our horse experiment utilized a mixed within-subject and between-subject design, and our analyses separated between groups (i.e. assumed independency), within conditions (i.e. assumed dependency), and pooled comparable conditions without dependency or independency concerns. The assumptions and requirements to properly perform a between-subjects dependent t-test while controlling for within-subject trials in a single assessment are not met in NHST. For this reason, we were presented with a challenging problem when performing the reported NHST assessments because the algebra involved in NHST dependent assessments is not applicable for our needs. For example, consider a simple PRP analysis comparing CRF versus fixed interval performance; the fixed interval performance likely depends on the previous CRF performance within an individual but performing a paired trial by trial comparison does not provide a desirable analysis.

Fifth, by using OOM, we were able to analyze repeated measures with "**missing**" data points that would have otherwise not been assessable in an NHST paradigm. Each trial contained a varying number of responses; thus, response duration and IRT within each session could not be assessed via NHST without a series of transformations (e.g. binning responses). A second similar limitation of NHST is the requirement of an equal number of data points for some dependent assessments (e.g. dependent t-test); using OOM, we did not have to have the same number for responses for each trial in order for our data to be assessed. A third similar limitation of NHST is that in OOM, considerations of unequal sample sizes for each group are unnecessary.

Sixth, the assessments between OOM and NHST are radically different and ask **separate questions**. Rather than simply assess if differences are observed between conditions, OOM assesses the direction of the expected differences. This analysis is a step above traditional NHST methods as simply rejecting a null hypothesis does not approximate the assessment of data fitting a hypothesized ordinal prediction. NHST is susceptible to type III errors in directionally (as observed when comparing the FI 90-sec and FI 180-sec sessions' latencies for Subject 4 (0-60/90/180-P)). OOM can be used to assess both directions and determine which ordinal prediction best characterized the observed data. Additionally, performing an NHST assessment of peak trials would not provide the desired information of selecting what bin contained the largest response tally but would only indicate if significant differences were observed between bins; in order to probe this assessment, we would have needed to perform 190 *post hoc* analyses that would clearly have depleted our alpha-levels.

Seventh, OOM is not as influenced by large **sample sizes** in determining if condition differences are present whereas NHST is heavily influenced by sample size. For example, many NHST assessments (e.g. quarter life, index of curvature, latency) involving Subject 3 (0-180-P) were not significant because of the few trials during this subject's final fixed interval session; OOM did detect differences that NHST could not due to the latter's dependency on N for its analyses. OOM also benefits from not requiring equal sample sizes for assessments, and does not become biased when unequal samples sizes are compared across conditions.

Finally, OOM encourages **abductive inferences** by allowing any number of required *post hoc* analyses of the observed data. Due to OOM's flexibility in its ordinal predictions, many hypotheses can be assessed. Indeed, for our four bin response bin analysis, we assessed five hypotheses. In contrast, NHST only assessed one null hypothesis (that the bins were equal), and inferred an alternative hypothesis (that the bins were not equal). The alternative hypothesis is not directional and provides little information compared to the ordinal analyses employed in OOM. Simply assessing two hypothesis (e.g. means are equal, or means are not equal) is likely insufficient to posit the best explanation of a phenomena; OOM provides the flexibility to develop any number of ordinal hypothesis that may be used to determine what model best describes the observed data and phenomena.

However, OOM is not without limitations. Complete pattern matches for multiple within-subject comparisons (e.g. the 20 bin comparison) were not observed; thus, CPCC values are a strict assessment for some analyses. When considering the bin comparison, dividing the fixed interval into too many bins nullifies the effectiveness of the CPCC value at determining pattern matches; relying on a smaller number of bin analyses (e.g. four bins) may be beneficial. Additionally, OOM requires a high-level of computing power in order to perform its randomizations. For this reason, 100 randomizations were performed for some larger analyses, for omnibus analyses beyond pair-wise comparisons could not be performed with 1,000 randomizations. An individual analysis can be taxing compared to an aggregate analysis, and we were able to perform omnibus assessments using NHST that could not be performed in OOM. Finally, pair-wise assessments in OOM can be more liberal compared to NHST assessments (e.g. for quarter life and indices of curvature assessments). However, for three or more order comparisons, OOM becomes increasingly conservative.

Future Directions

Future fixed interval investigations may benefit from addressing the inconsistently utilized measures that have been used to operationalize temporal control. Zeiler and Powell (1994) attempted to isolate a handful of measures (using response bins, PRP, breakpoint, and peak procedures) to operationalize temporal control; however, we recommend using a greater variety of measures to operationalize temporal control for two reasons. First, if IRT and response duration are recorded, all of the previously described measures can easily be constructed *post hoc*. Second, several measures (e.g. PRP, quarter life, break point, trial duration) do not describe responding throughout the entire interval; multiple measures must be addressed to fully describe temporally controlled behavior. Of the reviewed measures, we are hesitant to recommend returning to the index of curvature as an operationalism of temporal control due to its high correlation with quarter life (i.e. redundancy) and rather meaninglessness; calculating the area under a cumulative response curve is a product of incorrectly considering responding to be a continuous process and departs from the reality of the observations. In our view, returning to a within-trial analyses of IRT is critical and developing methods to assess break-and-run IRT response patterns seems likely to be a worthwhile endeavor. Echoing the concerns outlined by Branch and Gollub (1974), we believe researchers must consider the importance of focusing on individual observations, and we have outlined a series of viable individual analyses to keep the researcher close to the actual observations rather than chasing population parameters.

For future comparative fixed interval investigations, we recommend focusing on a greater diversity of species as per Richelle and Lejeune's (1980; 1984) first recommended strategy. No amphibians have been investigated, and only a handful of fish and reptiles have been assessed (and the majority of species investigations have not been replicated). Specifically, we recommend focusing on aquatic species and investigating a rather general hoop-swimming response that most species can likely emit. For example, we are interested in assessing if tadpole and frog hoop-swimming behavior can be brought under temporal control and comparing these response patterns with turtle and fish hoop-swimming behavioral patterns. This line of research echoes Richelle and Lejeune's (1980; 1984) second recommended strategy of investigating closely related species to reduce instrumental differences in between-species comparisons. An added benefit of working with aquatic species is that small amounts of experimenter oversight are required; in the present horse experiment, two experimenters were required to be present during data collection. This factor could facilitate a higher number of fixed interval trials and sessions being administered for aquatic species. Finally, continuing to investigate a greater variety of invertebrates is an important line of research; only bees have been investigated, and the high levels of individual variation in this sample of honey bee response patterns stifles general claims about invertebrates' ability to emit temporally controlled responses.

As per Richelle and Lejeune's (1980; 1984) third recommended strategy, we believe temporal control researchers would benefit from utilizing a wider range of reinforcers. For example, Place, Varnon, Craig, and Abramson (under review) trained rattlesnakes to make lever presses in order to receive changes in temperature; we plan to continue working with a similar protocol using spatial responses and exposing rattlesnake responding to fixed interval schedules in the future. Manipulating temperature for ectotherms is not a novel method within the fixed interval literature (Rozin, 1965), but temperature changes have not been used as the primary reinforcement for any fixed interval investigations. This may be an effective method for investigating species with slow metabolic rates, or for species that easily satiate. For example, allowing species to regulate an aquarium's temperature may allow more species comparisons than food reinforcers.

Conclusions

Several clear advantages of OOM are identifiable when compared with comparisons of measures of central tendency. Concerns of unrepresentative aggregates due of outlier effects or multiple trends in individual performances are irrelevant in OOM. Adjusting critical alpha-levels after performing multiple tests is unneeded in OOM. Complications with missing trial data do not result in most of the subjects' data remaining unassessed in OOM. Abstract, often impossible, population parameters are not compared as if they are concrete individual observations in OOM. Instead of providing a probability value of a dataset's extremity based on pre-determined alpha-levels, OOM provides a chance value of the observed dataset's uniqueness compared with a series of randomizations of the dataset. Finally, the PCC value indicates the percentage of data points in a group/condition that are larger or smaller than an alternative group/condition; we believe the information in a PCC value offers an easily comprehensible summary of the dataset compared with the required hodgepodge of tests to thoroughly assess a between-subject repeated-measures, or split-plot, design.

The present manuscript is the first to compare a vertebrate and an invertebrate species' ability to emit responses that come under temporal control of fixed interval schedules; additionally, we are the first to utilize a peak procedure with horse subjects. An extensive assessment of common fixed interval measures have been assessed, and modifications to traditional measures have been suggested as a means of improving temporal control investigators' descriptions and discussions of response patterns. These assessments revealed honey bees did not produce convincing evidence to support a conclusion their responding came under temporal control of the fixed interval schedules while horses did produce convincing evidence to conclude their responses were temporally controlled. Potential aggregate artifacts were identified for PRP, latency, and IRT measures; individual honey bees did not support a conclusion of temporal control while pooled and aggregate group assessments conform to predictions taken to indicate responding was temporally controlled; however if individuals do not fit these trends, concluding this sample of honey bees' responding came under temporal control is not realistic. In contrast, individual and pooled/aggregate group assessments support the conclusion horse responding came under temporal control of the fixed interval schedules.

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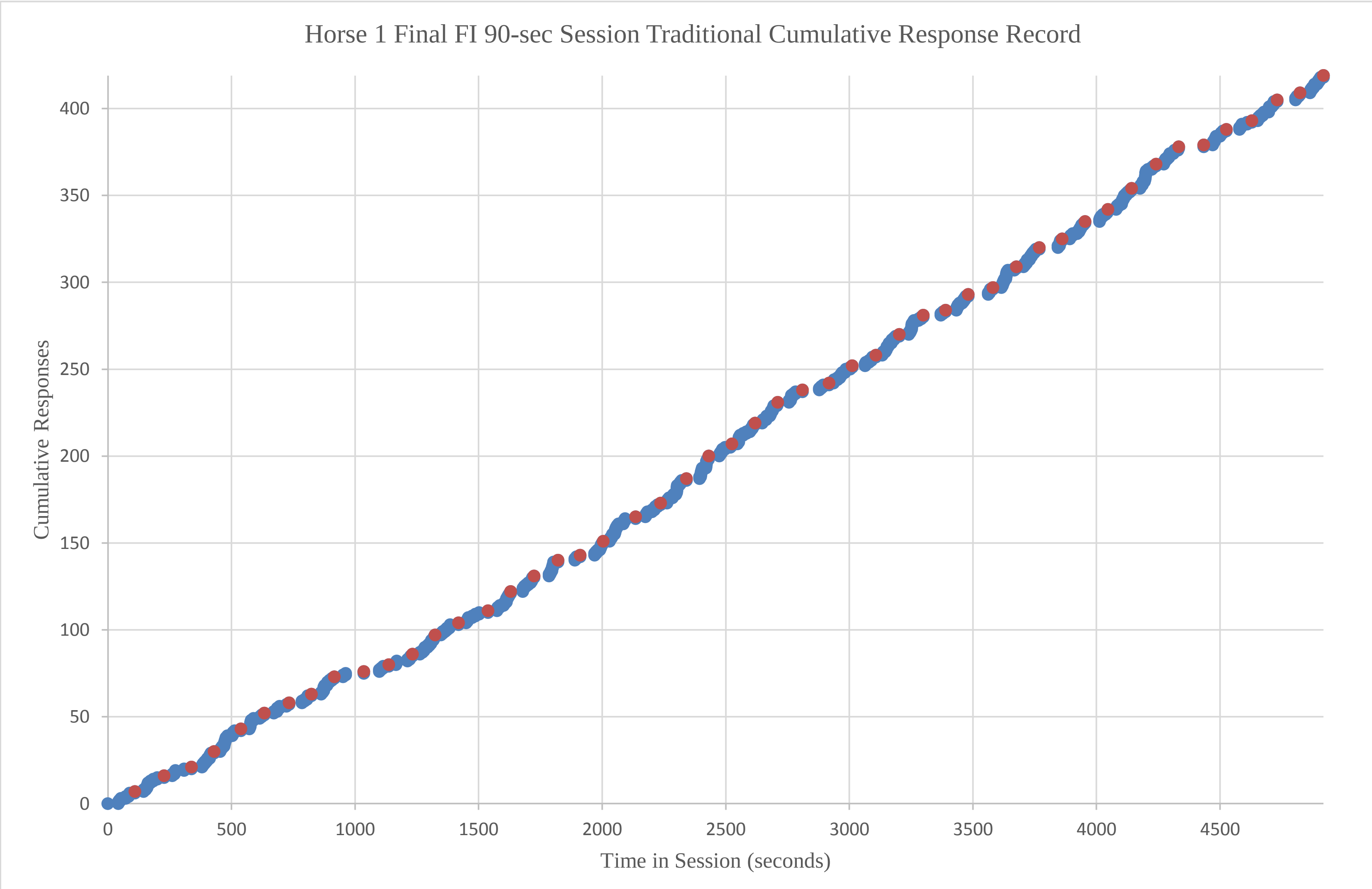
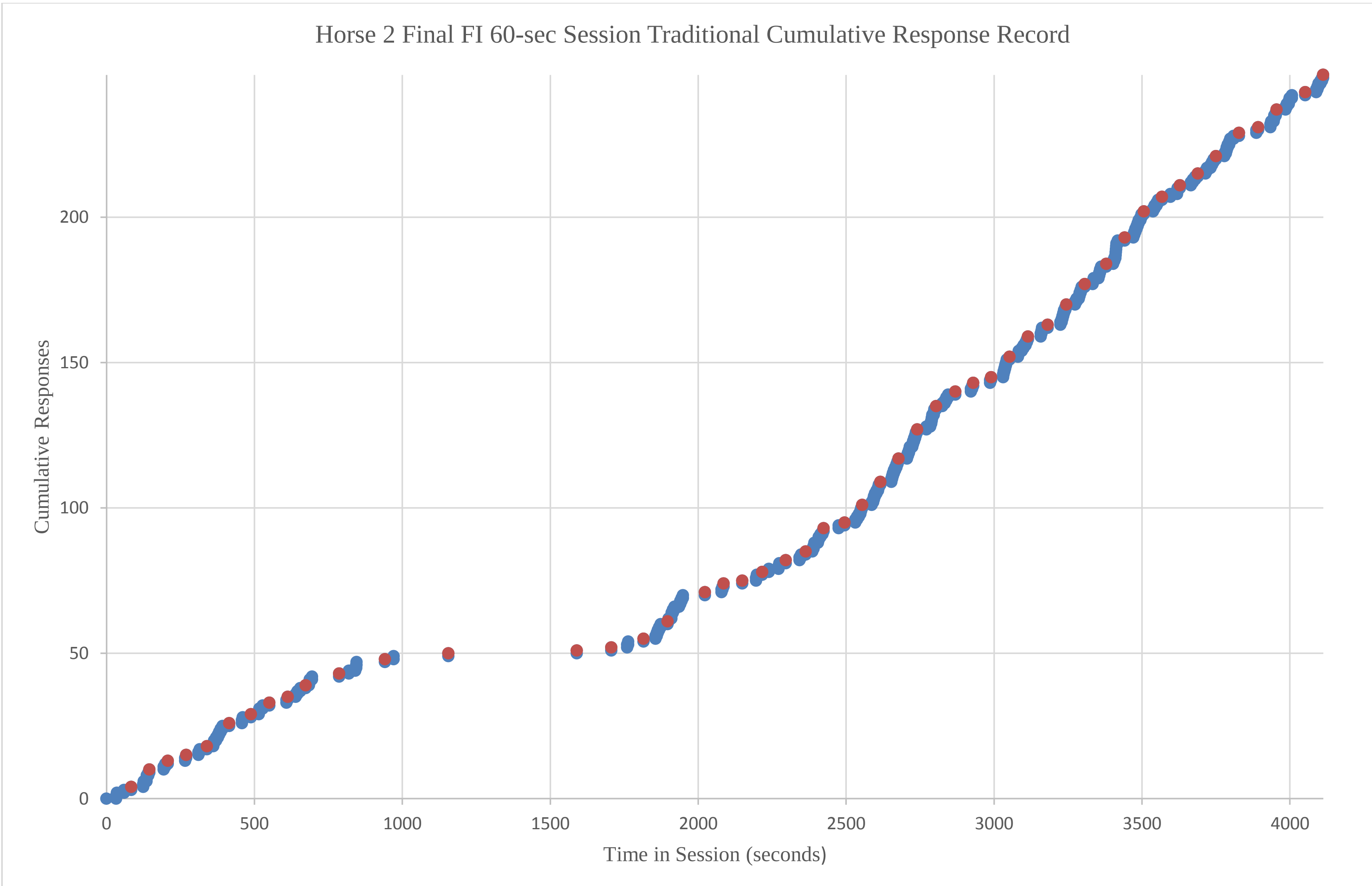
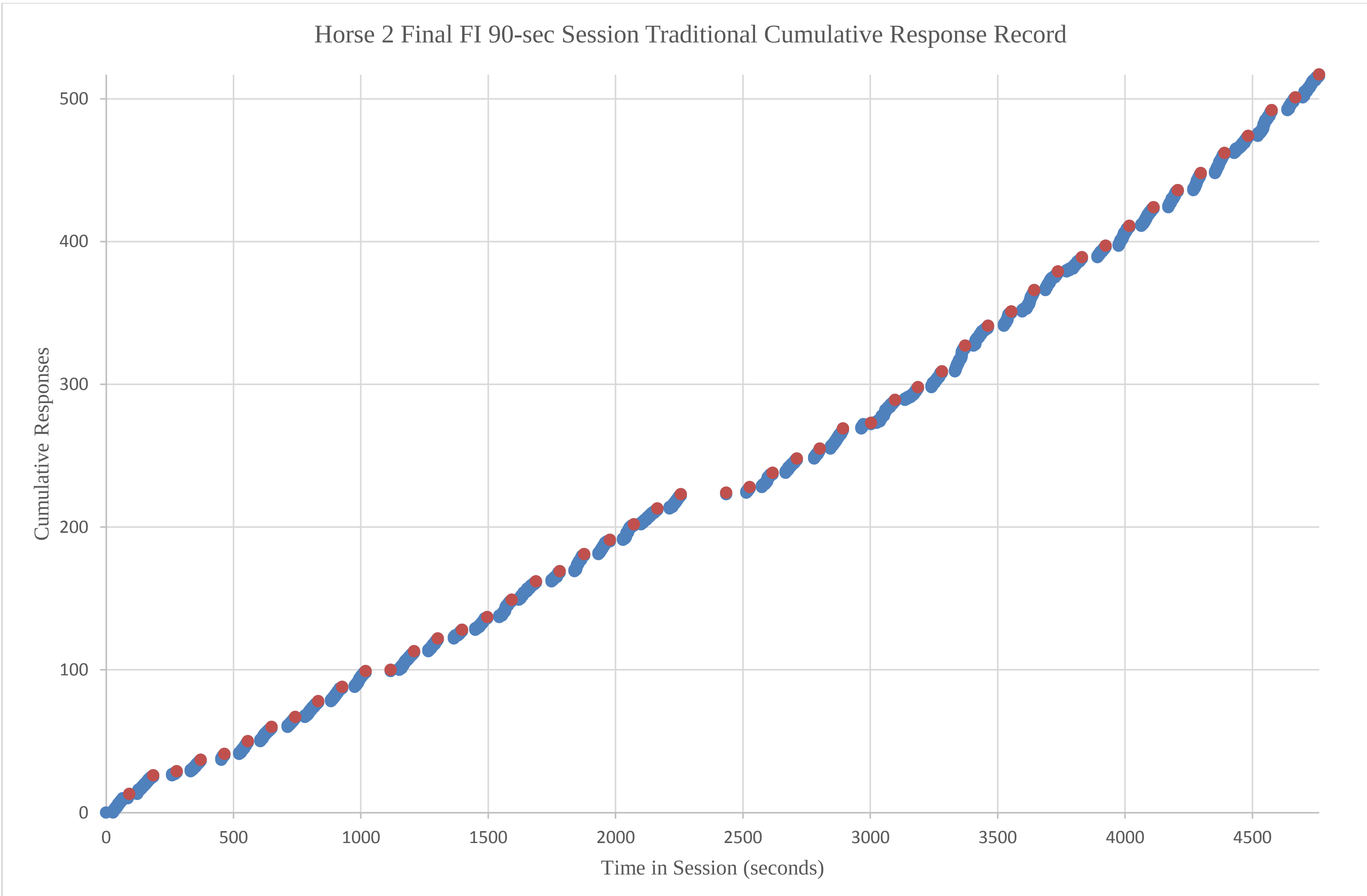
APPENDICES

Appendix 1: Traditional Cumulative Curves




Horse 2 Final FI 60-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
50
100
150
200
0
500
1000
1500
2000
2500
3000
3500
4000
Time in Session (seconds)


Horse 2 Final FI 90-sec Session Traditional Cumulative Response Record
Cumulative Responses
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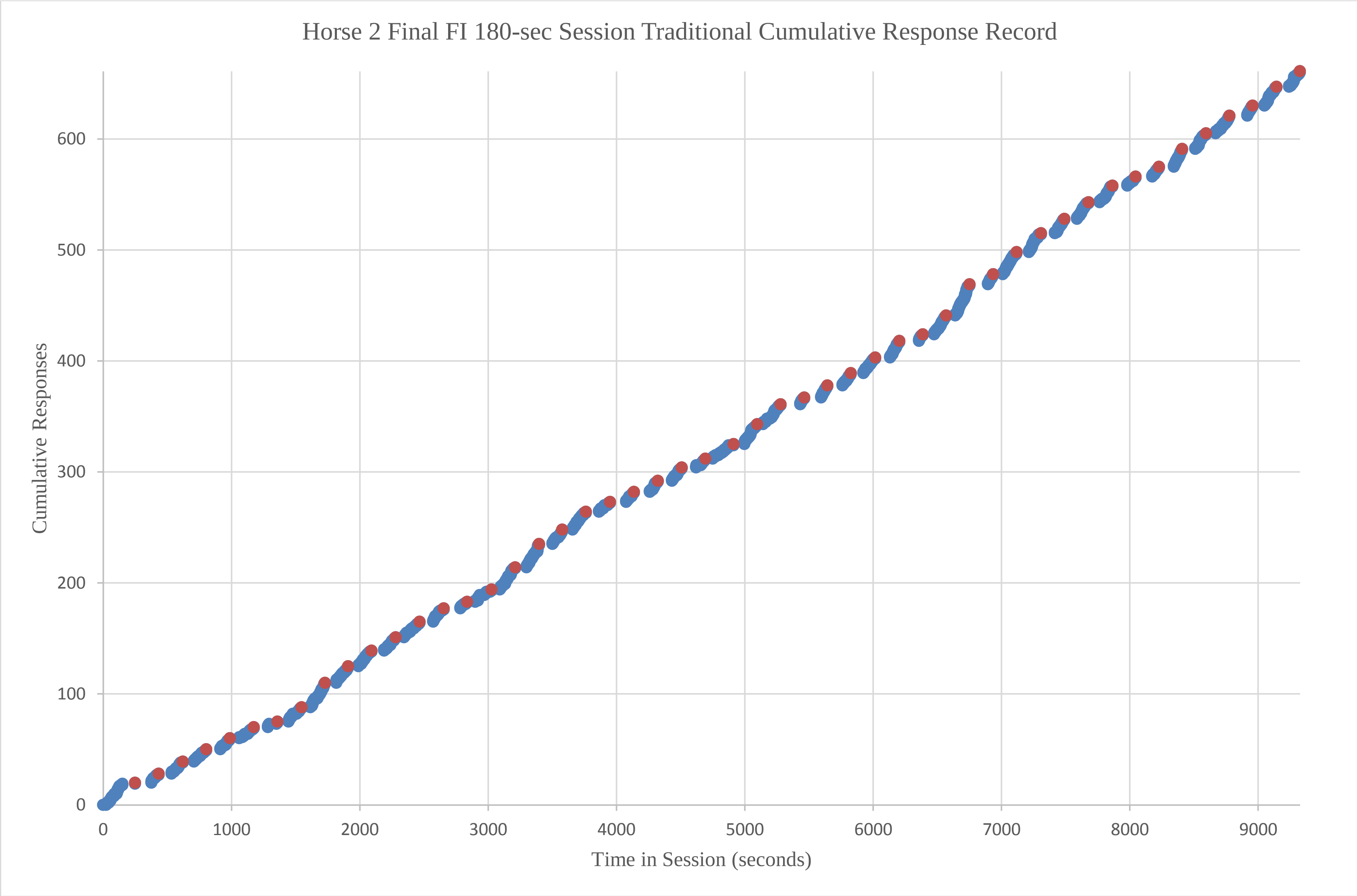
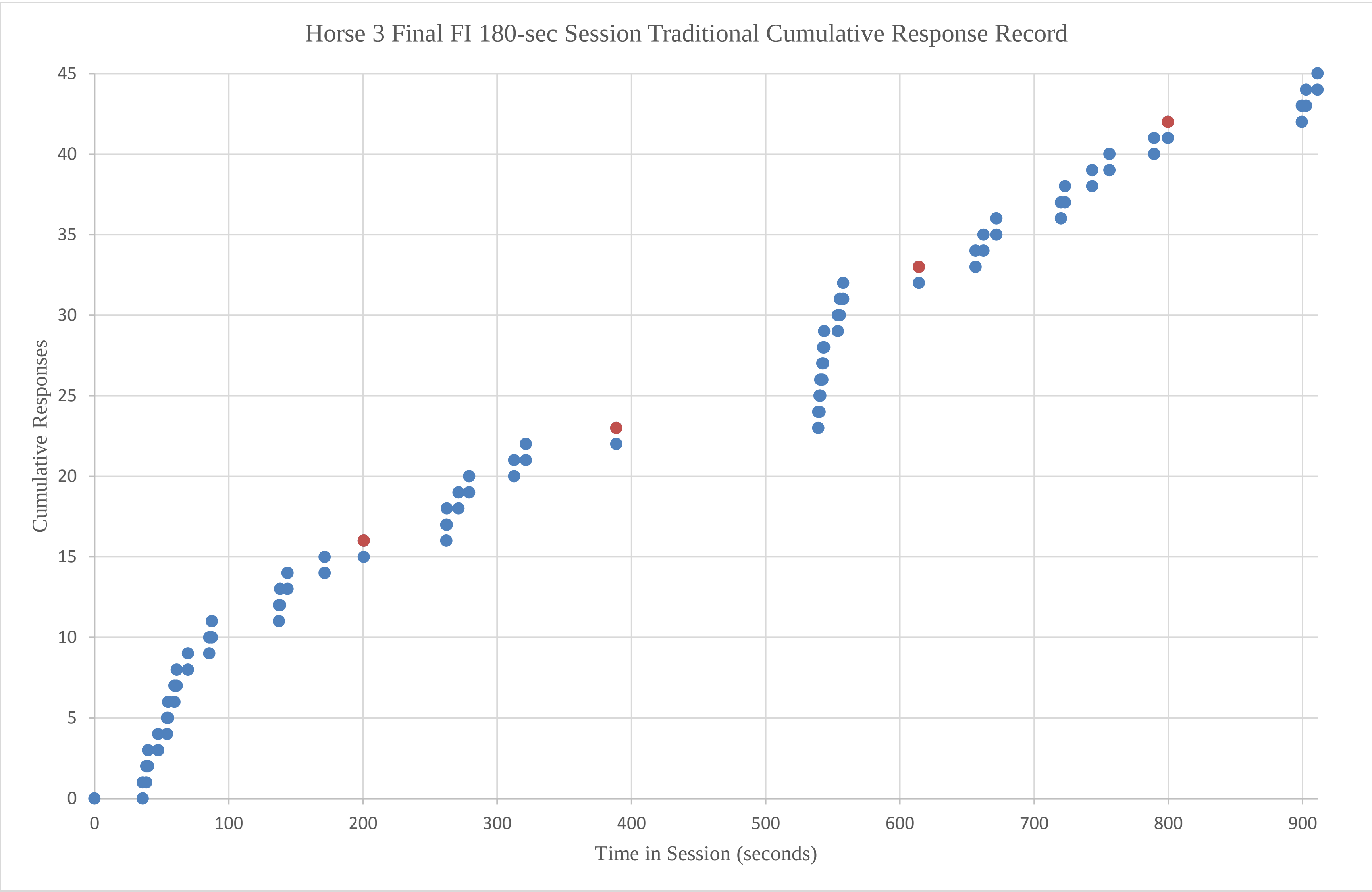
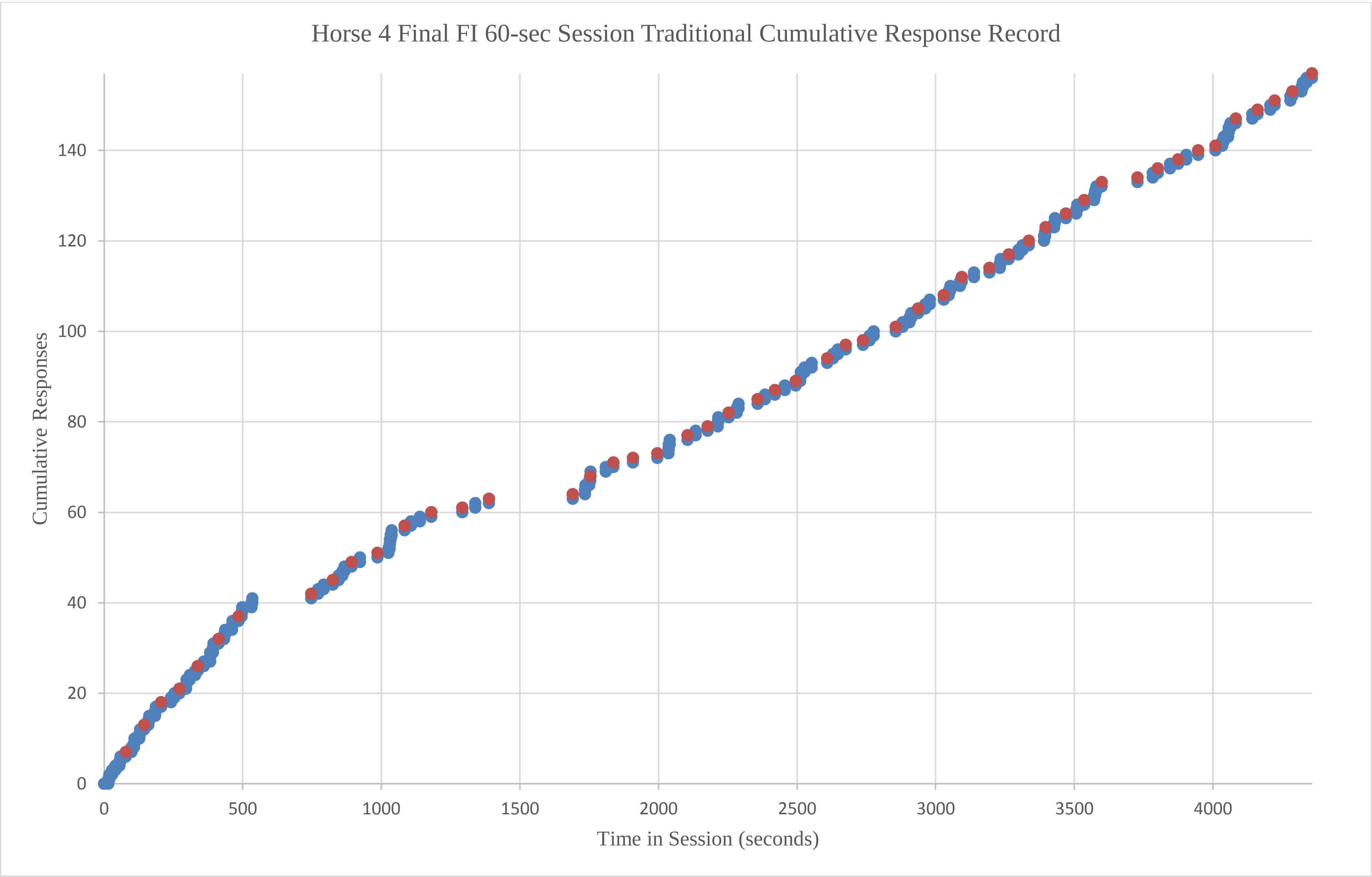
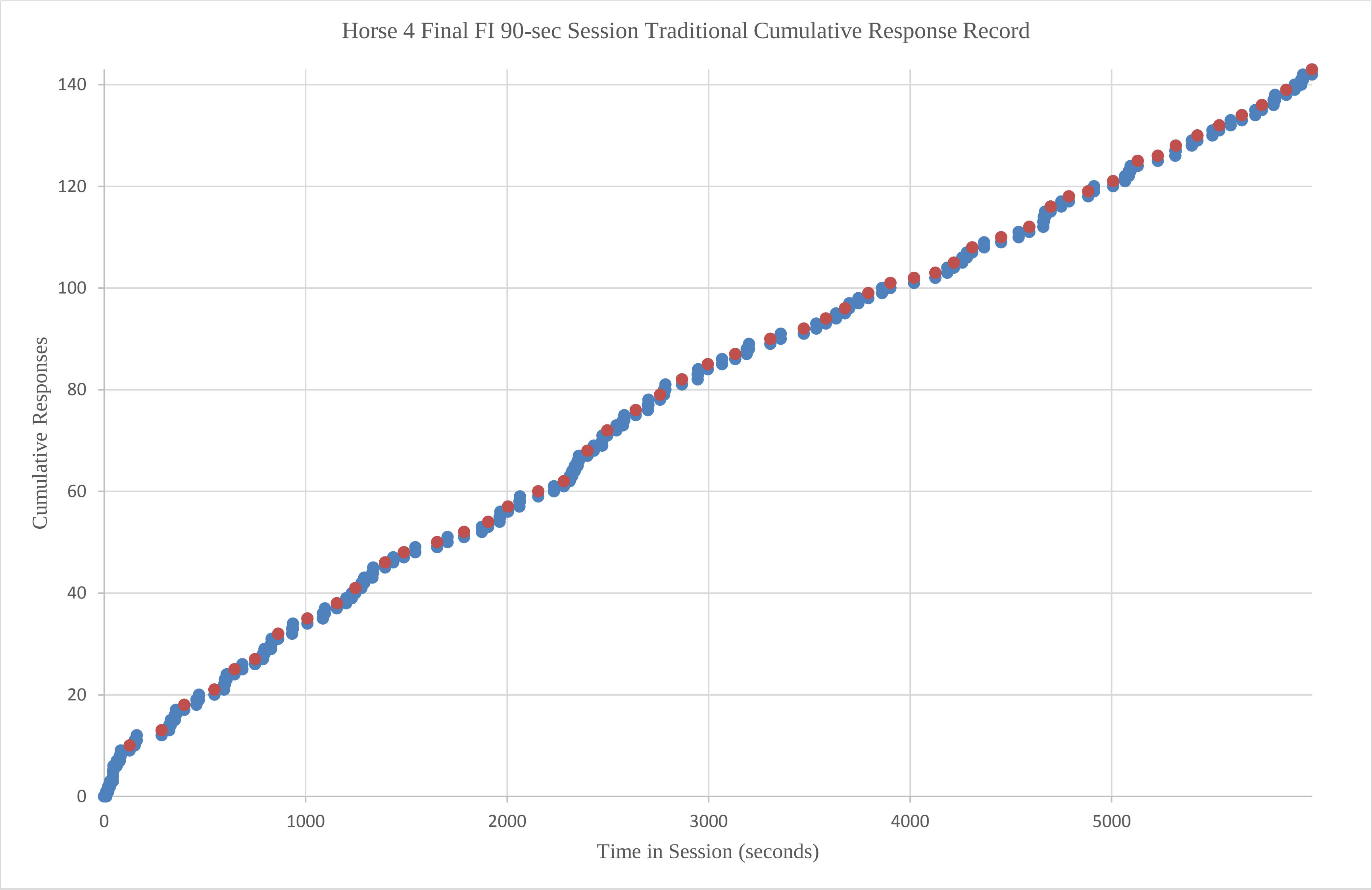
100
200
300
400
500
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Time in Session (seconds)



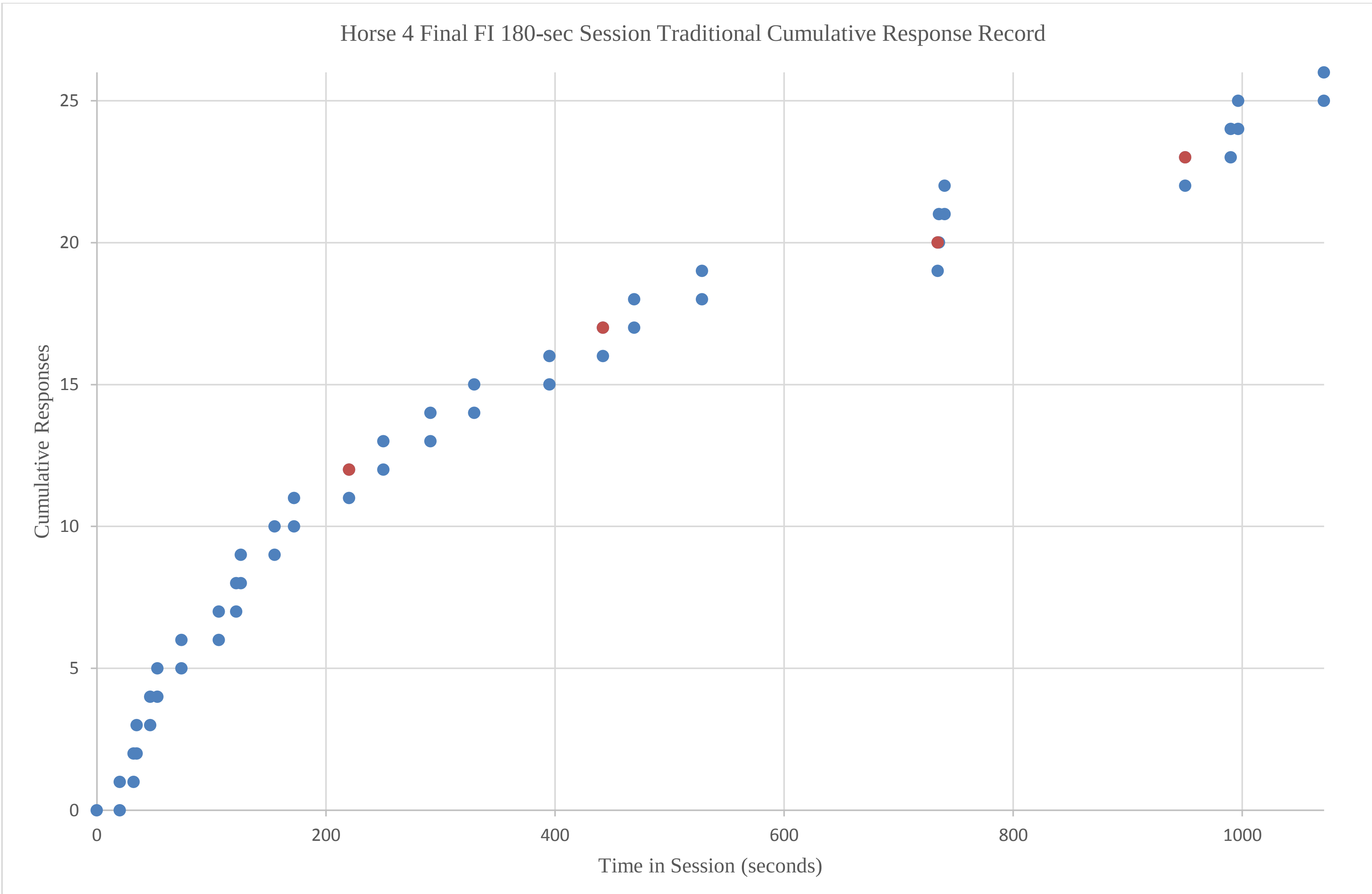
Horse 2 Final FI 180-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
100
200
300
400
500
600
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Time in Session (seconds)

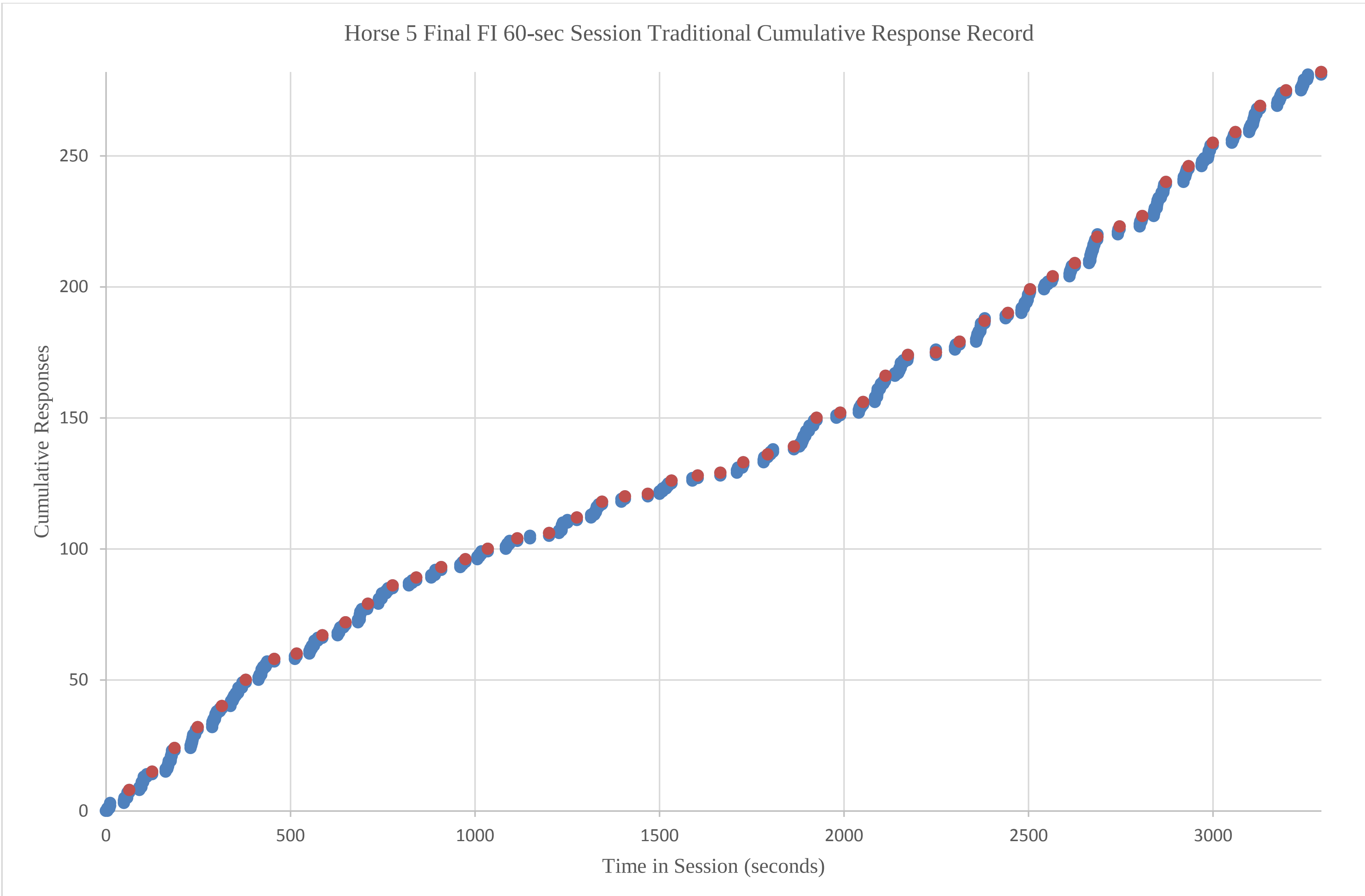

Horse 3 Final FI 180-sec Session Traditional Cumulative Response Record
Cumulative Responses
45
40
35
30
25
20
15
10
5
0
0
100
200
300
400
500
600
700
800
900
Time in Session (seconds)

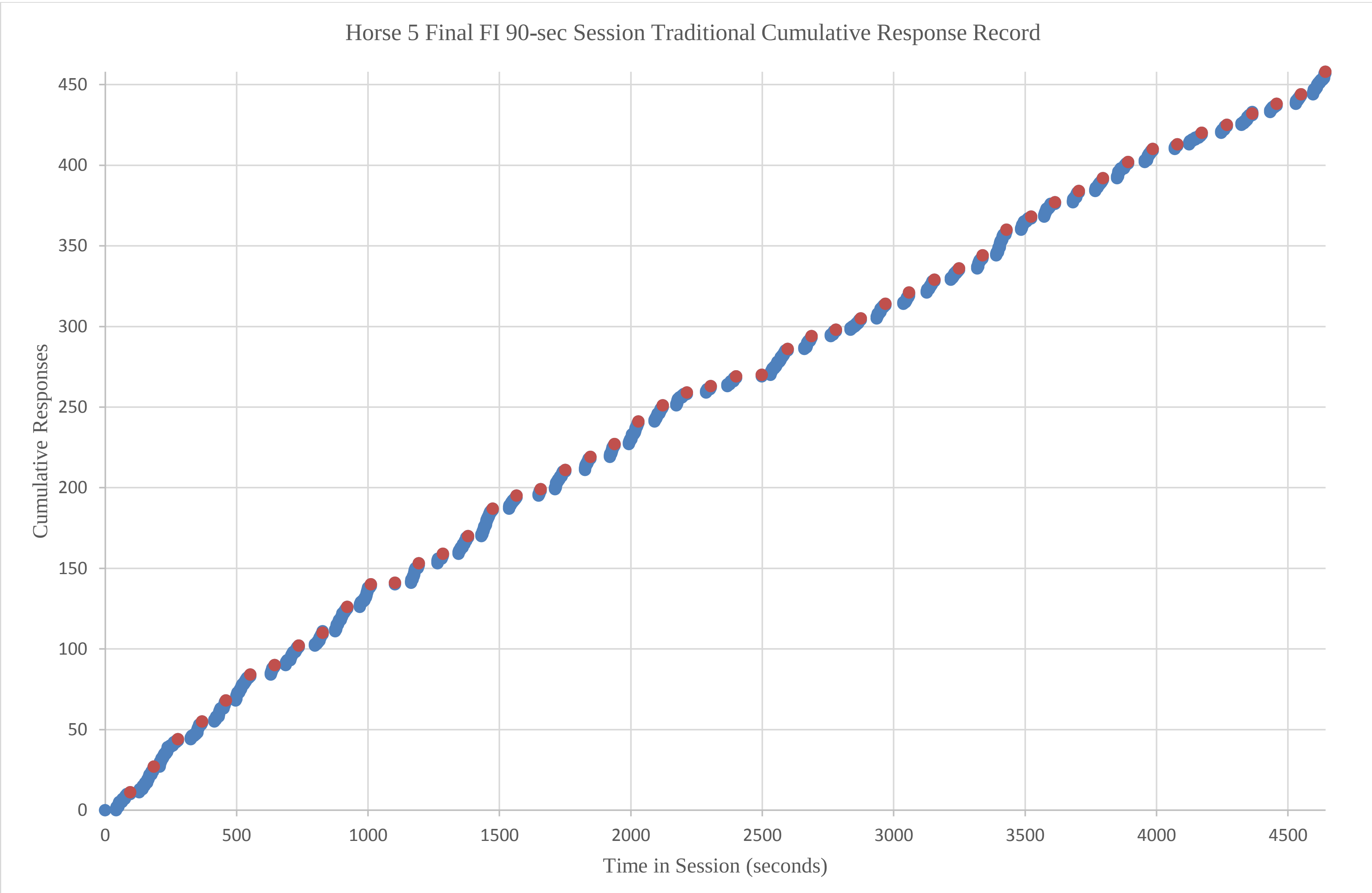

Horse 4 Final FI 60-sec Session Traditional Cumulative Response Record
Cumulative Responses
Time in Session (seconds)
0
20
40
60
80
100
120
140
0
500
1000
1500
2000
2500
3000
3500
4000



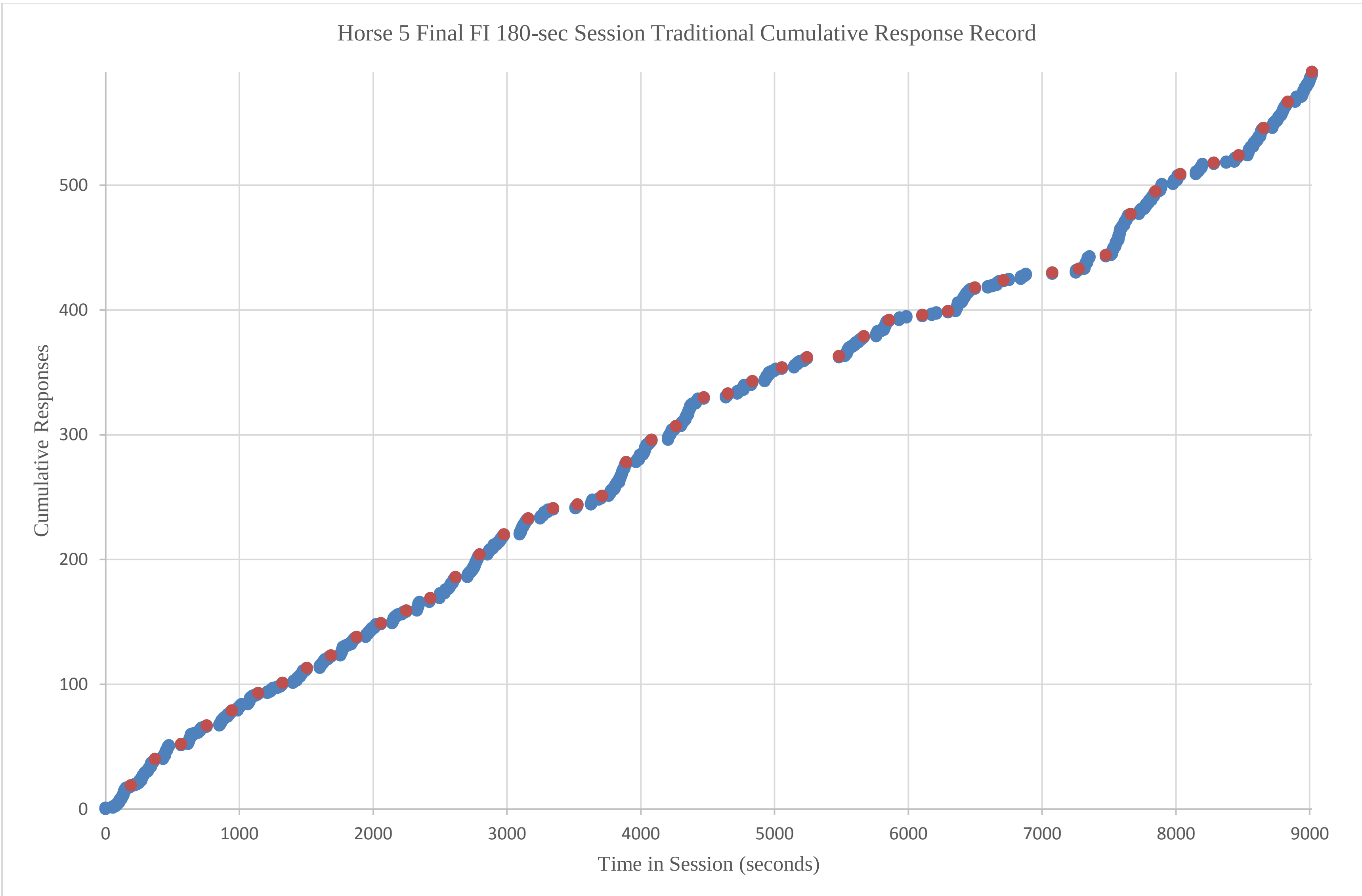
Horse 4 Final FI 90-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
20
40
60
80
100
120
140
0
1000
2000
3000
4000
5000
Time in Session (seconds)


Horse 4 Final FI 180-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
5
10
15
20
25
0
200
400
600
800
1000
Time in Session (seconds)

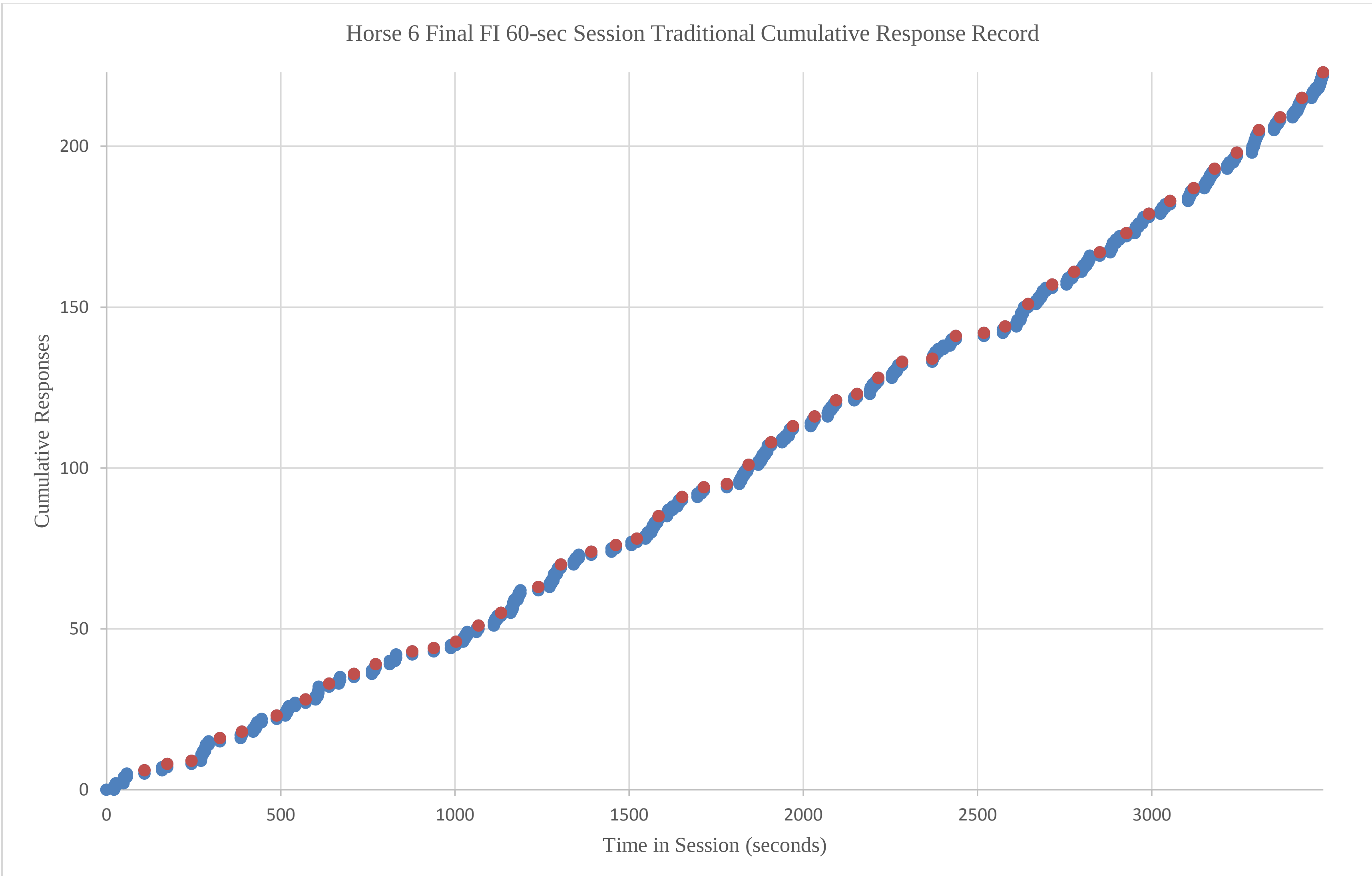

Horse 5 Final FI 60-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
50
100
150
200
250
0
500
1000
1500
2000
2500
3000
Time in Session (seconds)



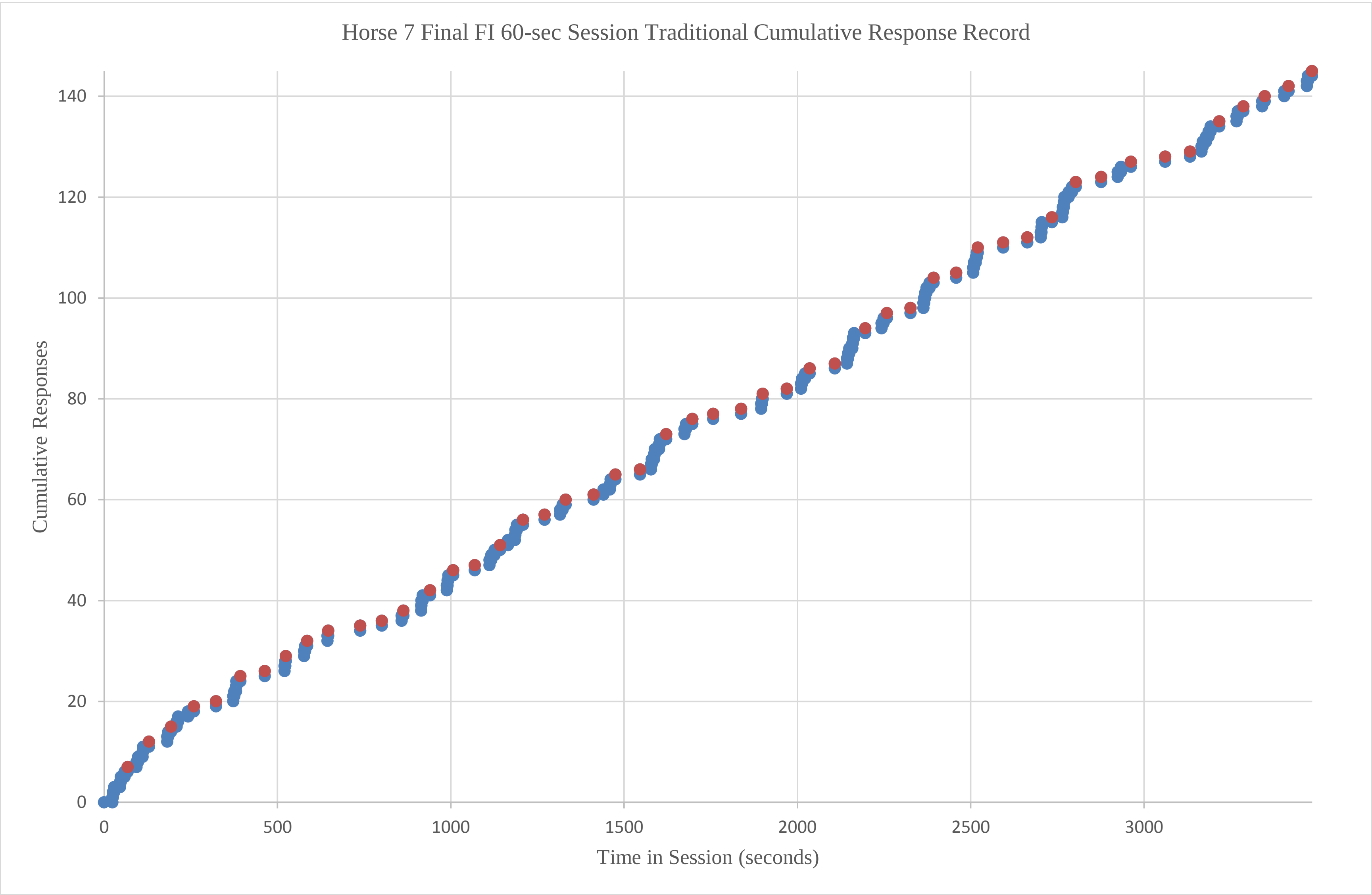
Horse 5 Final FI 90-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
50
100
150
200
250
300
350
400
450
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Time in Session (seconds)

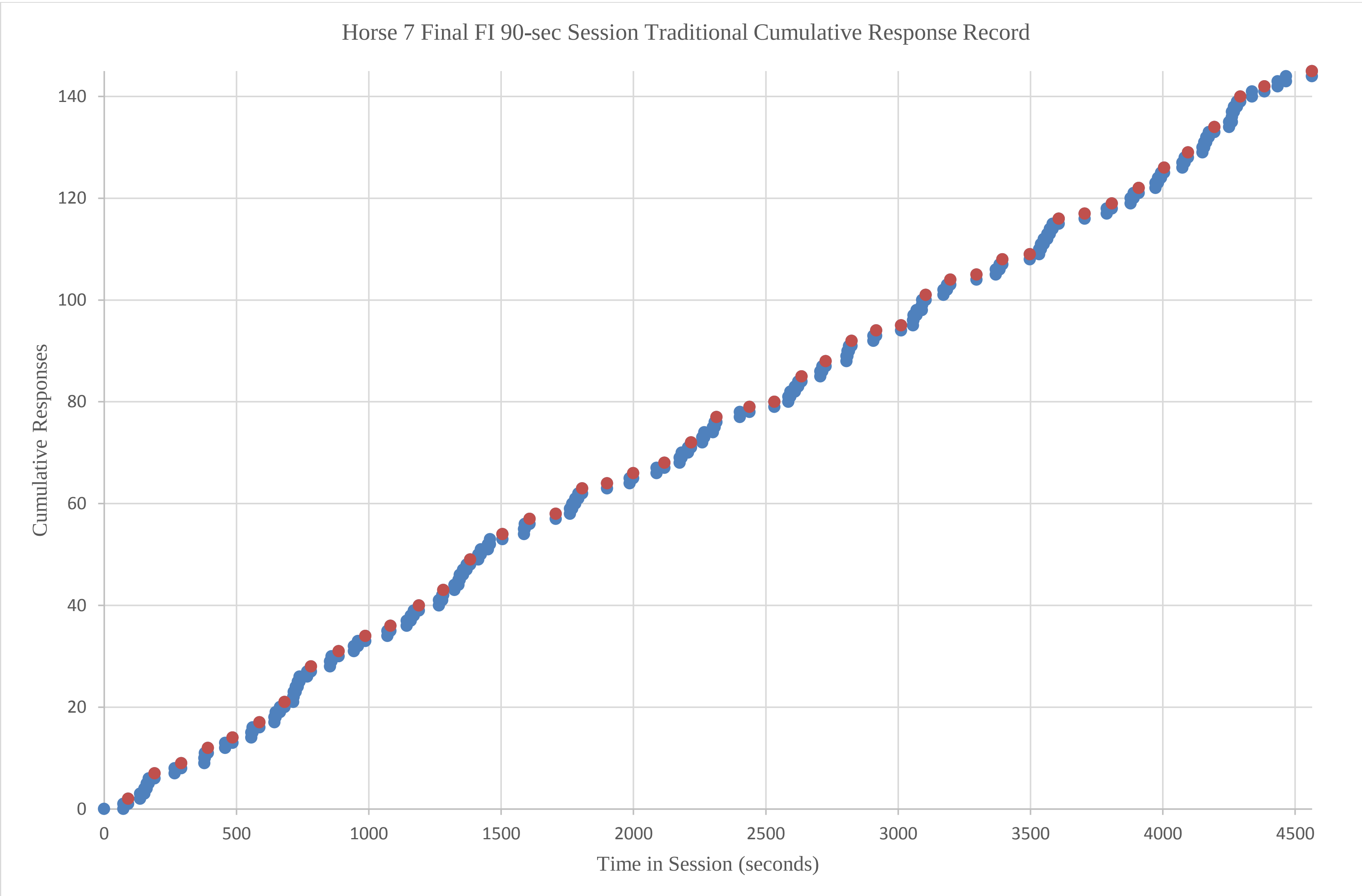


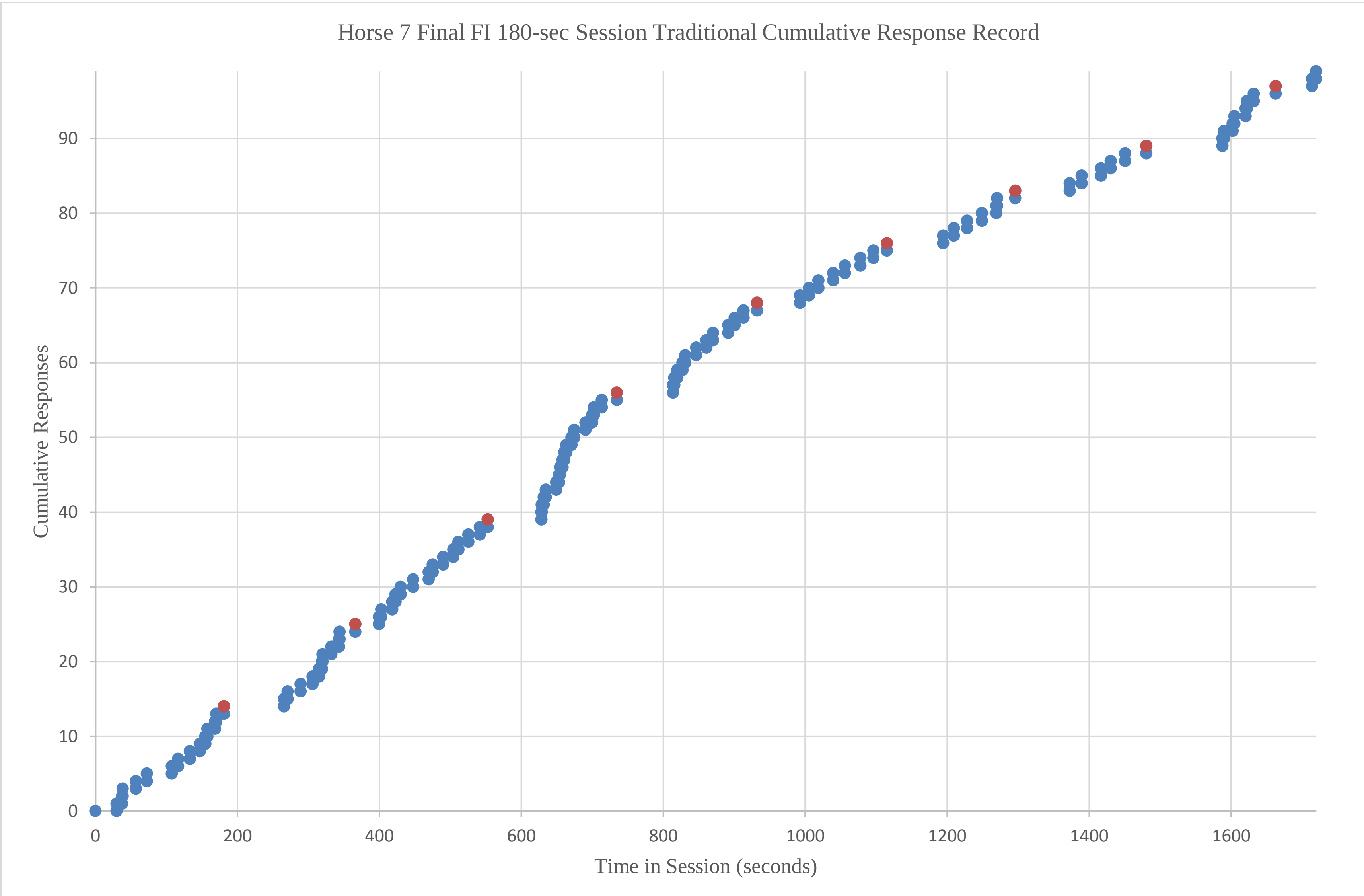
Horse 5 Final FI 180-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
100
200
300
400
500
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Time in Session (seconds)

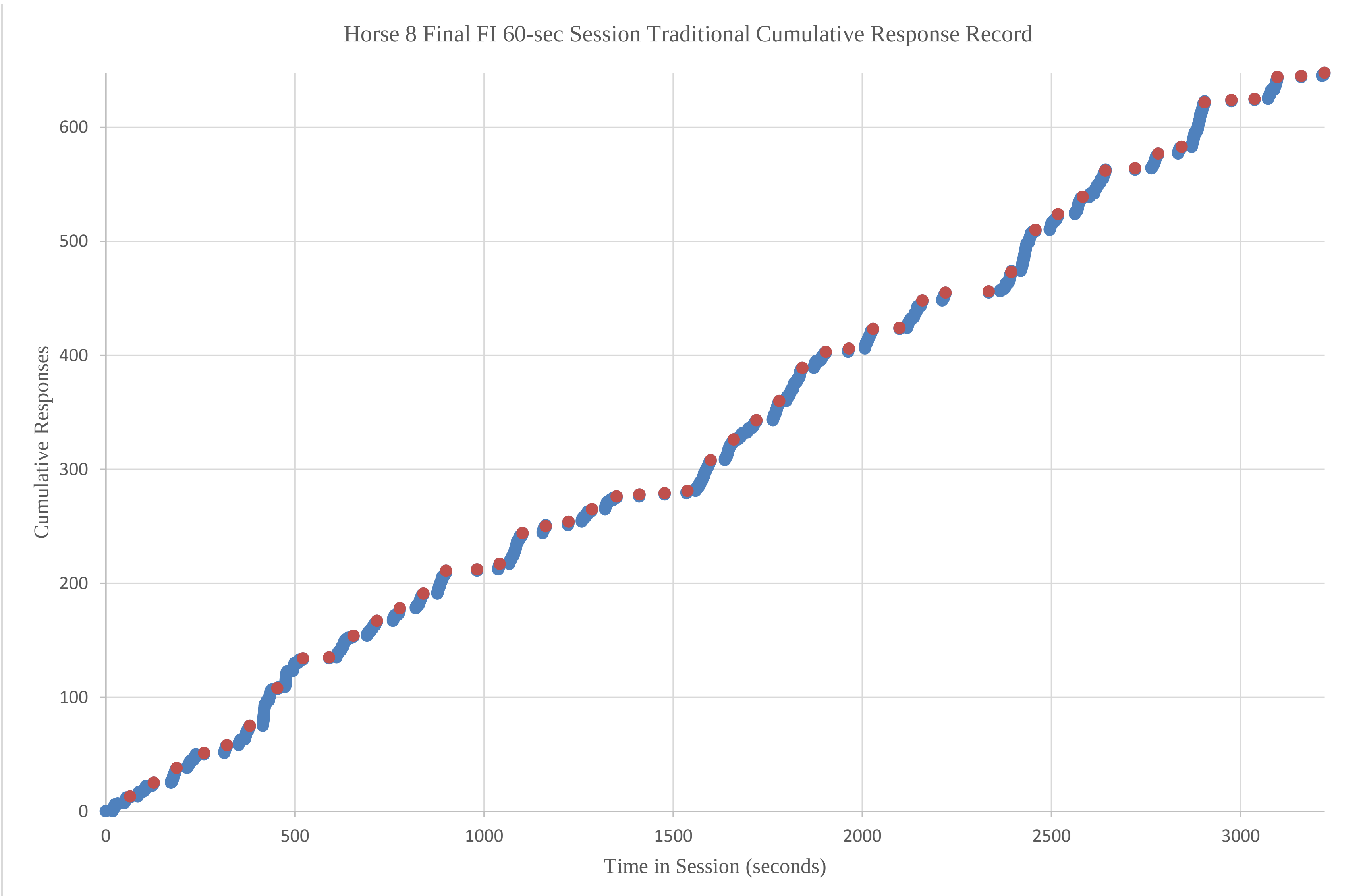


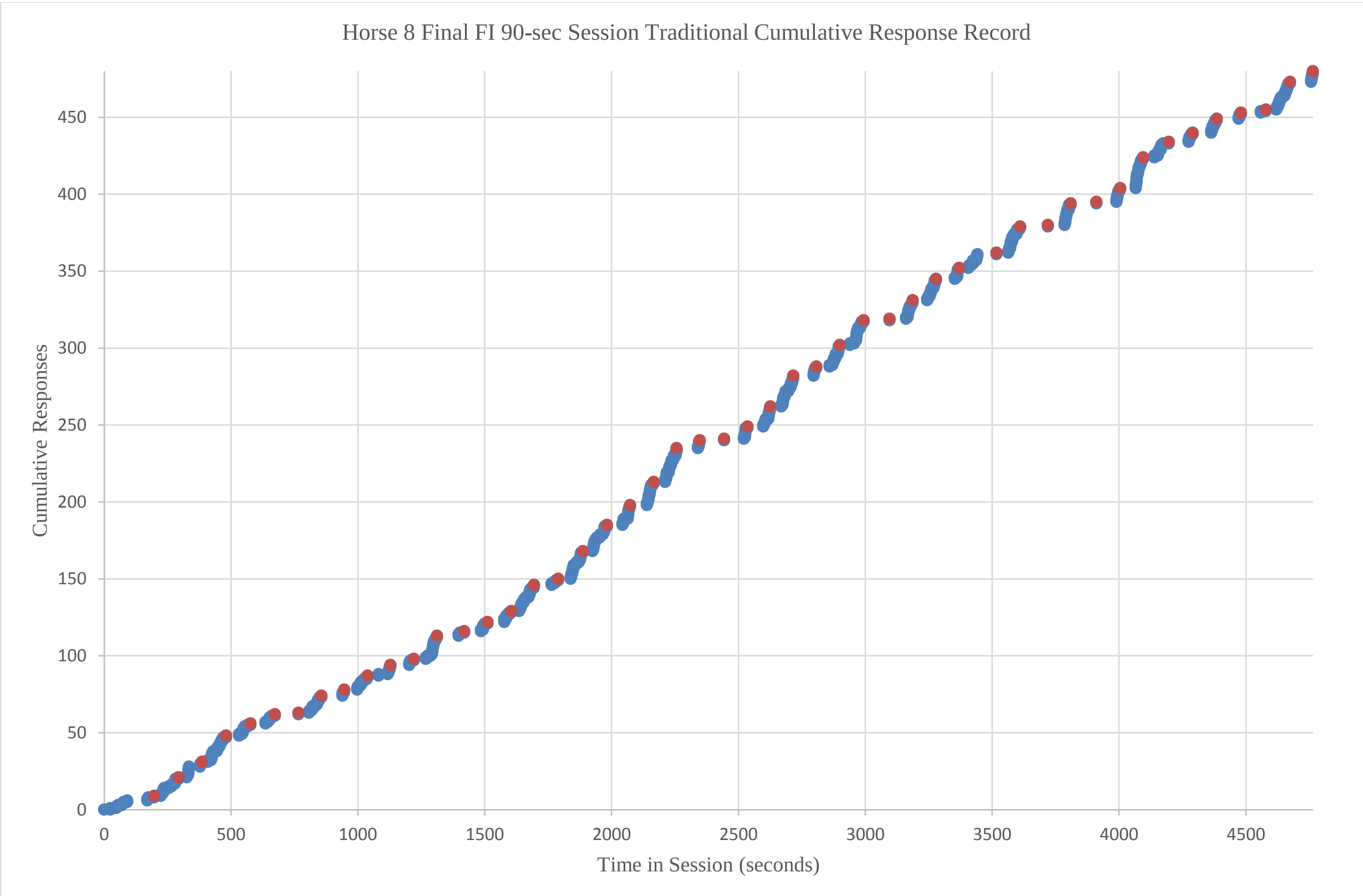
Horse 6 Final FI 60-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
50
100
150
200
0
500
1000
1500
2000
2500
3000
Time in Session (seconds)

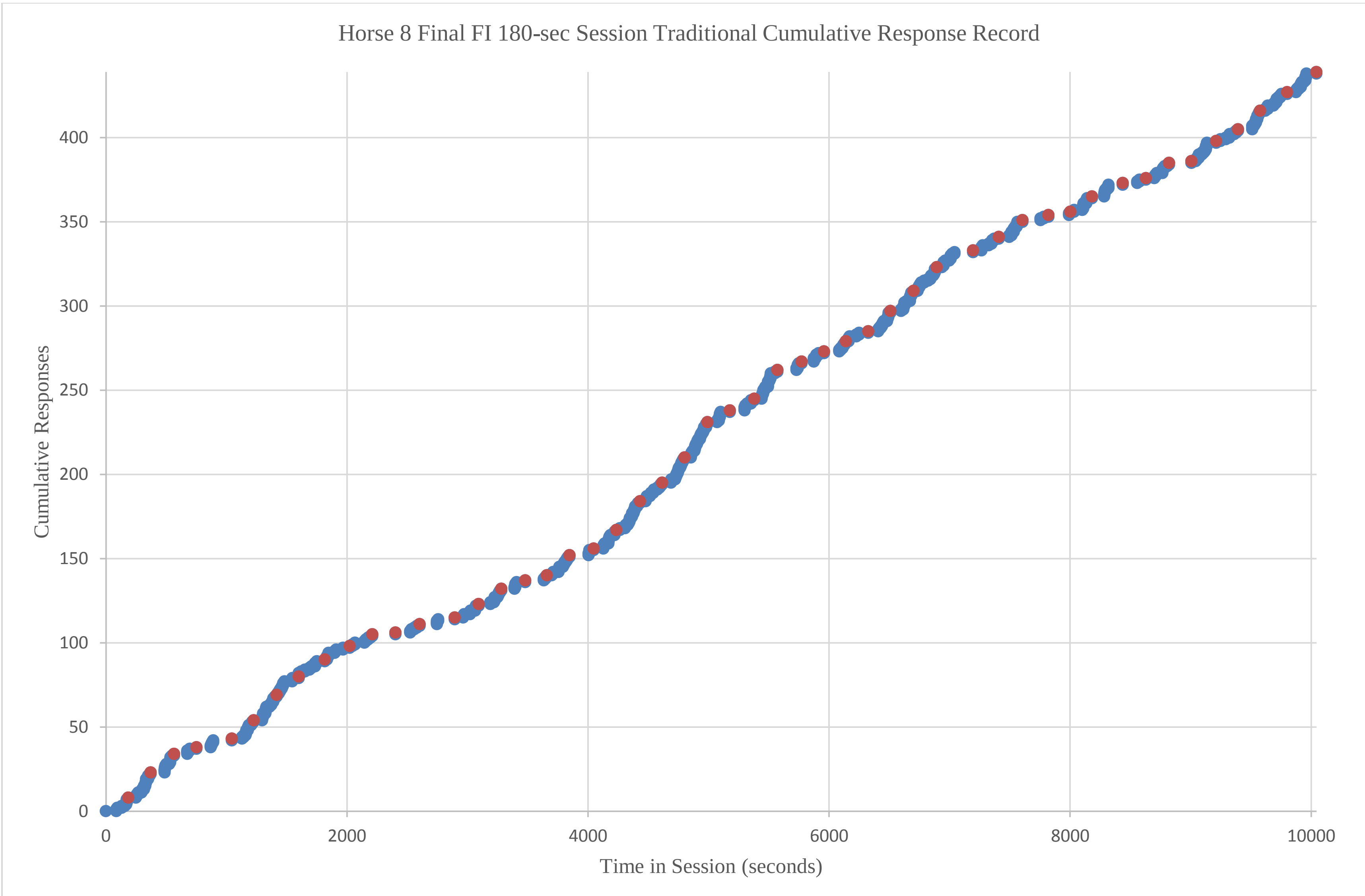

Horse 7 Final FI 60-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
20
40
60
80
100
120
140
0
500
1000
1500
2000
2500
3000
Time in Session (seconds)

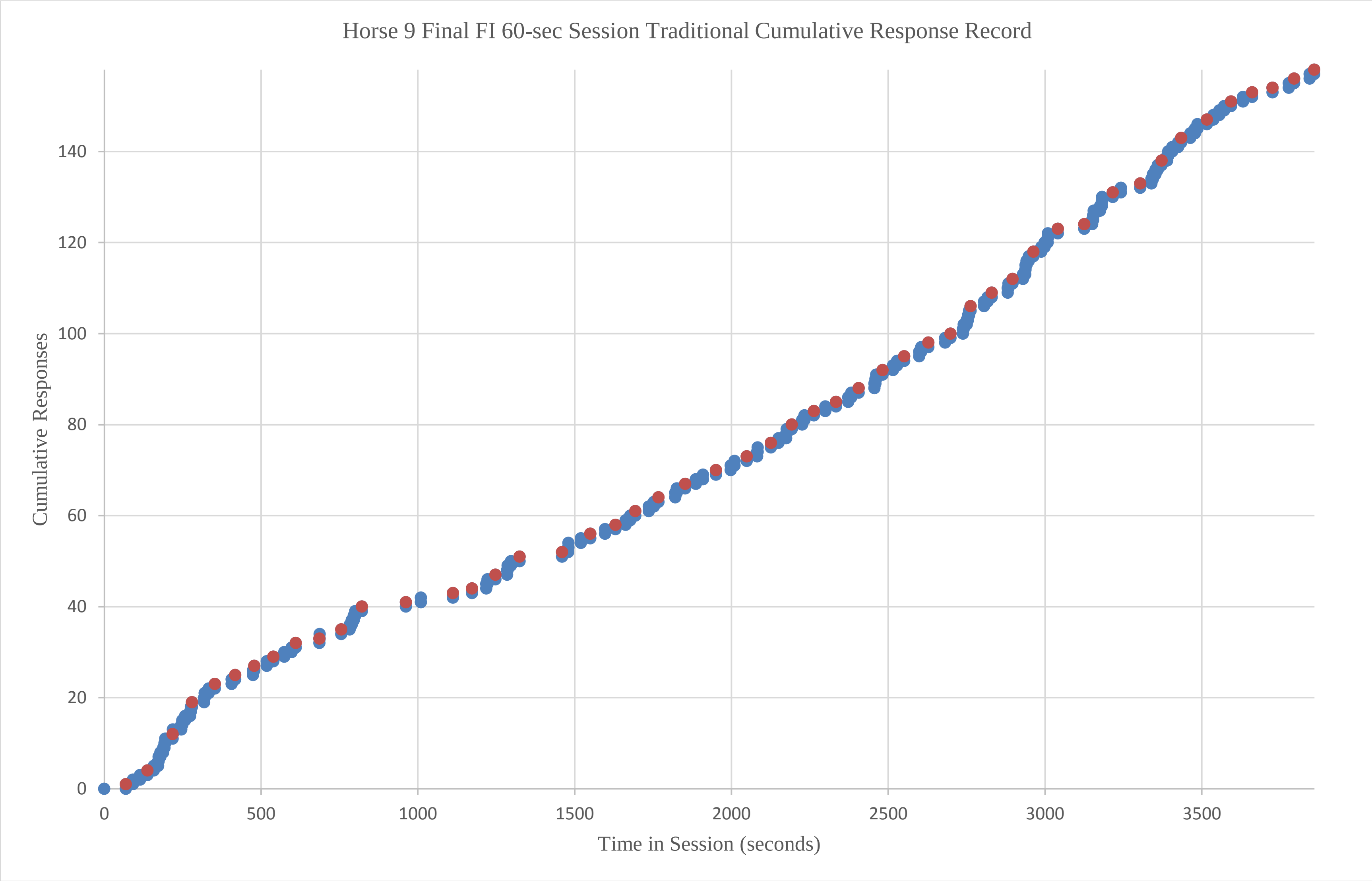

Horse 7 Final FI 90-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
20
40
60
80
100
120
140
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Time in Session (seconds)

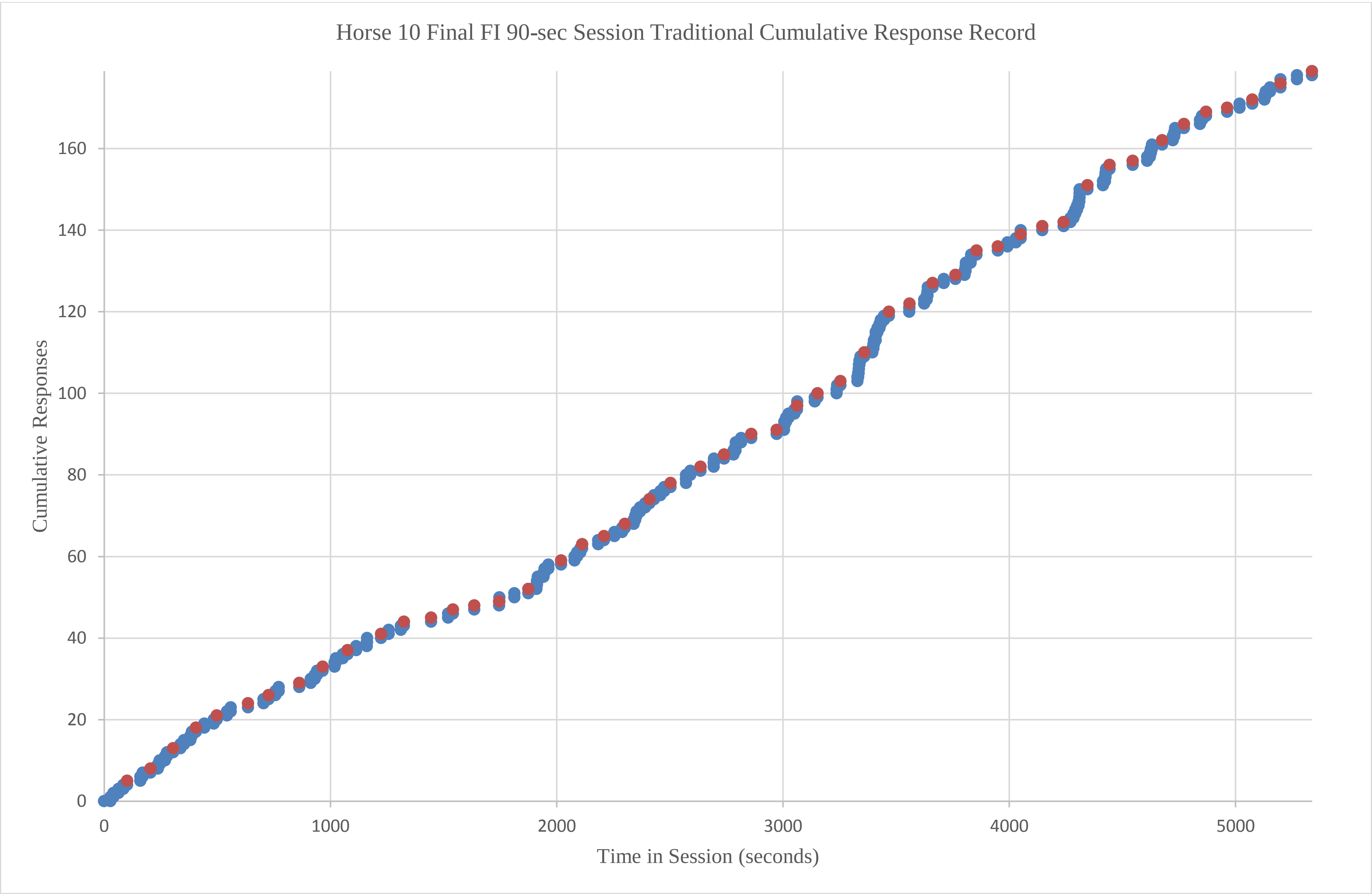

Horse 7 Final FI 180-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
10
20
30
40
50
60
70
80
90
0
200
400
600
800
1000
1200
1400
1600
Time in Session (seconds)

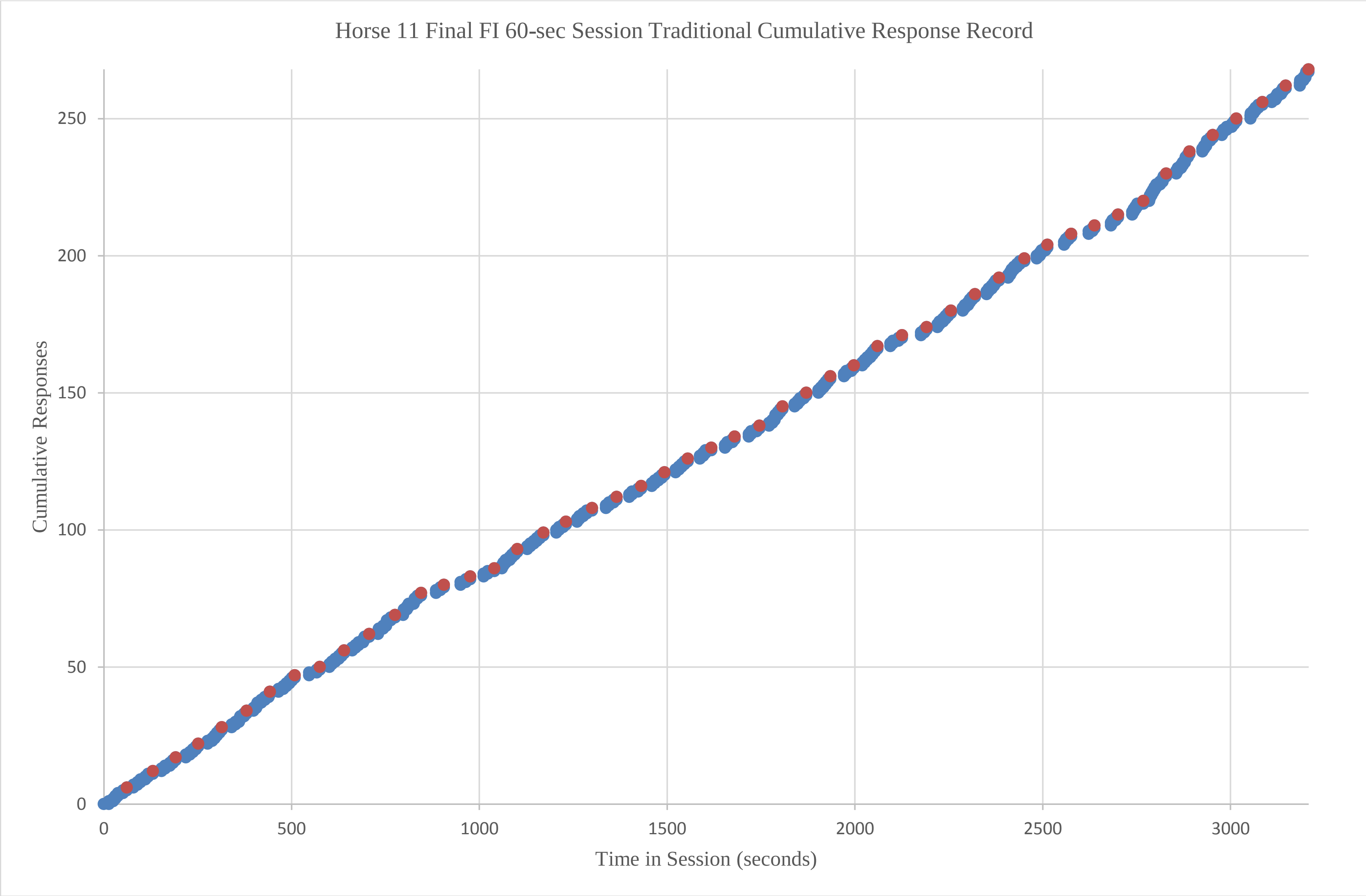

Horse 8 Final FI 60-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
100
200
300
400
500
600
0
500
1000
1500
2000
2500
3000
Time in Session (seconds)

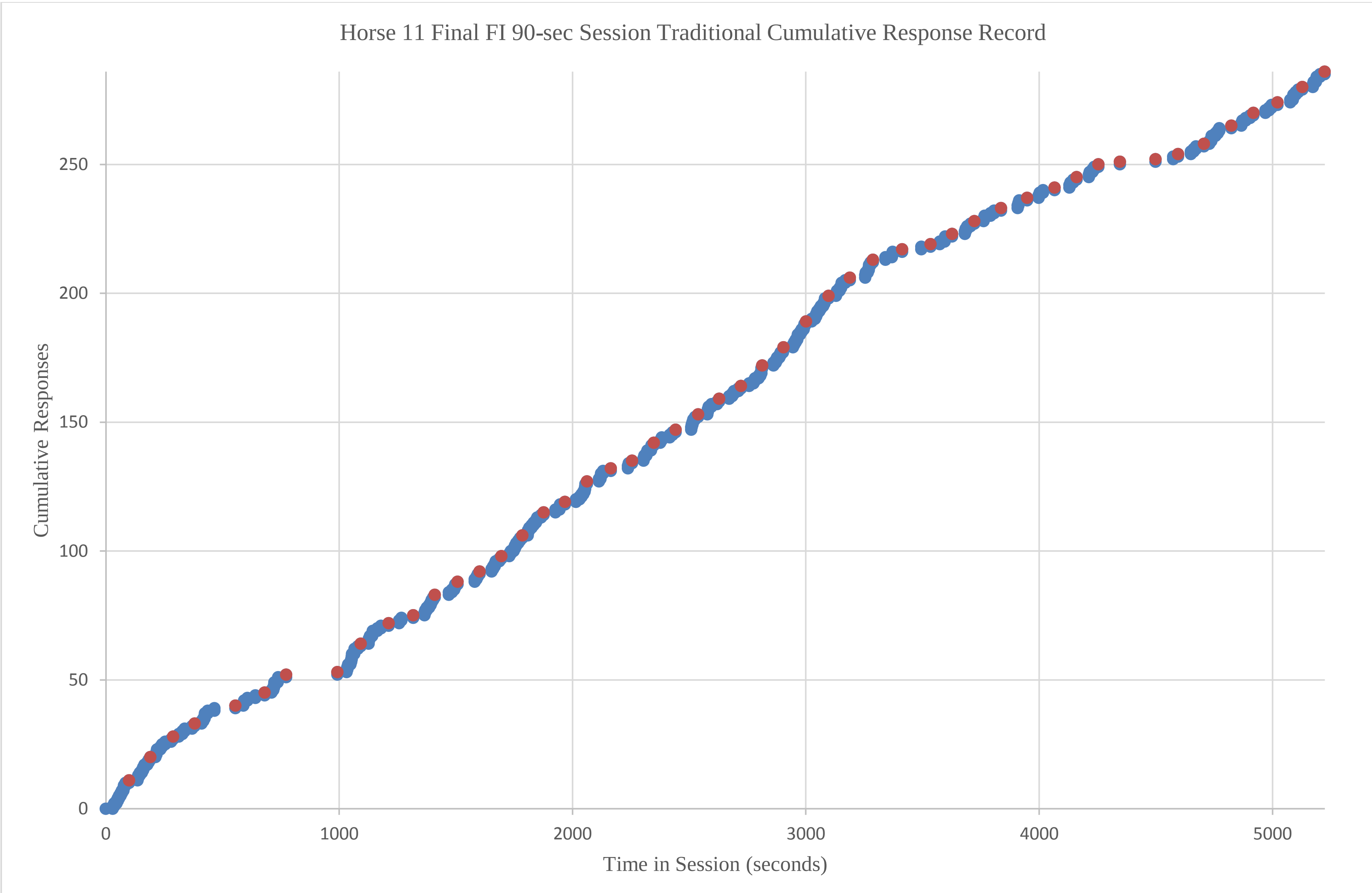

Horse 8 Final FI 90-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
50
100
150
200
250
300
350
400
450
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Time in Session (seconds)


Horse 8 Final FI 180-sec Session Traditional Cumulative Response Record
Cumulative Responses
Time in Session (seconds)
0
50
100
150
200
250
300
350
400
0
2000
4000
6000
8000
10000

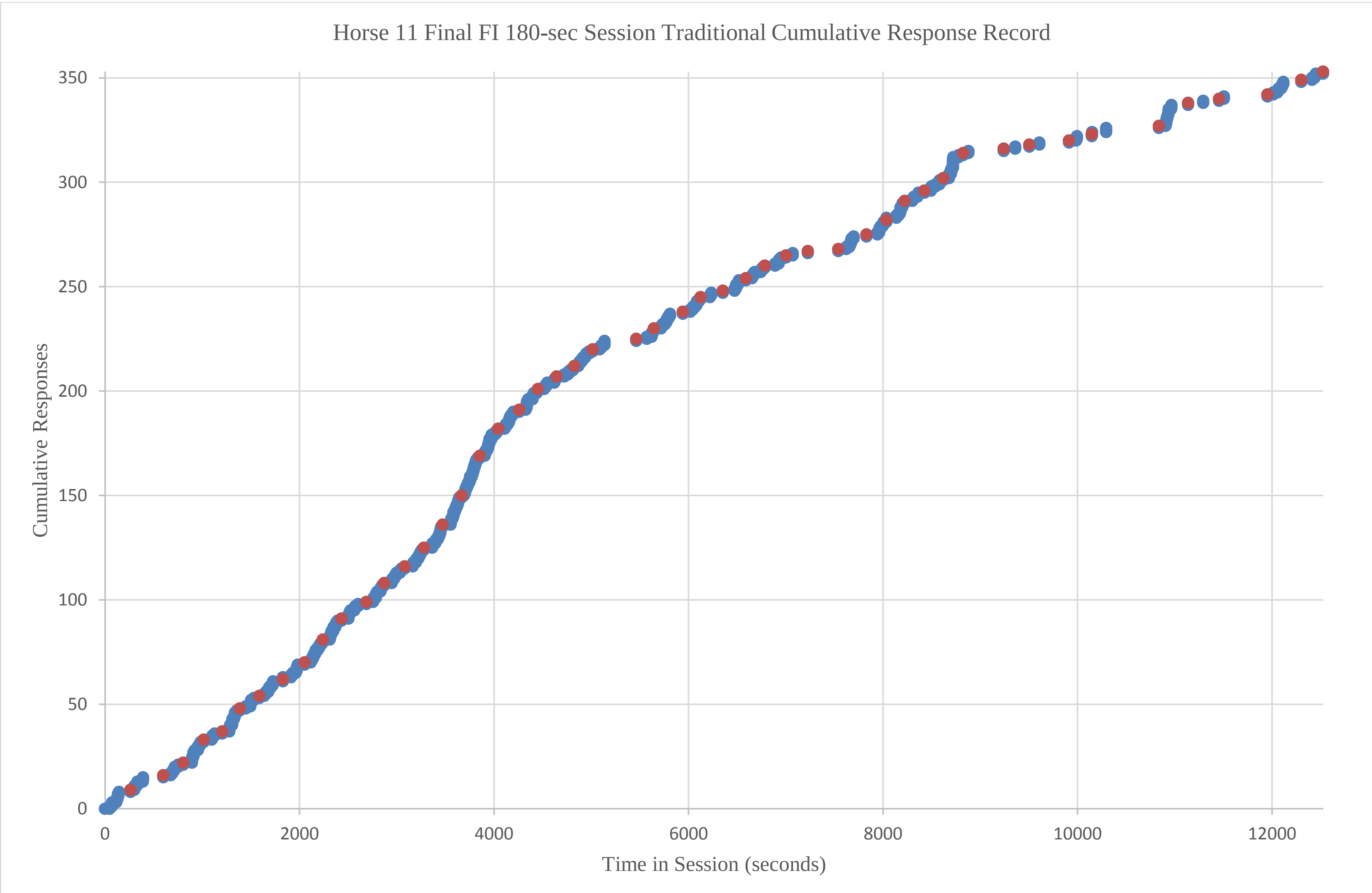

Horse 9 Final FI 60-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
20
40
60
80
100
120
140
0
500
1000
1500
2000
2500
3000
3500
Time in Session (seconds)

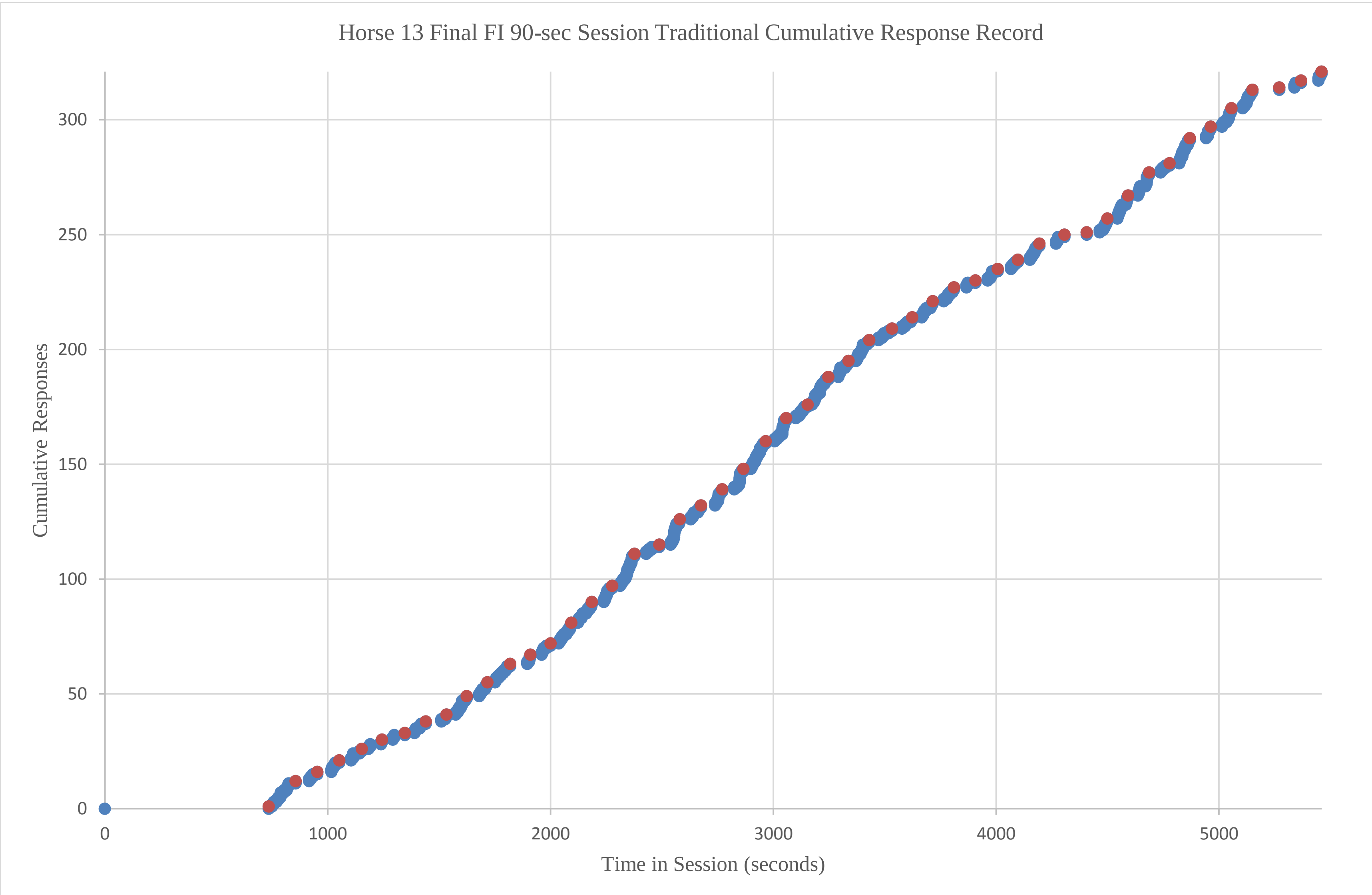

Horse 10 Final FI 90-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
20
40
60
80
100
120
140
160
0
1000
2000
3000
4000
5000
Time in Session (seconds)

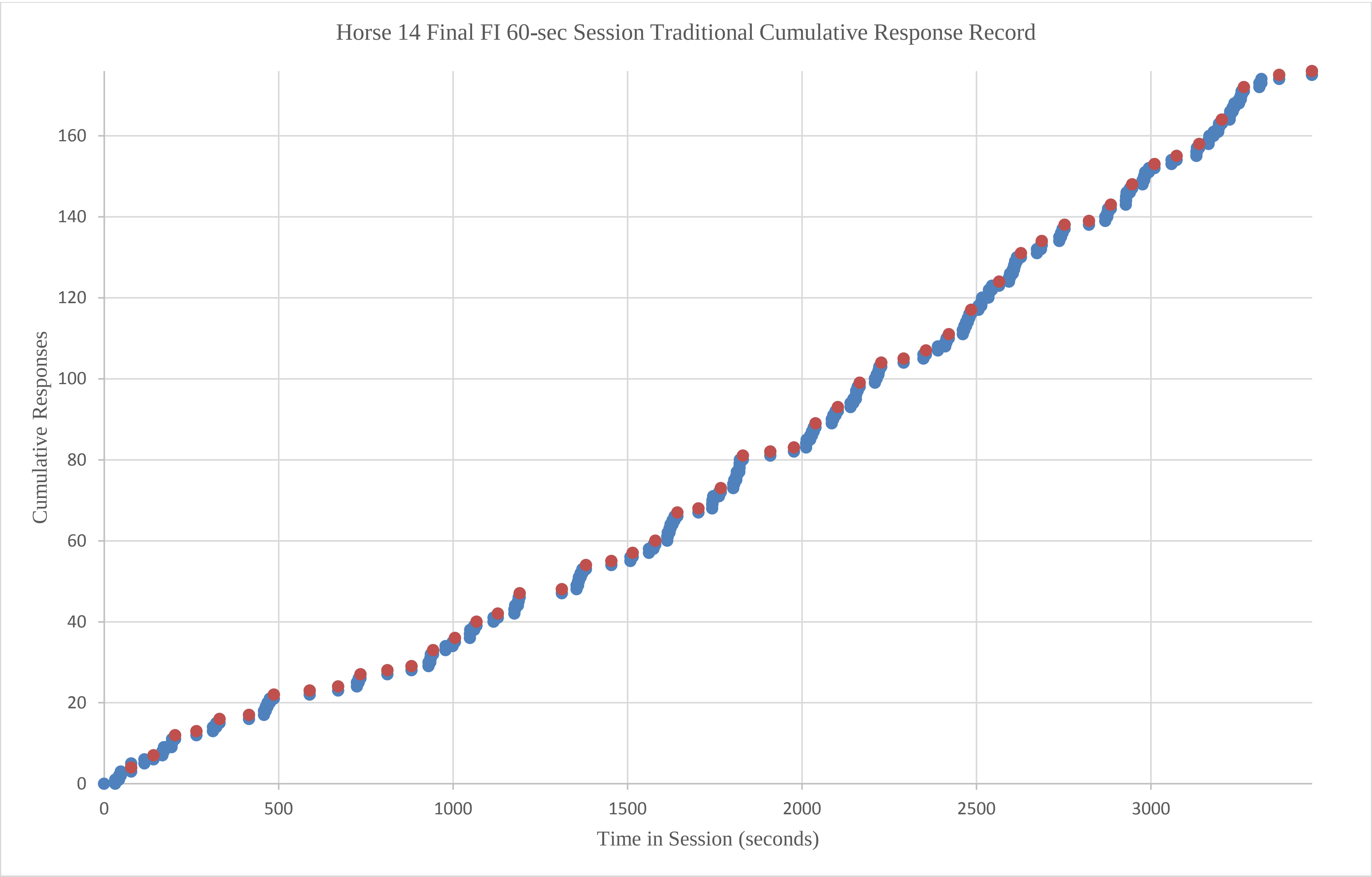

Horse 11 Final FI 60-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
50
100
150
200
250
0
500
1000
1500
2000
2500
3000
Time in Session (seconds)



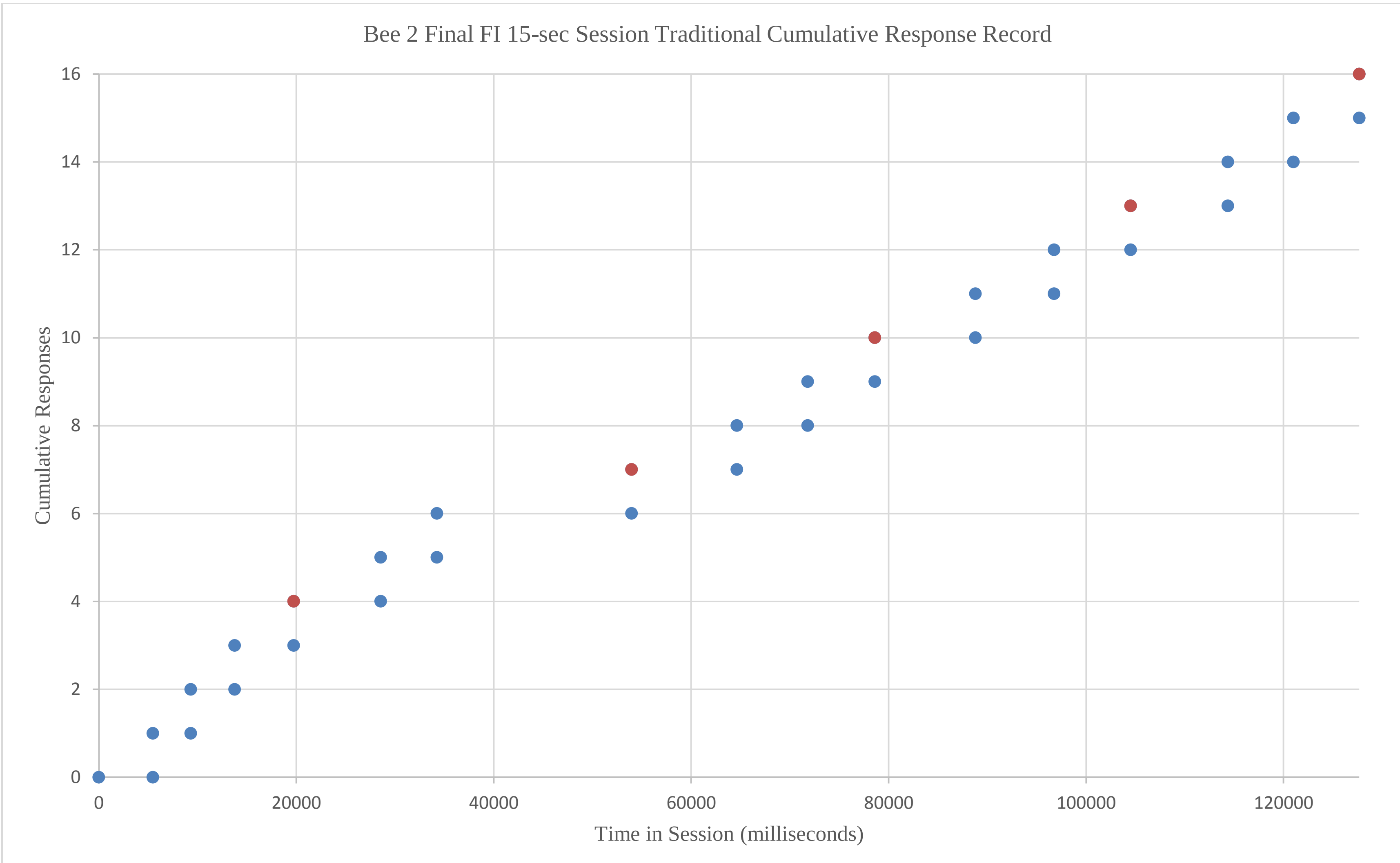
Horse 11 Final FI 90-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
50
100
150
200
250
0
1000
2000
3000
4000
5000
Time in Session (seconds)

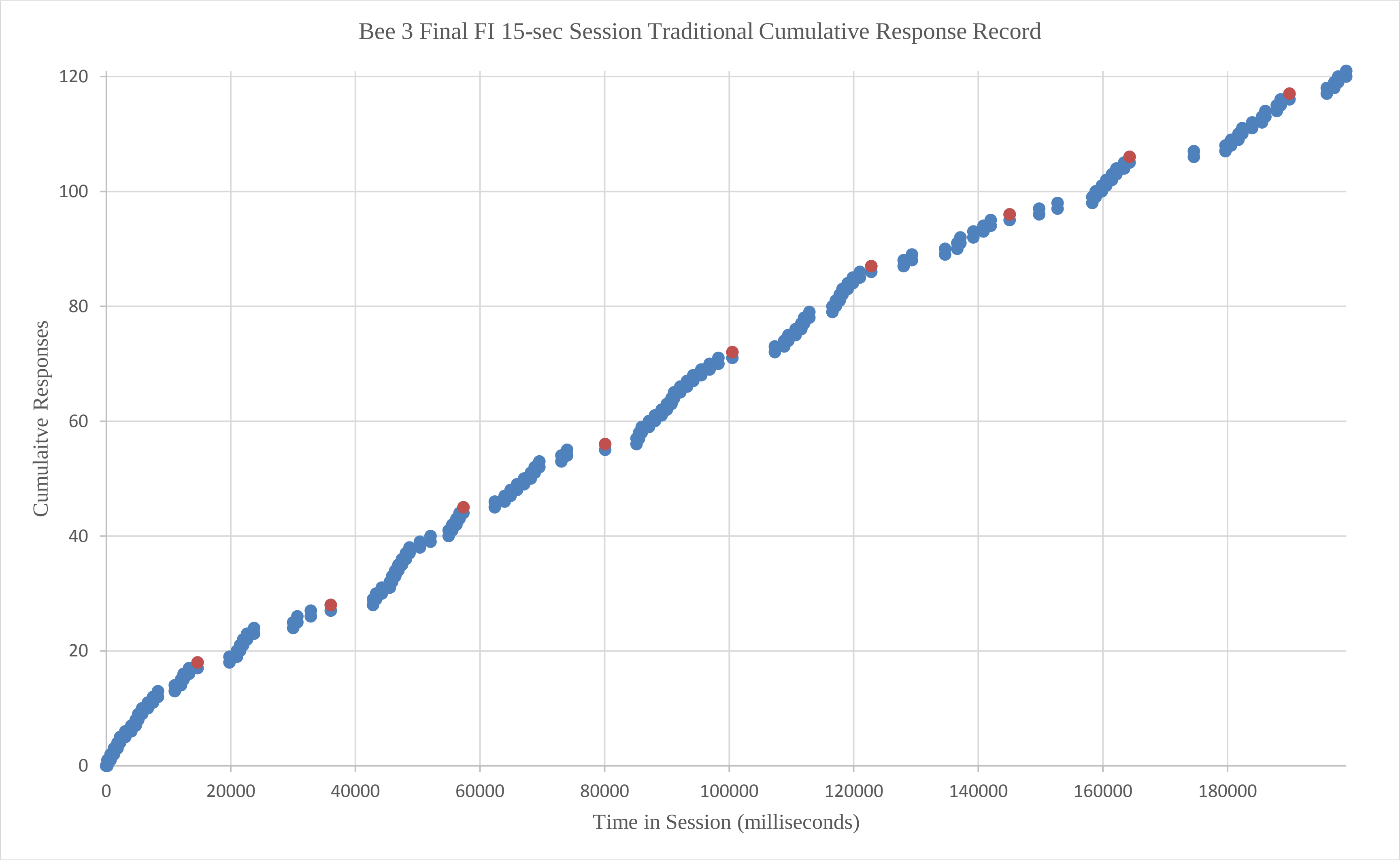

Horse 11 Final FI 180-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
50
100
150
200
250
300
350
0
2000
4000
6000
8000
10000
12000
Time in Session (seconds)

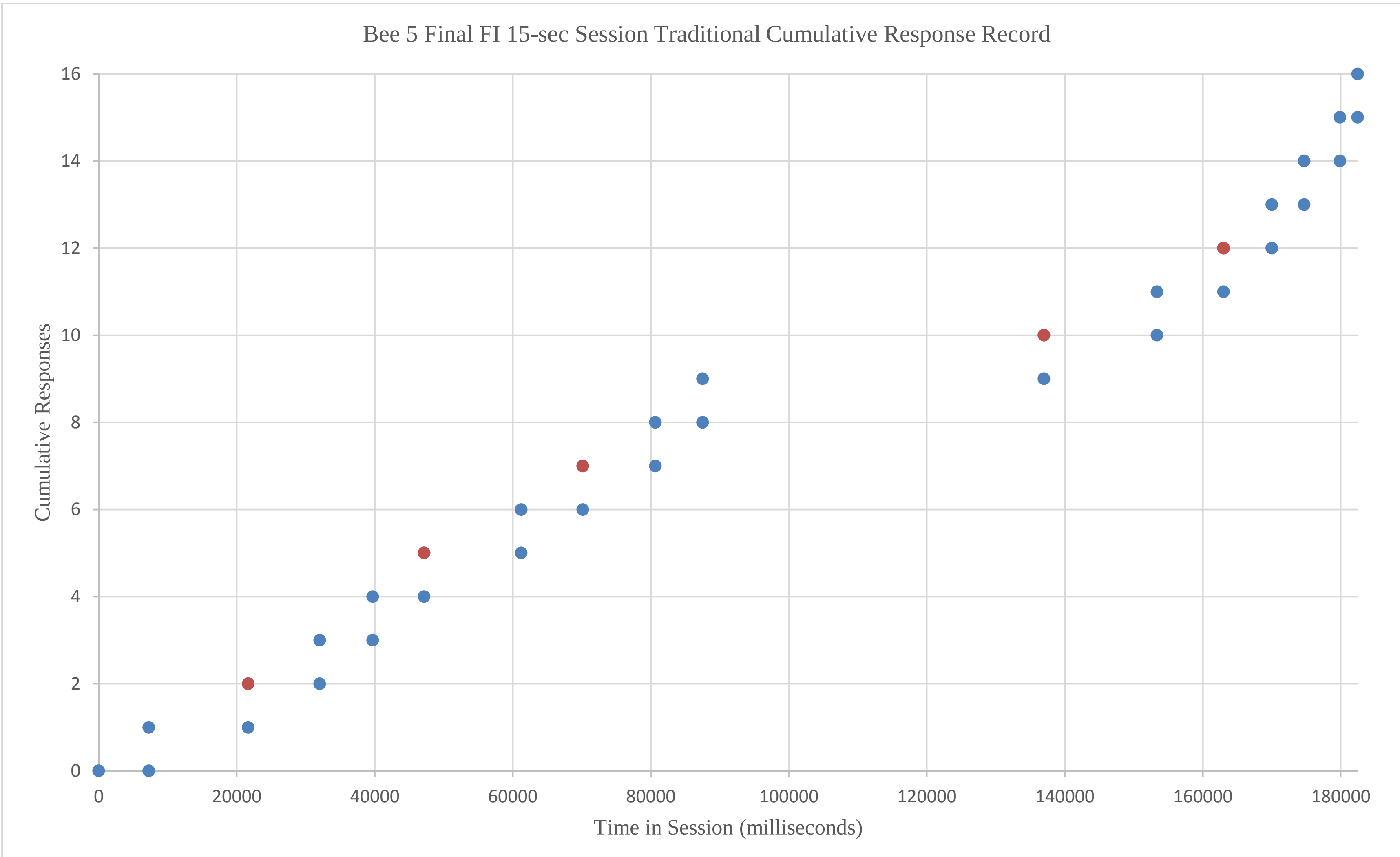

Horse 13 Final FI 90-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
50
100
150
200
250
300
0
1000
2000
3000
4000
5000
Time in Session (seconds)

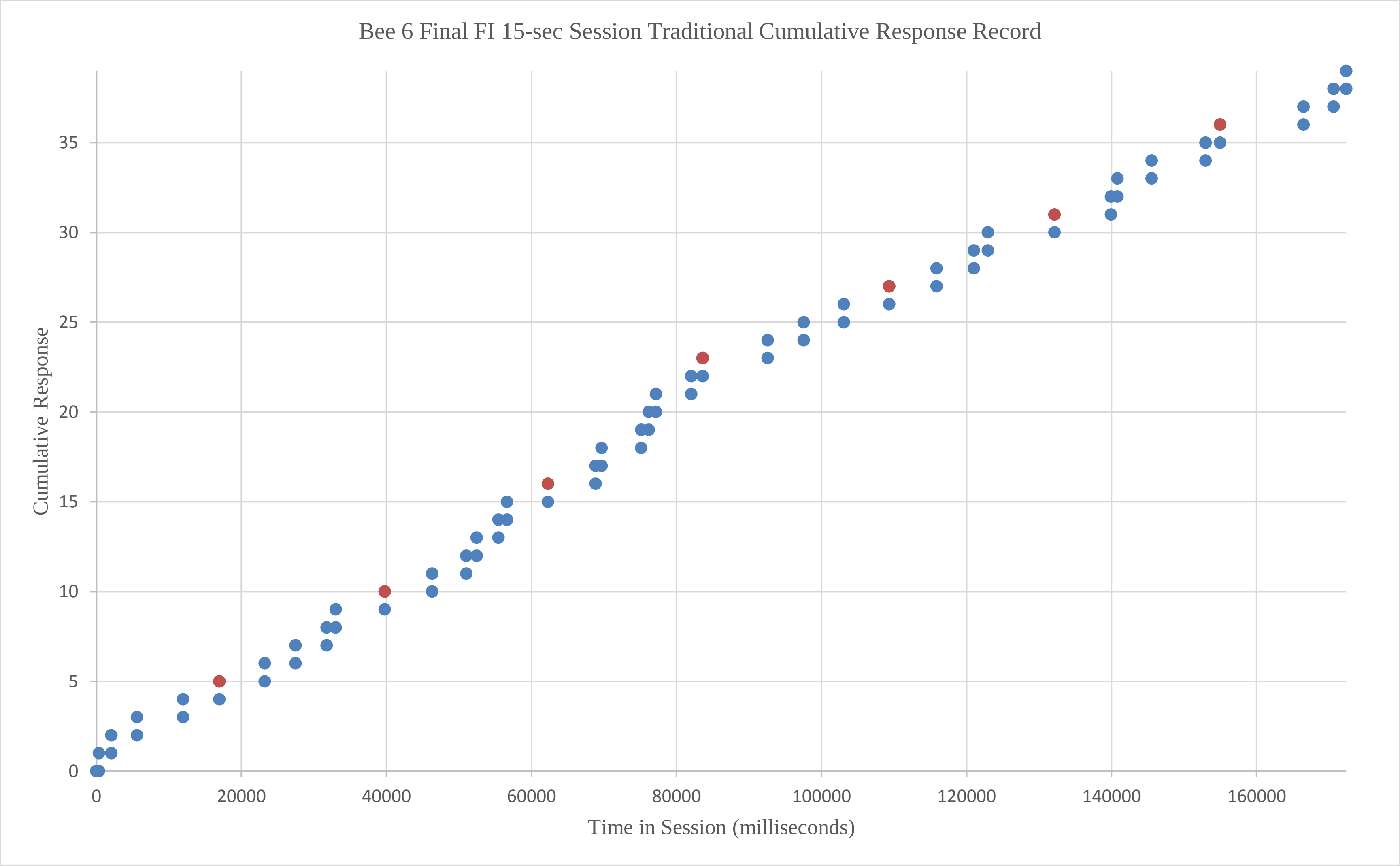


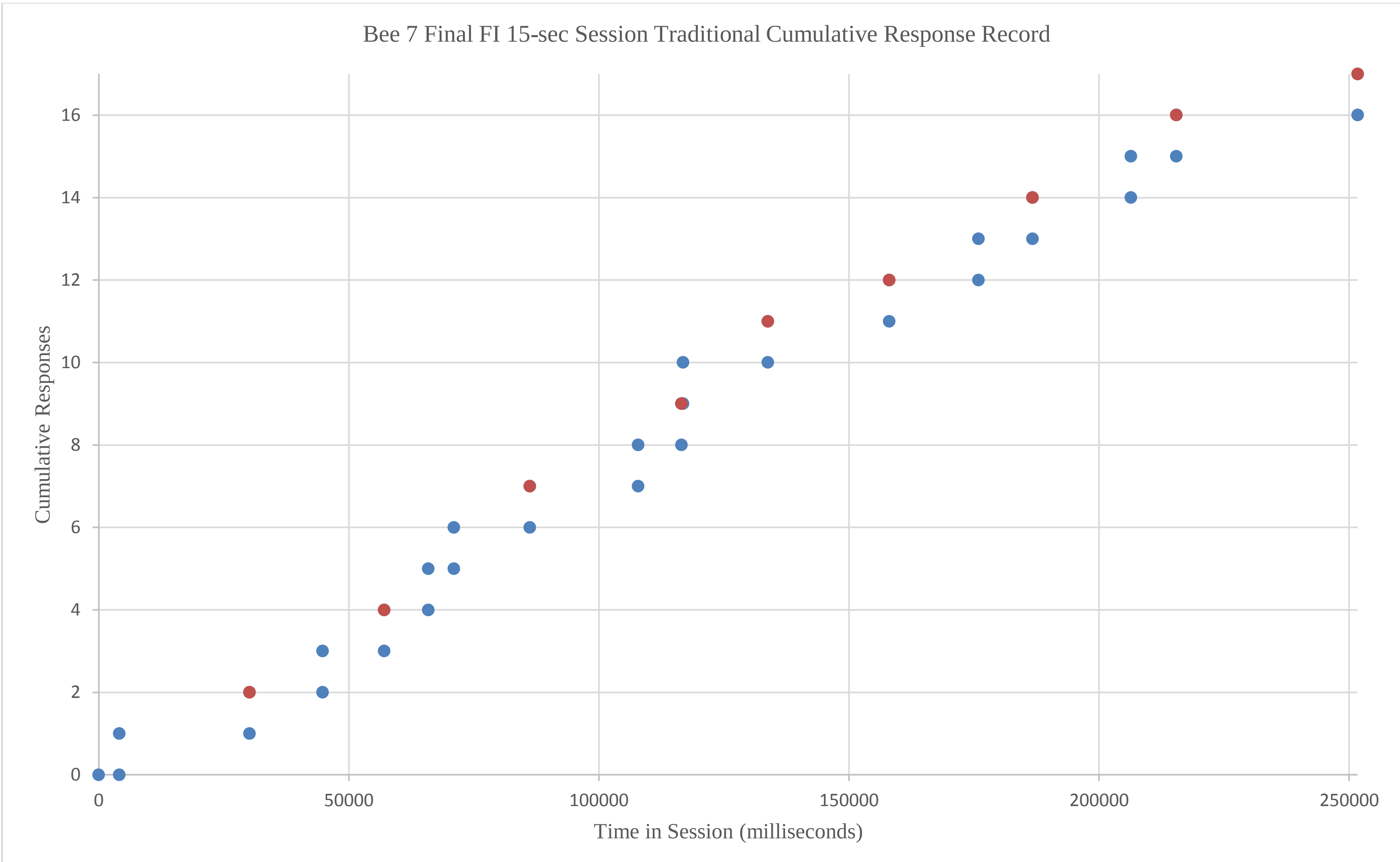
Horse 14 Final FI 60-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
20
40
60
80
100
120
140
160
0
500
1000
1500
2000
2500
3000
Time in Session (seconds)

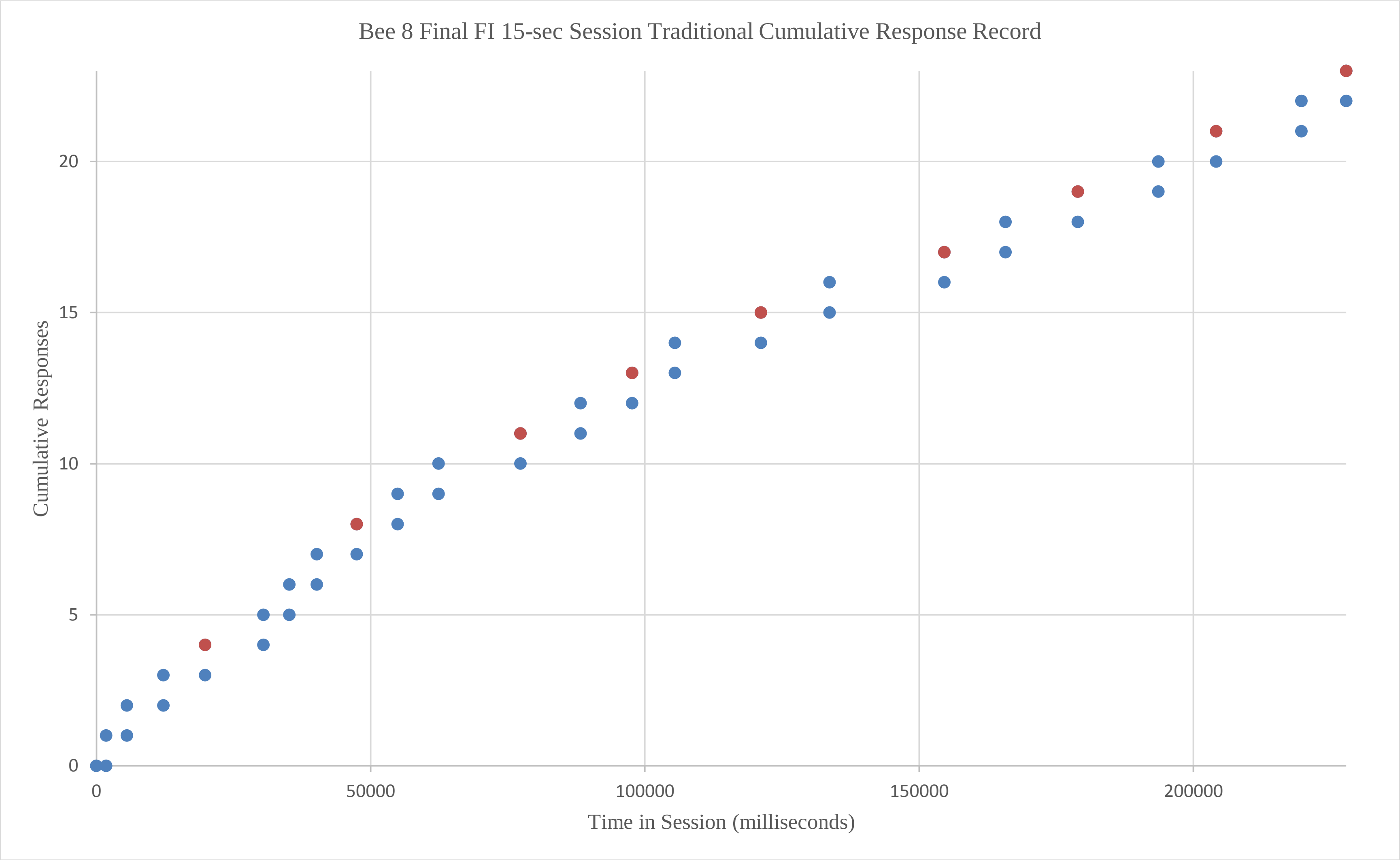

Bee 2 Final FI 15-sec Session Traditional Cumulative Response Record
Cumulative Responses
16
14
12
10
8
6
4
2
0
0
20000
40000
60000
80000
100000
120000
Time in Session (milliseconds)

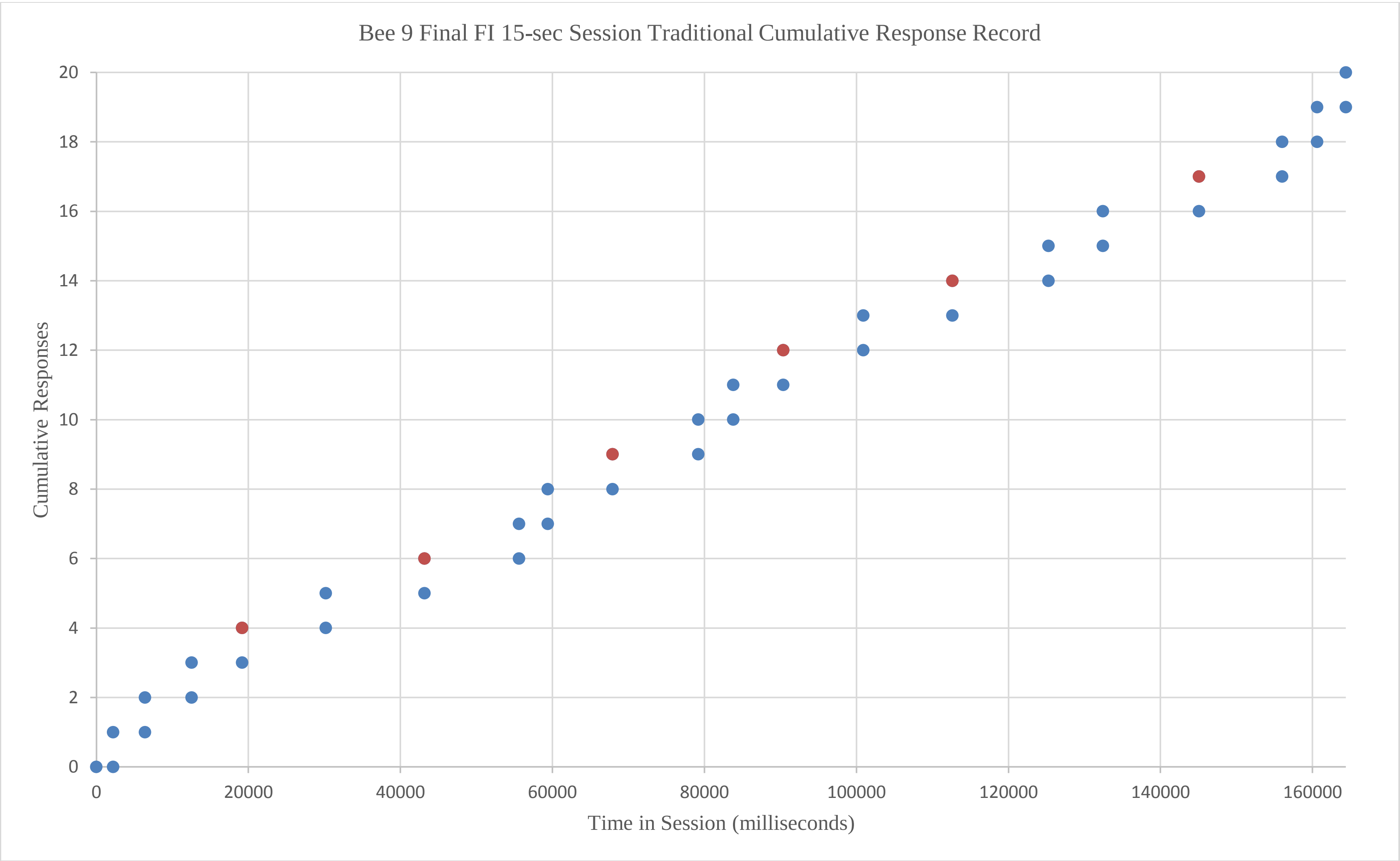

Bee 3 Final FI 15-sec Session Traditional Cumulative Response Record
Cumulaitve Responses
120
100
80
60
40
20
0
0
20000
40000
60000
80000
100000
120000
140000
160000
180000
Time in Session (milliseconds)

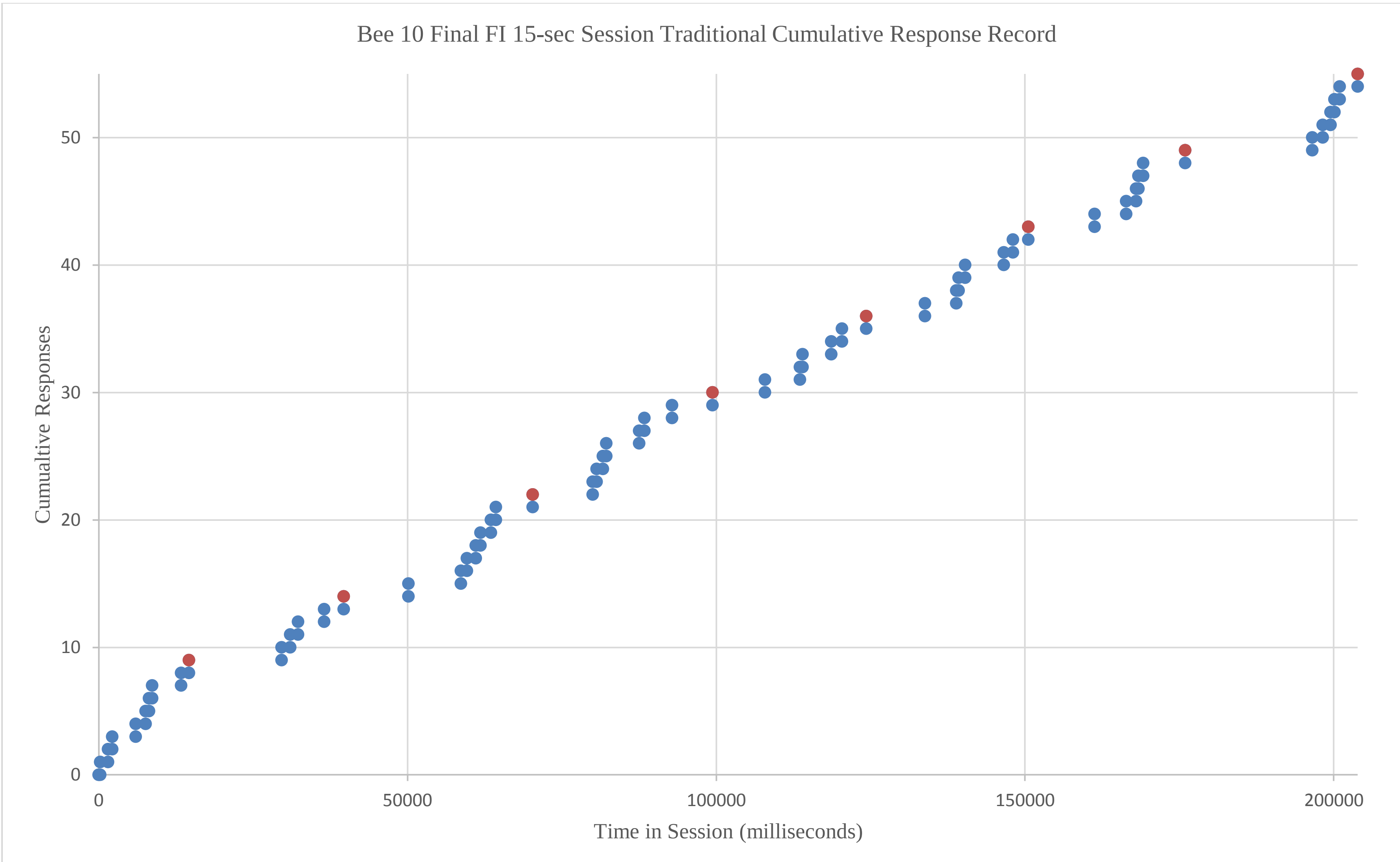

Bee 5 Final FI 15-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
2
4
6
8
10
12
14
16
0
20000
40000
60000
80000
100000
120000
140000
160000
180000
Time in Session (milliseconds)

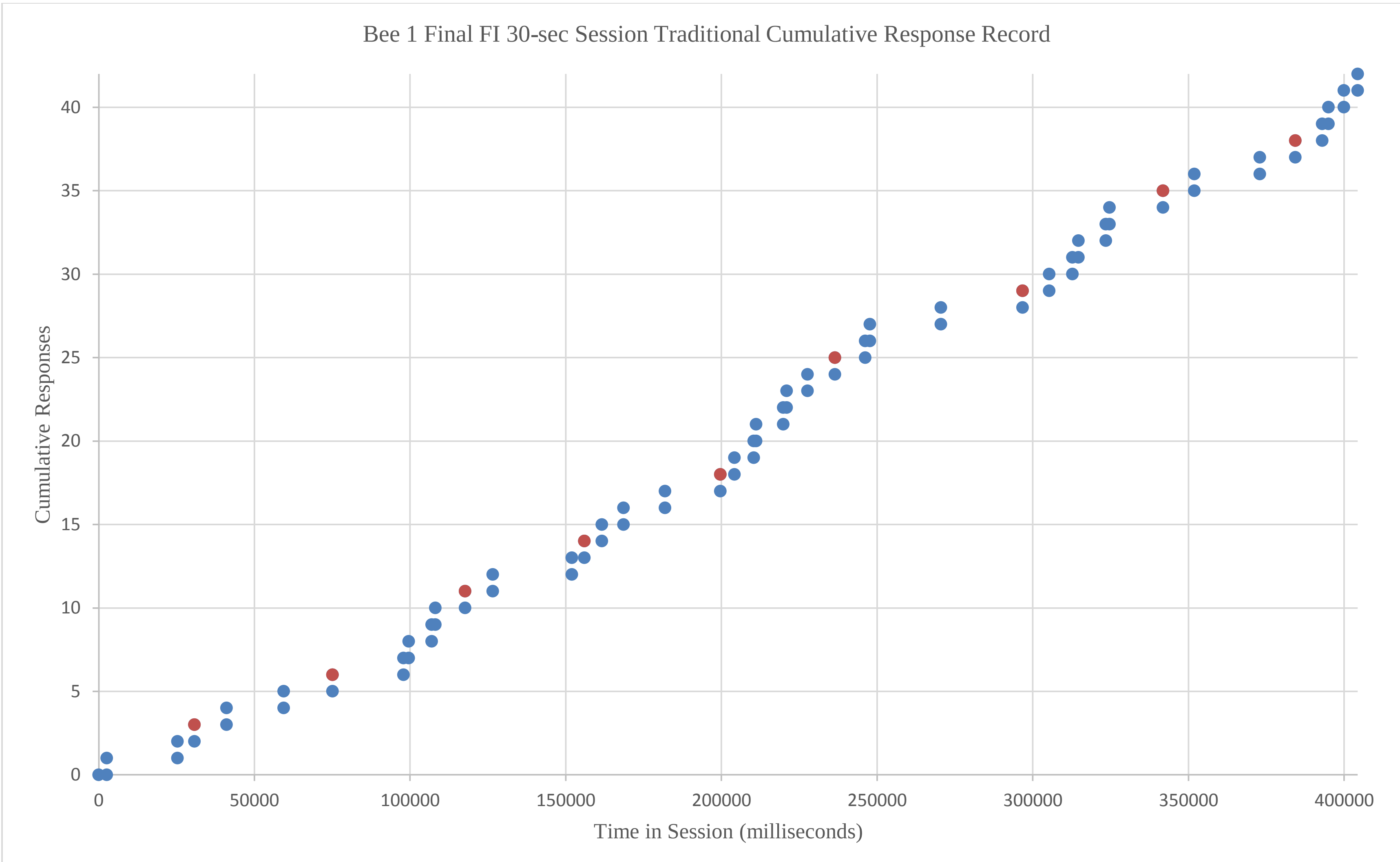

Bee 6 Final FI 15-sec Session Traditional Cumulative Response Record
Cumulative Response
0
5
10
15
20
25
30
35
0
20000
40000
60000
80000
100000
120000
140000
160000
Time in Session (milliseconds)

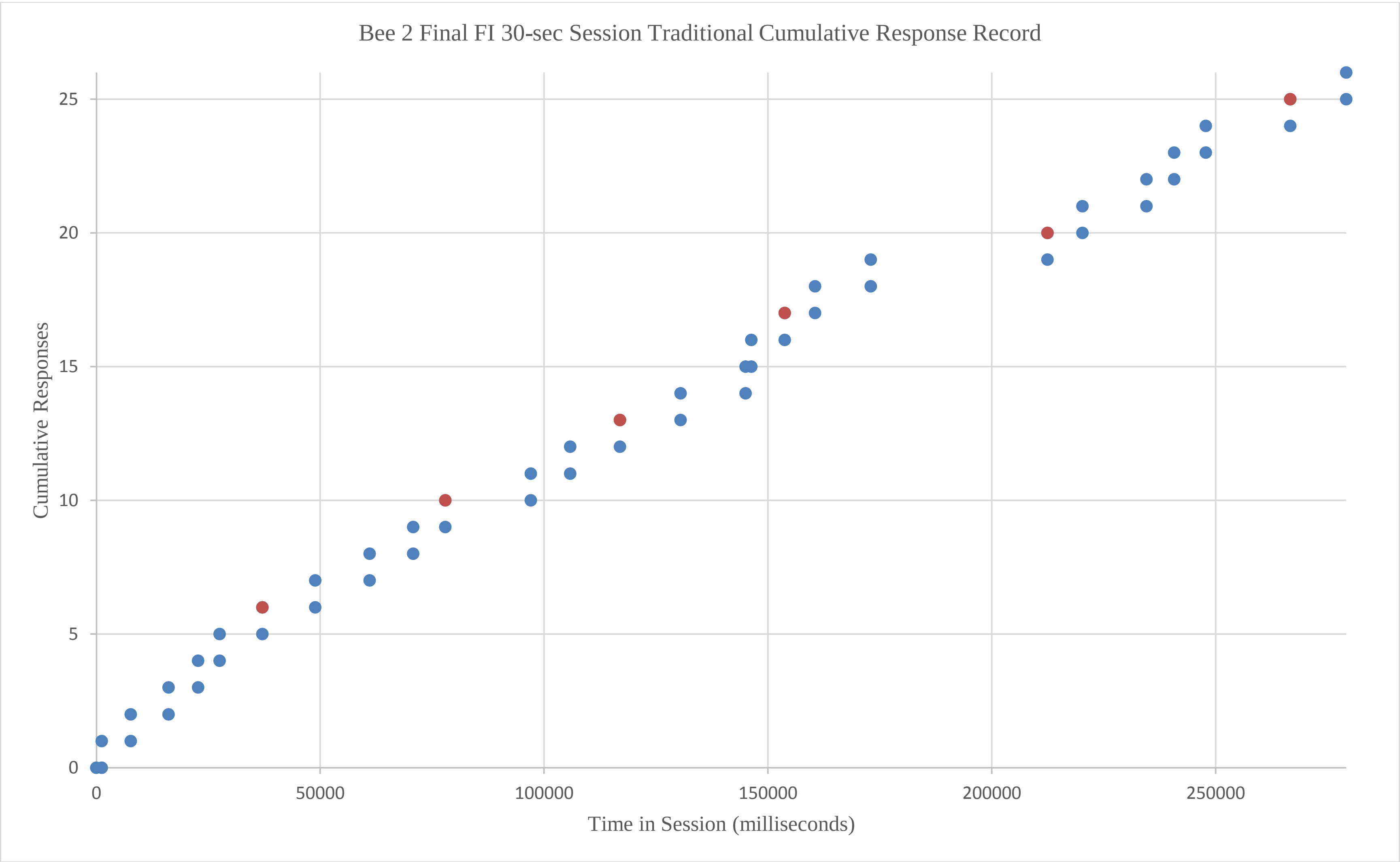

Bee 7 Final FI 15-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
2
4
6
8
10
12
14
16
0
50000
100000
150000
200000
250000
Time in Session (milliseconds)

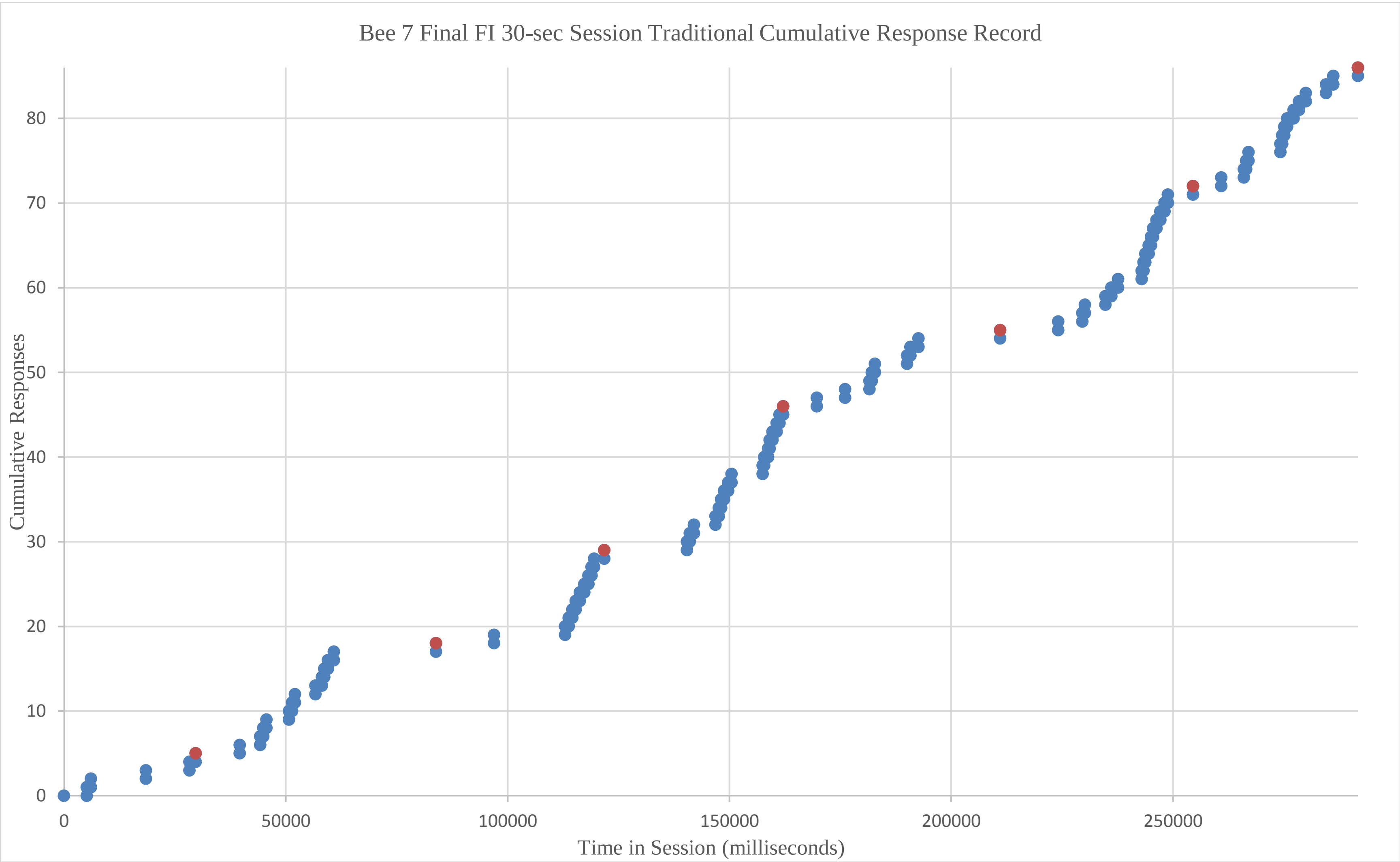

Bee 8 Final FI 15-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
5
10
15
20
0
50000
100000
150000
200000
Time in Session (milliseconds)


Bee 9 Final FI 15-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
2
4
6
8
10
12
14
16
18
20
0
20000
40000
60000
80000
100000
120000
140000
160000
Time in Session (milliseconds)

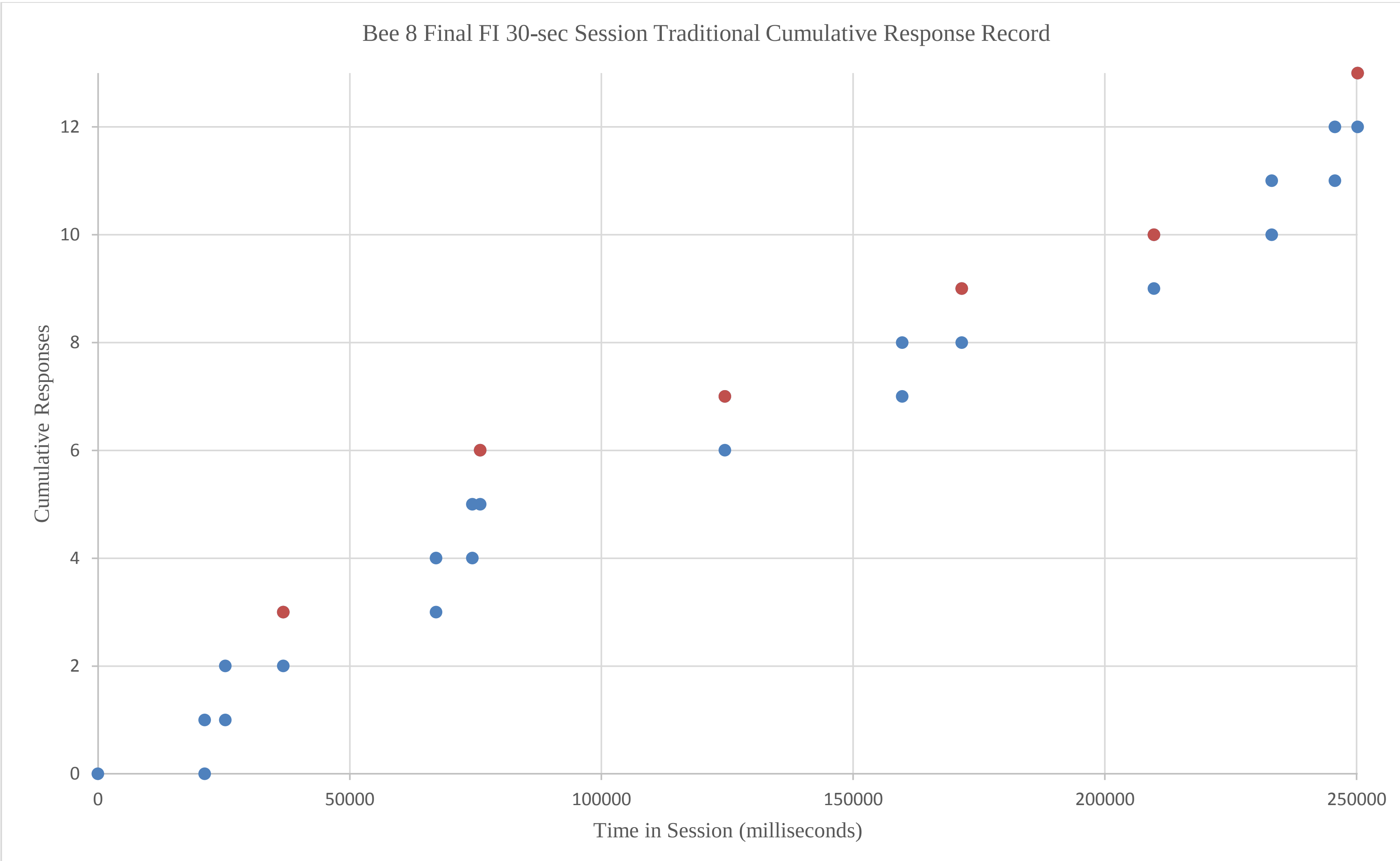

Bee 10 Final FI 15-sec Session Traditional Cumulative Response Record
Cumualtive Responses
0
10
20
30
40
50
0
50000
100000
150000
200000
Time in Session (milliseconds)

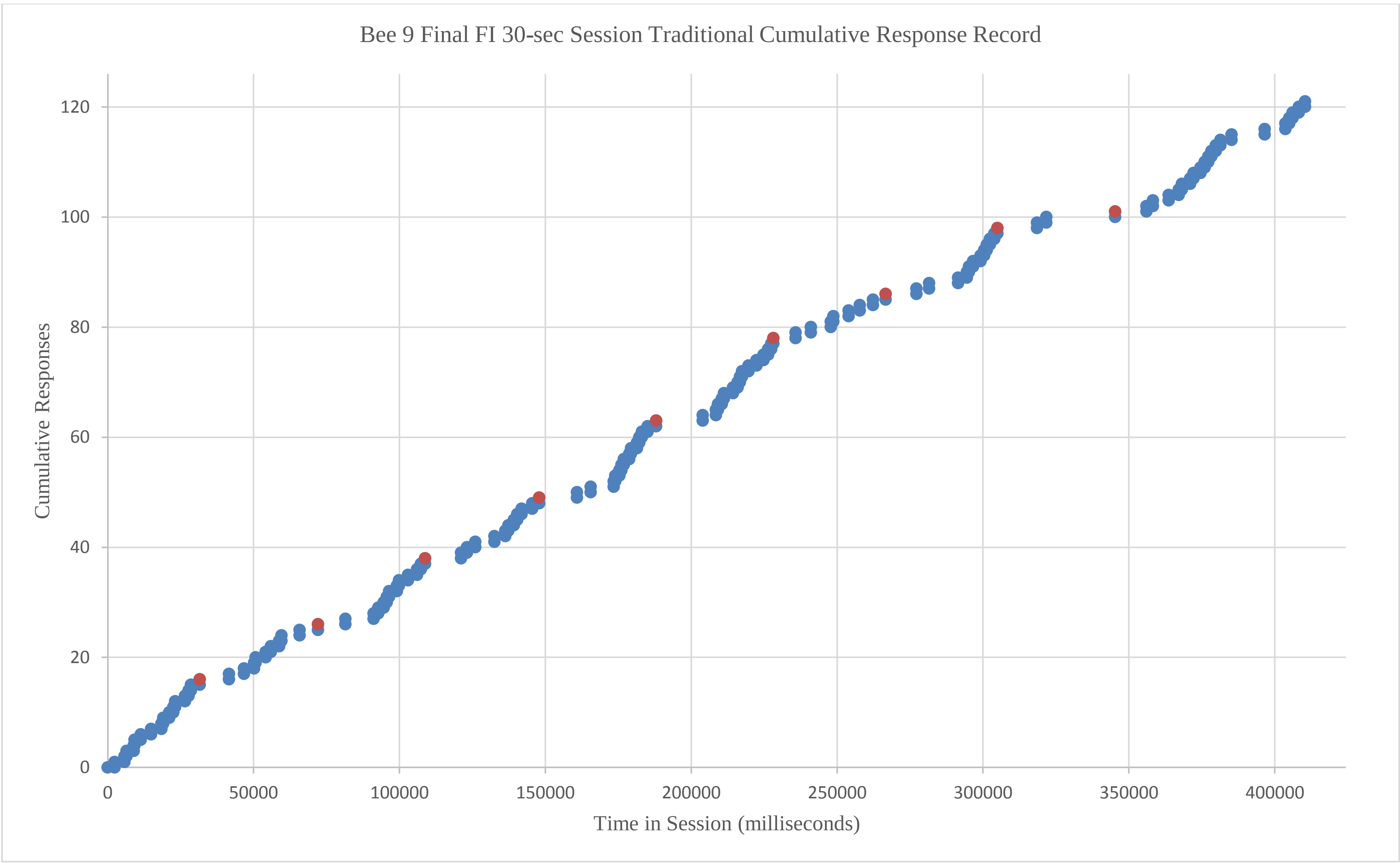

Bee 1 Final FI 30-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
5
10
15
20
25
30
35
40
0
50000
100000
150000
200000
250000
300000
350000
400000
Time in Session (milliseconds)


Bee 2 Final FI 30-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
5
10
15
20
25
0
50000
100000
150000
200000
250000
Time in Session (milliseconds)

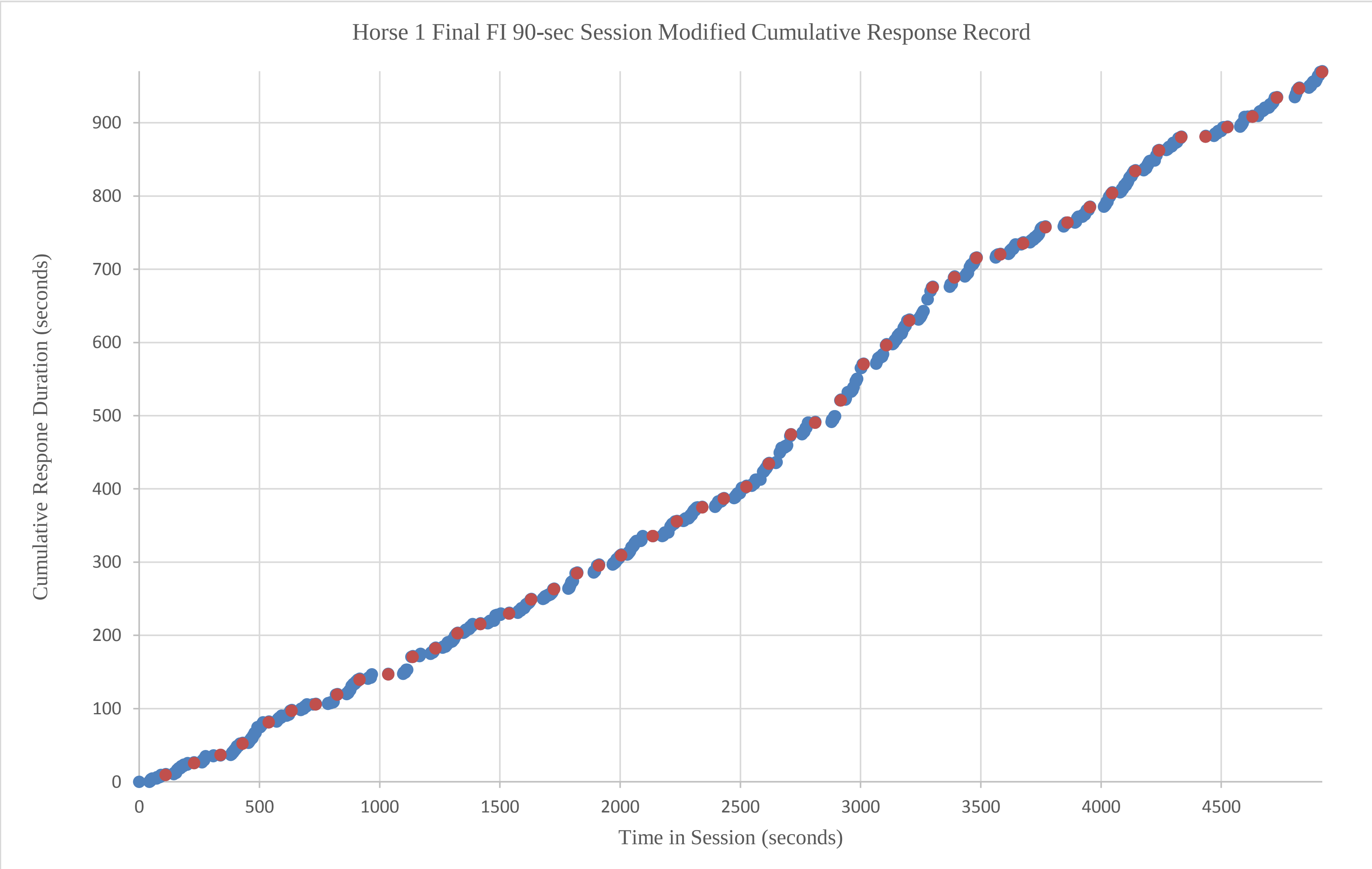


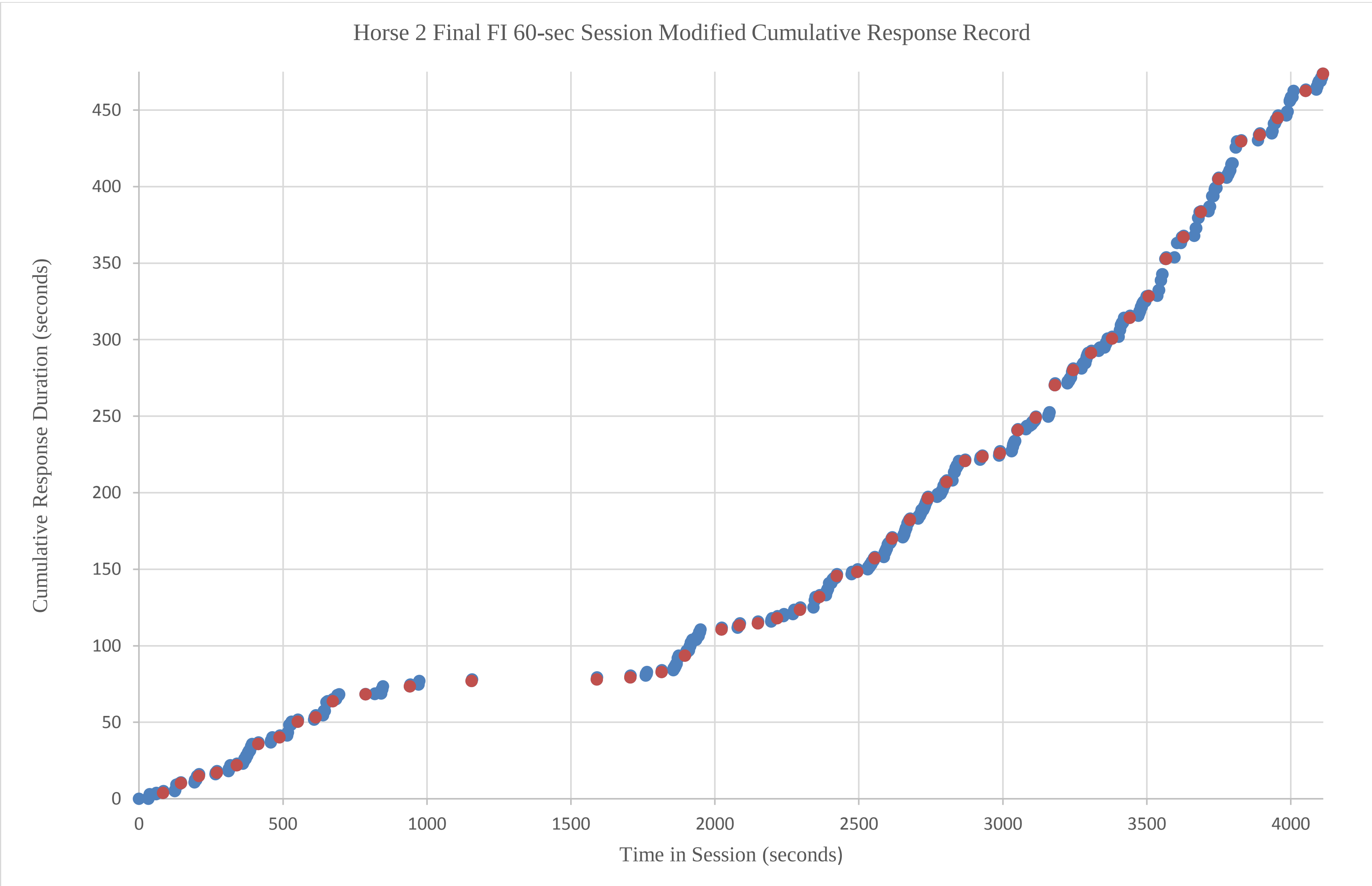
Bee 7 Final FI 30-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
10
20
30
40
50
60
70
80
0
50000
100000
150000
200000
250000
Time in Session (milliseconds)

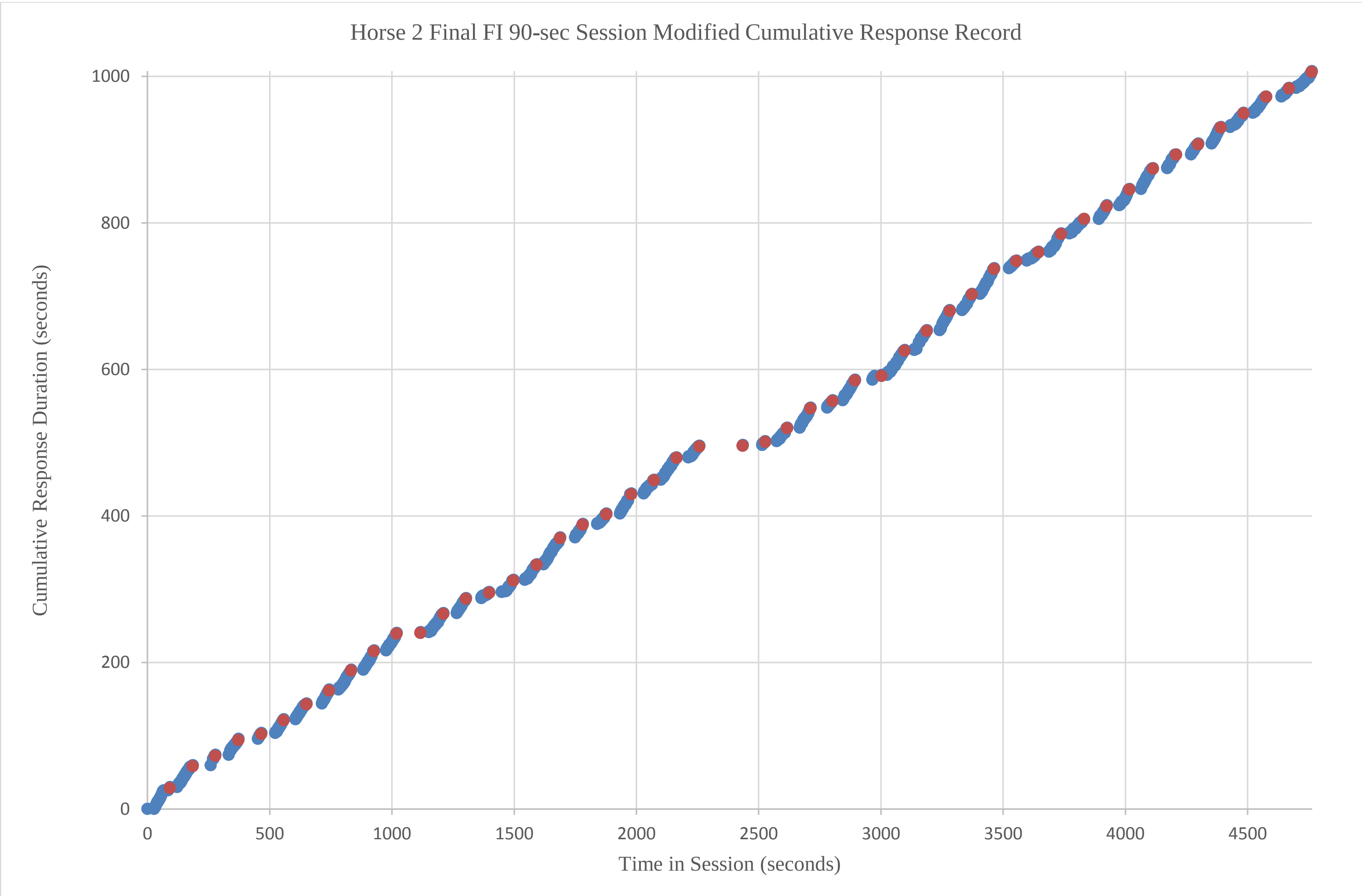

Bee 8 Final FI 30-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
2
4
6
8
10
12
0
50000
100000
150000
200000
250000
Time in Session (milliseconds)

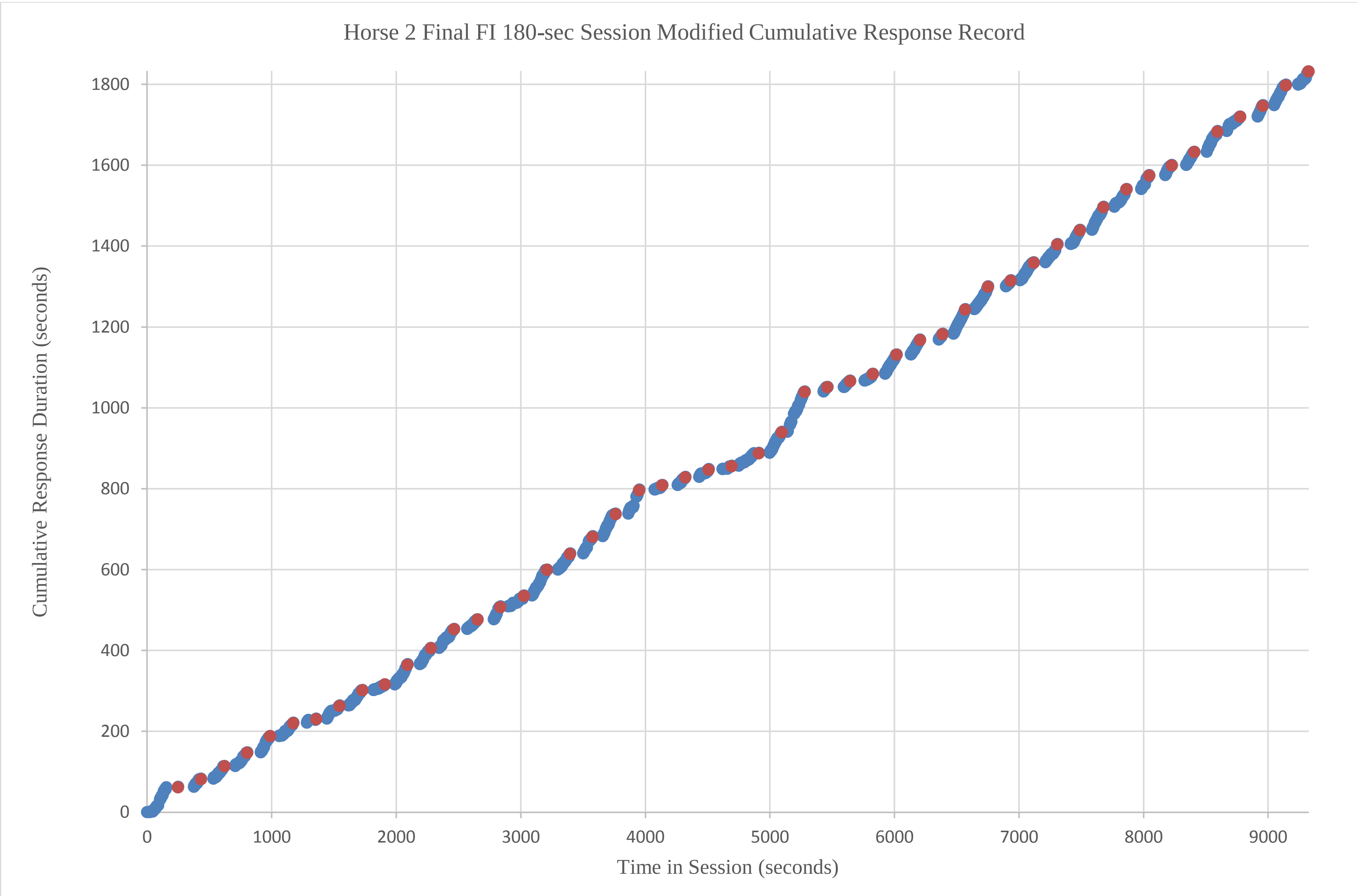

Bee 9 Final FI 30-sec Session Traditional Cumulative Response Record
Cumulative Responses
0
20
40
60
80
100
120
0
50000
100000
150000
200000
250000
300000
350000
400000
Time in Session (milliseconds)

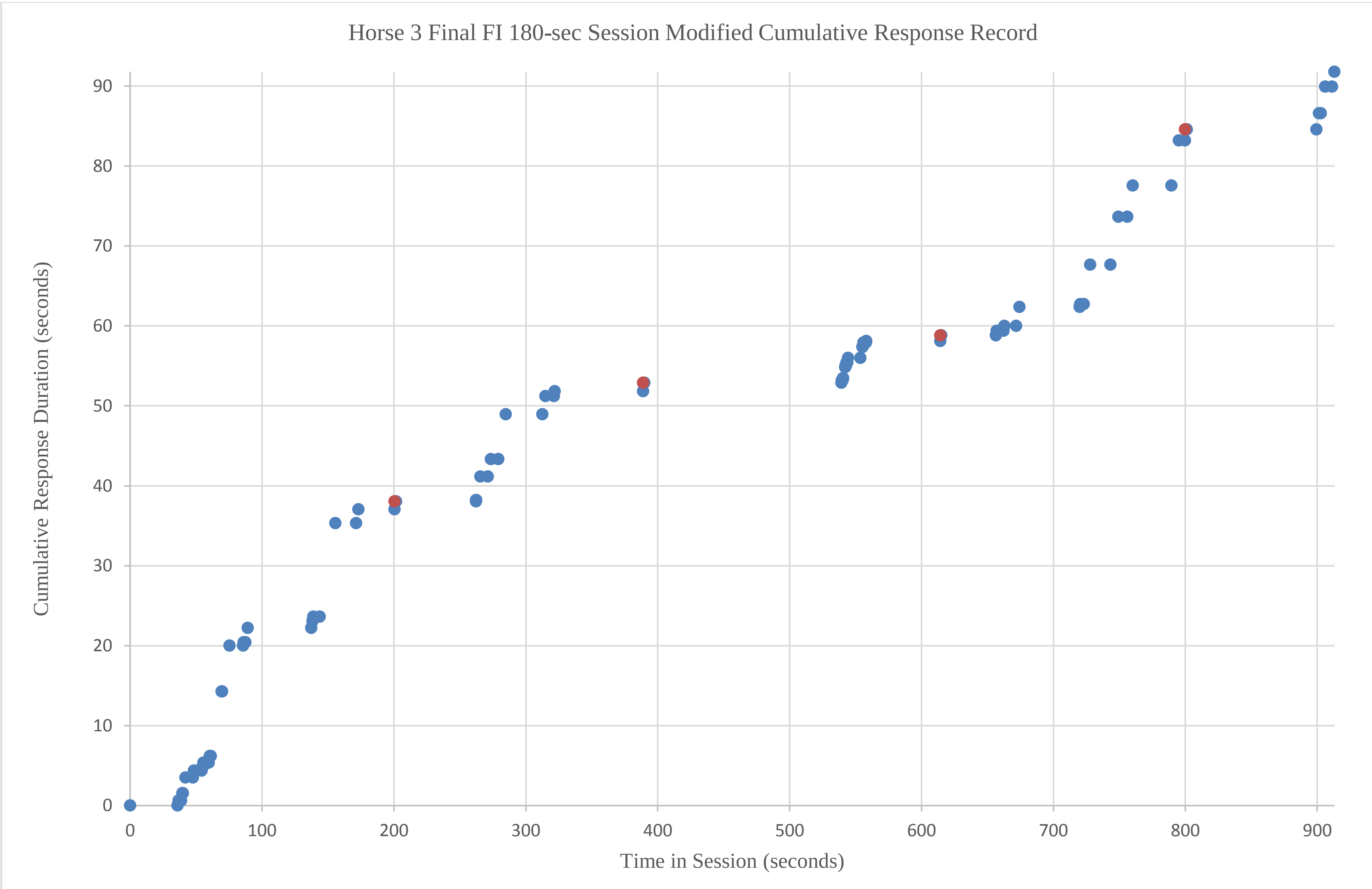
Appendix 2: Modified Cumulative Curves

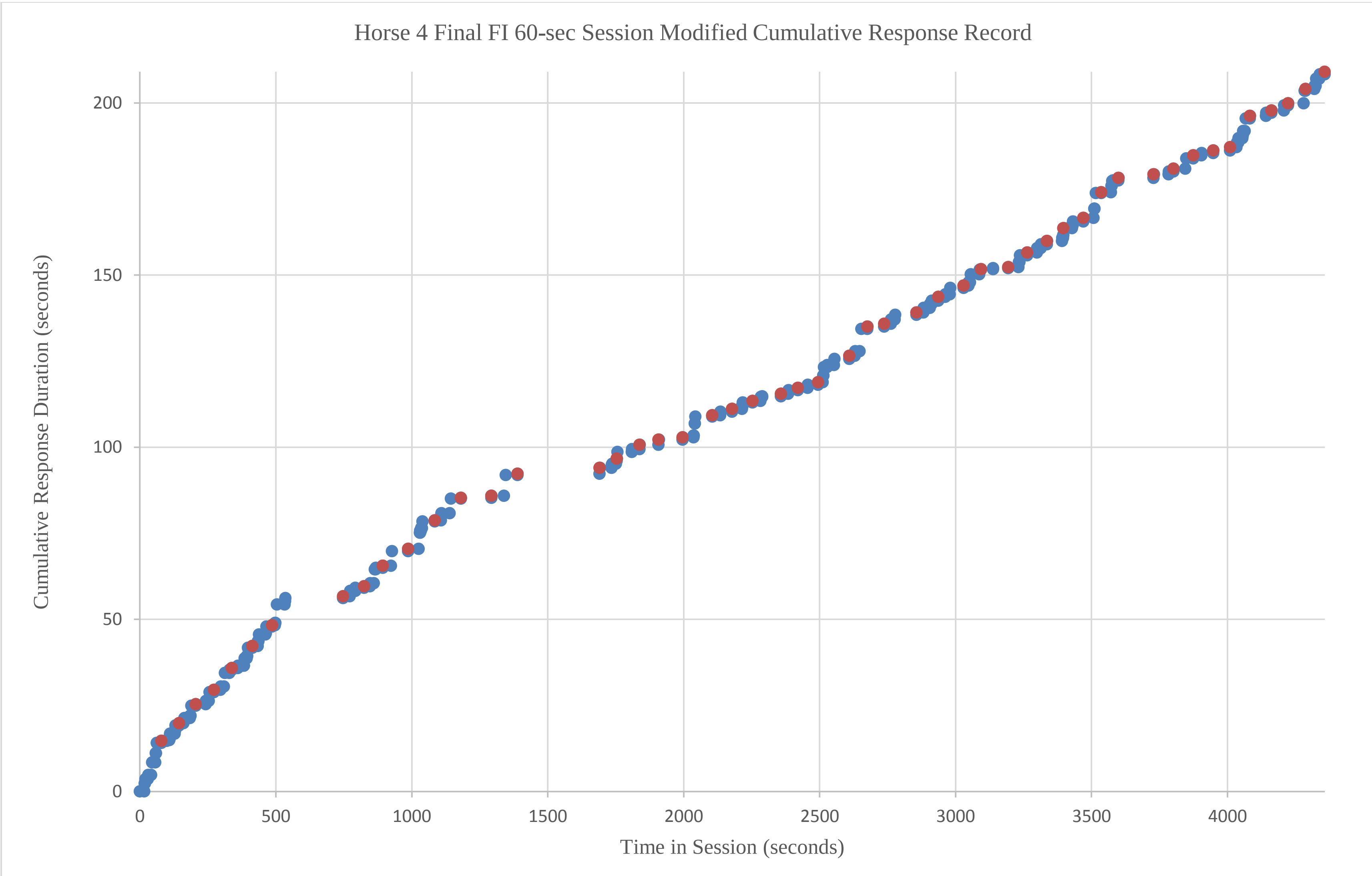


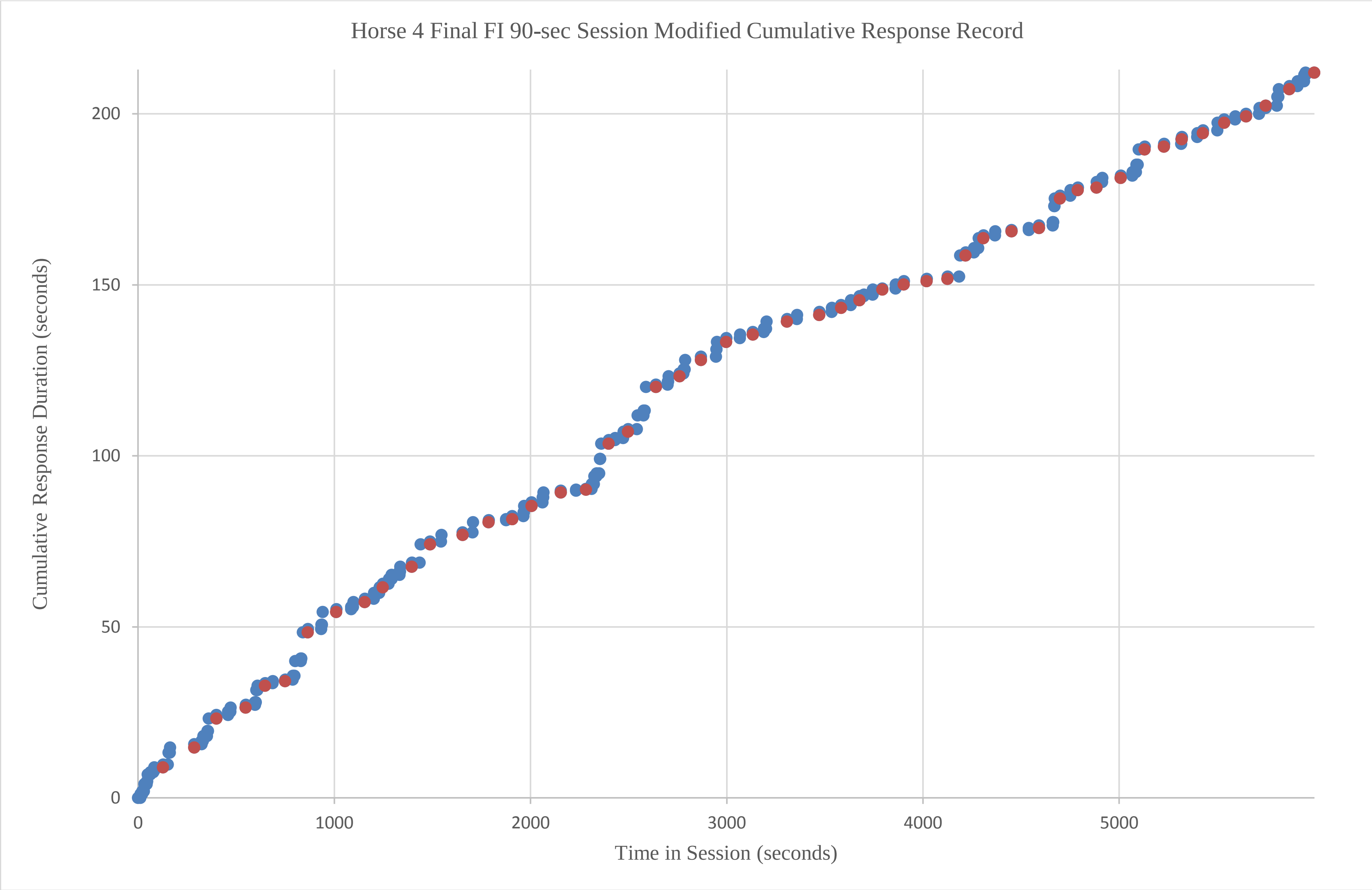

Horse 2 Final FI 60-sec Session Modified Cumulative Response Record
Cumulative Response Duration (seconds)
0
50
100
150
200
250
300
350
400
450
0
500
1000
1500
2000
2500
3000
3500
4000
Time in Session (seconds)

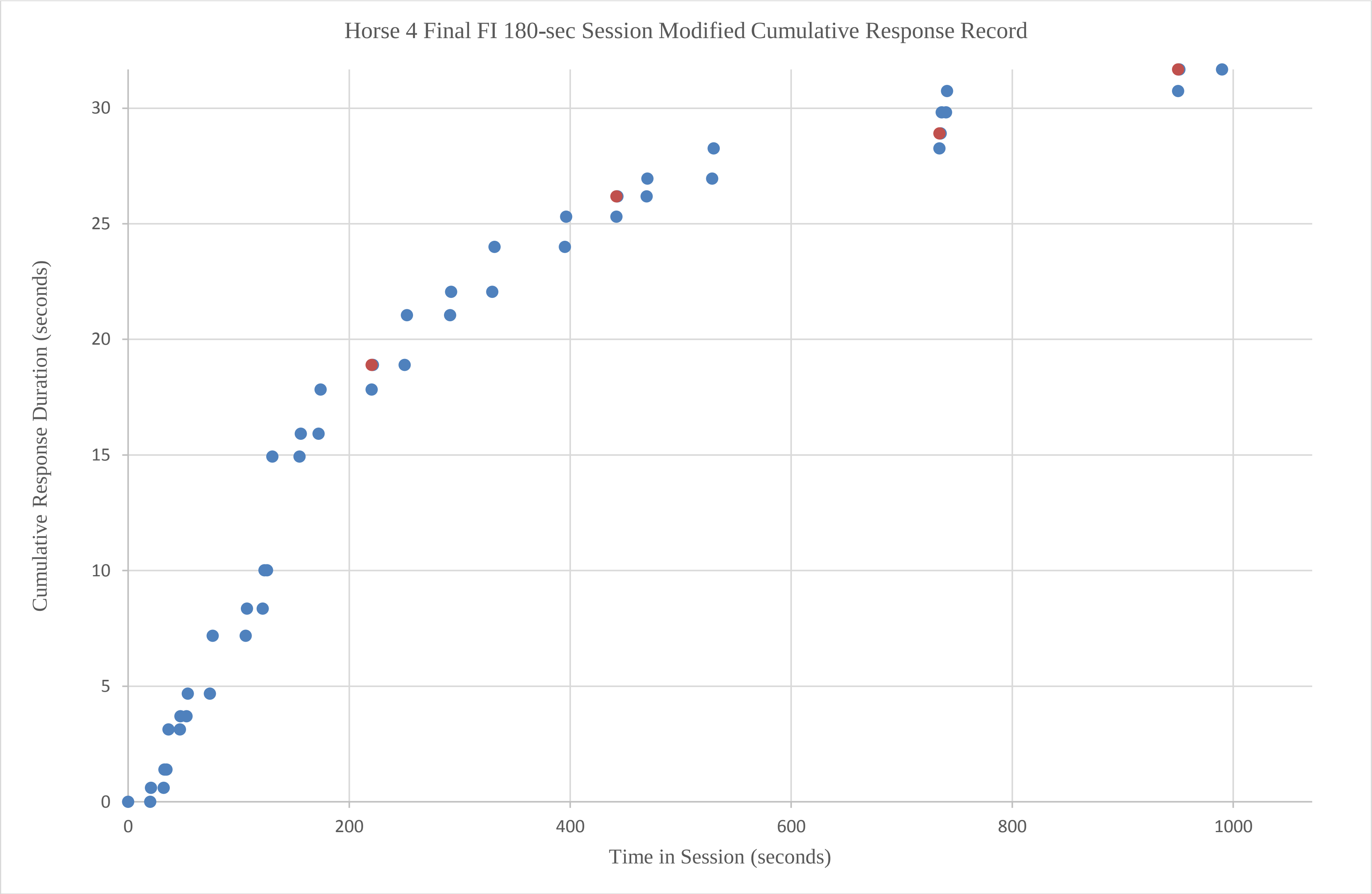

Horse 2 Final FI 90-sec Session Modified Cumulative Response Record
Cumulative Response Duration (seconds)
0
200
400
600
800
1000
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Time in Session (seconds)


Horse 2 Final FI 180-sec Session Modified Cumulative Response Record
Cumulative Response Duration (seconds)
0
200
400
600
800
1000
1200
1400
1600
1800
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Time in Session (seconds)

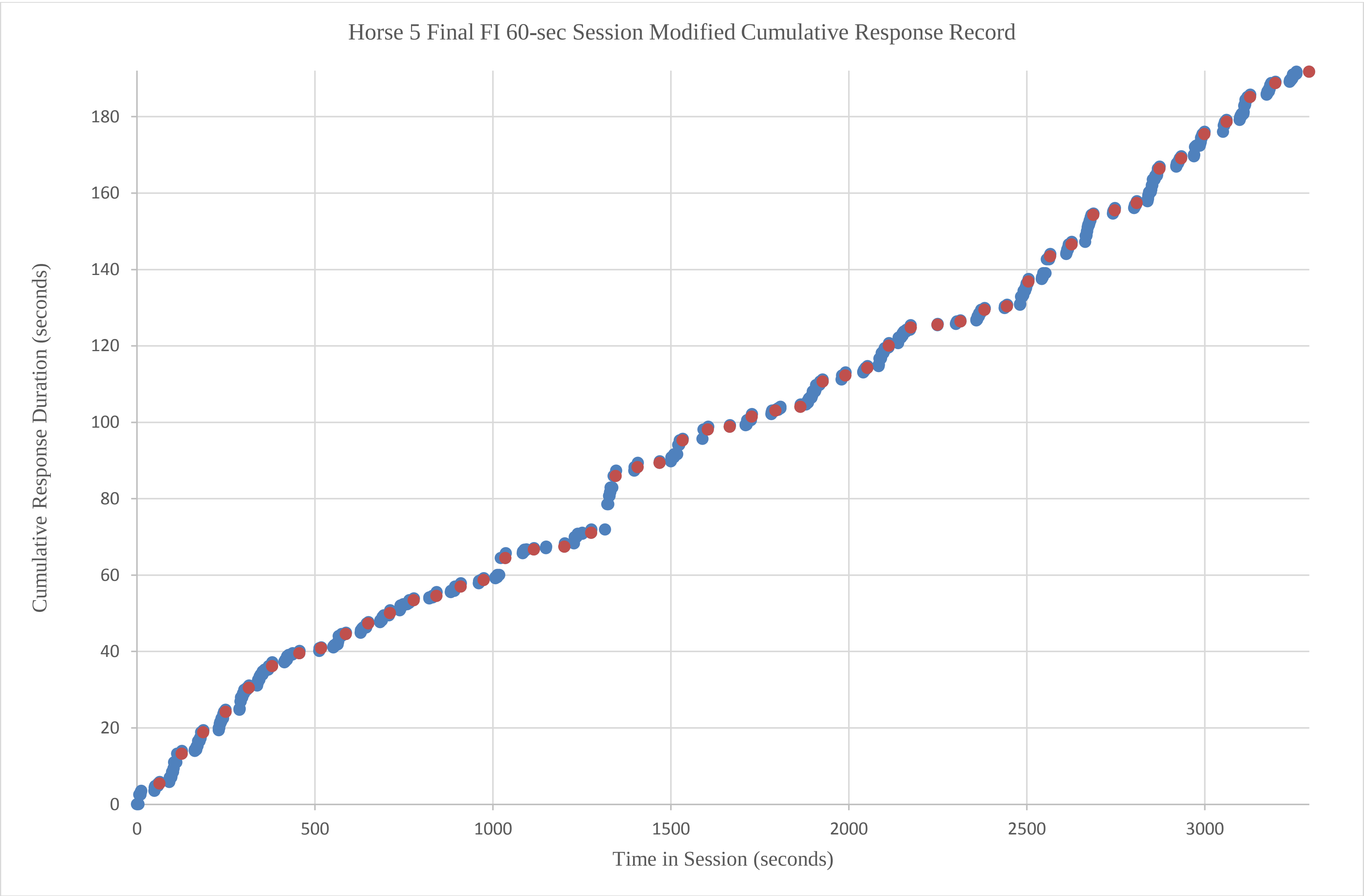

Horse 3 Final FI 180-sec Session Modified Cumulative Response Record
Cumulative Response Duration (seconds)
0
10
20
30
40
50
60
70
80
90
0
100
200
300
400
500
600
700
800
900
Time in Session (seconds)


Horse 4 Final FI 60-sec Session Modified Cumulative Response Record
Cumulative Response Duration (seconds)
0
50
100
150
200
0
500
1000
1500
2000
2500
3000
3500
4000
Time in Session (seconds)

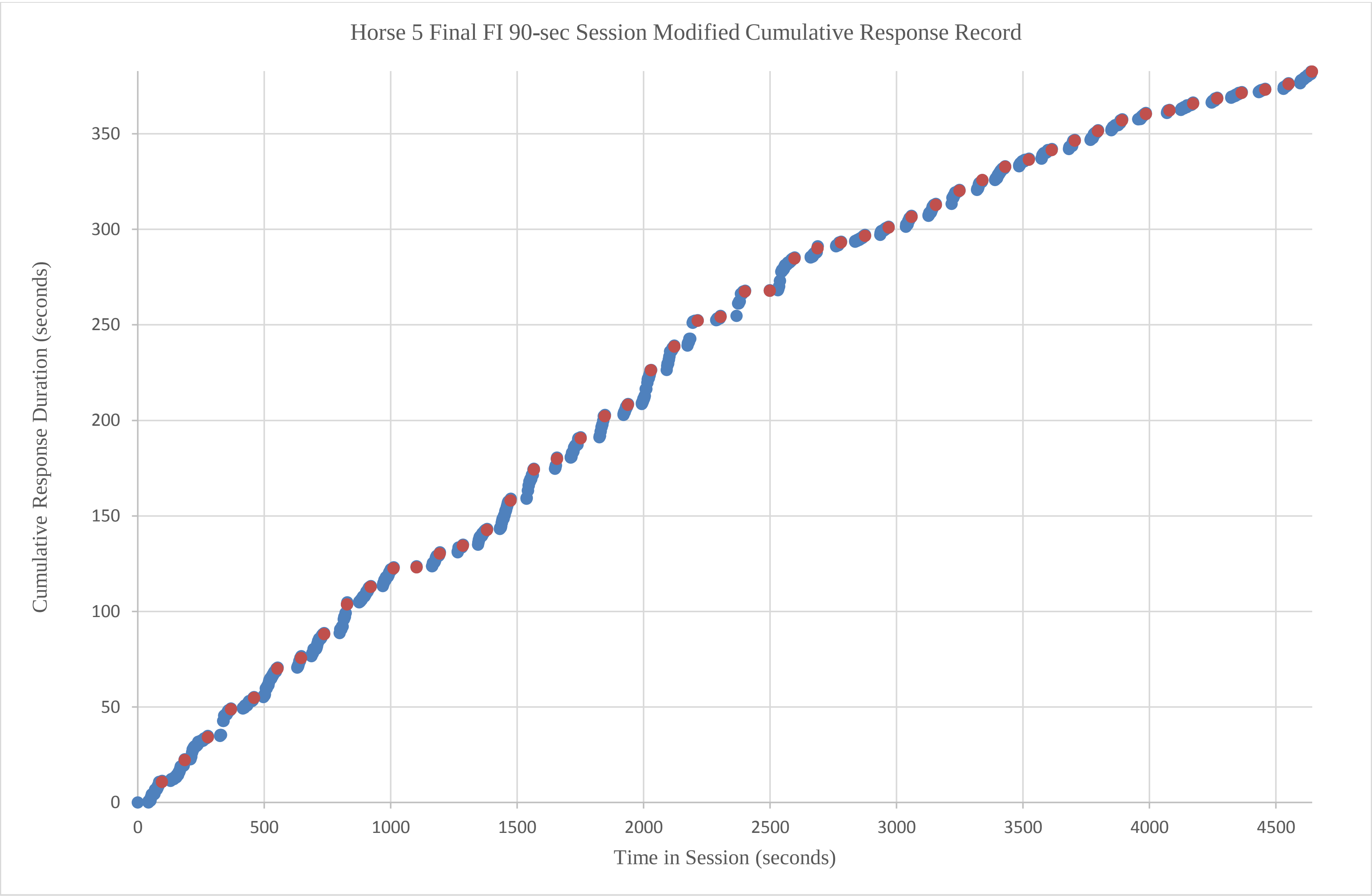

Horse 4 Final FI 90-sec Session Modified Cumulative Response Record
Cumulative Response Duration (seconds)
0
50
100
150
200
0
1000
2000
3000
4000
5000
Time in Session (seconds)



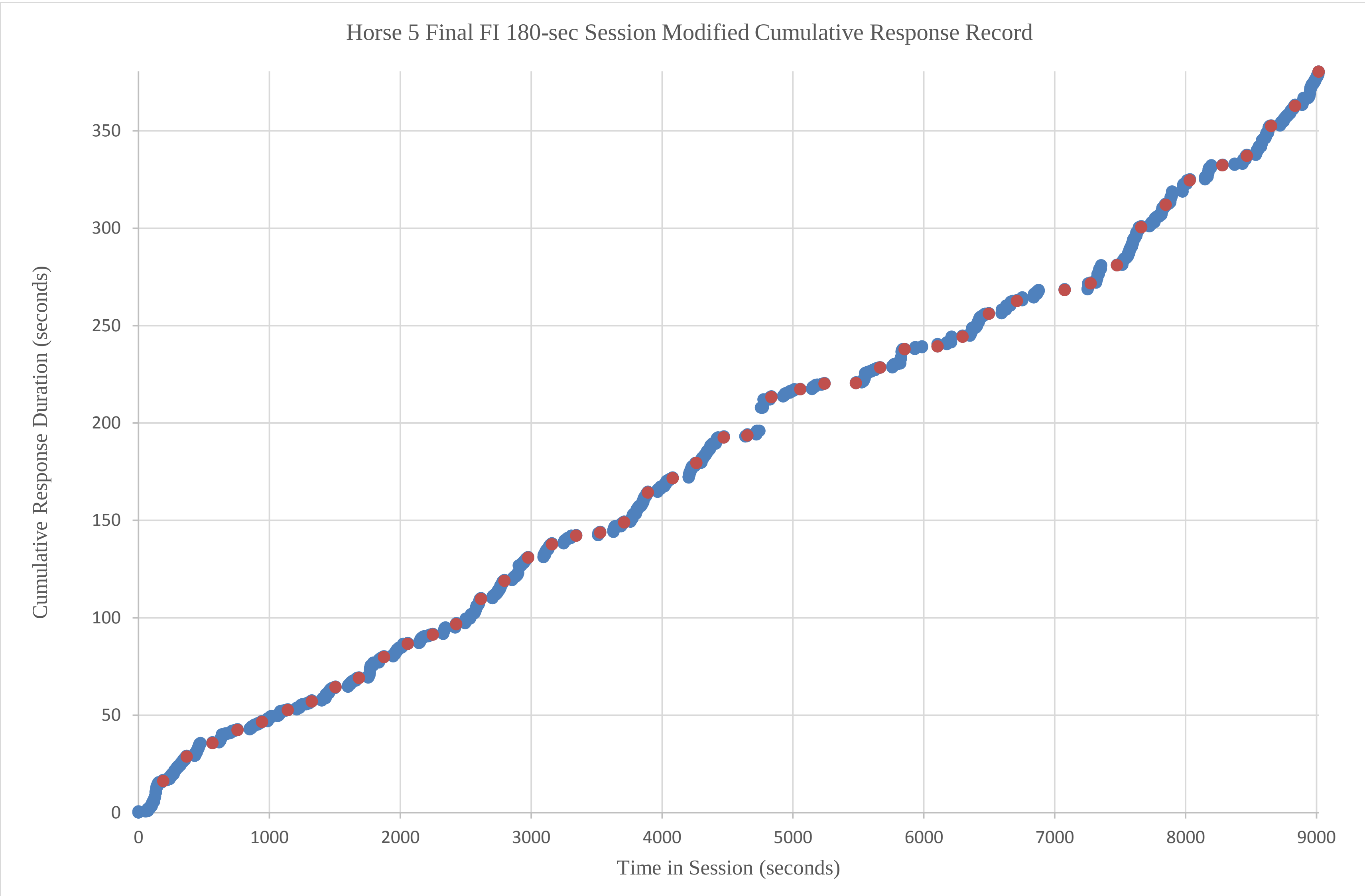
Horse 4 Final FI 180-sec Session Modified Cumulative Response Record
Cumulative Response Duration (seconds)
0
5
10
15
20
25
30
0
200
400
600
800
1000
Time in Session (seconds)



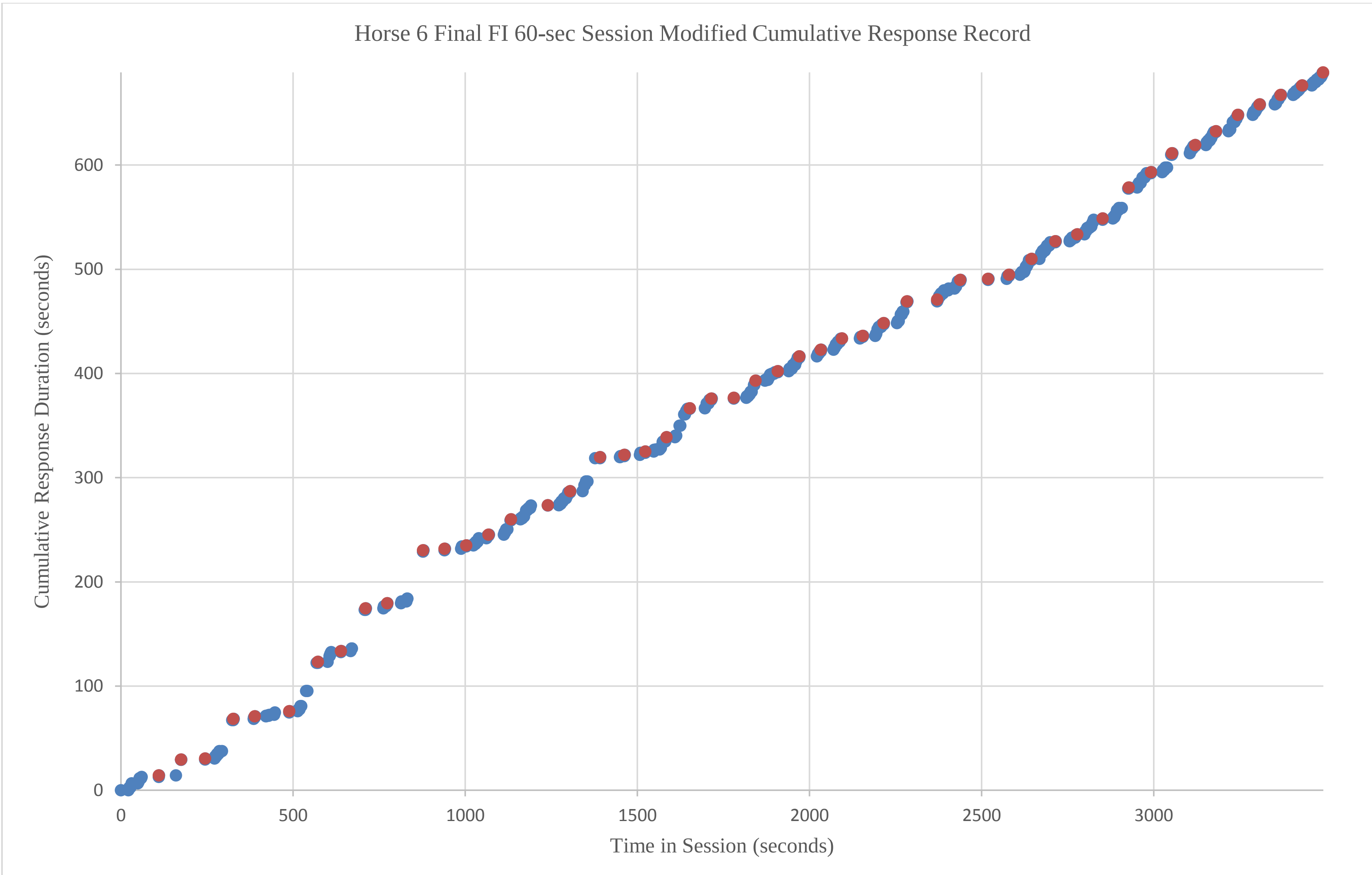
Horse 5 Final FI 60-sec Session Modified Cumulative Response Record
Cumulative Response Duration (seconds)
0
20
40
60
80
100
120
140
160
180
0
500
1000
1500
2000
2500
3000
Time in Session (seconds)

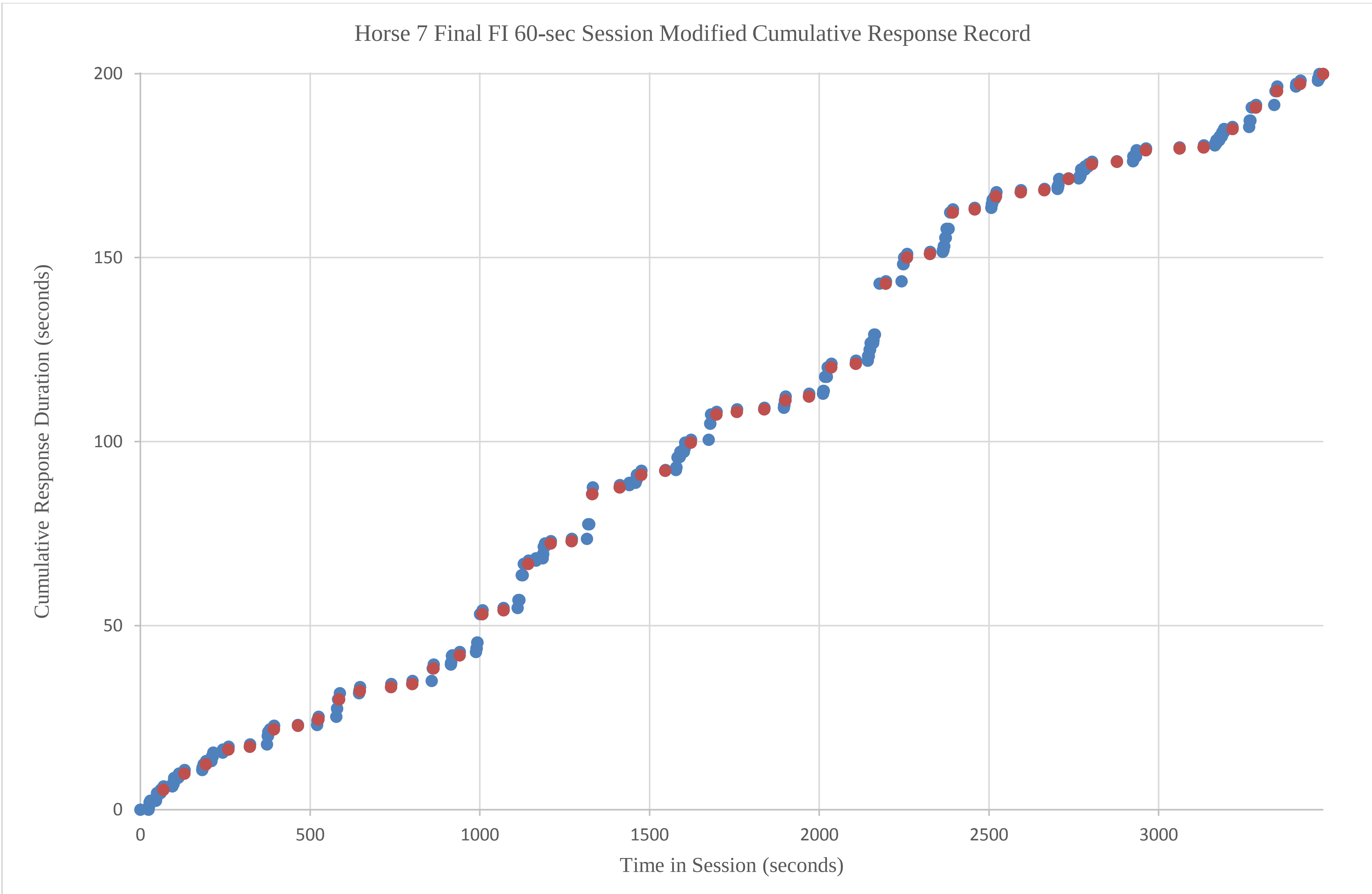


Horse 5 Final FI 90-sec Session Modified Cumulative Response Record
Cumulative Response Duration (seconds)
0
50
100
150
200
250
300
350
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Time in Session (seconds)

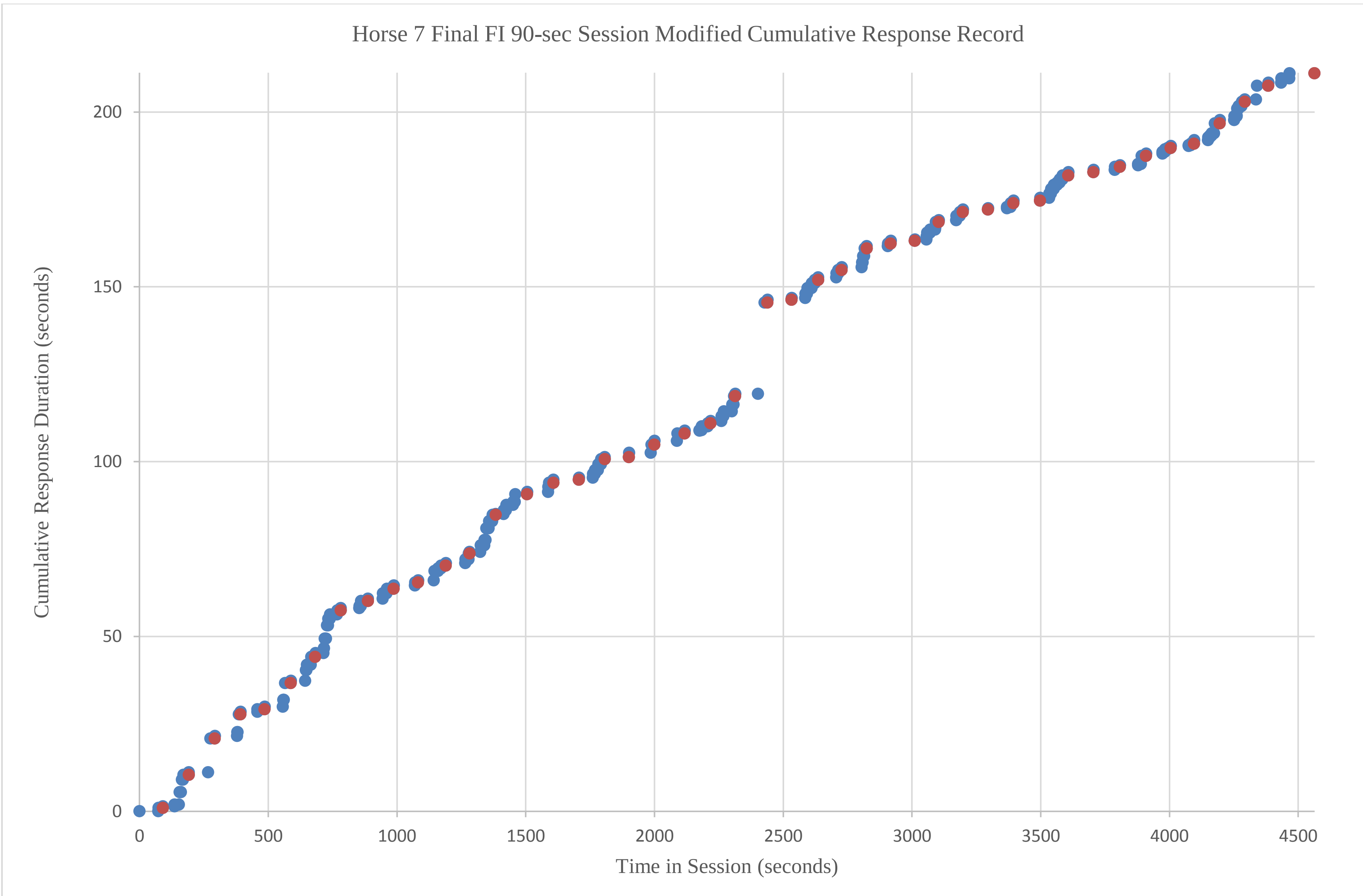


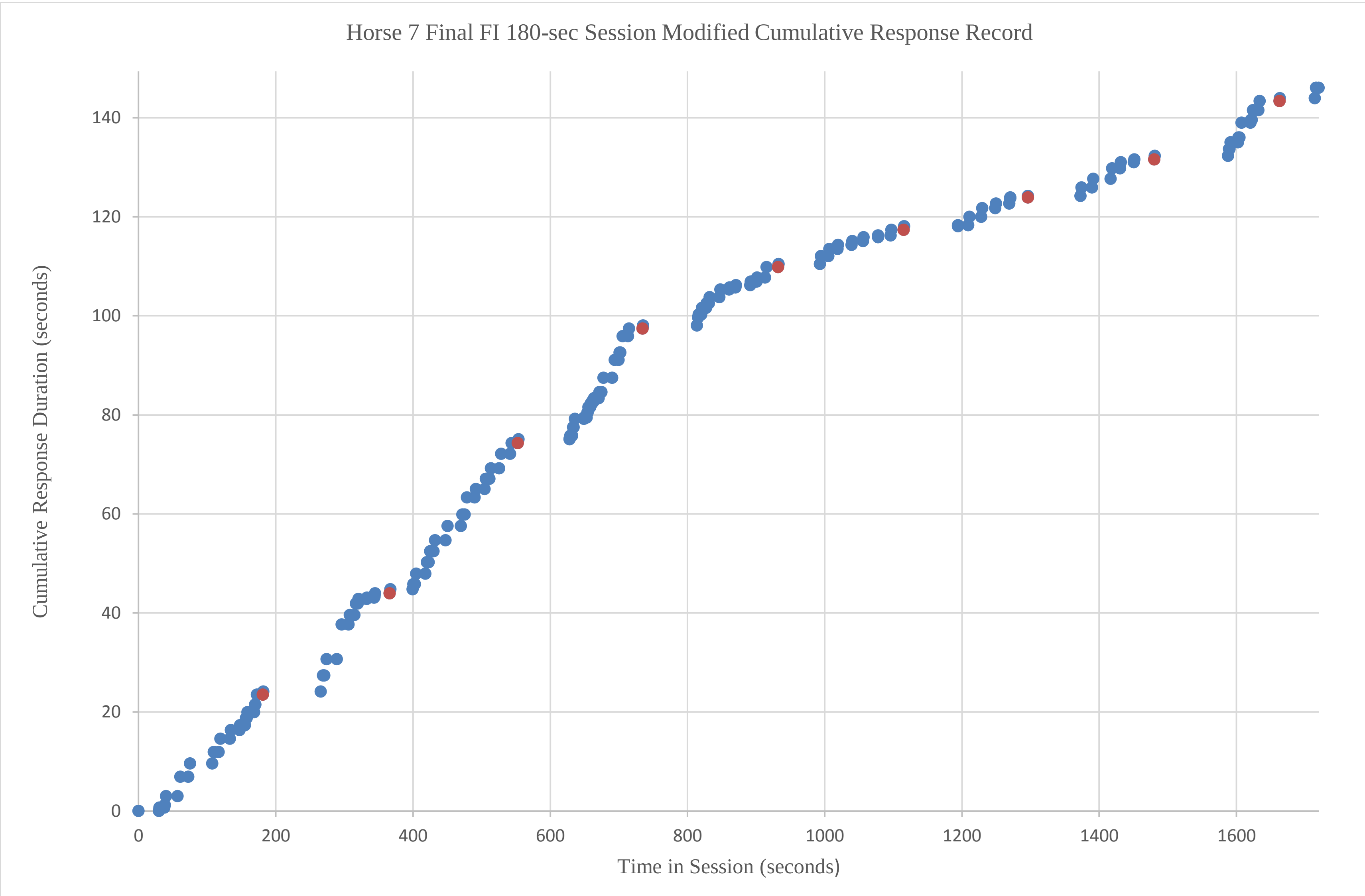
Horse 5 Final FI 180-sec Session Modified Cumulative Response Record
Cumulative Response Duration (seconds)
0
50
100
150
200
250
300
350
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Time in Session (seconds)

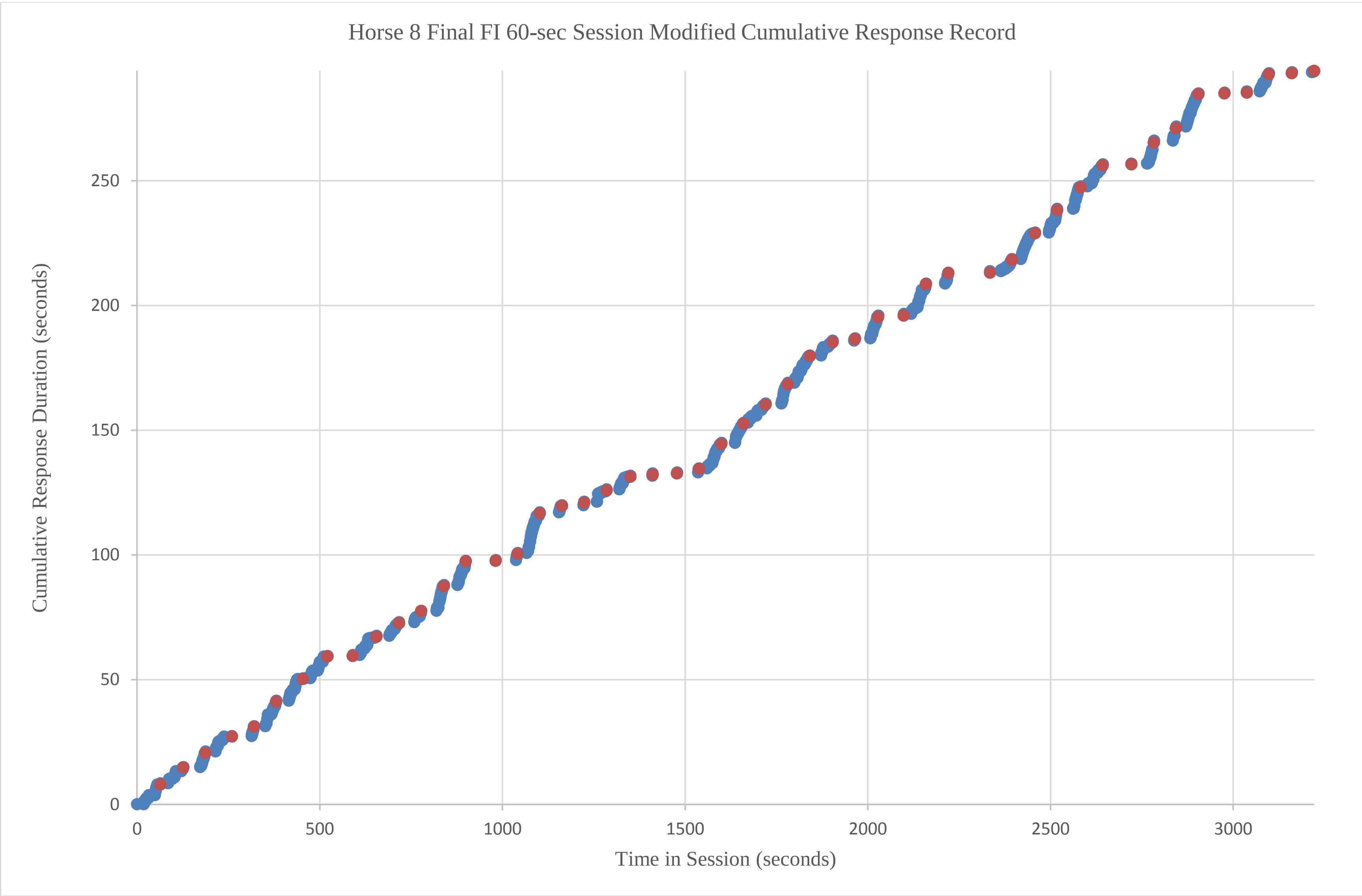

Horse 6 Final FI 60-sec Session Modified Cumulative Response Record
Cumulative Response Duration (seconds)
0
100
200
300
400
500
600
0
500
1000
1500
2000
2500
3000
Time in Session (seconds)

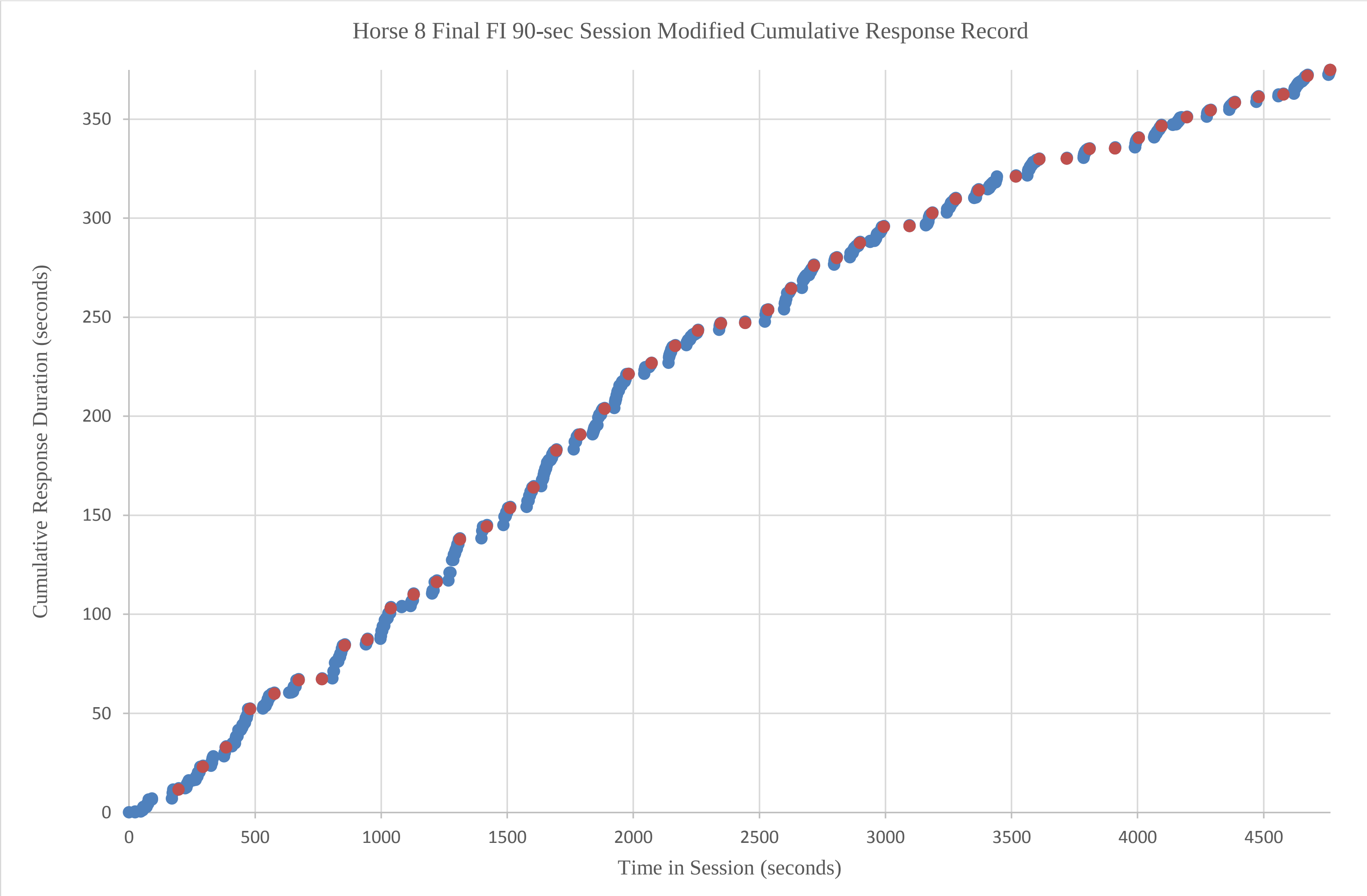


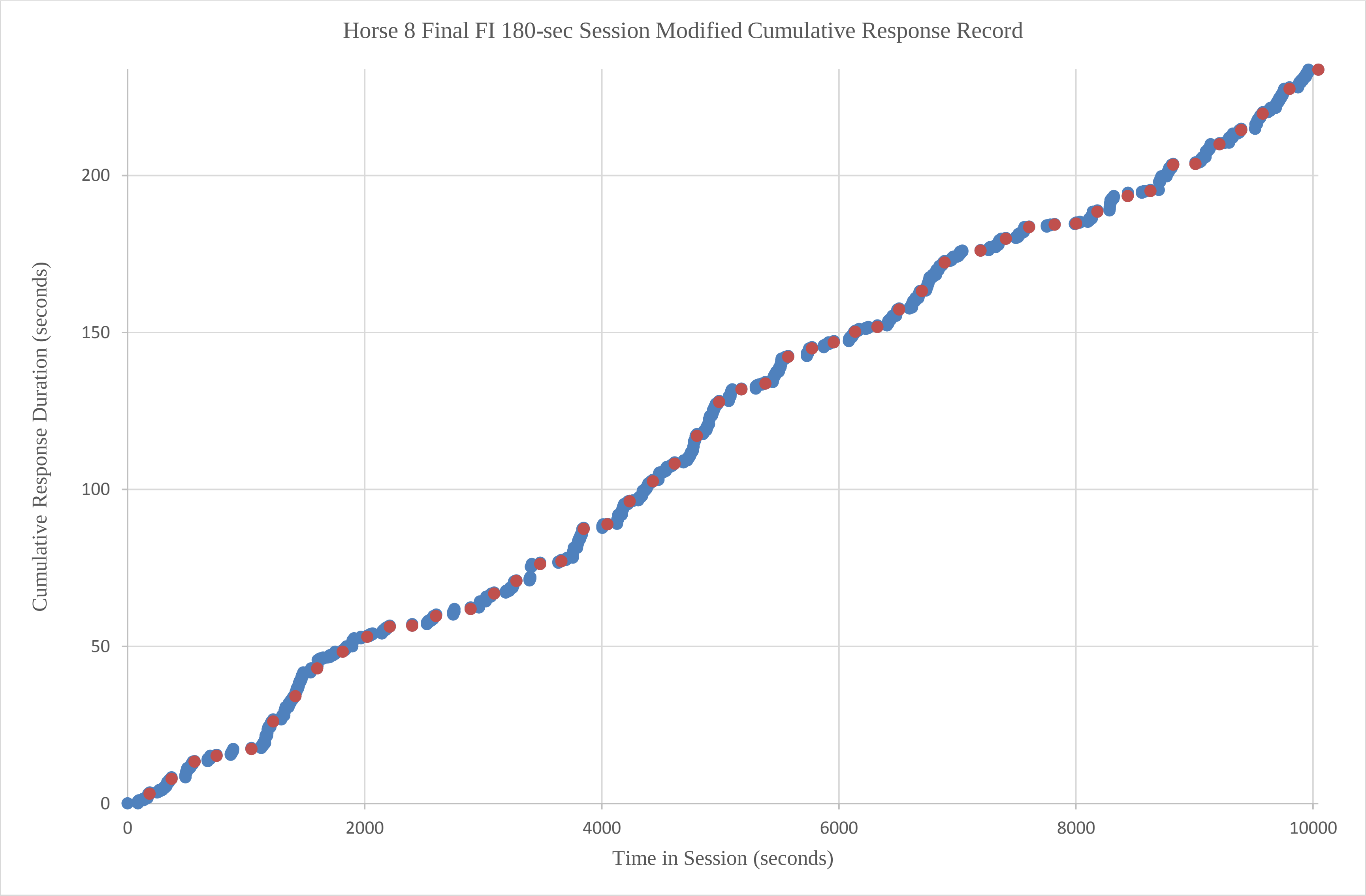
Horse 7 Final FI 60-sec Session Modified Cumulative Response Record
Cumulative Response Duration (seconds)
200
150
100
50
0
0
500
1000
1500
2000
2500
3000
Time in Session (seconds)

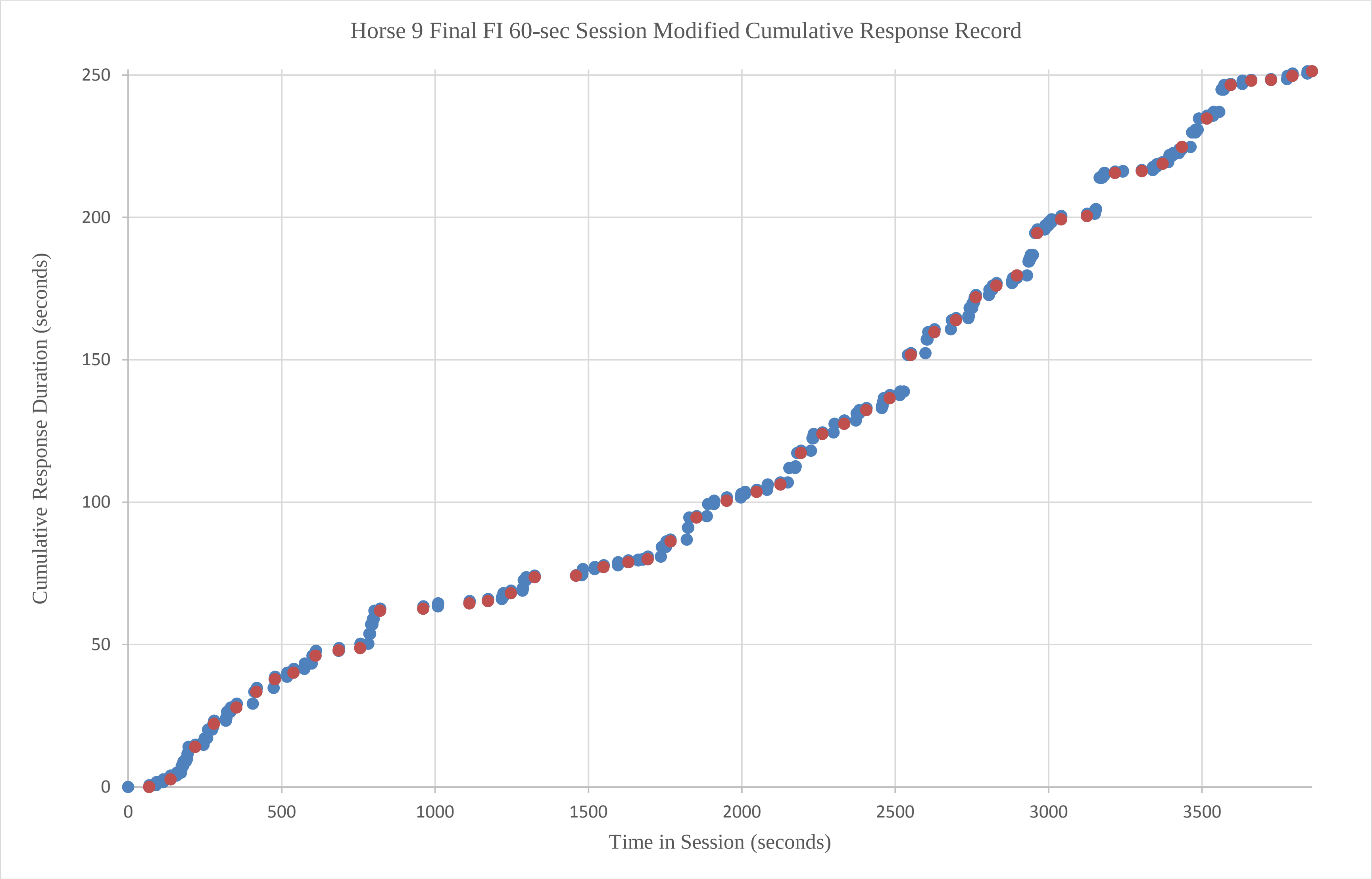

Horse 7 Final FI 90-sec Session Modified Cumulative Response Record
Cumulative Response Duration (seconds)
0
50
100
150
200
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Time in Session (seconds)


Horse 7 Final FI 180-sec Session Modified Cumulative Response Record
Cumulative Response Duration (seconds)
0
20
40
60
80
100
120
140
0
200
400
600
800
1000
1200
1400
1600
Time in Session (seconds)

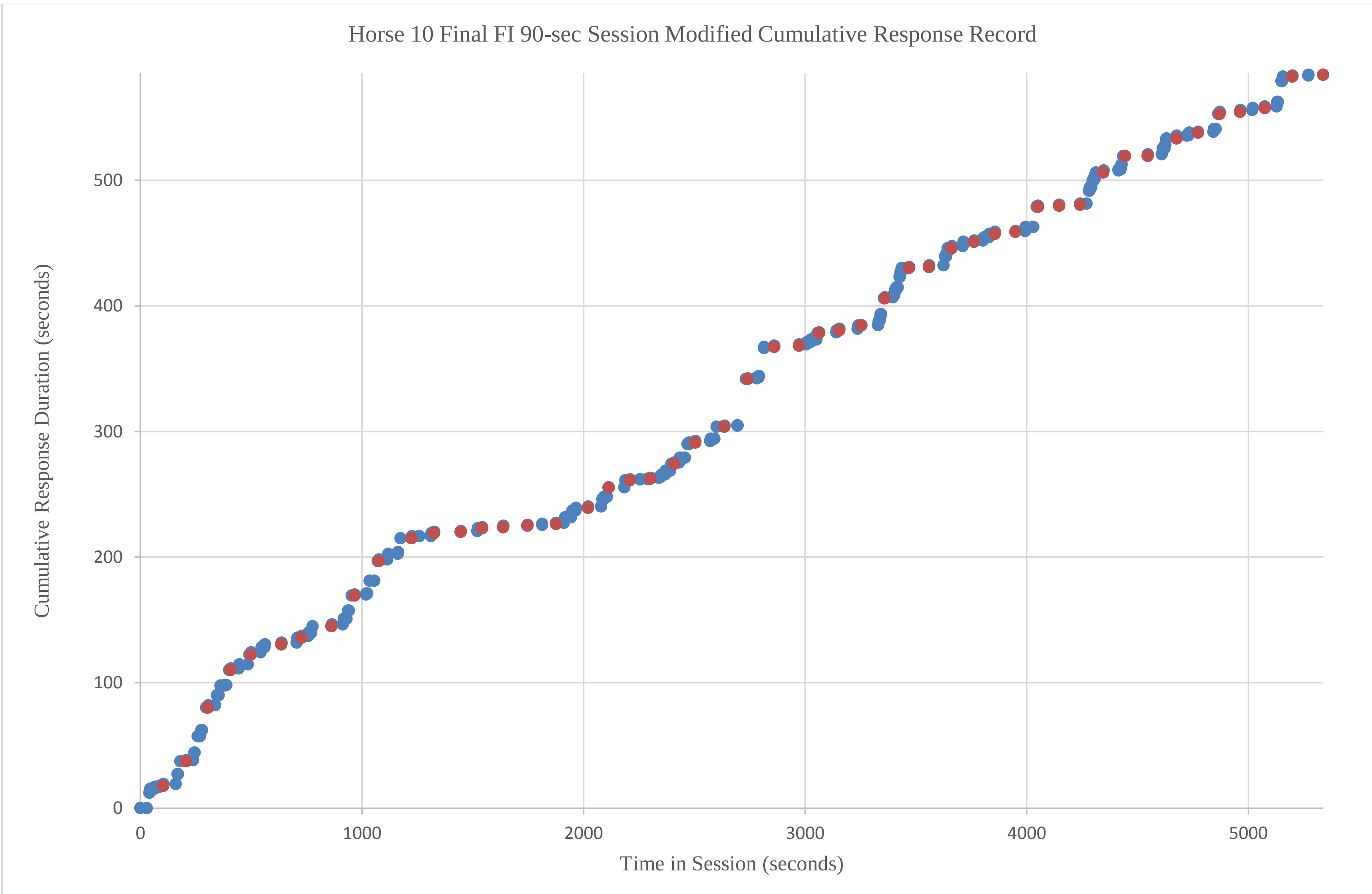

Horse 8 Final FI 60-sec Session Modified Cumulative Response Record
Cumulative Response Duration (seconds)
0
50
100
150
200
250
0
500
1000
1500
2000
2500
3000
Time in Session (seconds)

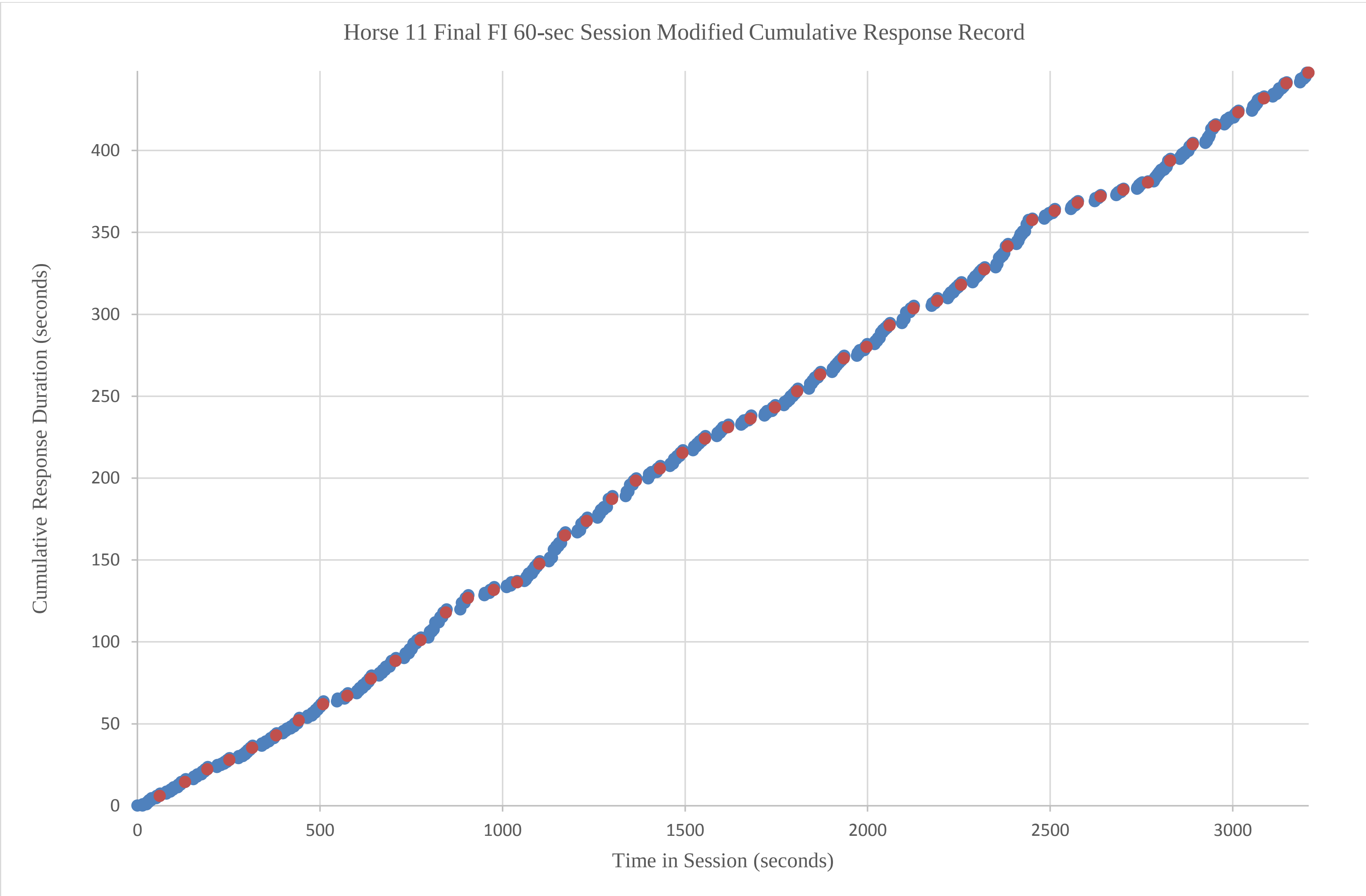

Horse 8 Final FI 90-sec Session Modified Cumulative Response Record
Cumulative Response Duration (seconds)
0
50
100
150
200
250
300
350
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Time in Session (seconds)

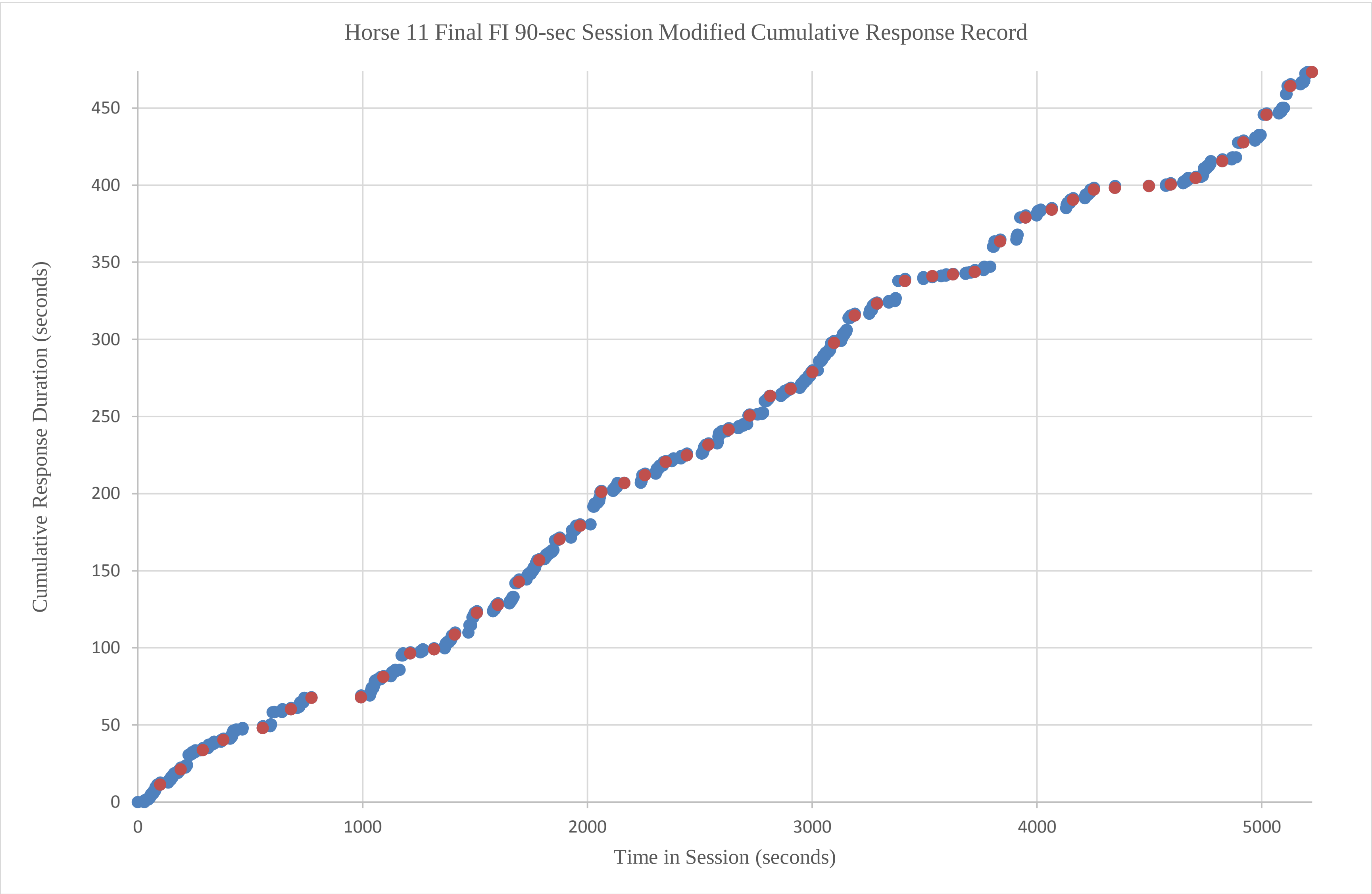

Horse 8 Final FI 180-sec Session Modified Cumulative Response Record
Cumulative Response Duration (seconds)
0
50
100
150
200
0
2000
4000
6000
8000
10000
Time in Session (seconds)

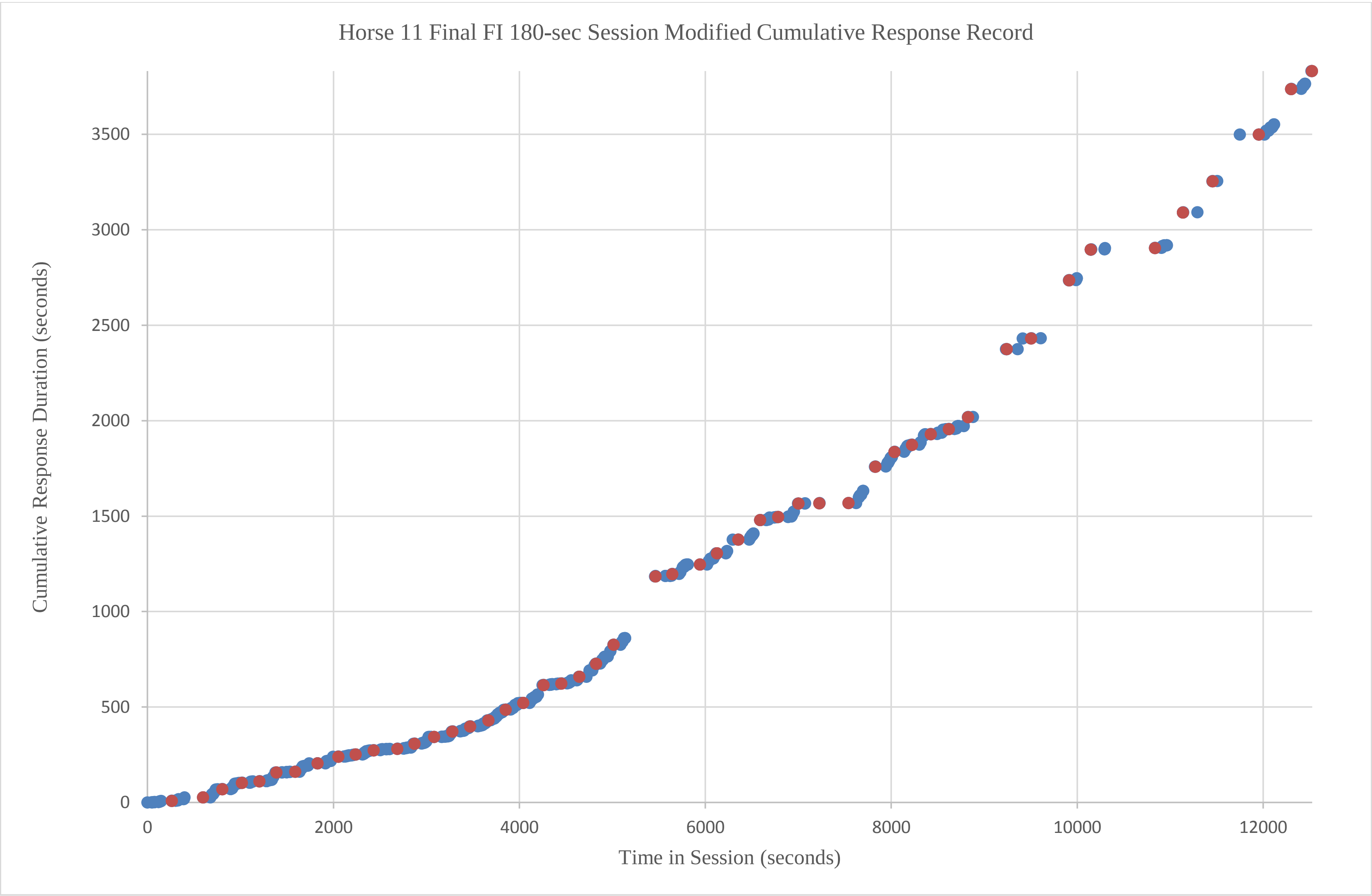


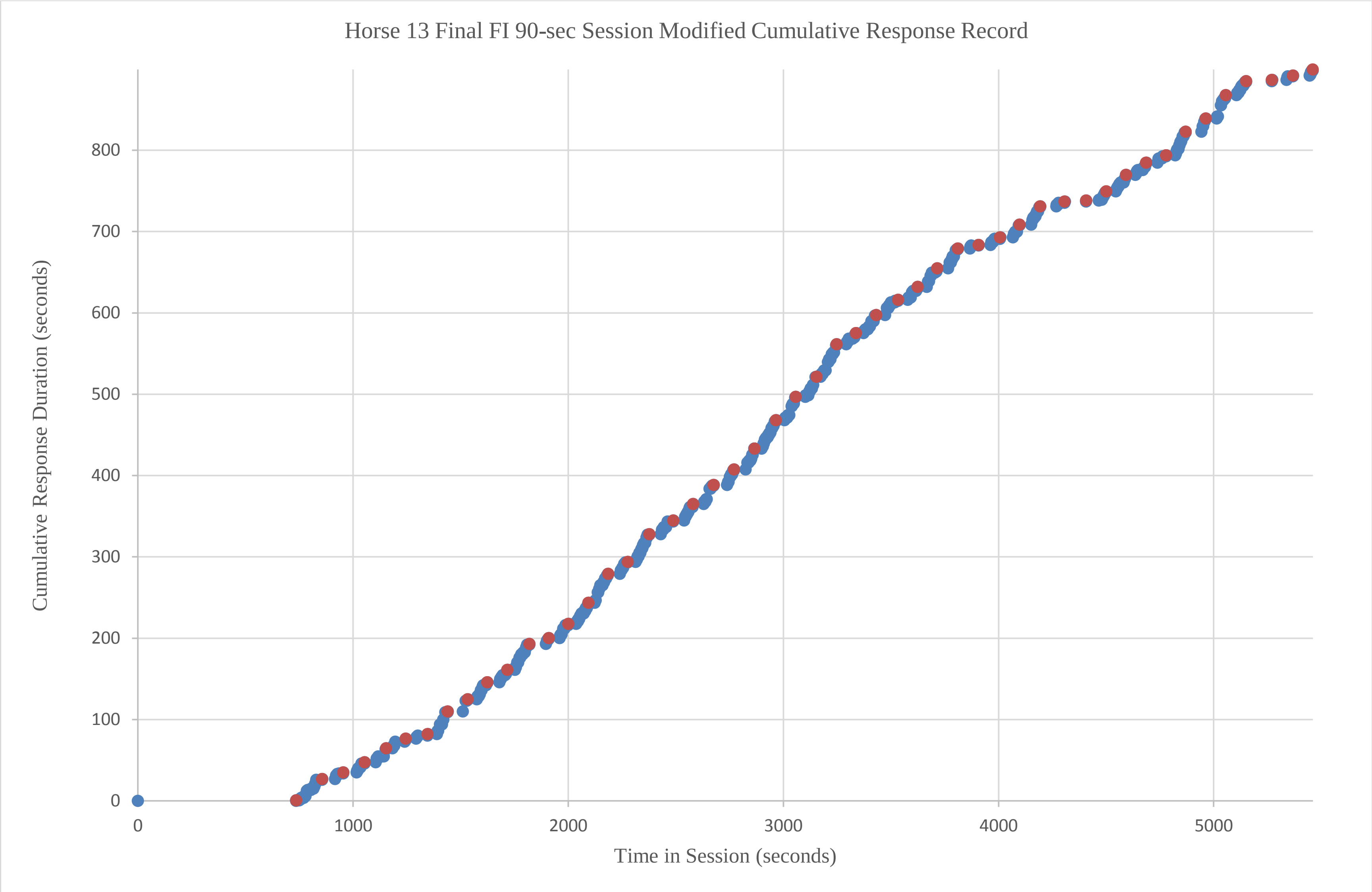
Horse 9 Final FI 60-sec Session Modified Cumulative Response Record
Cumulative Response Duration (seconds)
250
200
150
100
50
0
0
500
1000
1500
2000
2500
3000
3500
Time in Session (seconds)

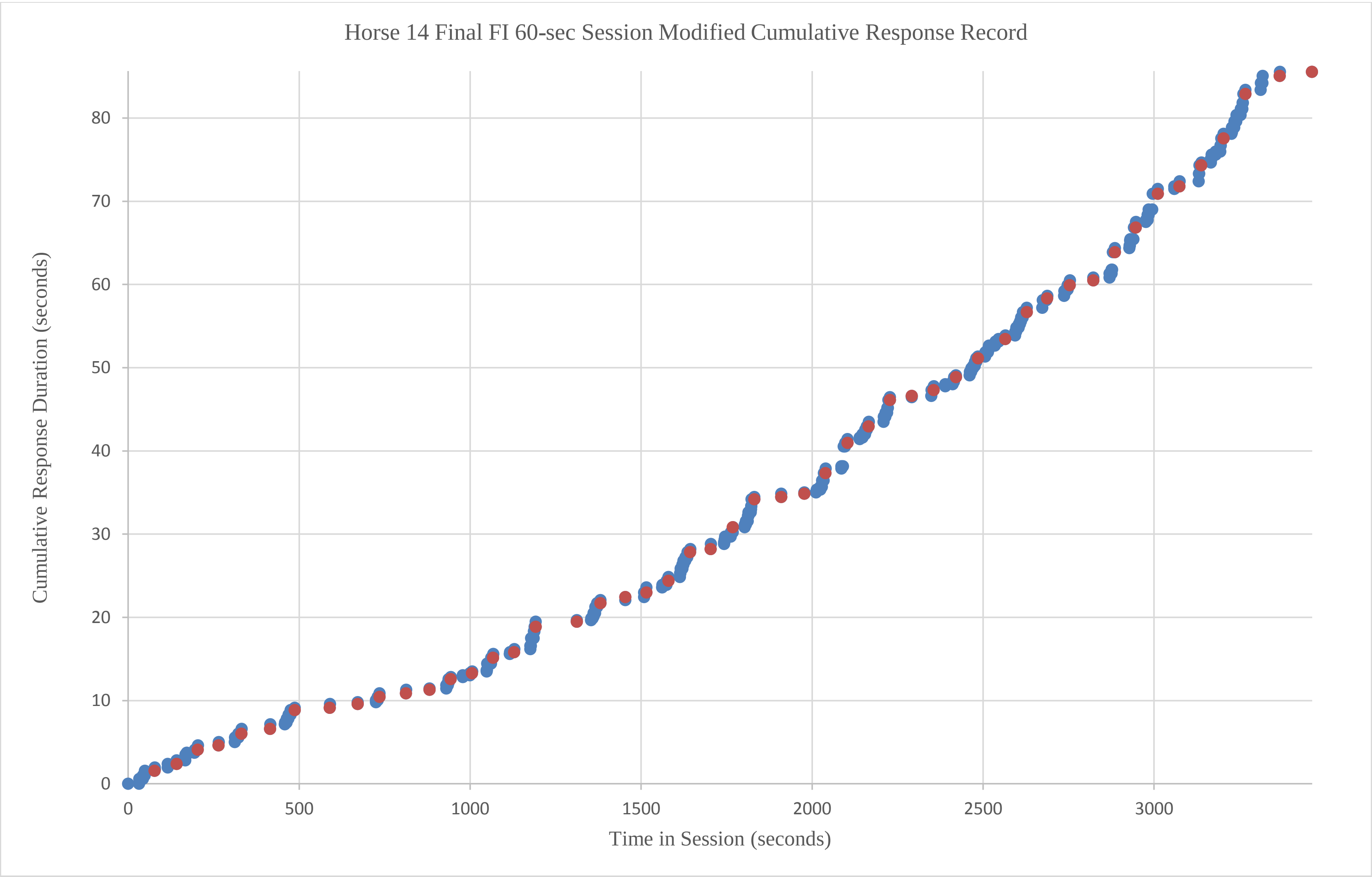

Horse 10 Final FI 90-sec Session Modified Cumulative Response Record
Cumulative Response Duration (seconds)
0
100
200
300
400
500
0
1000
2000
3000
4000
5000
Time in Session (seconds)


Horse 11 Final FI 60-sec Session Modified Cumulative Response Record
Cumulative Response Duration (seconds)
0
50
100
150
200
250
300
350
400
0
500
1000
1500
2000
2500
3000
Time in Session (seconds)

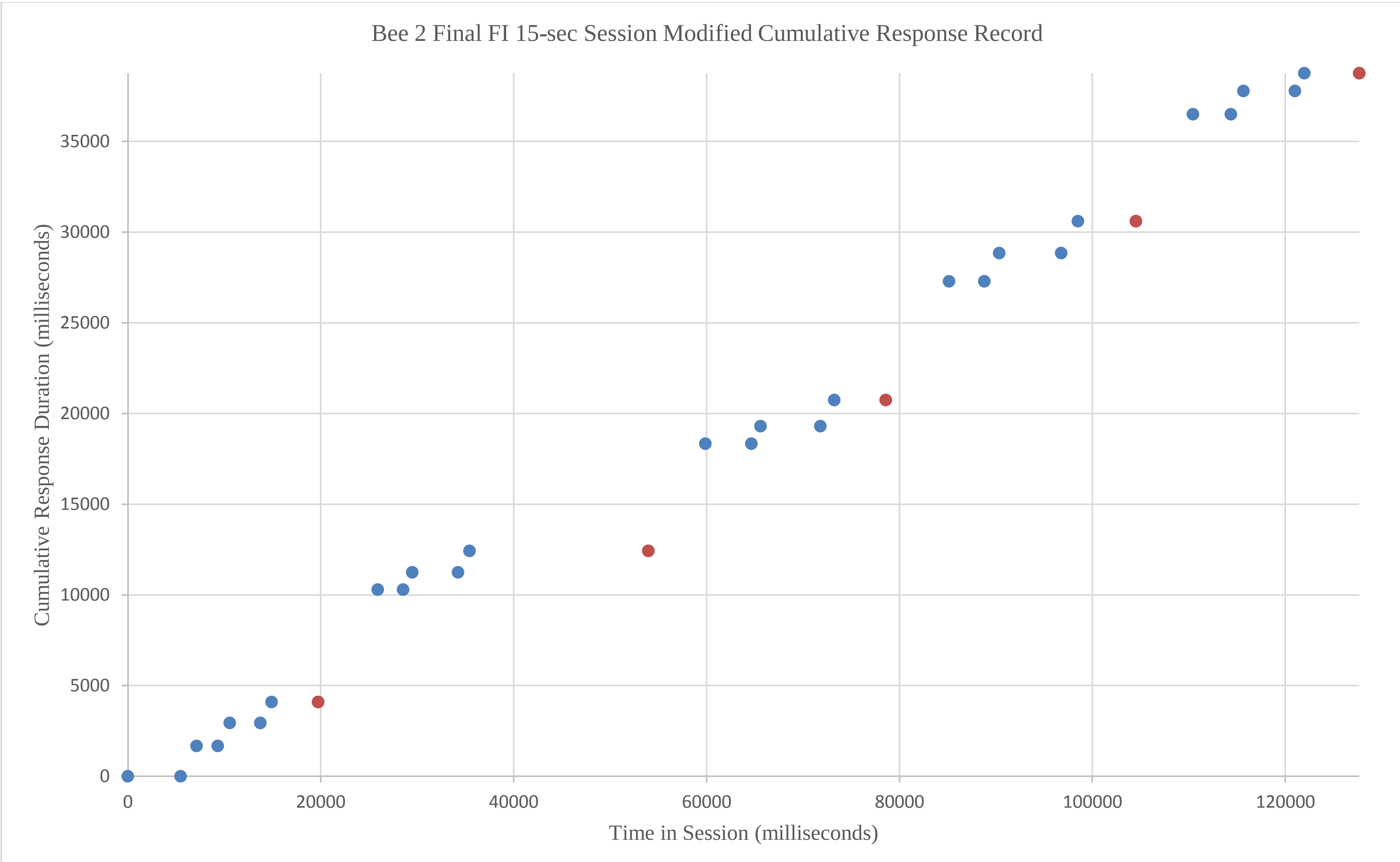

Horse 11 Final FI 90-sec Session Modified Cumulative Response Record
Cumulative Response Duration (seconds)
0
50
100
150
200
250
300
350
400
450
0
1000
2000
3000
4000
5000
Time in Session (seconds)

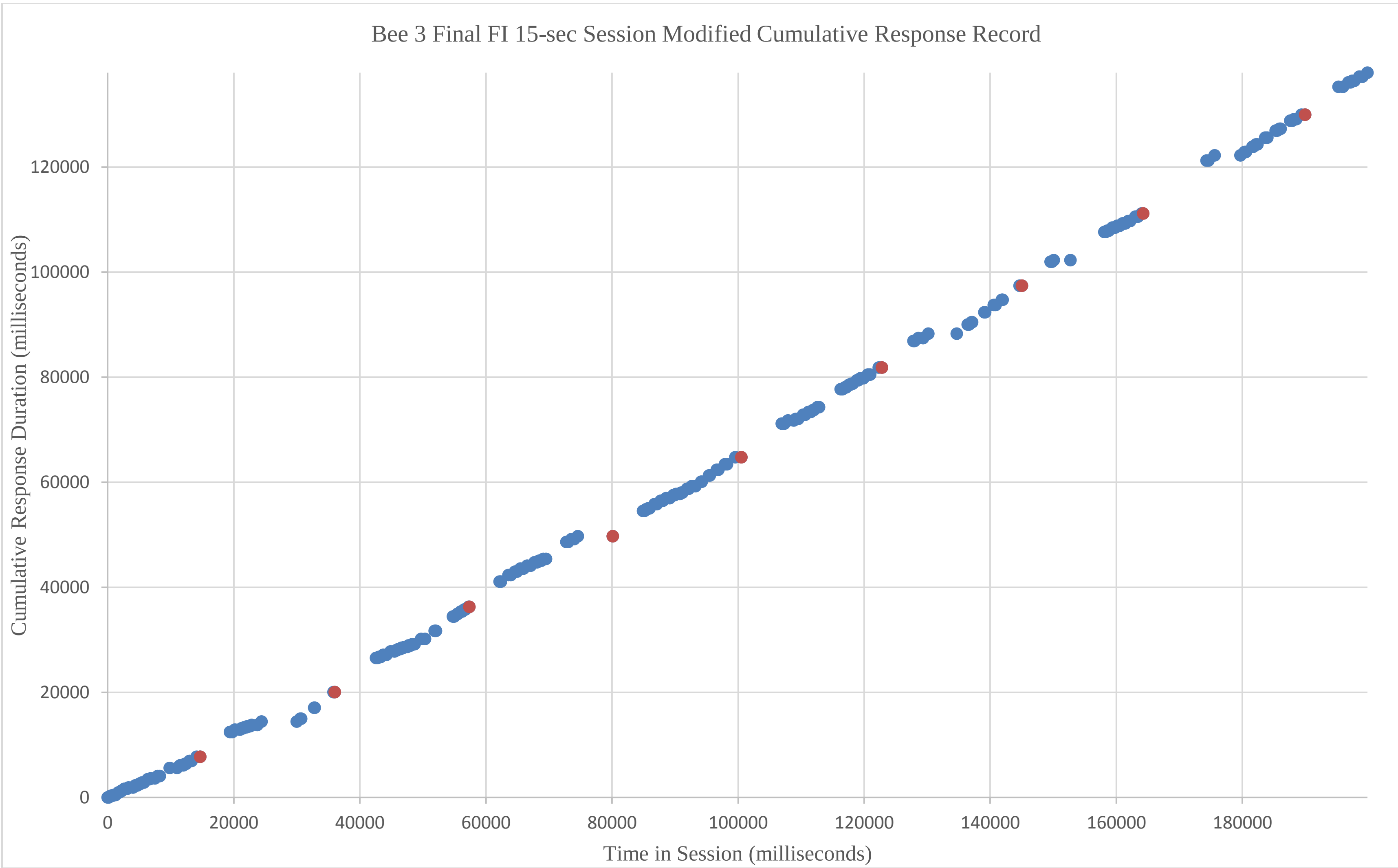

Horse 11 Final FI 180-sec Session Modified Cumulative Response Record
Cumulative Response Duration (seconds)
0
500
1000
1500
2000
2500
3000
3500
0
2000
4000
6000
8000
10000
12000
Time in Session (seconds)


Horse 13 Final FI 90-sec Session Modified Cumulative Response Record
Cumulative Response Duration (seconds)
0
100
200
300
400
500
600
700
800
0
1000
2000
3000
4000
5000
Time in Session (seconds)

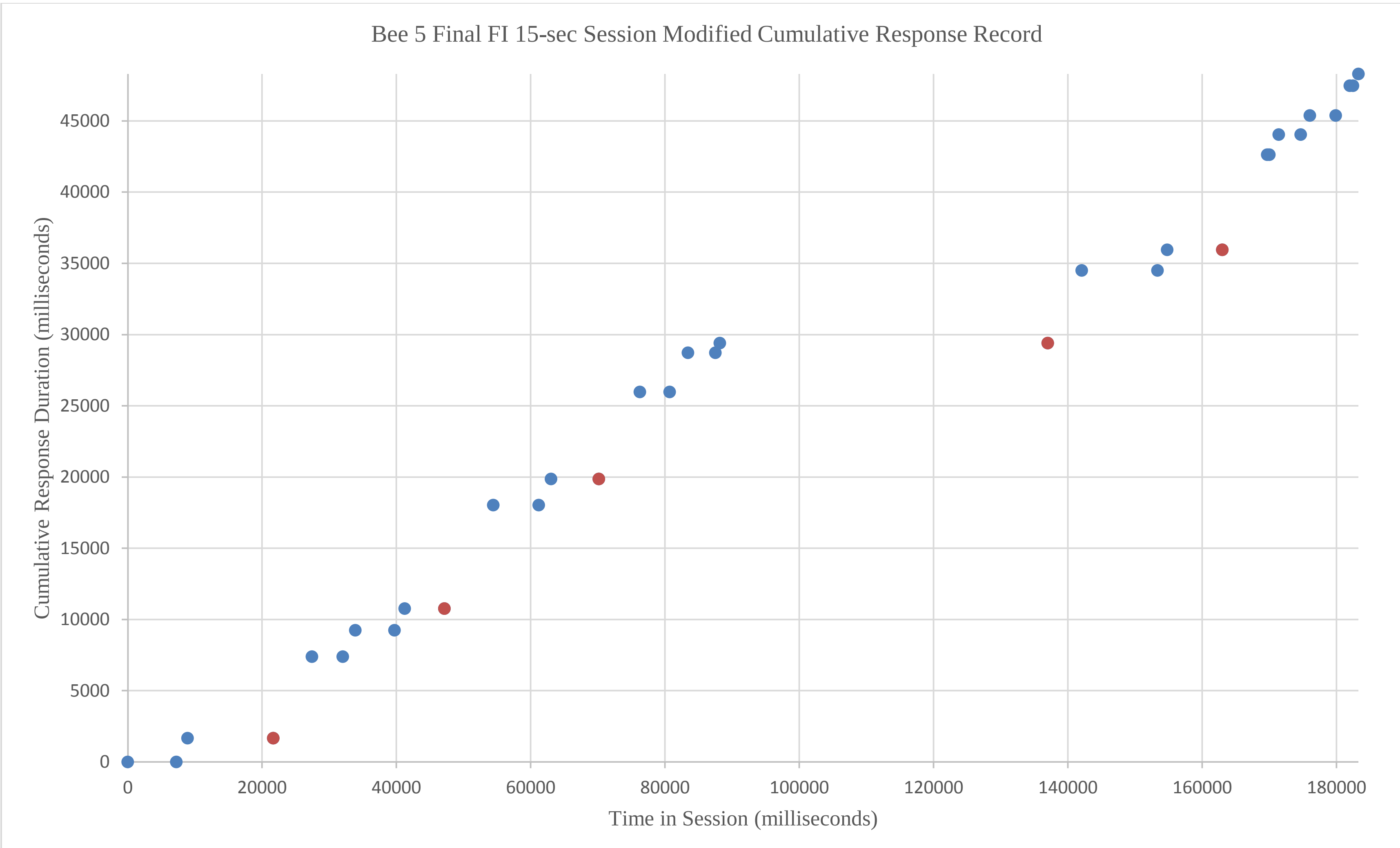


Horse 14 Final FI 60-sec Session Modified Cumulative Response Record
Cumulative Response Duration (seconds)
0
10
20
30
40
50
60
70
80
0
500
1000
1500
2000
2500
3000
Time in Session (seconds)

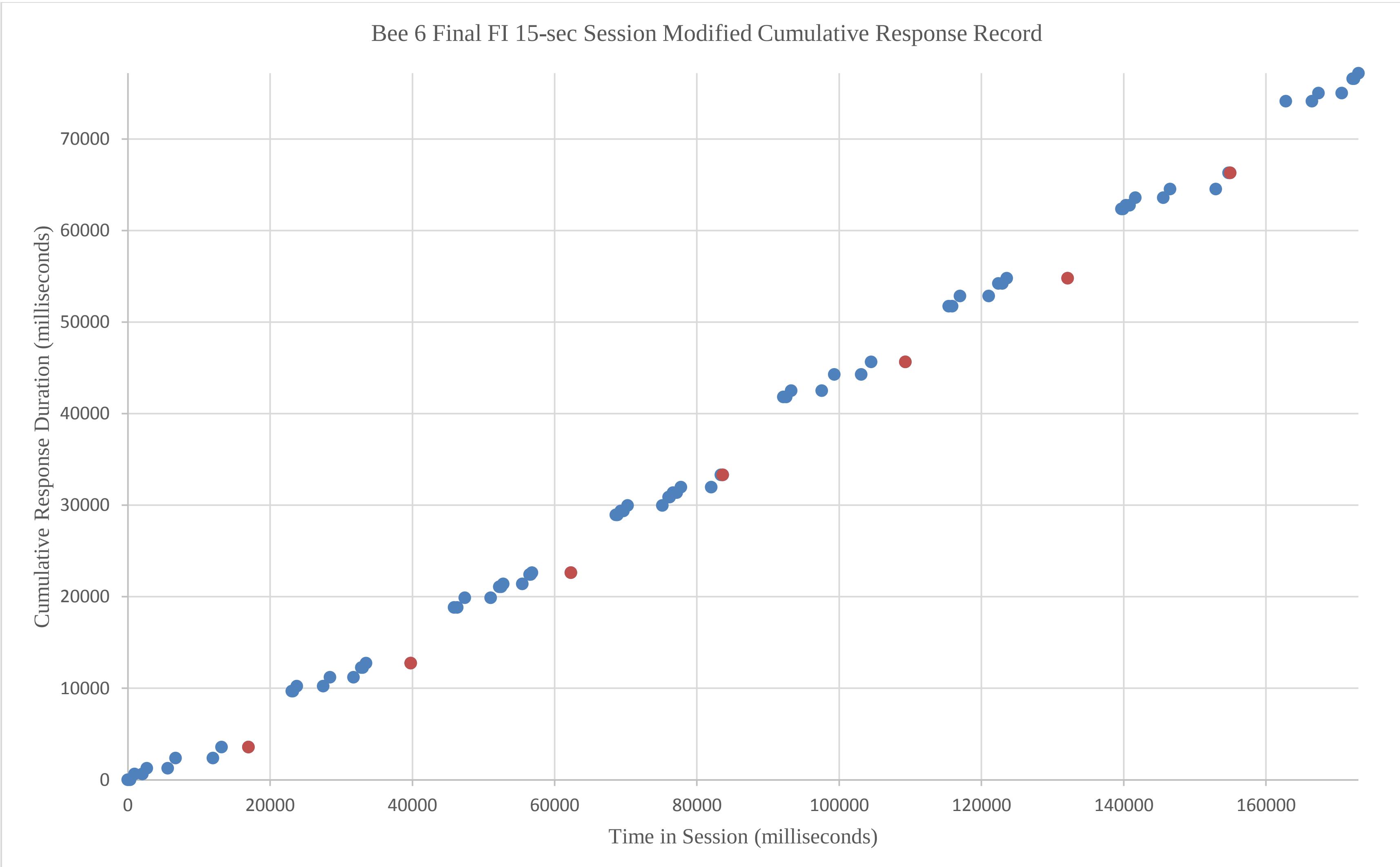

Bee 2 Final FI 15-sec Session Modified Cumulative Response Record
Cumulative Response Duration (milliseconds)
35000
30000
25000
20000
15000
10000
5000
0
0
20000
40000
60000
80000
100000
120000
Time in Session (milliseconds)



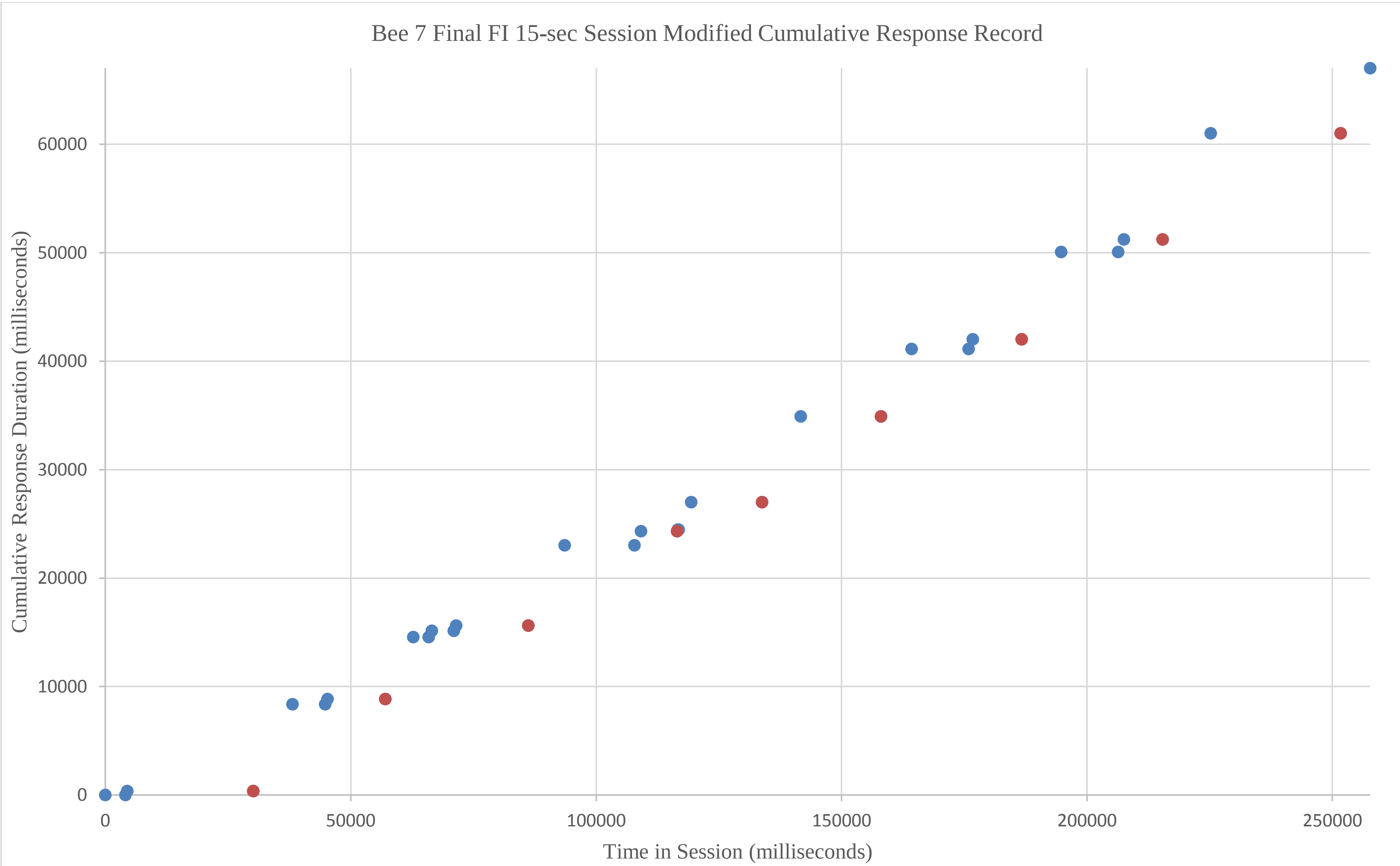
Bee 3 Final FI 15-sec Session Modified Cumulative Response Record
Cumulative Response Duration (milliseconds)
0
20000
40000
60000
80000
100000
120000
0
20000
40000
60000
80000
100000
120000
140000
160000
180000
Time in Session (milliseconds)



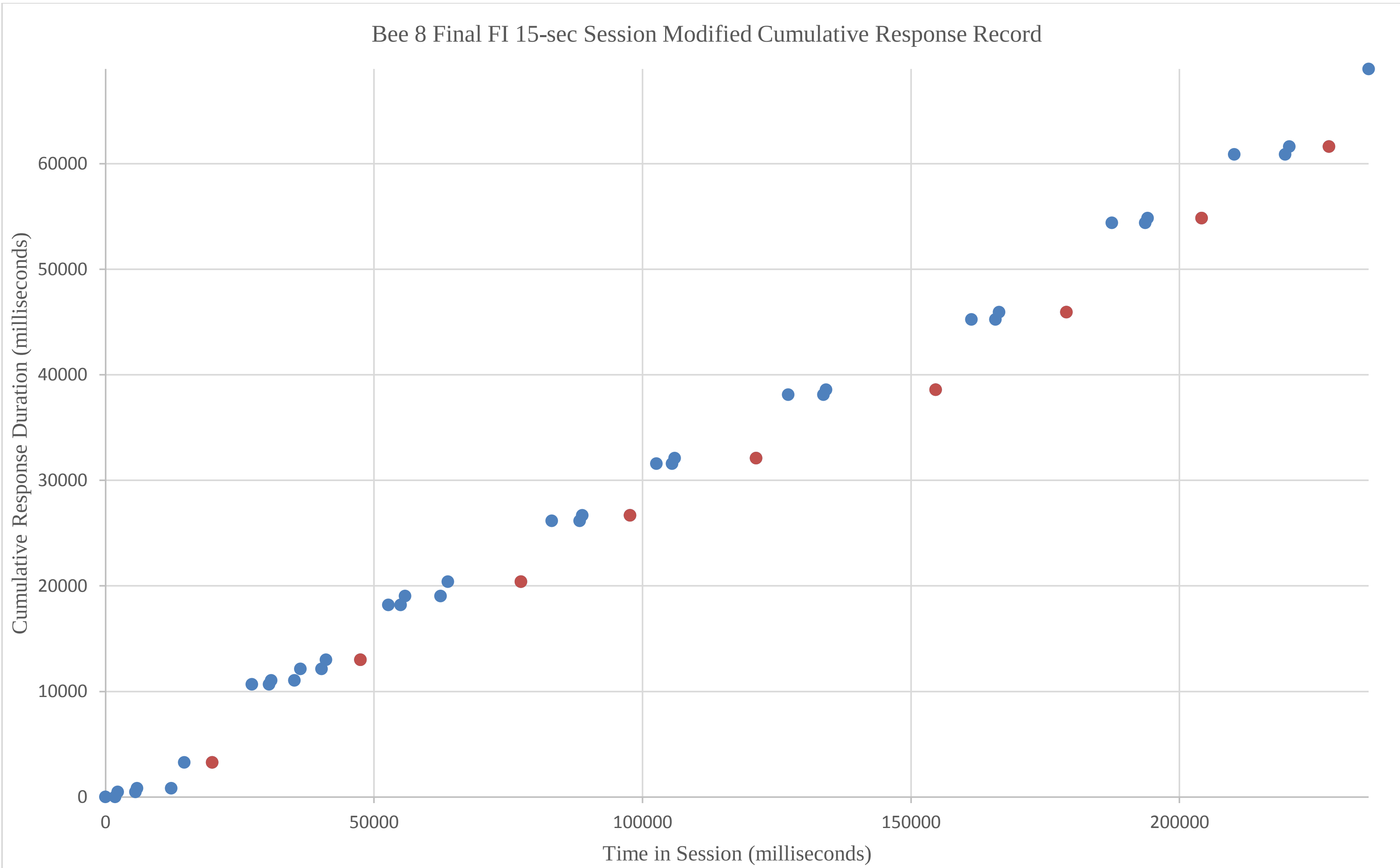
Bee 5 Final FI 15-sec Session Modified Cumulative Response Record
Cumulative Response Duration (milliseconds)
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
0
20000
40000
60000
80000
100000
120000
140000
160000
180000
Time in Session (milliseconds)

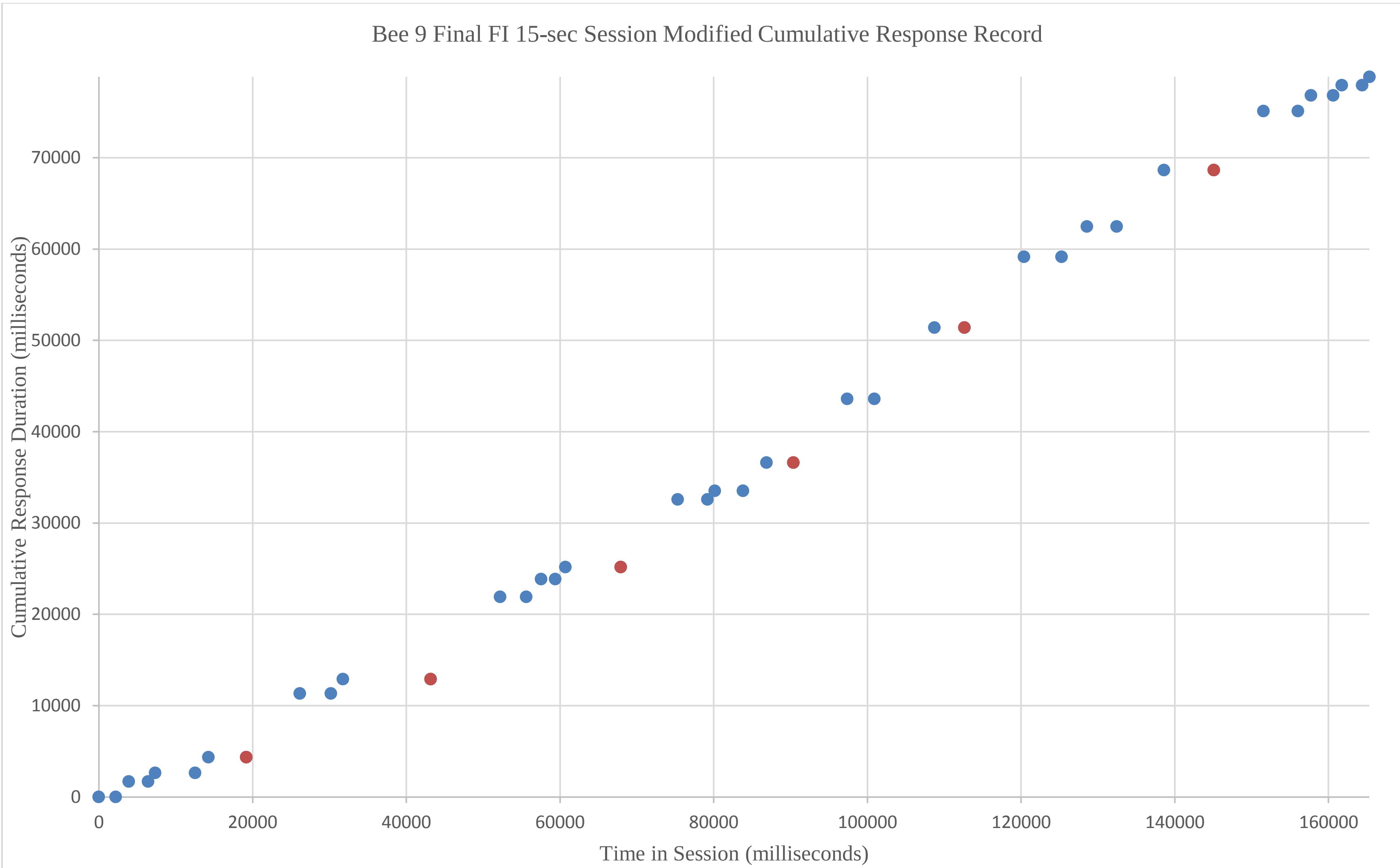


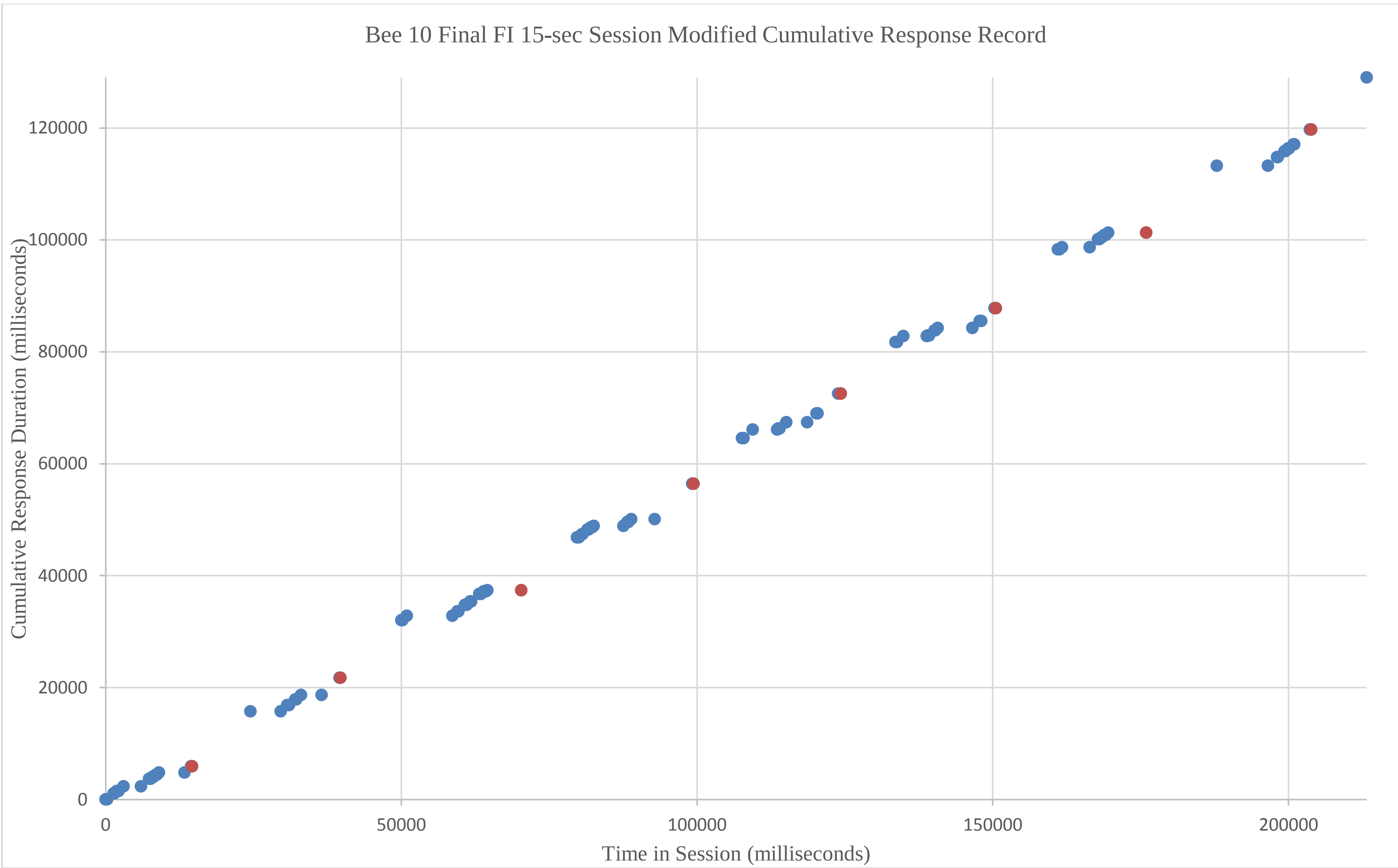
Bee 6 Final FI 15-sec Session Modified Cumulative Response Record
Cumulative Response Duration (milliseconds)
0
10000
20000
30000
40000
50000
60000
70000
0
20000
40000
60000
80000
100000
120000
140000
160000
Time in Session (milliseconds)

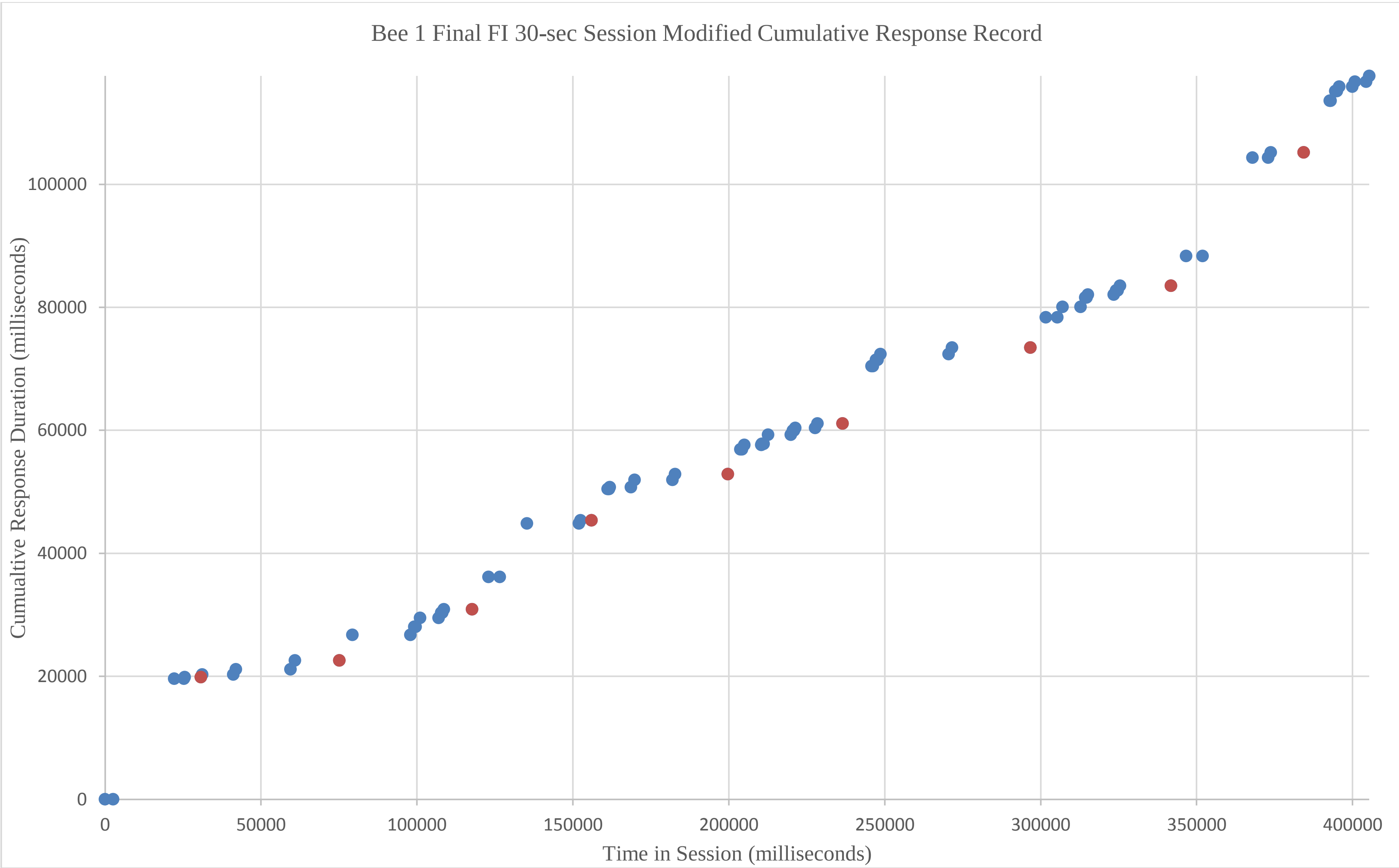


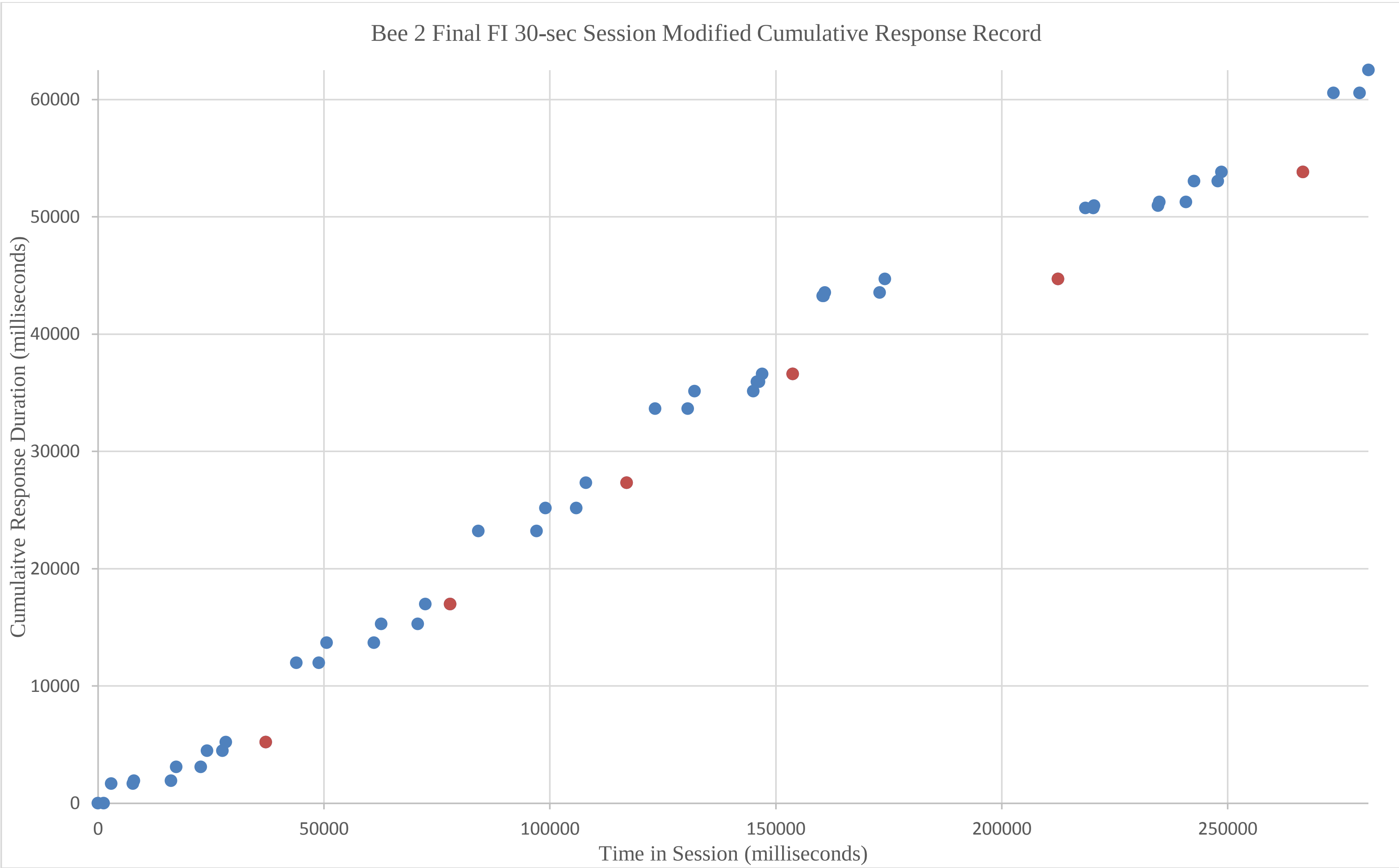
Bee 7 Final FI 15-sec Session Modified Cumulative Response Record
Cumulative Response Duration (milliseconds)
0
10000
20000
30000
40000
50000
60000
0
50000
100000
150000
200000
250000
Time in Session (milliseconds)

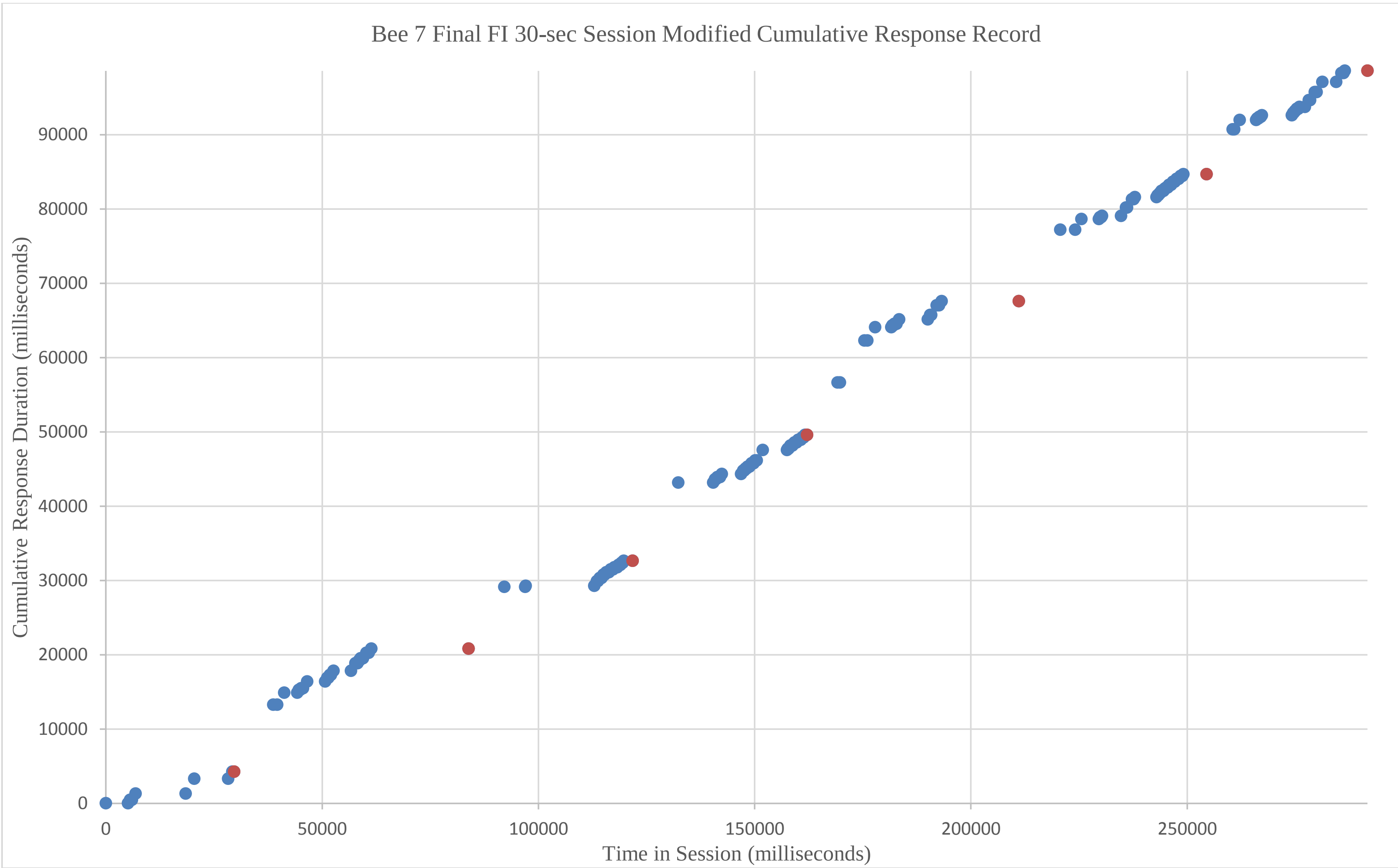

Bee 8 Final FI 15-sec Session Modified Cumulative Response Record
Cumulative Response Duration (milliseconds)
0
10000
20000
30000
40000
50000
60000
0
50000
100000
150000
200000
Time in Session (milliseconds)

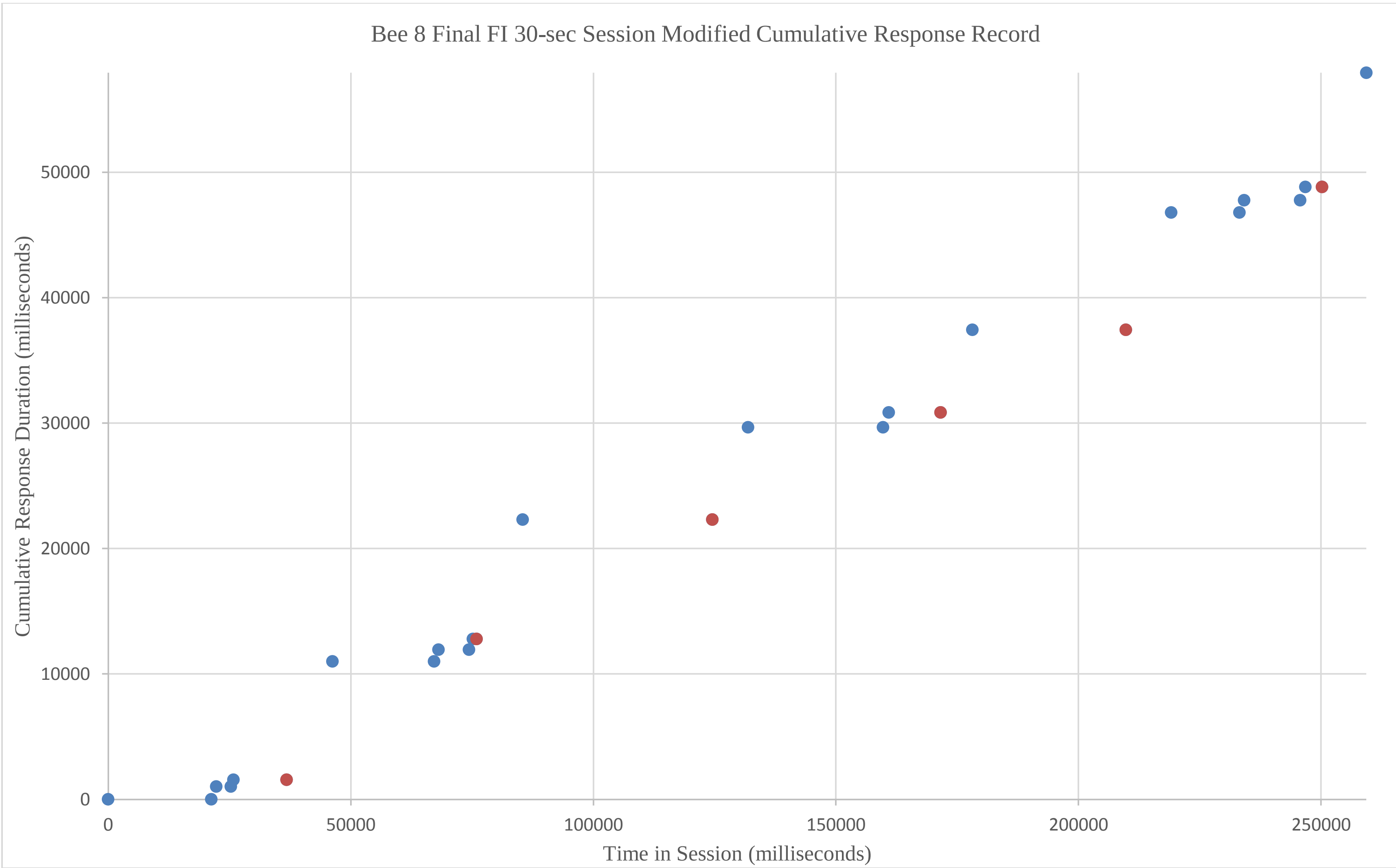

Bee 9 Final FI 15-sec Session Modified Cumulative Response Record
Cumulative Response Duration (milliseconds)
70000
60000
50000
40000
30000
20000
10000
0
0
20000
40000
60000
80000
100000
120000
140000
160000
Time in Session (milliseconds)

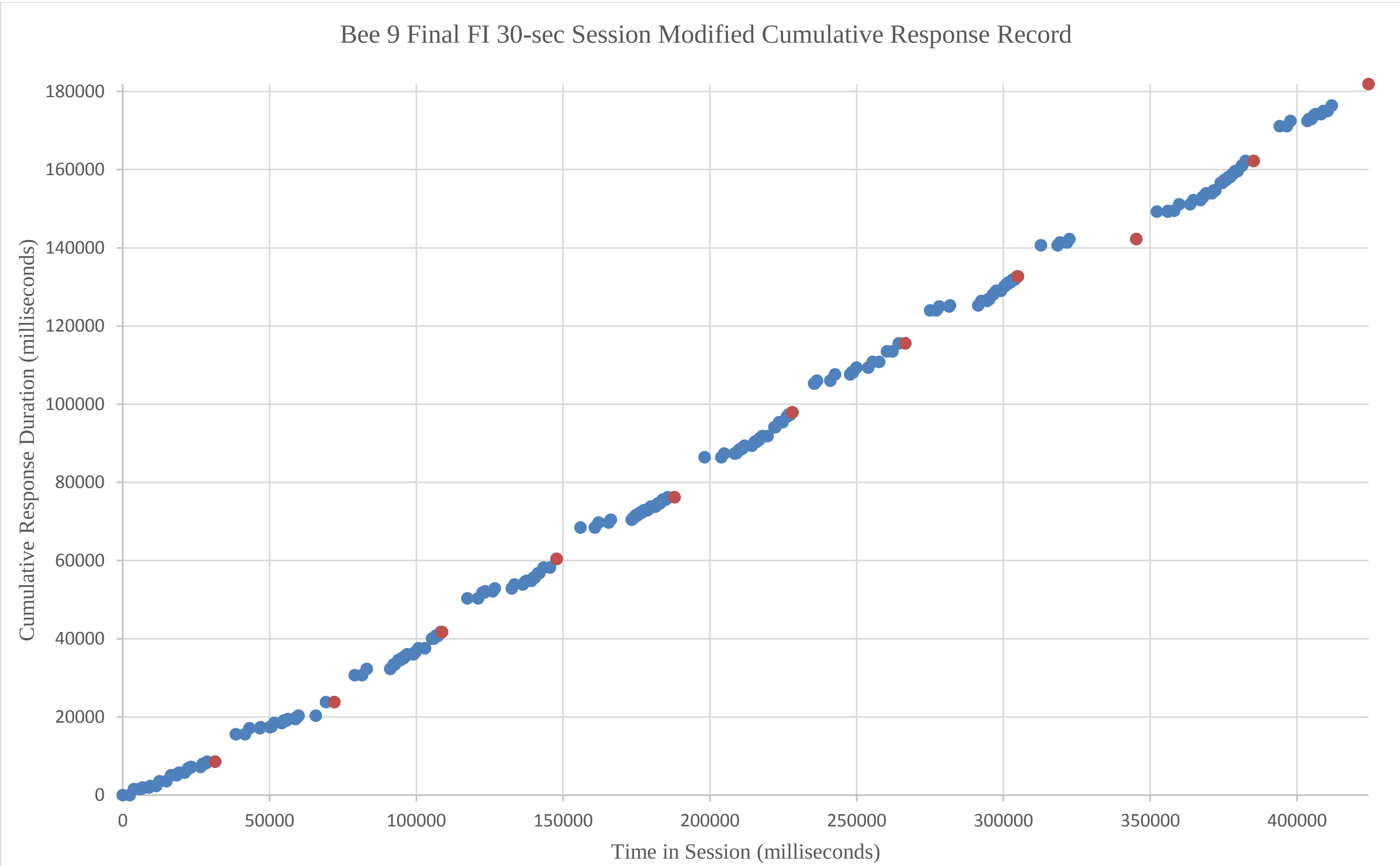

Bee 10 Final FI 15-sec Session Modified Cumulative Response Record
Cumulative Response Duration (milliseconds)
0
20000
40000
60000
80000
100000
120000
0
50000
100000
150000
200000
Time in Session (milliseconds)


Bee 1 Final FI 30-sec Session Modified Cumulative Response Record
Cumualtive Response Duration (milliseconds)
0
20000
40000
60000
80000
100000
0
50000
100000
150000
200000
250000
300000
350000
400000
Time in Session (milliseconds)


Bee 2 Final FI 30-sec Session Modified Cumulative Response Record
Cumulaitve Response Duration (milliseconds)
0
10000
20000
30000
40000
50000
60000
0
50000
100000
150000
200000
250000
Time in Session (milliseconds)


Bee 7 Final FI 30-sec Session Modified Cumulative Response Record
Cumulative Response Duration (milliseconds)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
50000
100000
150000
200000
250000
Time in Session (milliseconds)


Bee 8 Final FI 30-sec Session Modified Cumulative Response Record
Cumulative Response Duration (milliseconds)
0
10000
20000
30000
40000
50000
Time in Session (milliseconds)
0
50000
100000
150000
200000
250000



Bee 9 Final FI 30-sec Session Modified Cumulative Response Record
Cumulative Response Duration (milliseconds)
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
0
50000
100000
150000
200000
250000
300000
350000
400000
Time in Session (milliseconds)

Appendix 3: Response Bin OOM

Horse 0-60-P Two Bin OOM

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-60-P	FI 60-sec	Horse 6	1=2	0	0	0	1
0-60-P	FI 60-sec	Horse 6	Combinations 1=2	4.04	4.04	4.04	1
0-60-P	FI 60-sec	Horse 6	1>2	0	26.00	74.00	1
0-60-P	FI 60-sec	Horse 6	Combinations 1>2	1.92	44.08	50.80	1
0-60-P	FI 60-sec	Horse 6	1<2	**100**	**30.00**	**72.00**	**0.001**
0-60-P	FI 60-sec	Horse 6	Combinations 1<2	**94.04**	**44.48**	**51.92**	**0.001**
0-60-P	FI 60-sec	Horse 9	1=2	6.00	6.00	6.00	1
0-60-P	FI 60-sec	Horse 9	Combinations 1=2	5.40	5.40	5.40	1
0-60-P	FI 60-sec	Horse 9	1>2	0	28.00	68.00	1
0-60-P	FI 60-sec	Horse 9	Combinations 1>2	1.92	44.32	50.60	1
0-60-P	FI 60-sec	Horse 9	1<2	**94.00**	**24.00**	**70.00**	**0.001**
0-60-P	FI 60-sec	Horse 9	Combinations 1<2	**92.68**	**43.92**	**50.45**	**0.001**
0-60-P	FI 60-sec	Horse 14	1=2	0	0	0	1
0-60-P	FI 60-sec	Horse 14	Combinations 1=2	1.92	1.92	1.92	1
0-60-P	FI 60-sec	Horse 14	1>2	0	26.00	72.00	1
0-60-P	FI 60-sec	Horse 14	Combinations 1>2	2.24	45.72	52.16	1
0-60-P	FI 60-sec	Horse 14	1<2	**100**	**28.00**	**72.00**	**0.001**
0-60-P	FI 60-sec	Horse 14	Combinations 1<2	**95.84**	**46.00**	**52.40**	**0.001**
0-60-P	FI 60-sec	All	1=2	2.00	2.00	2.00	1
0-60-P	FI 60-sec	All	Combinations 1=2	4.20	4.20	4.20	1
0-60-P	FI 60-sec	All	1>2	0	32.67	62.67	1
0-60-P	FI 60-sec	All	Combinations 1>2	2.21	46.82	48.91	1
0-60-P	FI 60-sec	All	1<2	**98.00**	**35.33**	**60.67**	**0.001**
0-60-P	FI 60-sec	All	Combinations 1<2	**93.59**	**46.93**	**49.00**	**0.001**

Horse 0-60-P Four Bin OOM

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-60-P	FI 60-sec	Horse 6	1=2=3=4	25.00	25.00	25.00	1
0-60-P	FI 60-sec	Horse 6	Complete 1=2=3=4	0	0	0	1
0-60-P	FI 60-sec	Horse 6	1>2>3>4	4.67	27.00	46.67	1
0-60-P	FI 60-sec	Horse 6	Complete 1>2>3>4	0	0	6.00	1
0-60-P	FI 60-sec	Horse 6	1<2<3<4	70.33	27.33	48.67	0.001
0-60-P	FI 60-sec	Horse 6	Complete 1<2<3<4	10	0	6.00	0.001
0-60-P	FI 60-sec	Horse 6	1=2<3<4	**76.67**	**25.33**	**50.00**	**0.001**
0-60-P	FI 60-sec	Horse 6	Complete 1=2<3<4	**28.00**	**0**	**14.00**	**0.001**
0-60-P	FI 60-sec	Horse 6	1=2=3<4	66.00	19.00	44.33	0.001
0-60-P	FI 60-sec	Horse 6	Complete 1=2=3<4	28.00	0	18.00	0.001
0-60-P	FI 60-sec	Horse 9	1=2=3=4	32.33	32.33	32.33	1
0-60-P	FI 60-sec	Horse 9	Complete 1=2=3=4	0	0	0	1
0-60-P	FI 60-sec	Horse 9	1>2>3>4	4.00	26.00	43.00	1
0-60-P	FI 60-sec	Horse 9	Complete 1>2>3>4	0	0	2.00	1
0-60-P	FI 60-sec	Horse 9	1<2<3<4	63.67	24.67	42.67	0.001
0-60-P	FI 60-sec	Horse 9	Complete 1<2<3<4	2.00	0	2.00	0.04
0-60-P	FI 60-sec	Horse 9	1=2<3<4	72.67	19.33	48.33	0.001
0-60-P	FI 60-sec	Horse 9	Complete 1=2<3<4	20.00	0	14.00	0.001
0-60-P	FI 60-sec	Horse 9	1=2=3<4	**72.33**	**21.00**	**46.67**	**0.001**
0-60-P	FI 60-sec	Horse 9	Complete 1=2=3<4	**40.00**	**0**	**24.00**	**0.001**
0-60-P	FI 60-sec	Horse 14	1=2=3=4	36.00	36.00	36.00	1
0-60-P	FI 60-sec	Horse 14	Complete 1=2=3=4	0	0	0	1
0-60-P	FI 60-sec	Horse 14	1>2>3>4	2.33	23.67	39.67	1
0-60-P	FI 60-sec	Horse 14	Complete 1>2>3>4	0	0	4.00	1
0-60-P	FI 60-sec	Horse 14	1<2<3<4	61.67	26.67	40.67	0.001
0-60-P	FI 60-sec	Horse 14	Complete 1<2<3<4	0	0	2.00	1
0-60-P	FI 60-sec	Horse 14	1=2<3<4	74.67	21.00	45.67	0.001
0-60-P	FI 60-sec	Horse 14	Complete 1=2<3<4	22.00	0	12.00	0.001
0-60-P	FI 60-sec	Horse 14	1=2=3<4	**81.67**	**20.00**	**49.33**	**0.001**
0-60-P	FI 60-sec	Horse 14	Complete 1=2=3<4	**56.00**	**2.00**	**32.00**	**0.001**
0-60-P	FI 60-sec	All	1=2=3=4	31.11	31.11	31.11	1
0-60-P	FI 60-sec	All	Complete 1=2=3=4	0	0	0	1
0-60-P	FI 60-sec	All	1>2>3>4	3.67	29.11	39.33	1
0-60-P	FI 60-sec	All	Complete 1>2>3>4	0	0	2.00	1
0-60-P	FI 60-sec	All	1<2<3<4	65.22	29.11	40.78	0.001
0-60-P	FI 60-sec	All	Complete 1<2<3<4	4.00	0	2.67	0.001
0-60-P	FI 60-sec	All	1=2<3<4	74.67	26.89	41.22	0.001
0-60-P	FI 60-sec	All	Complete 1=2<3<4	23.33	0	7.33	0.001
0-60-P	FI 60-sec	All	1=2=3<4	**74.00**	**26.67**	**42.78**	**0.001**

0-60-P	FI 60-sec	All	Complete 1=2=3<4	**41.33**	**3.33**	**18.00**	**0.001**

Horse 0-60-P Ten Bin OOM

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-60-P	FI 60-sec	Horse 6	1>…>10	4.84	20.44	28.89	1
0-60-P	FI 60-sec	Horse 6	Complete 1>…>10	0	0	0	1
0-60-P	FI 60-sec	Horse 6	1<…<10	**44.04**	**18.76**	**28.84**	**0.001**
0-60-P	FI 60-sec	Horse 6	Complete 1<…<10	0	0	0	1
0-60-P	FI 60-sec	Horse 9	1>…>10	5.11	16.22	24.36	1
0-60-P	FI 60-sec	Horse 9	Complete 1>…>10	0	0	0	1
0-60-P	FI 60-sec	Horse 9	1<…<10	**35.64**	**16.89**	**24.4**	**0.001**
0-60-P	FI 60-sec	Horse 9	Complete 1<…<10	0	0	0	1
0-60-P	FI 60-sec	Horse 14	1>…>10	2.49	15.42	23.87	1
0-60-P	FI 60-sec	Horse 14	Complete 1>…>10	0	0	0	1
0-60-P	FI 60-sec	Horse 14	1<…<10	**36.98**	**16.00**	**23.47**	**0.001**
0-60-P	FI 60-sec	Horse 14	Complete 1<…<10	0	0	0	1
0-60-P	FI 60-sec	All	1>…>10	4.15	19.01	23.56	1
0-60-P	FI 60-sec	All	Complete 1>…>10	0	0	0	1
0-60-P	FI 60-sec	All	1<…<10	**38.89**	**18.44**	**23.63**	**0.001**
0-60-P	FI 60-sec	All	Complete 1<…<10	0	0	0	1

Horse 0-60-P 20 Bin OOM

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-60-P	FI 60-sec	Horse 6	1>…>20	5.06	48.08	18.80	1
0-60-P	FI 60-sec	Horse 6	Complete 1>…>20	0	0	0	1
0-60-P	FI 60-sec	Horse 6	1<…<20	**27.52**	**13.89**	**18.73**	**0.001**
0-60-P	FI 60-sec	Horse 6	Complete 1<…<20	0	0	0	1
0-60-P	FI 60-sec	Horse 9	1>…>20	3.87	10.49	15.11	1
0-60-P	FI 60-sec	Horse 9	Complete 1>…>20	0	0	0	1
0-60-P	FI 60-sec	Horse 9	1<…<20	**21.24**	**10.29**	**14.39**	**0.001**
0-60-P	FI 60-sec	Horse 9	Complete 1<…<20	0	0	0	1
0-60-P	FI 60-sec	Horse 14	1>…>20	2.65	10.31	14.85	1
0-60-P	FI 60-sec	Horse 14	Complete 1>…>20	0	0	0	1
0-60-P	FI 60-sec	Horse 14	1<…<20	**23.15**	**10.60**	**14.91**	**0.001**
0-60-P	FI 60-sec	Horse 14	Complete 1<…<20	0	0	0	1
0-60-P	FI 60-sec	All	1>…>20	3.86	12.56	15.35	1
0-60-P	FI 60-sec	All	Complete 1>…>20	0	0	0	1
0-60-P	FI 60-sec	All	1<…<20	**23.97**	**12.67**	**15.27**	**0.001**
0-60-P	FI 60-sec	All	Complete 1<…<20	0	0	0	1

Horse 0-90-P Two Bin OOM

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-90-P	FI 90-sec	Horse 1	1=2	0	0	0	1
0-90-P	FI 90-sec	Horse 1	Combinations 1=2	3.92	3.92	3.92	1
0-90-P	FI 90-sec	Horse 1	1>2	2.00	30.00	76.00	1
0-90-P	FI 90-sec	Horse 1	Combinations 1>2	4.24	45.16	51.28	1
0-90-P	FI 90-sec	Horse 1	1<2	**98.00**	**30.00**	**74.00**	**0.001**
0-90-P	FI 90-sec	Horse 1	Combinations 1<2	**91.84**	**45.2**	**51.28**	**0.001**
0-90-P	FI 90-sec	Horse 10	1=2	4.00	4.00	4.00	1
0-90-P	FI 90-sec	Horse 10	Combinations 1=2	8.52	8.52	8.52	1
0-90-P	FI 90-sec	Horse 10	1>2	2.00	26.00	70.00	1
0-90-P	FI 90-sec	Horse 10	Combinations 1>2	4.64	42.8	48.6	1
0-90-P	FI 90-sec	Horse 10	1<2	**94.00**	**26.00**	**70.00**	**0.001**
0-90-P	FI 90-sec	Horse 10	Combinations 1<2	**86.84**	**42.84**	**48.88**	**0.001**
0-90-P	FI 90-sec	Horse 13	1=2	2.00	2.00	2.00	1
0-90-P	FI 90-sec	Horse 13	Combinations 1=2	2.36	2.36	2.36	1
0-90-P	FI 90-sec	Horse 13	1>2	0	26.00	76.00	1
0-90-P	FI 90-sec	Horse 13	Combinations 1>2	1.92	45.76	51.48	1
0-90-P	FI 90-sec	Horse 13	1<2	**98.00**	**22.00**	**70.00**	**0.001**
0-90-P	FI 90-sec	Horse 13	Combinations 1<2	**95.72**	**45.72**	**51.80**	**0.001**
0-90-P	FI 90-sec	All	1=2	2.00	2.00	2.00	1
0-90-P	FI 90-sec	All	Combinations 1=2	5.08	5.08	5.08	1
0-90-P	FI 90-sec	All	1>2	1.33	38.00	62.00	1
0-90-P	FI 90-sec	All	Combinations 1>2	5.72	46.25	48.59	1
0-90-P	FI 90-sec	All	1<2	**96.67**	**34.67**	**65.33**	**0.001**
0-90-P	FI 90-sec	All	Combinations 1<2	**89.21**	**46.40**	**48.45**	**0.001**

Horse 0-90-P Four Bin OOM

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-90-P	FI 90-sec	Horse 1	1=2=3=4	17.33	17.33	17.33	1
0-90-P	FI 90-sec	Horse 1	Complete 1=2=3=4	0	0	0	1
0-90-P	FI 90-sec	Horse 1	1>2>3>4	10.00	30.67	52.67	1
0-90-P	FI 90-sec	Horse 1	Complete 1>2>3>4	0	0	10.00	1
0-90-P	FI 90-sec	Horse 1	1<2<3<4	**72.67**	**32.33**	**52.33**	**0.001**
0-90-P	FI 90-sec	Horse 1	Complete 1<2<3<4	8.00	0	10.00	0.01
0-90-P	FI 90-sec	Horse 1	1=2<3<4	68.00	26.33	47.33	0.001
0-90-P	FI 90-sec	Horse 1	Complete 1=2<3<4	14.00	0	8.00	0.001
0-90-P	FI 90-sec	Horse 1	1=2=3<4	52.33	19.33	43.67	0.001
0-90-P	FI 90-sec	Horse 1	Complete 1=2=3<4	14.00	0	12.00	0.001
0-90-P	FI 90-sec	Horse 10	1=2=3=4	30.00	30.00	30.00	1
0-90-P	FI 90-sec	Horse 10	Complete 1=2=3=4	0	0	0	1
0-90-P	FI 90-sec	Horse 10	1>2>3>4	8.33	26.33	45.33	1
0-90-P	FI 90-sec	Horse 10	Complete 1>2>3>4	1.00	0	4.00	1
0-90-P	FI 90-sec	Horse 10	1<2<3<4	61.67	25.67	45.67	0.001
0-90-P	FI 90-sec	Horse 10	Complete 1<2<3<4	2.00	0	4.00	0.12
0-90-P	FI 90-sec	Horse 10	1=2<3<4	66.67	22.67	49.67	0.001
0-90-P	FI 90-sec	Horse 10	Complete 1=2<3<4	10.00	0	14.00	0.01
0-90-P	FI 90-sec	Horse 10	1=2=3<4	**68.00**	**20.67**	**46.67**	**0.001**
0-90-P	FI 90-sec	Horse 10	Complete 1=2=3<4	**34.00**	**0**	**24.00**	**0.001**
0-90-P	FI 90-sec	Horse 13	1=2=3=4	20.67	20.67	20.67	1
0-90-P	FI 90-sec	Horse 13	Complete 1=2=3=4	0	0	0	1
0-90-P	FI 90-sec	Horse 13	1>2>3>4	4.00	27.67	49.33	1
0-90-P	FI 90-sec	Horse 13	Complete 1>2>3>4	0	0	8.00	1
0-90-P	FI 90-sec	Horse 13	1<2<3<4	75.33	30.33	50.33	0.001
0-90-P	FI 90-sec	Horse 13	Complete 1<2<3<4	14.00	0	8.00	0.001
0-90-P	FI 90-sec	Horse 13	1=2<3<4	**79.33**	**25.00**	**50.33**	**0.001**
0-90-P	FI 90-sec	Horse 13	Complete 1=2<3<4	**28.00**	**0**	**14.00**	**0.001**
0-90-P	FI 90-sec	Horse 13	1=2=3<4	61.33	18.00	42.00	0.001
0-90-P	FI 90-sec	Horse 13	Complete 1=2=3<4	18.00	0	12.00	0.001
0-90-P	FI 90-sec	All	1=2=3=4	22.67	22.67	22.67	1
0-90-P	FI 90-sec	All	Complete 1=2=3=4	0	0	0	1
0-90-P	FI 90-sec	All	1>2>3>4	7.44	32.89	45.44	1
0-90-P	FI 90-sec	All	Complete 1>2>3>4	1.00	0	4.00	1
0-90-P	FI 90-sec	All	1<2<3<4	69.89	32.22	45.44	0.001
0-90-P	FI 90-sec	All	Complete 1<2<3<4	8.00	0	4.00	0.001
0-90-P	FI 90-sec	All	1=2<3<4	**71.33**	**28.33**	**42.22**	**0.001**
0-90-P	FI 90-sec	All	Complete 1=2<3<4	**17.33**	**0**	**7.33**	**0.001**
0-90-P	FI 90-sec	All	1=2=3<4	60.56	23.56	38.33	0.001

0-90-P	FI 90-sec	All	Complete 1=2=3<4	22.00	1.33	10.64	0.001

Horse 0-90-P Ten Bin OOM

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-90-P	FI 90-sec	Horse 1	1>…>10	10.89	28.09	37.38	1
0-90-P	FI 90-sec	Horse 1	Complete 1>…>10	0	0	0	1
0-90-P	FI 90-sec	Horse 1	1<…<10	**54.44**	**26.84**	**37.82**	**0.001**
0-90-P	FI 90-sec	Horse 1	Complete 1<…<10	0	0	0	1
0-90-P	FI 90-sec	Horse 10	1>…>10	7.11	17.16	25.42	1
0-90-P	FI 90-sec	Horse 10	Complete 1>…>10	0	0	0	1
0-90-P	FI 90-sec	Horse 10	1<…<10	**36.00**	**17.69**	**26.22**	**0.001**
0-90-P	FI 90-sec	Horse 10	Complete 1<…<10	0	0	0	1
0-90-P	FI 90-sec	Horse 13	1>…>10	6.04	24.22	34.09	1
0-90-P	FI 90-sec	Horse 13	Complete 1>…>10	0	0	0	1
0-90-P	FI 90-sec	Horse 13	1<…<10	**51.51**	**24.62**	**33.91**	**0.001**
0-90-P	FI 90-sec	Horse 13	Complete 1<…<10	0	0	0	1
0-90-P	FI 90-sec	All	1>…>10	8.01	25.01	30.24	1
0-90-P	FI 90-sec	All	Complete 1>…>10	0	0	0	1
0-90-P	FI 90-sec	All	1<…<10	**47.32**	**25.53**	**30.16**	**0.001**
0-90-P	FI 90-sec	All	Complete 1<…<10	0	0	0	1

Horse 0-90-P 20 Bin OOM

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-90-P	FI 90-sec	Horse 1	1>…>20	10.05	21.07	26.79	1
0-90-P	FI 90-sec	Horse 1	Complete 1>…>20	0	0	0	1
0-90-P	FI 90-sec	Horse 1	1<…<20	**37.59**	**21.06**	**26.40**	**0.001**
0-90-P	FI 90-sec	Horse 1	Complete 1<…<20	0	0	0	1
0-90-P	FI 90-sec	Horse 10	1>…>20	5.39	11.18	15.83	1
0-90-P	FI 90-sec	Horse 10	Complete 1>…>20	0	0	0	1
0-90-P	FI 90-sec	Horse 10	1<…<20	**21.44**	**11.27**	**15.57**	**0.001**
0-90-P	FI 90-sec	Horse 10	Complete 1<…<20	0	0	0	1
0-90-P	FI 90-sec	Horse 13	1>…>20	6.16	17.71	22.91	1
0-90-P	FI 90-sec	Horse 13	Complete 1>…>20	0	0	0	1
0-90-P	FI 90-sec	Horse 13	1<…<20	**34.20**	**16.37**	**22.84**	**0.001**
0-90-P	FI 90-sec	Horse 13	Complete 1<…<20	0	0	0	1
0-90-P	FI 90-sec	All	1>…>20	7.20	17.31	20.56	1
0-90-P	FI 90-sec	All	Complete 1>…>20	0	0	0	1
0-90-P	FI 90-sec	All	1<…<20	**31.08**	**17.73**	**20.68**	**0.001**
0-90-P	FI 90-sec	All	Complete 1<…<20	0	0	0	1

Horse 0-180-P Two Bin OOM

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-180-P	FI 180-sec	Horse 3	1=2	0	0	0	1
0-180-P	FI 180-sec	Horse 3	Combinations 1=2	8.00	8.00	8.00	1
0-180-P	FI 180-sec	Horse 3	1>2	40.00	0	100	0.8
0-180-P	FI 180-sec	Horse 3	Combinations 1>2	28.00	16.00	76.00	0.98
0-180-P	FI 180-sec	Horse 3	1<2	60.00	0	100	0.49
0-180-P	FI 180-sec	Horse 3	Combinations 1<2	64.00	16.00	76.00	0.06

Horse 0-180-P Four Bin OOM

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-180-P	FI 180-sec	Horse 3	1=2=3=4	23.33	23.33	23.33	1
0-180-P	FI 180-sec	Horse 3	Complete 1=2=3=4	0	0	0	1
0-180-P	FI 180-sec	Horse 3	1>2>3>4	23.33	3.33	70.00	0.96
0-180-P	FI 180-sec	Horse 3	Complete 1>2>3>4	0	0	20.00	1
0-180-P	FI 180-sec	Horse 3	1<2<3<4	53.33	10.00	66.67	0.1
0-180-P	FI 180-sec	Horse 3	Complete 1<2<3<4	0	0	40.00	1
0-180-P	FI 180-sec	Horse 3	1=2<3<4	50.00	3.33	70.00	0.13
0-180-P	FI 180-sec	Horse 3	Complete 1=2<3<4	0	0	0	1
0-180-P	FI 180-sec	Horse 3	1=2=3<4	40.00	10.00	66.67	0.28
0-180-P	FI 180-sec	Horse 3	Complete 1=2=3<4	20.00	0	10.00	0.44

Horse 0-180-P Ten Bin OOM

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-180-P	FI 180-sec	Horse 3	1>…>10	20.89	13.33	44.00	0.97
0-180-P	FI 180-sec	Horse 3	Complete 1>…>10	0	0	0	1
0-180-P	FI 180-sec	Horse 3	1<…<10	36.89	13.33	43.11	0.06
0-180-P	FI 180-sec	Horse 3	Complete 1<…<10	0	0	0	1

Horse 0-180-P 20 Bin OOM

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-180-P	FI 180-sec	Horse 3	1>…>20	15.89	13.05	29.89	0.98
0-180-P	FI 180-sec	Horse 3	Complete 1>…>20	0	0	0	1
0-180-P	FI 180-sec	Horse 3	1<…<20	**26.74**	**12.74**	**30.42**	**0.02**
0-180-P	FI 180-sec	Horse 3	Complete 1<…<20	0	0	0	1

Horse 0-60/90/180-P Two Bin OOM

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-60/90/180-P	FI 60-sec	Horse 4	1=2	6.00	6.00	6.00	1
0-60/90/180-P	FI 60-sec	Horse 4	Combinations 1=2	10.28	10.28	10.28	1
0-60/90/180-P	FI 60-sec	Horse 4	1>2	0	26.00	72.00	1
0-60/90/180-P	FI 60-sec	Horse 4	Combinations 1>2	3.60	41.92	48.28	1
0-60/90/180-P	FI 60-sec	Horse 4	1<2	**94.00**	**26.00**	**72.00**	**0.001**
0-60/90/180-P	FI 60-sec	Horse 4	Combinations 1<2	**86.12**	**41.64**	**47.52**	**0.001**
0-60/90/180-P	FI 90-sec	Horse 4	1=2	8.00	8.00	8.00	1
0-60/90/180-P	FI 90-sec	Horse 4	Combinations 1=2	6.48	6.48	6.48	1
0-60/90/180-P	FI 90-sec	Horse 4	1>2	4.00	24.00	68.00	1
0-60/90/180-P	FI 90-sec	Horse 4	Combinations 1>2	3.40	43.52	49.32	1
0-60/90/180-P	FI 90-sec	Horse 4	1<2	**88.00**	**26.00**	**68.00**	**0.001**
0-60/90/180-P	FI 90-sec	Horse 4	Combinations 1<2	**90.12**	**43.56**	**49.52**	**0.001**
0-60/90/180-P	FI 180-sec	Horse 4	1=2	20.00	20.00	20.00	1
0-60/90/180-P	FI 180-sec	Horse 4	Combinations 1=2	4.00	4.00	4.00	1
0-60/90/180-P	FI 180-sec	Horse 4	1>2	60.00	0	80.00	0.34
0-60/90/180-P	FI 180-sec	Horse 4	Combinations 1>2	64.00	20.00	76.00	0.07
0-60/90/180-P	FI 180-sec	Horse 4	1<2	20.00	0	80.00	0.93
0-60/90/180-P	FI 180-sec	Horse 4	Combinations 1<2	32.00	16.00	76.00	0.97
0-60/90/180-P	FI 60-sec	Horse 11	1=2	4.00	4.00	4.00	1
0-60/90/180-P	FI 60-sec	Horse 11	Combinations 1=2	1.84	1.84	1.84	1
0-60/90/180-P	FI 60-sec	Horse 11	1>2	0	26.00	70.00	1
0-60/90/180-P	FI 60-sec	Horse 11	Combinations 1>2	1.92	46.44	52.16	1
0-60/90/180-P	FI 60-sec	Horse 11	1<2	**96.00**	**28.00**	**72.00**	**0.001**
0-60/90/180-P	FI 60-sec	Horse 11	Combinations 1<2	**96.24**	**45.96**	**52.12**	**0.001**
0-60/90/180-P	FI 90-sec	Horse 11	1=2	2.00	2.00	2.00	1
0-60/90/180-P	FI 90-sec	Horse 11	Combinations 1=2	4.56	4.56	4.56	1
0-60/90/180-P	FI 90-sec	Horse 11	1>2	4.00	30.00	68.00	1
0-60/90/180-P	FI 90-sec	Horse 11	Combinations 1>2	4.04	43.72	50.56	1
0-60/90/180-P	FI 90-sec	Horse 11	1<2	**94.00**	**30.00**	**76.00**	**0.001**
0-60/90/180-P	FI 90-sec	Horse 11	Combinations 1<2	**91.40**	**44.20**	**50.48**	**0.001**
0-60/90/180-P	FI 180-sec	Horse 11	1=2	8.00	8.00	8.00	1
0-60/90/180-P	FI 180-sec	Horse 11	Combinations 1=2	7.12	7.12	7.12	1
0-60/90/180-P	FI 180-sec	Horse 11	1>2	4.00	26.00	70.00	1
0-60/90/180-P	FI 180-sec	Horse 11	Combinations 1>2	9.76	43.52	50.28	1
0-60/90/180-P	FI 180-sec	Horse 11	1<2	**88.00**	**28.00**	**68.00**	**0.001**
0-60/90/180-P	FI 180-sec	Horse 11	Combinations 1<2	**83.12**	**42.96**	**49.72**	**0.001**
0-60/90/180-P	FI 60-sec	All	1=2	5.00	5.00	5.00	1
0-60/90/180-P	FI 60-sec	All	Combinations 1=2	6.15	6.15	6.15	1
0-60/90/180-P	FI 60-sec	All	1>2	0	33.00	62.00	1

0-60/90/180-P	FI 60-sec	All	Combinations 1>2	2.96	45.33	48.34	1
0-60/90/180-P	FI 60-sec	All	1<2	**95.00**	**33.00**	**61.00**	**0.001**
0-60/90/180-P	FI 60-sec	All	Combinations 1<2	**90.89**	**45.41**	**48.39**	**0.001**
0-60/90/180-P	FI 90-sec	All	1=2	5.00	5.00	5.00	1
0-60/90/180-P	FI 90-sec	All	Combinations 1=2	6.30	6.30	6.30	1
0-60/90/180-P	FI 90-sec	All	1>2	4.00	30.00	62.00	1
0-60/90/180-P	FI 90-sec	All	Combinations 1>2	5.70	45.08	48.33	1
0-60/90/180-P	FI 90-sec	All	1<2	**91.00**	**32.00**	**63.00**	**0.001**
0-60/90/180-P	FI 90-sec	All	Combinations 1<2	**88.00**	**45.18**	**48.25**	**0.001**
0-60/90/180-P	FI 180-sec	All	1=2	9.09	9.09	9.09	1
0-60/90/180-P	FI 180-sec	All	Combinations 1=2	8.40	8.40	8.40	1
0-60/90/180-P	FI 180-sec	All	1>2	9.09	27.27	67.27	1
0-60/90/180-P	FI 180-sec	All	Combinations 1>2	12.83	42.94	48.76	1
0-60/90/180-P	FI 180-sec	All	1<2	**81.82**	**27.27**	**70.91**	**0.001**
0-60/90/180-P	FI 180-sec	All	Combinations 1<2	**78.78**	**43.17**	**48.43**	**0.001**

Horse 0-60/90/180-P Four Bin OOM

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-60/90/180-P	FI 60-sec	Horse 4	1=2=3=4	31.67	31.67	31.67	1
0-60/90/180-P	FI 60-sec	Horse 4	Complete 1=2=3=4	0	0	0	1
0-60/90/180-P	FI 60-sec	Horse 4	1>2>3>4	7.33	23.33	43.67	1
0-60/90/180-P	FI 60-sec	Horse 4	Complete 1>2>3>4	0	0	4.00	1
0-60/90/180-P	FI 60-sec	Horse 4	1<2<3<4	61.00	24.67	46.00	0.001
0-60/90/180-P	FI 60-sec	Horse 4	Complete 1<2<3<4	2.00	0	4.00	0.09
0-60/90/180-P	FI 60-sec	Horse 4	1=2<3<4	64.33	23.00	47.33	0.001
0-60/90/180-P	FI 60-sec	Horse 4	Complete 1=2<3<4	6.00	0	10.00	0.08
0-60/90/180-P	FI 60-sec	Horse 4	1=2=3<4	**62.33**	**23.00**	**45.00**	**0.001**
0-60/90/180-P	FI 60-sec	Horse 4	Complete 1=2=3<4	**26.00**	**0**	**16.00**	**0.001**
0-60/90/180-P	FI 90-sec	Horse 4	1=2=3=4	33.67	33.67	33.67	1
0-60/90/180-P	FI 90-sec	Horse 4	Complete 1=2=3=4	0	0	0	1
0-60/90/180-P	FI 90-sec	Horse 4	1>2>3>4	6.00	23.67	43.33	1
0-60/90/180-P	FI 90-sec	Horse 4	Complete 1>2>3>4	0	0	2.00	1
0-60/90/180-P	FI 90-sec	Horse 4	1<2<3<4	60.33	22.33	43.33	0.001
0-60/90/180-P	FI 90-sec	Horse 4	Complete 1<2<3<4	0	0	2.00	1
0-60/90/180-P	FI 90-sec	Horse 4	1=2<3<4	68.67	22.33	44.33	0.001
0-60/90/180-P	FI 90-sec	Horse 4	Complete 1=2<3<4	10.00	0	10.00	0.01
0-60/90/180-P	FI 90-sec	Horse 4	1=2=3<4	**67.67**	**21.33**	**46.33**	**0.001**
0-60/90/180-P	FI 90-sec	Horse 4	Complete 1=2=3<4	**32.00**	**0**	**20.00**	**0.001**
0-60/90/180-P	FI 180-sec	Horse 4	1=2=3=4	53.33	53.33	53.33	1
0-60/90/180-P	FI 180-sec	Horse 4	Complete 1=2=3=4	20.00	20.00	20.00	1
0-60/90/180-P	FI 180-sec	Horse 4	1>2>3>4	26.67	0	46.67	0.42
0-60/90/180-P	FI 180-sec	Horse 4	Complete 1>2>3>4	0	0	0	1
0-60/90/180-P	FI 180-sec	Horse 4	1<2<3<4	20.00	0	46.67	0.75
0-60/90/180-P	FI 180-sec	Horse 4	Complete 1<2<3<4	0	0	0	1
0-60/90/180-P	FI 180-sec	Horse 4	1=2<3<4	33.33	10	50.00	0.39
0-60/90/180-P	FI 180-sec	Horse 4	Complete 1=2<3<4	0	0	20.00	1
0-60/90/180-P	FI 180-sec	Horse 4	1=2=3<4	56.67	26.67	63.33	0.09
0-60/90/180-P	FI 180-sec	Horse 4	Complete 1=2=3<4	20.00	0	20.00	0.27
0-60/90/180-P	FI 60-sec	Horse 11	1=2=3=4	19.00	19.00	19.00	1
0-60/90/180-P	FI 60-sec	Horse 11	Complete 1=2=3=4	0	0	0	1
0-60/90/180-P	FI 60-sec	Horse 11	1>2>3>4	1.67	30.00	50.33	1
0-60/90/180-P	FI 60-sec	Horse 11	Complete 1>2>3>4	0	0	8.00	1
0-60/90/180-P	FI 60-sec	Horse 11	1<2<3<4	79.33	30.33	52.67	0.001
0-60/90/180-P	FI 60-sec	Horse 11	Complete 1<2<3<4	16.00	0	8.00	0.001
0-60/90/180-P	FI 60-sec	Horse 11	1=2<3<4	**80.67**	**23.67**	**48.67**	**0.001**
0-60/90/180-P	FI 60-sec	Horse 11	Complete 1=2<3<4	**30.00**	**0**	**10.00**	**0.001**
0-60/90/180-P	FI 60-sec	Horse 11	1=2=3<4	58.67	20.00	39.33	0.001

0-60/90/180-P	FI 60-sec	Horse 11	Complete 1=2=3<4	4.00	0	4.00	0.07
0-60/90/180-P	FI 90-sec	Horse 11	1=2=3=4	21.67	21.67	21.67	1
0-60/90/180-P	FI 90-sec	Horse 11	Complete 1=2=3=4	0	0	0	1
0-60/90/180-P	FI 90-sec	Horse 11	1>2>3>4	8.67	30.00	48.33	1
0-60/90/180-P	FI 90-sec	Horse 11	Complete 1>2>3>4	0	0	6.00	1
0-60/90/180-P	FI 90-sec	Horse 11	1<2<3<4	69.67	29.33	50.00	0.001
0-60/90/180-P	FI 90-sec	Horse 11	Complete 1<2<3<4	6.00	0	4.00	0.001
0-60/90/180-P	FI 90-sec	Horse 11	1=2<3<4	**71.67**	**23.00**	**48.00**	**0.001**
0-60/90/180-P	FI 90-sec	Horse 11	Complete 1=2<3<4	**20.00**	**0**	**16.00**	**0.001**
0-60/90/180-P	FI 90-sec	Horse 11	1=2=3<4	55.67	18.00	40.33	0.001
0-60/90/180-P	FI 90-sec	Horse 11	Complete 1=2=3<4	16.00	0	12.00	0.001
0-60/90/180-P	FI 180-sec	Horse 11	1=2=3=4	16.33	16.33	16.33	1
0-60/90/180-P	FI 180-sec	Horse 11	Complete 1=2=3=4	0	0	0	1
0-60/90/180-P	FI 180-sec	Horse 11	1>2>3>4	12.33	29.67	51.67	1
0-60/90/180-P	FI 180-sec	Horse 11	Complete 1>2>3>4	0	0	8.00	1
0-60/90/180-P	FI 180-sec	Horse 11	1<2<3<4	71.33	31.67	51.00	0.001
0-60/90/180-P	FI 180-sec	Horse 11	Complete 1<2<3<4	6.00	0	8.00	0.01
0-60/90/180-P	FI 180-sec	Horse 11	1=2<3<4	**63.33**	**27.67**	**48.00**	**0.001**
0-60/90/180-P	FI 180-sec	Horse 11	Complete 1=2<3<4	**12.00**	**0**	**10.00**	**0.001**
0-60/90/180-P	FI 180-sec	Horse 11	1=2=3<4	46.00	20.00	38.67	0.001
0-60/90/180-P	FI 180-sec	Horse 11	Complete 1=2=3<4	4.00	0	4.00	0.06
0-60/90/180-P	FI 60-sec	All	1=2=3=4	25.33	25.33	25.33	1
0-60/90/180-P	FI 60-sec	All	Complete 1=2=3=4	0	0	0	1
0-60/90/180-P	FI 60-sec	All	1>2>3>4	4.50	30.50	44.67	1
0-60/90/180-P	FI 60-sec	All	Complete 1>2>3>4	0	0	3.00	1
0-60/90/180-P	FI 60-sec	All	1<2<3<4	70.17	31.17	44.17	0.001
0-60/90/180-P	FI 60-sec	All	Complete 1<2<3<4	9.00	0	4.00	0.001
0-60/90/180-P	FI 60-sec	All	1=2<3<4	**72.50**	**28.00**	**43.17**	**0.001**
0-60/90/180-P	FI 60-sec	All	Complete 1=2<3<4	**18.00**	**0**	**7.00**	**0.001**
0-60/90/180-P	FI 60-sec	All	1=2=3<4	60.50	22.83	39.00	0.001
0-60/90/180-P	FI 60-sec	All	Complete 1=2=3<4	15.00	0	10.00	0.001
0-60/90/180-P	FI 90-sec	All	1=2=3=4	27.67	27.67	27.67	1
0-60/90/180-P	FI 90-sec	All	Complete 1=2=3=4	0	0	0	1
0-60/90/180-P	FI 90-sec	All	1>2>3>4	7.33	29.00	41.67	1
0-60/90/180-P	FI 90-sec	All	Complete 1>2>3>4	0	0	3.00	1
0-60/90/180-P	FI 90-sec	All	1<2<3<4	65.00	30.00	44.33	0.001
0-60/90/180-P	FI 90-sec	All	Complete 1<2<3<4	3.00	0	4.00	0.01
0-60/90/180-P	FI 90-sec	All	1=2<3<4	**70.17**	**25.33**	**42.17**	**0.001**
0-60/90/180-P	FI 90-sec	All	Complete 1=2<3<4	**15.00**	**0**	**9.00**	**0.001**
0-60/90/180-P	FI 90-sec	All	1=2=3<4	61.67	21.33	40.17	0.001
0-60/90/180-P	FI 90-sec	All	Complete 1=2=3<4	24.00	0	13.00	0.001
0-60/90/180-P	FI 180-sec	All	1=2=3=4	19.70	19.70	19.7	1

0-60/90/180-P	FI 180-sec	All	Complete 1=2=3=4	1.82	1.82	1.82	1
0-60/90/180-P	FI 180-sec	All	1>2>3>4	13.64	30.30	50.00	1
0-60/90/180-P	FI 180-sec	All	Complete 1>2>3>4	0	0	7.27	1
0-60/90/180-P	FI 180-sec	All	1<2<3<4	66.67	29.39	49.09	0.001
0-60/90/180-P	FI 180-sec	All	Complete 1<2<3<4	5.45	0	7.27	0.02
0-60/90/180-P	FI 180-sec	All	1=2<3<4	**60.61**	**26.36**	**46.97**	**0.001**
0-60/90/180-P	FI 180-sec	All	Complete 1=2<3<4	**10.91**	**0**	**9.09**	**0.001**
0-60/90/180-P	FI 180-sec	All	1=2=3<4	46.97	21.21	38.79	0.001
0-60/90/180-P	FI 180-sec	All	Complete 1=2=3<4	5.45	0	5.45	0.02

Horse 0-60/90/180-P Ten Bin OOM

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-60/90/180-P	FI 60-sec	Horse 4	1>…>10	7.78	16.22	23.69	1
0-60/90/180-P	FI 60-sec	Horse 4	Complete 1>…>10	0	0	0	1
0-60/90/180-P	FI 60-sec	Horse 4	1<…<10	**32.93**	**16.49**	**24.98**	**0.001**
0-60/90/180-P	FI 60-sec	Horse 4	Complete 1<…<10	0	0	0	1
0-60/90/180-P	FI 90-sec	Horse 4	1>…>10	5.73	15.73	24.13	1
0-60/90/180-P	FI 90-sec	Horse 4	Complete 1>…>10	0	0	0	1
0-60/90/180-P	FI 90-sec	Horse 4	1<…<10	**33.91**	**16.18**	**23.69**	**0.001**
0-60/90/180-P	FI 90-sec	Horse 4	Complete 1<…<10	0	0	0	1
0-60/90/180-P	FI 180-sec	Horse 4	1>…>10	25.33	11.56	41.33	0.62
0-60/90/180-P	FI 180-sec	Horse 4	Complete 1>…>10	0	0	0	1
0-60/90/180-P	FI 180-sec	Horse 4	1<…<10	27.11	13.78	39.56	0.43
0-60/90/180-P	FI 180-sec	Horse 4	Complete 1<…<10	0	0	0	1
0-60/90/180-P	FI 60-sec	Horse 11	1>…>10	6.13	22.62	32.84	1
0-60/90/180-P	FI 60-sec	Horse 11	Complete 1>…>10	0	0	0	1
0-60/90/180-P	FI 60-sec	Horse 11	1<…<10	**50.71**	**22.98**	**32.53**	**0.001**
0-60/90/180-P	FI 60-sec	Horse 11	Complete 1<…<10	0	0	0	1
0-60/90/180-P	FI 90-sec	Horse 11	1>…>10	8.62	22.71	32.8	1
0-60/90/180-P	FI 90-sec	Horse 11	Complete 1>…>10	0	0	0	1
0-60/90/180-P	FI 90-sec	Horse 11	1<…<10	**47.02**	**23.6**	**33.16**	**0.001**
0-60/90/180-P	FI 90-sec	Horse 11	Complete 1<…<10	0	0	0	1
0-60/90/180-P	FI 180-sec	Horse 11	1>…>10	12.09	25.02	35.69	1
0-60/90/180-P	FI 180-sec	Horse 11	Complete 1>…>10	0	0	0	1
0-60/90/180-P	FI 180-sec	Horse 11	1<…<10	**48.71**	**25.07**	**35.33**	**0.001**
0-60/90/180-P	FI 180-sec	Horse 11	Complete 1<…<10	0	0	0	1
0-60/90/180-P	FI 60-sec	All	1>…>10	6.96	21.47	27.44	1
0-60/90/180-P	FI 60-sec	All	Complete 1>…>10	0	0	0	1
0-60/90/180-P	FI 60-sec	All	1<…<10	**41.82**	**20.87**	**27.67**	**0.001**
0-60/90/180-P	FI 60-sec	All	Complete 1<…<10	0	0	0	1
0-60/90/180-P	FI 90-sec	All	1>…>10	7.18	20.89	27.04	1
0-60/90/180-P	FI 90-sec	All	Complete 1>…>10	0	0	0	1
0-60/90/180-P	FI 90-sec	All	1<…<10	**40.47**	**21.09**	**26.64**	**0.001**
0-60/90/180-P	FI 90-sec	All	Complete 1<…<10	0	0	0	1
0-60/90/180-P	FI 180-sec	All	1>…>10	13.29	25.66	35.35	1
0-60/90/180-P	FI 180-sec	All	Complete 1>…>10	0	0	0	1
0-60/90/180-P	FI 180-sec	All	1<…<10	**46.75**	**25.41**	**34.26**	**0.001**
0-60/90/180-P	FI 180-sec	All	Complete 1<…<10	0	0	0	1

Horse 0-60/90/180-P 20 Bin OOM

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-60/90/180-P	FI 60-sec	Horse 4	1>…>20	5.58	10.2	15.27	1
0-60/90/180-P	FI 60-sec	Horse 4	Complete 1>…>20	0	0	0	1
0-60/90/180-P	FI 60-sec	Horse 4	1<…<20	**19.62**	**10.76**	**15.13**	**0.001**
0-60/90/180-P	FI 60-sec	Horse 4	Complete 1<…<20	0	0	0	1
0-60/90/180-P	FI 90-sec	Horse 4	1>…>20	4.35	9.63	13.81	1
0-60/90/180-P	FI 90-sec	Horse 4	Complete 1>…>20	0	0	0	1
0-60/90/180-P	FI 90-sec	Horse 4	1<…<20	**19.2**	**9.31**	**13.98**	**0.001**
0-60/90/180-P	FI 90-sec	Horse 4	Complete 1<…<20	0	0	0	1
0-60/90/180-P	FI 180-sec	Horse 4	1>…>20	16.42	8.42	25.16	0.55
0-60/90/180-P	FI 180-sec	Horse 4	Complete 1>…>20	0	0	0	1
0-60/90/180-P	FI 180-sec	Horse 4	1<…<20	17.05	9.05	25.26	0.45
0-60/90/180-P	FI 180-sec	Horse 4	Complete 1<…<20	0	0	0	1
0-60/90/180-P	FI 60-sec	Horse 11	1>…>20	6.78	15.98	21.49	1
0-60/90/180-P	FI 60-sec	Horse 11	Complete 1>…>20	0	0	0	1
0-60/90/180-P	FI 60-sec	Horse 11	1<…<20	**31.03**	**16.4**	**21.59**	**0.001**
0-60/90/180-P	FI 60-sec	Horse 11	Complete 1<…<20	0	0	0	1
0-60/90/180-P	FI 90-sec	Horse 11	1>…>20	7.36	16.77	21.82	1
0-60/90/180-P	FI 90-sec	Horse 11	Complete 1>…>20	0	0	0	1
0-60/90/180-P	FI 90-sec	Horse 11	1<…<20	**31.02**	**15.87**	**22.04**	**0.001**
0-60/90/180-P	FI 90-sec	Horse 11	Complete 1<…<20	0	0	0	1
0-60/90/180-P	FI 180-sec	Horse 11	1>…>20	10.55	18.04	24.81	1
0-60/90/180-P	FI 180-sec	Horse 11	Complete 1>…>20	0	0	0	1
0-60/90/180-P	FI 180-sec	Horse 11	1<…<20	**32.20**	**18.77**	**24.17**	**0.001**
0-60/90/180-P	FI 180-sec	Horse 11	Complete 1<…<20	0	0	0	1
0-60/90/180-P	FI 60-sec	All	1>…>20	6.18	13.89	17.43	1
0-60/90/180-P	FI 60-sec	All	Complete 1>…>20	0	0	0	1
0-60/90/180-P	FI 60-sec	All	1<…<20	**25.33**	**14.22**	**17.59**	**0.001**
0-60/90/180-P	FI 60-sec	All	Complete 1<…<20	0	0	0	1
0-60/90/180-P	FI 90-sec	All	1>…>20	5.97	13.86	17.31	1
0-60/90/180-P	FI 90-sec	All	Complete 1>…>20	0	0	0	1
0-60/90/180-P	FI 90-sec	All	1<…<20	**25.11**	**13.15**	**17.24**	**0.001**
0-60/90/180-P	FI 90-sec	All	Complete 1<…<20	0	0	0	1
0-60/90/180-P	FI 180-sec	All	1>…>20	11.08	18.21	23.46	1
0-60/90/180-P	FI 180-sec	All	Complete 1>…>20	0	0	0	1
0-60/90/180-P	FI 180-sec	All	1<…<20	**30.82**	**18.41**	**23.82**	**0.001**
0-60/90/180-P	FI 180-sec	All	Complete 1<…<20	0	0	0	1

Horse 0-60-90-180-P Two Bin OOM

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-60-90-180-P	FI 60-sec	Horse 2	1=2	6.00	6.00	6.00	1
0-60-90-180-P	FI 60-sec	Horse 2	Combinations 1=2	4.28	4.28	4.28	1
0-60-90-180-P	FI 60-sec	Horse 2	1>2	2.00	28.00	70.00	1
0-60-90-180-P	FI 60-sec	Horse 2	Combinations 1>2	2.68	44.44	50.96	1
0-60-90-180-P	FI 60-sec	Horse 2	1<2	**92.00**	**26.00**	**68.00**	**0.001**
0-60-90-180-P	FI 60-sec	Horse 2	Combinations 1<2	**93.04**	**45.04**	**51.32**	**0.001**
0-60-90-180-P	FI 90-sec	Horse 2	1=2	0	0	0	1
0-60-90-180-P	FI 90-sec	Horse 2	Combinations 1=2	0.92	0.92	0.92	1
0-60-90-180-P	FI 90-sec	Horse 2	1>2	0	28.00	72.00	1
0-60-90-180-P	FI 90-sec	Horse 2	Combinations 1>2	1.40	46.00	52.76	1
0-60-90-180-P	FI 90-sec	Horse 2	1<2	**100**	**28.00**	**70.00**	**0.001**
0-60-90-180-P	FI 90-sec	Horse 2	Combinations 1<2	**97.68**	**46.72**	**52.92**	**0.001**
0-60-90-180-P	FI 180-sec	Horse 2	1=2	2.00	2.00	2.00	1
0-60-90-180-P	FI 180-sec	Horse 2	Combinations 1=2	0.28	0.28	0.28	1
0-60-90-180-P	FI 180-sec	Horse 2	1>2	0	20.00	72.00	1
0-60-90-180-P	FI 180-sec	Horse 2	Combinations 1>2	0.56	46.52	52.44	1
0-60-90-180-P	FI 180-sec	Horse 2	1<2	**98.00**	**24.00**	**72.00**	**0.001**
0-60-90-180-P	FI 180-sec	Horse 2	Combinations 1<2	**99.16**	**47.00**	**53.12**	**0.001**
0-60-90-180-P	FI 60-sec	Horse 5	1=2	0	0	0	1
0-60-90-180-P	FI 60-sec	Horse 5	Combinations 1=2	1.96	1.96	1.96	1
0-60-90-180-P	FI 60-sec	Horse 5	1>2	2.00	28.00	72.00	1
0-60-90-180-P	FI 60-sec	Horse 5	Combinations 1>2	1.72	45.92	51.88	1
0-60-90-180-P	FI 60-sec	Horse 5	1<2	**98.00**	**32.00**	**72.00**	**0.001**
0-60-90-180-P	FI 60-sec	Horse 5	Combinations 1<2	**96.32**	**44.72**	**51.92**	**0.001**
0-60-90-180-P	FI 90-sec	Horse 5	1=2	2.00	2.00	2.00	1
0-60-90-180-P	FI 90-sec	Horse 5	Combinations 1=2	2.44	2.44	2.44	1
0-60-90-180-P	FI 90-sec	Horse 5	1>2	0	26.00	70.00	1
0-60-90-180-P	FI 90-sec	Horse 5	Combinations 1>2	1.64	45.36	51.96	1
0-60-90-180-P	FI 90-sec	Horse 5	1<2	**98.00**	**32.00**	**68.00**	**0.001**
0-60-90-180-P	FI 90-sec	Horse 5	Combinations 1<2	**95.92**	**45.56**	**51.80**	**0.001**
0-60-90-180-P	FI 180-sec	Horse 5	1=2	2.17	2.17	2.17	1
0-60-90-180-P	FI 180-sec	Horse 5	Combinations 1=2	3.36	3.36	3.36	1
0-60-90-180-P	FI 180-sec	Horse 5	1>2	6.52	26.09	78.26	1
0-60-90-180-P	FI 180-sec	Horse 5	Combinations 1>2	12.10	45.13	51.61	1
0-60-90-180-P	FI 180-sec	Horse 5	1<2	**91.30**	**28.26**	**69.57**	**0.001**
0-60-90-180-P	FI 180-sec	Horse 5	Combinations 1<2	**84.55**	**44.66**	**51.47**	**0.001**
0-60-90-180-P	FI 60-sec	Horse 7	1=2	2.00	2.00	2.00	1
0-60-90-180-P	FI 60-sec	Horse 7	Combinations 1=2	2.92	2.92	2.92	1
0-60-90-180-P	FI 60-sec	Horse 7	1>2	0	28.00	70.00	1

0-60-90-180-P	FI 60-sec	Horse 7	Combinations 1>2	1.72	45.24	51.52	1
0-60-90-180-P	FI 60-sec	Horse 7	1<2	**98.00**	**26.00**	**74.00**	**0.001**
0-60-90-180-P	FI 60-sec	Horse 7	Combinations 1<2	**95.36**	**45.08**	**51.72**	**0.001**
0-60-90-180-P	FI 90-sec	Horse 7	1=2	2.22	2.22	2.22	1
0-60-90-180-P	FI 90-sec	Horse 7	Combinations 1=2	2.72	2.72	2.72	1
0-60-90-180-P	FI 90-sec	Horse 7	1>2	0	28.89	73.33	1
0-60-90-180-P	FI 90-sec	Horse 7	Combinations 1>2	1.63	45.28	52.59	1
0-60-90-180-P	FI 90-sec	Horse 7	1<2	**97.78**	**31.11**	**73.33**	**0.001**
0-60-90-180-P	FI 90-sec	Horse 7	Combinations 1<2	**95.65**	**44.99**	**52.00**	**0.001**
0-60-90-180-P	FI 180-sec	Horse 7	1=2	0	0	0	1
0-60-90-180-P	FI 180-sec	Horse 7	Combinations 1=2	4.00	4.00	4.00	1
0-60-90-180-P	FI 180-sec	Horse 7	1>2	10.00	0	100	1
0-60-90-180-P	FI 180-sec	Horse 7	Combinations 1>2	11.00	33.00	64.00	1
0-60-90-180-P	FI 180-sec	Horse 7	1<2	**90.00**	**10.00**	**100**	**0.01**
0-60-90-180-P	FI 180-sec	Horse 7	Combinations 1<2	**85.00**	**30.00**	**65.00**	**0.001**
0-60-90-180-P	FI 60-sec	Horse 8	1=2	4.00	4.00	4.00	1
0-60-90-180-P	FI 60-sec	Horse 8	Combinations 1=2	2.40	2.40	2.40	1
0-60-90-180-P	FI 60-sec	Horse 8	1>2	2.00	24.00	66.00	1
0-60-90-180-P	FI 60-sec	Horse 8	Combinations 1>2	8.24	45.68	53.32	1
0-60-90-180-P	FI 60-sec	Horse 8	1<2	**94.00**	**28.00**	**72.00**	**0.001**
0-60-90-180-P	FI 60-sec	Horse 8	Combinations 1<2	**89.36**	**46.12**	**51.96**	**0.001**
0-60-90-180-P	FI 90-sec	Horse 8	1=2	0	0	0	1
0-60-90-180-P	FI 90-sec	Horse 8	Combinations 1=2	2.48	2.48	2.48	1
0-60-90-180-P	FI 90-sec	Horse 8	1>2	2.00	20.00	72.00	1
0-60-90-180-P	FI 90-sec	Horse 8	Combinations 1>2	3.72	45.52	51.72	1
0-60-90-180-P	FI 90-sec	Horse 8	1<2	**98.00**	**26.00**	**72.00**	**0.001**
0-60-90-180-P	FI 90-sec	Horse 8	Combinations 1<2	**93.80**	**46.00**	**52.04**	**0.001**
0-60-90-180-P	FI 180-sec	Horse 8	1=2	2.00	2.00	2.00	1
0-60-90-180-P	FI 180-sec	Horse 8	Combinations 1=2	4.44	4.44	4.44	1
0-60-90-180-P	FI 180-sec	Horse 8	1>2	6.00	30.00	72.00	1
0-60-90-180-P	FI 180-sec	Horse 8	Combinations 1>2	7.36	44.28	50.60	1
0-60-90-180-P	FI 180-sec	Horse 8	1<2	**92.00**	**22.00**	**76.00**	**0.001**
0-60-90-180-P	FI 180-sec	Horse 8	Combinations 1<2	**88.20**	**44.20**	**51.12**	**0.001**
0-60-90-180-P	FI 60-sec	All	1=2	3.00	3.00	3.00	1
0-60-90-180-P	FI 60-sec	All	Combinations 1=2	3.46	3.46	3.46	1
0-60-90-180-P	FI 60-sec	All	1>2	1.50	35.50	58.00	1
0-60-90-180-P	FI 60-sec	All	Combinations 1>2	5.41	47.34	49.04	1
0-60-90-180-P	FI 60-sec	All	1<2	**95.5**	**36.00**	**60.50**	**0.001**
0-60-90-180-P	FI 60-sec	All	Combinations 1<2	**91.13**	**47.39**	**48.98**	**0.001**
0-60-90-180-P	FI 90-sec	All	1=2	1.03	1.03	1.03	1
0-60-90-180-P	FI 90-sec	All	Combinations 1=2	2.11	2.11	2.11	1
0-60-90-180-P	FI 90-sec	All	1>2	0.51	37.95	61.03	1

0-60-90-180-P	FI 90-sec	All	Combinations 1>2	3.11	48.11	49.69	1
0-60-90-180-P	FI 90-sec	All	1<2	**98.46**	**40.51**	**62.56**	**0.001**
0-60-90-180-P	FI 90-sec	All	Combinations 1<2	**94.79**	**48.11**	**49.86**	**0.001**
0-60-90-180-P	FI 180-sec	All	1=2	1.92	1.92	1.92	1
0-60-90-180-P	FI 180-sec	All	Combinations 1=2	2.74	2.74	2.74	1
0-60-90-180-P	FI 180-sec	All	1>2	4.49	35.9	60.26	1
0-60-90-180-P	FI 180-sec	All	Combinations 1>2	6.22	47.6	49.51	1
0-60-90-180-P	FI 180-sec	All	1<2	**93.59**	**36.54**	**61.51**	**0.001**
0-60-90-180-P	FI 180-sec	All	Combinations 1<2	**91.04**	**47.70**	**49.66**	**0.001**

Horse 0-60-90-180-P Four Bin OOM

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-60-90-180-P	FI 60-sec	Horse 2	1=2=3=4	26.00	26.00	26.00	1
0-60-90-180-P	FI 60-sec	Horse 2	Complete 1=2=3=4	0	0	0	1
0-60-90-180-P	FI 60-sec	Horse 2	1>2>3>4	6	27.33	48.33	1
0-60-90-180-P	FI 60-sec	Horse 2	Complete 1>2>3>4	0	0	6.00	1
0-60-90-180-P	FI 60-sec	Horse 2	1<2<3<4	68.00	27.00	46.00	0.001
0-60-90-180-P	FI 60-sec	Horse 2	Complete 1<2<3<4	10.00	0	6.00	0.001
0-60-90-180-P	FI 60-sec	Horse 2	1=2<3<4	**73.33**	**24.67**	**49.67**	**0.001**
0-60-90-180-P	FI 60-sec	Horse 2	Complete 1=2<3<4	**26.00**	**0**	**10.00**	**0.001**
0-60-90-180-P	FI 60-sec	Horse 2	1=2=3<4	68.67	20.33	45.67	0.001
0-60-90-180-P	FI 60-sec	Horse 2	Complete 1=2=3<4	30.00	0	22.00	0.001
0-60-90-180-P	FI 90-sec	Horse 2	1=2=3=4	20.00	20.00	20.00	1
0-60-90-180-P	FI 90-sec	Horse 2	Complete 1=2=3=4	0	0	0	1
0-60-90-180-P	FI 90-sec	Horse 2	1>2>3>4	2.00	29.67	50.33	1
0-60-90-180-P	FI 90-sec	Horse 2	Complete 1>2>3>4	0	0	4.00	1
0-60-90-180-P	FI 90-sec	Horse 2	1<2<3<4	78.00	29.67	49.67	0.001
0-60-90-180-P	FI 90-sec	Horse 2	Complete 1<2<3<4	10.00	0	6.00	0.001
0-60-90-180-P	FI 90-sec	Horse 2	1=2<3<4	**84.00**	**26.00**	**48.67**	**0.001**
0-60-90-180-P	FI 90-sec	Horse 2	Complete 1=2<3<4	**50.00**	**0**	**16.00**	**0.001**
0-60-90-180-P	FI 90-sec	Horse 2	1=2=3<4	62.00	18.00	41.67	0.001
0-60-90-180-P	FI 90-sec	Horse 2	Complete 1=2=3<4	14.00	0	12.00	0.001
0-60-90-180-P	FI 180-sec	Horse 2	1=2=3=4	15.33	15.33	15.33	1
0-60-90-180-P	FI 180-sec	Horse 2	Complete 1=2=3=4	0	0	0	1
0-60-90-180-P	FI 180-sec	Horse 2	1>2>3>4	3.33	33.33	52.00	1
0-60-90-180-P	FI 180-sec	Horse 2	Complete 1>2>3>4	0	0	8.00	1
0-60-90-180-P	FI 180-sec	Horse 2	1<2<3<4	81.33	33.00	51.67	0.001
0-60-90-180-P	FI 180-sec	Horse 2	Complete 1<2<3<4	22.00	0	10.00	0.001
0-60-90-180-P	FI 180-sec	Horse 2	1=2<3<4	**84.67**	**26.33**	**51.67**	**0.001**
0-60-90-180-P	FI 180-sec	Horse 2	Complete 1=2<3<4	**42.00**	**0**	**16.00**	**0.001**
0-60-90-180-P	FI 180-sec	Horse 2	1=2=3<4	59.00	15.67	39.00	0.001
0-60-90-180-P	FI 180-sec	Horse 2	Complete 1=2=3<4	8.00	0	6.00	0.001
0-60-90-180-P	FI 60-sec	Horse 5	1=2=3=4	28.33	28.33	28.33	1
0-60-90-180-P	FI 60-sec	Horse 5	Complete 1=2=3=4	0	0	0	1
0-60-90-180-P	FI 60-sec	Horse 5	1>2>3>4	6.33	25.33	45.00	1
0-60-90-180-P	FI 60-sec	Horse 5	Complete 1>2>3>4	0	0	4.00	1
0-60-90-180-P	FI 60-sec	Horse 5	1<2<3<4	65.33	24.67	47.33	0.001
0-60-90-180-P	FI 60-sec	Horse 5	Complete 1<2<3<4	0	0	4.00	1
0-60-90-180-P	FI 60-sec	Horse 5	1=2<3<4	**77.00**	**23.00**	**46.33**	**0.001**
0-60-90-180-P	FI 60-sec	Horse 5	Complete 1=2<3<4	**34.00**	**0**	**16.00**	**0.001**
0-60-90-180-P	FI 60-sec	Horse 5	1=2=3<4	72.67	19.33	46.33	0.001

0-60-90-180-P	FI 60-sec	Horse 5	Complete 1=2=3<4	34.00	0	22.00	0.001
0-60-90-180-P	FI 90-sec	Horse 5	1=2=3=4	27.67	27.67	27.67	1
0-60-90-180-P	FI 90-sec	Horse 5	Complete 1=2=3=4	2.00	2.00	2.00	1
0-60-90-180-P	FI 90-sec	Horse 5	1>2>3>4	3.67	26.00	45.67	1
0-60-90-180-P	FI 90-sec	Horse 5	Complete 1>2>3>4	0	0	4.00	1
0-60-90-180-P	FI 90-sec	Horse 5	1<2<3<4	68.67	26.67	46.33	0.001
0-60-90-180-P	FI 90-sec	Horse 5	Complete 1<2<3<4	4.00	0	6.00	0.02
0-60-90-180-P	FI 90-sec	Horse 5	1=2<3<4	**80.67**	**24.33**	**49.00**	**0.001**
0-60-90-180-P	FI 90-sec	Horse 5	Complete 1=2<3<4	**38.00**	**0**	**14.00**	**0.001**
0-60-90-180-P	FI 90-sec	Horse 5	1=2=3<4	70.67	18.33	46.33	0.001
0-60-90-180-P	FI 90-sec	Horse 5	Complete 1=2=3<4	30.00	0	20.00	0.001
0-60-90-180-P	FI 180-sec	Horse 5	1=2=3=4	12.32	12.32	12.32	1
0-60-90-180-P	FI 180-sec	Horse 5	Complete 1=2=3=4	0	0	0	1
0-60-90-180-P	FI 180-sec	Horse 5	1>2>3>4	13.77	32.61	54.35	1
0-60-90-180-P	FI 180-sec	Horse 5	Complete 1>2>3>4	0	0	15.22	1
0-60-90-180-P	FI 180-sec	Horse 5	1<2<3<4	**73.91**	**32.97**	**56.52**	**0.001**
0-60-90-180-P	FI 180-sec	Horse 5	Complete 1<2<3<4	**17.39**	**0**	**10.87**	**0.001**
0-60-90-180-P	FI 180-sec	Horse 5	1=2<3<4	68.84	27.17	50.00	0.001
0-60-90-180-P	FI 180-sec	Horse 5	Complete 1=2<3<4	13.04	0	10.87	0.001
0-60-90-180-P	FI 180-sec	Horse 5	1=2=3<4	49.64	16.67	41.30	0.001
0-60-90-180-P	FI 180-sec	Horse 5	Complete 1=2=3<4	8.70	0	16.52	0
0-60-90-180-P	FI 60-sec	Horse 7	1=2=3=4	41.67	41.67	41.67	1
0-60-90-180-P	FI 60-sec	Horse 7	Complete 1=2=3=4	0	0	0	1
0-60-90-180-P	FI 60-sec	Horse 7	1>2>3>4	2.00	20.33	37.00	1
0-60-90-180-P	FI 60-sec	Horse 7	Complete 1>2>3>4	0	0	0	1
0-60-90-180-P	FI 60-sec	Horse 7	1<2<3<4	56.33	21.00	39.00	0.001
0-60-90-180-P	FI 60-sec	Horse 7	Complete 1<2<3<4	0	0	0	1
0-60-90-180-P	FI 60-sec	Horse 7	1=2<3<4	69.67	18.33	43.33	0.001
0-60-90-180-P	FI 60-sec	Horse 7	Complete 1=2<3<4	8.00	0	8.00	0.004
0-60-90-180-P	FI 60-sec	Horse 7	1=2=3<4	**87.33**	**22.00**	**54.67**	**0.001**
0-60-90-180-P	FI 60-sec	Horse 7	Complete 1=2=3<4	**72.00**	**4.00**	**40.00**	**0.001**
0-60-90-180-P	FI 90-sec	Horse 7	1=2=3=4	37.78	37.78	37.78	1
0-60-90-180-P	FI 90-sec	Horse 7	Complete 1=2=3=4	0	0	0	1
0-60-90-180-P	FI 90-sec	Horse 7	1>2>3>4	1.48	21.48	41.11	1
0-60-90-180-P	FI 90-sec	Horse 7	Complete 1>2>3>4	0	0	2.22	1
0-60-90-180-P	FI 90-sec	Horse 7	1<2<3<4	60.74	22.22	41.85	0.001
0-60-90-180-P	FI 90-sec	Horse 7	Complete 1<2<3<4	2.22	0	2.22	0.04
0-60-90-180-P	FI 90-sec	Horse 7	1=2<3<4	72.96	18.15	43.7	0.001
0-60-90-180-P	FI 90-sec	Horse 7	Complete 1=2<3<4	17.78	0	8.89	0.001
0-60-90-180-P	FI 90-sec	Horse 7	1=2=3<4	**81.48**	**21.48**	**50.37**	**0.001**
0-60-90-180-P	FI 90-sec	Horse 7	Complete 1=2=3<4	**57.78**	**2.22**	**33.33**	**0.001**
0-60-90-180-P	FI 180-sec	Horse 7	1=2=3=4	13.33	13.33	13.33	1

0-60-90-180-P	FI 180-sec	Horse 7	Complete 1=2=3=4	0	0	0	1
0-60-90-180-P	FI 180-sec	Horse 7	1>2>3>4	11.67	21.67	66.67	1
0-60-90-180-P	FI 180-sec	Horse 7	Complete 1>2>3>4	0	0	30.00	1
0-60-90-180-P	FI 180-sec	Horse 7	1<2<3<4	**75.00**	**20.00**	**65.00**	**0.001**
0-60-90-180-P	FI 180-sec	Horse 7	Complete 1<2<3<4	**20.00**	**0**	**30.00**	**0.02**
0-60-90-180-P	FI 180-sec	Horse 7	1=2<3<4	63.33	16.67	60.00	0.001
0-60-90-180-P	FI 180-sec	Horse 7	Complete 1=2<3<4	0	0	0	1
0-60-90-180-P	FI 180-sec	Horse 7	1=2=3<4	41.67	11.67	50.00	0.02
0-60-90-180-P	FI 180-sec	Horse 7	Complete 1=2=3<4	0	0	10.00	1
0-60-90-180-P	FI 60-sec	Horse 8	1=2=3=4	25.67	25.67	25.67	1
0-60-90-180-P	FI 60-sec	Horse 8	Complete 1=2=3=4	0	0	0	1
0-60-90-180-P	FI 60-sec	Horse 8	1>2>3>4	6.00	27.00	49.00	1
0-60-90-180-P	FI 60-sec	Horse 8	Complete 1>2>3>4	0	0	6.00	1
0-60-90-180-P	FI 60-sec	Horse 8	1<2<3<4	68.33	27.00	47.67	0.001
0-60-90-180-P	FI 60-sec	Horse 8	Complete 1<2<3<4	8.00	0	8.00	0.001
0-60-90-180-P	FI 60-sec	Horse 8	1=2<3<4	**74.67**	**23.67**	**46.67**	**0.001**
0-60-90-180-P	FI 60-sec	Horse 8	Complete 1=2<3<4	**26.00**	**0**	**12.00**	**0.001**
0-60-90-180-P	FI 60-sec	Horse 8	1=2=3<4	68.67	21.00	45.00	0.001
0-60-90-180-P	FI 60-sec	Horse 8	Complete 1=2=3<4	34.00	0	22.00	0.001
0-60-90-180-P	FI 90-sec	Horse 8	1=2=3=4	28.00	28.00	28.00	1
0-60-90-180-P	FI 90-sec	Horse 8	Complete 1=2=3=4	0	0	0	1
0-60-90-180-P	FI 90-sec	Horse 8	1>2>3>4	2.67	26.33	44.67	1
0-60-90-180-P	FI 90-sec	Horse 8	Complete 1>2>3>4	0	0	6.00	1
0-60-90-180-P	FI 90-sec	Horse 8	1<2<3<4	69.33	27.00	45.67	0.001
0-60-90-180-P	FI 90-sec	Horse 8	Complete 1<2<3<4	14.00	0	8.00	0.001
0-60-90-180-P	FI 90-sec	Horse 8	1=2<3<4	76.67	21.33	48.67	0.001
0-60-90-180-P	FI 90-sec	Horse 8	Complete 1=2<3<4	22.00	0	10.00	0.001
0-60-90-180-P	FI 90-sec	Horse 8	1=2=3<4	**75.00**	**19.67**	**48.33**	**0.001**
0-60-90-180-P	FI 90-sec	Horse 8	Complete 1=2=3<4	**42.00**	**0**	**28.00**	**0.001**
0-60-90-180-P	FI 180-sec	Horse 8	1=2=3=4	16.00	16.00	16.00	1
0-60-90-180-P	FI 180-sec	Horse 8	Complete 1=2=3=4	0	0	0	1
0-60-90-180-P	FI 180-sec	Horse 8	1>2>3>4	12.67	32.67	52.67	1
0-60-90-180-P	FI 180-sec	Horse 8	Complete 1>2>3>4	2.00	0	8.00	0.57
0-60-90-180-P	FI 180-sec	Horse 8	1<2<3<4	71.33	32.33	54.00	0.001
0-60-90-180-P	FI 180-sec	Horse 8	Complete 1<2<3<4	16.00	0	8.00	0.001
0-60-90-180-P	FI 180-sec	Horse 8	1=2<3<4	**71.00**	**26.00**	**50.00**	**0.001**
0-60-90-180-P	FI 180-sec	Horse 8	Complete 1=2<3<4	**18.00**	**0**	**12.00**	**0.001**
0-60-90-180-P	FI 180-sec	Horse 8	1=2=3<4	55.33	17.00	39.33	0.001
0-60-90-180-P	FI 180-sec	Horse 8	Complete 1=2=3<4	16.00	0	14.00	0.001
0-60-90-180-P	FI 60-sec	All	1=2=3=4	30.42	30.42	30.42	1
0-60-90-180-P	FI 60-sec	All	Complete 1=2=3=4	0	0	0	1
0-60-90-180-P	FI 60-sec	All	1>2>3>4	5.08	30.25	39.25	1

0-60-90-180-P	FI 60-sec	All	Complete 1>2>3>4	0	0	2.50	1
0-60-90-180-P	FI 60-sec	All	1<2<3<4	64.50	28.67	40.25	0.001
0-60-90-180-P	FI 60-sec	All	Complete 1<2<3<4	4.50	0	2.00	0.001
0-60-90-180-P	FI 60-sec	All	1=2<3<4	73.67	27.08	39.67	0.001
0-60-90-180-P	FI 60-sec	All	Complete 1=2<3<4	23.50	0	7.50	0.001
0-60-90-180-P	FI 60-sec	All	1=2=3<4	**73.58**	**25.92**	**39.42**	**0.001**
0-60-90-180-P	FI 60-sec	All	Complete 1=2=3<4	**42.50**	**4.00**	**18.00**	**0.001**
0-60-90-180-P	FI 90-sec	All	1=2=3=4	28.12	28.12	28.12	1
0-60-90-180-P	FI 90-sec	All	Complete 1=2=3=4	0.51	0.51	0.51	1
0-60-90-180-P	FI 90-sec	All	1>2>3>4	2.48	31.11	40.60	1
0-60-90-180-P	FI 90-sec	All	Complete 1>2>3>4	0	0	2.56	1
0-60-90-180-P	FI 90-sec	All	1<2<3<4	69.40	30.29	41.11	0.001
0-60-90-180-P	FI 90-sec	All	Complete 1<2<3<4	7.69	0	2.56	0.001
0-60-90-180-P	FI 90-sec	All	1=2<3<4	78.72	28.89	40.60	0.001
0-60-90-180-P	FI 90-sec	All	Complete 1=2<3<4	32.31	0	7.69	0.001
0-60-90-180-P	FI 90-sec	All	1=2=3<4	**72.05**	**25.90**	**39.66**	**0.001**
0-60-90-180-P	FI 90-sec	All	Complete 1=2=3<4	**35.38**	**2.56**	**15.38**	**0.001**
0-60-90-180-P	FI 180-sec	All	1=2=3=4	14.53	14.53	14.53	1
0-60-90-180-P	FI 180-sec	All	Complete 1=2=3=4	0	0	0	1
0-60-90-180-P	FI 180-sec	All	1>2>3>4	9.94	37.39	49.89	1
0-60-90-180-P	FI 180-sec	All	Complete 1>2>3>4	0.64	0	6.41	0.93
0-60-90-180-P	FI 180-sec	All	1<2<3<4	75.53	34.94	48.93	0.001
0-60-90-180-P	FI 180-sec	All	Complete 1<2<3<4	18.59	0	5.13	0.001
0-60-90-180-P	FI 180-sec	All	1=2<3<4	**74.25**	**33.01**	**44.02**	**0.001**
0-60-90-180-P	FI 180-sec	All	Complete 1=2<3<4	**23.08**	**0**	**7.69**	**0.001**
0-60-90-180-P	FI 180-sec	All	1=2=3<4	53.95	22.65	36.54	0.001
0-60-90-180-P	FI 180-sec	All	Complete 1=2=3<4	10.26	0	7.05	0.001

Horse 0-60-90-180-P Ten Bin OOM

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-60-90-180-P	FI 60-sec	Horse 2	1>…>10	5.33	19.51	28.49	1
0-60-90-180-P	FI 60-sec	Horse 2	Complete 1>…>10	0	0	0	1
0-60-90-180-P	FI 60-sec	Horse 2	1<…<10	**44.04**	**21.02**	**28.98**	**0.001**
0-60-90-180-P	FI 60-sec	Horse 2	Complete 1<…<10	0	0	0	1
0-60-90-180-P	FI 90-sec	Horse 2	1>…>10	4.22	28.00	38.18	1
0-60-90-180-P	FI 90-sec	Horse 2	Complete 1>…>10	0	0	0	1
0-60-90-180-P	FI 90-sec	Horse 2	1<…<10	**61.87**	**27.78**	**37.60**	**0.001**
0-60-90-180-P	FI 90-sec	Horse 2	Complete 1<…<10	0	0	0	1
0-60-90-180-P	FI 180-sec	Horse 2	1>…>10	5.73	29.47	39.73	1
0-60-90-180-P	FI 180-sec	Horse 2	Complete 1>…>10	0	0	0	1
0-60-90-180-P	FI 180-sec	Horse 2	1<…<10	**63.07**	**29.87**	**39.29**	**0.001**
0-60-90-180-P	FI 180-sec	Horse 2	Complete 1<…<10	0	0	0	1
0-60-90-180-P	FI 60-sec	Horse 5	1>…>10	5.33	20.39	28.89	1
0-60-90-180-P	FI 60-sec	Horse 5	Complete 1>…>10	0	0	0	1
0-60-90-180-P	FI 60-sec	Horse 5	1<…<10	**43.87**	**20.09**	**29.02**	**0.001**
0-60-90-180-P	FI 60-sec	Horse 5	Complete 1<…<10	0	0	0	1
0-60-90-180-P	FI 90-sec	Horse 5	1>…>10	5.11	23.64	32.84	1
0-60-90-180-P	FI 90-sec	Horse 5	Complete 1>…>10	0	0	0	1
0-60-90-180-P	FI 90-sec	Horse 5	1<…<10	**51.82**	**22.8**	**32.89**	**0.001**
0-60-90-180-P	FI 90-sec	Horse 5	Complete 1<…<10	0	0	0	1
0-60-90-180-P	FI 180-sec	Horse 5	1>…>10	13.29	29.28	39.32	1
0-60-90-180-P	FI 180-sec	Horse 5	Complete 1>…>10	0	0	0	1
0-60-90-180-P	FI 180-sec	Horse 5	1<…<10	**54.06**	**28.21**	**39.18**	**0.001**
0-60-90-180-P	FI 180-sec	Horse 5	Complete 1<…<10	0	0	0	1
0-60-90-180-P	FI 60-sec	Horse 7	1>…>10	2.04	12.98	20.27	1
0-60-90-180-P	FI 60-sec	Horse 7	Complete 1>…>10	0	0	0	1
0-60-90-180-P	FI 60-sec	Horse 7	1<…<10	**31.47**	**13.07**	**20.49**	**0.001**
0-60-90-180-P	FI 60-sec	Horse 7	Complete 1<…<10	0	0	0	1
0-60-90-180-P	FI 90-sec	Horse 7	1>…>10	2.91	15.51	23.36	1
0-60-90-180-P	FI 90-sec	Horse 7	Complete 1>…>10	0	0	0	1
0-60-90-180-P	FI 90-sec	Horse 7	1<…<10	**36.00**	**14.77**	**24.25**	**0.001**
0-60-90-180-P	FI 90-sec	Horse 7	Complete 1<…<10	0	0	0	1
0-60-90-180-P	FI 180-sec	Horse 7	1>…>10	13.11	22.89	44.67	1
0-60-90-180-P	FI 180-sec	Horse 7	Complete 1>…>10	0	0	0	1
0-60-90-180-P	FI 180-sec	Horse 7	1<…<10	**52.89**	**22.44**	**44.44**	**0.001**
0-60-90-180-P	FI 180-sec	Horse 7	Complete 1<…<10	0	0	0	1
0-60-90-180-P	FI 60-sec	Horse 8	1>…>10	7.56	22.40	31.29	1
0-60-90-180-P	FI 60-sec	Horse 8	Complete 1>…>10	0	0	0	1
0-60-90-180-P	FI 60-sec	Horse 8	1<…<10	**46.49**	**22.4**	**31.11**	**0.001**

0-60-90-180-P	FI 60-sec	Horse 8	Complete 1<…<10	0	0	0	1
0-60-90-180-P	FI 90-sec	Horse 8	1>…>10	4.31	21.16	31.42	1
0-60-90-180-P	FI 90-sec	Horse 8	Complete 1>…>10	0	0	0	1
0-60-90-180-P	FI 90-sec	Horse 8	1<…<10	**47.16**	**21.82**	**30.18**	**0.001**
0-60-90-180-P	FI 90-sec	Horse 8	Complete 1<…<10	0	0	0	1
0-60-90-180-P	FI 180-sec	Horse 8	1>…>10	12.09	27.07	36.93	1
0-60-90-180-P	FI 180-sec	Horse 8	Complete 1>…>10	0	0	0	1
0-60-90-180-P	FI 180-sec	Horse 8	1<…<10	**50.71**	**26.8**	**35.96**	**0.001**
0-60-90-180-P	FI 180-sec	Horse 8	Complete 1<…<10	0	0	0	1
0-60-90-180-P	FI 60-sec	All	1>…>10	5.07	21.29	25.59	1
0-60-90-180-P	FI 60-sec	All	Complete 1>…>10	0	0	0	1
0-60-90-180-P	FI 60-sec	All	1<…<10	**41.47**	**21.43**	**25.36**	**0.001**
0-60-90-180-P	FI 60-sec	All	Complete 1<…<10	0	0	0	1
0-60-90-180-P	FI 90-sec	All	1>…>10	4.17	24.64	29.61	1
0-60-90-180-P	FI 90-sec	All	Complete 1>…>10	0	0	0	1
0-60-90-180-P	FI 90-sec	All	1<…<10	**49.55**	**24.57**	**28.93**	**0.001**
0-60-90-180-P	FI 90-sec	All	Complete 1<…<10	0	0	0	1
0-60-90-180-P	FI 180-sec	All	1>…>10	10.47	30.19	35.75	1
0-60-90-180-P	FI 180-sec	All	Complete 1>…>10	0	0	0	1
0-60-90-180-P	FI 180-sec	All	1<…<10	**55.80**	**30.66**	**35.94**	**0.001**
0-60-90-180-P	FI 180-sec	All	Complete 1<…<10	0	0	0	1

Horse 0-60-90-180-P 20 Bin OOM

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-60-90-180-P	FI 60-sec	Horse 2	1>…>20	5.04	14.87	19.36	1
0-60-90-180-P	FI 60-sec	Horse 2	Complete 1>…>20	0	0	0	1
0-60-90-180-P	FI 60-sec	Horse 2	1<…<20	**28.97**	**13.87**	**19.60**	**0.001**
0-60-90-180-P	FI 60-sec	Horse 2	Complete 1<…<20	0	0	0	1
0-60-90-180-P	FI 90-sec	Horse 2	1>…>20	5.16	23.57	29.07	1
0-60-90-180-P	FI 90-sec	Horse 2	Complete 1>…>20	0	0	0	1
0-60-90-180-P	FI 90-sec	Horse 2	1<…<20	**47.47**	**23.19**	**29.15**	**0.001**
0-60-90-180-P	FI 90-sec	Horse 2	Complete 1<…<20	0	0	0	1
0-60-90-180-P	FI 180-sec	Horse 2	1>…>20	6.14	25.31	32.06	1
0-60-90-180-P	FI 180-sec	Horse 2	Complete 1>…>20	0	0	0	1
0-60-90-180-P	FI 180-sec	Horse 2	1<…<20	**51.36**	**25.43**	**31.79**	**0.001**
0-60-90-180-P	FI 180-sec	Horse 2	Complete 1<…<20	0	0	0	1
0-60-90-180-P	FI 60-sec	Horse 5	1>…>20	4.74	15.43	19.94	1
0-60-90-180-P	FI 60-sec	Horse 5	Complete 1>…>20	1	0	0	0
0-60-90-180-P	FI 60-sec	Horse 5	1<…<20	**30.63**	**15.45**	**20.12**	**0.001**
0-60-90-180-P	FI 60-sec	Horse 5	Complete 1<…<20	0	0	0	1
0-60-90-180-P	FI 90-sec	Horse 5	1>…>20	5.00	19.75	25.04	1
0-60-90-180-P	FI 90-sec	Horse 5	Complete 1>…>20	0	0	0	1
0-60-90-180-P	FI 90-sec	Horse 5	1<…<20	**39.87**	**19.54**	**25.2**	**0.001**
0-60-90-180-P	FI 90-sec	Horse 5	Complete 1<…<20	0	0	0	1
0-60-90-180-P	FI 180-sec	Horse 5	1>…>20	11.98	23.30	29.97	1
0-60-90-180-P	FI 180-sec	Horse 5	Complete 1>…>20	0	0	0	1
0-60-90-180-P	FI 180-sec	Horse 5	1<…<20	**41.49**	**23.82**	**29.66**	**0.001**
0-60-90-180-P	FI 180-sec	Horse 5	Complete 1<…<20	0	0	0	1
0-60-90-180-P	FI 60-sec	Horse 7	1>…>20	2.00	8.82	12.64	1
0-60-90-180-P	FI 60-sec	Horse 7	Complete 1>…>20	0	0	0	1
0-60-90-180-P	FI 60-sec	Horse 7	1<…<20	**19.87**	**9.12**	**13.07**	**0.001**
0-60-90-180-P	FI 60-sec	Horse 7	Complete 1<…<20	0	0	0	1
0-60-90-180-P	FI 90-sec	Horse 7	1>…>20	2.81	10.15	15.12	1
0-60-90-180-P	FI 90-sec	Horse 7	Complete 1>…>20	0	0	0	1
0-60-90-180-P	FI 90-sec	Horse 7	1<…<20	**22.01**	**10.35**	**14.81**	**0.001**
0-60-90-180-P	FI 90-sec	Horse 7	Complete 1<…<20	0	0	0	1
0-60-90-180-P	FI 180-sec	Horse 7	1>…>20	12.89	18.95	31.58	1
0-60-90-180-P	FI 180-sec	Horse 7	Complete 1>…>20	0	0	0	1
0-60-90-180-P	FI 180-sec	Horse 7	1<…<20	**38.68**	**19.00**	**34.37**	**0.001**
0-60-90-180-P	FI 180-sec	Horse 7	Complete 1<…<20	0	0	0	1
0-60-90-180-P	FI 60-sec	Horse 8	1>…>20	7.01	18.76	24.89	1
0-60-90-180-P	FI 60-sec	Horse 8	Complete 1>…>20	0	0	0	1
0-60-90-180-P	FI 60-sec	Horse 8	1<…<20	**37.09**	**19.64**	**24.91**	**0.001**

0-60-90-180-P	FI 60-sec	Horse 8	Complete 1<…<20	0	0	0	1
0-60-90-180-P	FI 90-sec	Horse 8	1>…>20	4.82	17.83	22.56	1
0-60-90-180-P	FI 90-sec	Horse 8	Complete 1>…>20	0	0	0	1
0-60-90-180-P	FI 90-sec	Horse 8	1<…<20	**35.22**	**17.76**	**22.86**	**0.001**
0-60-90-180-P	FI 90-sec	Horse 8	Complete 1<…<20	0	0	0	1
0-60-90-180-P	FI 180-sec	Horse 8	1>…>20	11.17	20.54	26.24	1
0-60-90-180-P	FI 180-sec	Horse 8	Complete 1>…>20	0	0	0	1
0-60-90-180-P	FI 180-sec	Horse 8	1<…<20	**35.95**	**20.49**	**26.23**	**0.001**
0-60-90-180-P	FI 180-sec	Horse 8	Complete 1<…<20	0	0	0	1
0-60-90-180-P	FI 60-sec	All	1>…>20	4.70	15.74	18.14	1
0-60-90-180-P	FI 60-sec	All	Complete 1>…>20	0	0	0	1
0-60-90-180-P	FI 60-sec	All	1<…<20	**29.13**	**15.76**	**18.07**	**0.001**
0-60-90-180-P	FI 60-sec	All	Complete 1<…<20	0	0	0	1
0-60-90-180-P	FI 90-sec	All	1>…>20	4.49	18.80	22.03	1
0-60-90-180-P	FI 90-sec	All	Complete 1>…>20	0	0	0	1
0-60-90-180-P	FI 90-sec	All	1<…<20	**36.51**	**18.70**	**21.71**	**0.001**
0-60-90-180-P	FI 90-sec	All	Complete 1<…<20	0	0	0	1
0-60-90-180-P	FI 180-sec	All	1>…>20	9.91	24.73	27.98	1
0-60-90-180-P	FI 180-sec	All	Complete 1>…>20	0	0	0	1
0-60-90-180-P	FI 180-sec	All	1<…<20	**42.7**	**24.56**	**28.18**	**0.001**
0-60-90-180-P	FI 180-sec	All	Complete 1<…<20	0	0	0	1

Honey Bee 0-15-X Two Bin OOM

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-15-X	FI 15-sec	Bee 2	1=2	0	0	0	1
0-15-X	FI 15-sec	Bee 2	Combinations 1=2	0	0	0	1
0-15-X	FI 15-sec	Bee 2	1>2	0	0	100	1
0-15-X	FI 15-sec	Bee 2	Combinations 1>2	0	16.00	80.00	1
0-15-X	FI 15-sec	Bee 2	1<2	**100**	**0**	**100**	**0.03**
0-15-X	FI 15-sec	Bee 2	Combinations 1<2	**100**	**16.00**	**76.00**	**0.001**
0-15-X	FI 15-sec	Bee 3	1=2	0	0	0	1
0-15-X	FI 15-sec	Bee 3	Combinations 1=2	10.00	10.00	10.00	1
0-15-X	FI 15-sec	Bee 3	1>2	60.00	0	100	0.38
0-15-X	FI 15-sec	Bee 3	Combinations 1>2	51.00	31.00	60.00	0.13
0-15-X	FI 15-sec	Bee 3	1<2	40.00	0	100	0.84
0-15-X	FI 15-sec	Bee 3	Combinations 1<2	39.00	28.00	58.00	0.92
0-15-X	FI 15-sec	Bee 5	1=2	50.00	50.00	50.00	1
0-15-X	FI 15-sec	Bee 5	Combinations 1=2	33.33	33.33	33.33	1
0-15-X	FI 15-sec	Bee 5	1>2	0	0	50.00	1
0-15-X	FI 15-sec	Bee 5	Combinations 1>2	5.56	13.89	58.33	1
0-15-X	FI 15-sec	Bee 5	1<2	50.00	0	50.00	0.12
0-15-X	FI 15-sec	Bee 5	Combinations 1<2	**61.11**	**11.11**	**55.56**	**0.001**
0-15-X	FI 15-sec	Bee 6	1=2	50.00	50.00	50.00	1
0-15-X	FI 15-sec	Bee 6	Combinations 1=2	27.00	27.00	27.00	1
0-15-X	FI 15-sec	Bee 6	1>2	20.00	0	50.00	0.8
0-15-X	FI 15-sec	Bee 6	Combinations 1>2	36.00	23.00	51.00	0.59
0-15-X	FI 15-sec	Bee 6	1<2	30.00	0	50.00	0.5
0-15-X	FI 15-sec	Bee 6	Combinations 1<2	37.00	22.00	49.00	0.51
0-15-X	FI 15-sec	Bee 7	1=2	33.33	33.33	33.33	1
0-15-X	FI 15-sec	Bee 7	Combinations 1=2	24.69	24.69	24.69	1
0-15-X	FI 15-sec	Bee 7	1>2	0	0	66.67	1
0-15-X	FI 15-sec	Bee 7	Combinations 1>2	0	23.46	51.85	1
0-15-X	FI 15-sec	Bee 7	1<2	**66.67**	**0**	**66.67**	**0.02**
0-15-X	FI 15-sec	Bee 7	Combinations 1<2	**75.31**	**22.22**	**54.32**	**0.001**
0-15-X	FI 15-sec	Bee 8	1=2	66.67	66.67	66.67	1
0-15-X	FI 15-sec	Bee 8	Combinations 1=2	46.91	46.91	46.91	1
0-15-X	FI 15-sec	Bee 8	1>2	12.50	0	75.00	0.99
0-15-X	FI 15-sec	Bee 8	Combinations 1>2	0	0	33.33	1
0-15-X	FI 15-sec	Bee 8	1<2	33.33	0	33.33	0.12
0-15-X	FI 15-sec	Bee 8	Combinations 1<2	**46.91**	**13.58**	**39.51**	**0.001**
0-15-X	FI 15-sec	Bee 9	1=2	42.86	42.86	42.86	1
0-15-X	FI 15-sec	Bee 9	Combinations 1=2	46.94	46.94	46.94	1
0-15-X	FI 15-sec	Bee 9	1>2	14.29	0	57.14	0.94

0-15-X	FI 15-sec	Bee 9	Combinations 1>2	12.24	10.20	42.86	1
0-15-X	FI 15-sec	Bee 9	1<2	42.86	0	57.14	0.31
0-15-X	FI 15-sec	Bee 9	Combinations 1<2	**40.82**	**10.20**	**42.86**	**0.01**
0-15-X	FI 15-sec	Bee 10	1=2	25.00	25.00	25.00	1
0-15-X	FI 15-sec	Bee 10	Combinations 1=2	12.50	12.50	12.50	1
0-15-X	FI 15-sec	Bee 10	1>2	25.00	0	75.00	0.9
0-15-X	FI 15-sec	Bee 10	Combinations 1>2	26.56	23.44	60.94	1
0-15-X	FI 15-sec	Bee 10	1<2	50.00	0	75.00	0.36
0-15-X	FI 15-sec	Bee 10	Combinations 1<2	**60.94**	**23.44**	**68.75**	**0.003**
0-15-X	FI 15-sec	All	1=2	32.26	32.26	32.26	1
0-15-X	FI 15-sec	All	Combinations 1=2	19.17	19.17	19.17	1
0-15-X	FI 15-sec	All	1>2	17.74	16.13	51.61	1
0-15-X	FI 15-sec	All	Combinations 1>2	26.82	37.54	42.74	1
0-15-X	FI 15-sec	All	1<2	**50.00**	**19.35**	**48.39**	**0.001**
0-15-X	FI 15-sec	All	Combinations 1<2	**54.01**	**37.41**	**42.35**	**0.001**

Honey Bee 0-15-X Four Bin OOM

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-15-X	FI 15-sec	Bee 2	1=2=3=4	30.00	30.00	30.00	1
0-15-X	FI 15-sec	Bee 2	Complete 1=2=3=4	0	0	0	1
0-15-X	FI 15-sec	Bee 2	1>2>3>4	13.33	6.67	60.00	0.99
0-15-X	FI 15-sec	Bee 2	Complete 1>2>3>4	0	0	0	1
0-15-X	FI 15-sec	Bee 2	1<2<3<4	**56.67**	**3.33**	**63.33**	**0.01**
0-15-X	FI 15-sec	Bee 2	Complete 1<2<3<4	0	0	0	1
0-15-X	FI 15-sec	Bee 2	1=2<3<4	46.67	10.00	63.33	0.12
0-15-X	FI 15-sec	Bee 2	Complete 1=2<3<4	0	0	40.00	1
0-15-X	FI 15-sec	Bee 2	1=2=3<4	53.33	16.67	60.00	0.03
0-15-X	FI 15-sec	Bee 2	Complete 1=2=3<4	0	0	0	1
0-15-X	FI 15-sec	Bee 3	1=2=3=4	18.33	18.33	18.33	1
0-15-X	FI 15-sec	Bee 3	Complete 1=2=3=4	0	0	0	1
0-15-X	FI 15-sec	Bee 3	1>2>3>4	41.67	18.33	61.67	0.49
0-15-X	FI 15-sec	Bee 3	Complete 1>2>3>4	0	0	20	1
0-15-X	FI 15-sec	Bee 3	1<2<3<4	40.00	23.33	63.33	0.59
0-15-X	FI 15-sec	Bee 3	Complete 1<2<3<4	0	0	20	1
0-15-X	FI 15-sec	Bee 3	1=2<3<4	40.00	18.33	63.33	0.38
0-15-X	FI 15-sec	Bee 3	Complete 1=2<3<4	0	0	20.00	1
0-15-X	FI 15-sec	Bee 3	1=2=3<4	**41.67**	**11.67**	**50.00**	**0.05**
0-15-X	FI 15-sec	Bee 3	Complete 1=2=3<4	0	0	0	1
0-15-X	FI 15-sec	Bee 5	1=2=3=4	41.67	41.67	41.67	1
0-15-X	FI 15-sec	Bee 5	Complete 1=2=3=4	16.67	16.67	16.67	1
0-15-X	FI 15-sec	Bee 5	1>2>3>4	11.11	5.56	52.78	0.99
0-15-X	FI 15-sec	Bee 5	Complete 1>2>3>4	0	0	0	1
0-15-X	FI 15-sec	Bee 5	1<2<3<4	47.22	8.33	52.78	0.03
0-15-X	FI 15-sec	Bee 5	Complete 1<2<3<4	0	0	0	1
0-15-X	FI 15-sec	Bee 5	1=2<3<4	41.67	8.33	63.89	0.19
0-15-X	FI 15-sec	Bee 5	Complete 1=2<3<4	0	0	33.33	1
0-15-X	FI 15-sec	Bee 5	1=2=3<4	**63.89**	**16.67**	**63.59**	**0.002**
0-15-X	FI 15-sec	Bee 5	Complete 1=2=3<4	16.67	0	16.67	0.28
0-15-X	FI 15-sec	Bee 6	1=2=3=4	52.08	52.08	52.08	1
0-15-X	FI 15-sec	Bee 6	Complete 1=2=3=4	25.00	25.00	25.00	1
0-15-X	FI 15-sec	Bee 6	1>2>3>4	22.92	4.17	41.67	0.62
0-15-X	FI 15-sec	Bee 6	Complete 1>2>3>4	0	0	0	1
0-15-X	FI 15-sec	Bee 6	1<2<3<4	25.00	4.17	43.75	0.51
0-15-X	FI 15-sec	Bee 6	Complete 1<2<3<4	0	0	0	1
0-15-X	FI 15-sec	Bee 6	1=2<3<4	29.17	14.58	45.83	0.52
0-15-X	FI 15-sec	Bee 6	Complete 1=2<3<4	0	0	0	1
0-15-X	FI 15-sec	Bee 6	1=2=3<4	33.33	29.18	52.08	0.9

0-15-X	FI 15-sec	Bee 6	Complete 1=2=3<4	0	0	12.50	1
0-15-X	FI 15-sec	Bee 7	1=2=3=4	44.44	44.44	44.44	1
0-15-X	FI 15-sec	Bee 7	Complete 1=2=3=4	0	0	0	1
0-15-X	FI 15-sec	Bee 7	1>2>3>4	9.26	5.56	46.30	1
0-15-X	FI 15-sec	Bee 7	Complete 1>2>3>4	0	0	0	1
0-15-X	FI 15-sec	Bee 7	1<2<3<4	46.30	7.41	46.30	0.001
0-15-X	FI 15-sec	Bee 7	Complete 1<2<3<4	0	0	0	1
0-15-X	FI 15-sec	Bee 7	1=2<3<4	51.85	9.26	61.11	0.01
0-15-X	FI 15-sec	Bee 7	Complete 1=2<3<4	0	0	0	1
0-15-X	FI 15-sec	Bee 7	1=2=3<4	**75.93**	**18.52**	**68.52**	**0.001**
0-15-X	FI 15-sec	Bee 7	Complete 1=2=3<4	**55.56**	**0**	**44.44**	**0.001**
0-15-X	FI 15-sec	Bee 8	1=2=3=4	31.48	31.48	31.48	1
0-15-X	FI 15-sec	Bee 8	Complete 1=2=3=4	0	0	0	1
0-15-X	FI 15-sec	Bee 8	1>2>3>4	18.52	14.81	55.56	0.99
0-15-X	FI 15-sec	Bee 8	Complete 1>2>3>4	0	0	0	1
0-15-X	FI 15-sec	Bee 8	1<2<3<4	50.00	9.26	55.56	0.02
0-15-X	FI 15-sec	Bee 8	Complete 1<2<3<4	0	0	0	1
0-15-X	FI 15-sec	Bee 8	1=2<3<4	46.30	16.67	59.26	0.08
0-15-X	FI 15-sec	Bee 8	Complete 1=2<3<4	0	0	0	1
0-15-X	FI 15-sec	Bee 8	1=2=3<4	**51.85**	**18.52**	**50.00**	**0.001**
0-15-X	FI 15-sec	Bee 8	Complete 1=2=3<4	0	0	0	1
0-15-X	FI 15-sec	Bee 9	1=2=3=4	35.71	35.71	35.71	1
0-15-X	FI 15-sec	Bee 9	Complete 1=2=3=4	0	0	0	1
0-15-X	FI 15-sec	Bee 9	1>2>3>4	19.05	0	54.76	0.98
0-15-X	FI 15-sec	Bee 9	Complete 1>2>3>4	0	0	0	1
0-15-X	FI 15-sec	Bee 9	1<2<3<4	45.24	4.76	57.14	0.08
0-15-X	FI 15-sec	Bee 9	Complete 1<2<3<4	0	0	0	1
0-15-X	FI 15-sec	Bee 9	1=2<3<4	40.48	16.67	59.52	0.2
0-15-X	FI 15-sec	Bee 9	Complete 1=2<3<4	0	0	14.29	1
0-15-X	FI 15-sec	Bee 9	1=2=3<4	**47.62**	**21.43**	**54.76**	**0.04**
0-15-X	FI 15-sec	Bee 9	Complete 1=2=3<4	0	0	0	1
0-15-X	FI 15-sec	Bee 10	1=2=3=4	20.83	20.83	20.83	1
0-15-X	FI 15-sec	Bee 10	Complete 1=2=3=4	0	0	0	1
0-15-X	FI 15-sec	Bee 10	1>2>3>4	27.08	14.58	62.50	0.96
0-15-X	FI 15-sec	Bee 10	Complete 1>2>3>4	0	0	12.50	1
0-15-X	FI 15-sec	Bee 10	1<2<3<4	52.08	16.67	64.58	0.09
0-15-X	FI 15-sec	Bee 10	Complete 1<2<3<4	0	0	12.50	1
0-15-X	FI 15-sec	Bee 10	1=2<3<4	45.83	14.58	66.67	0.15
0-15-X	FI 15-sec	Bee 10	Complete 1=2<3<4	12.50	0	12.50	0.07
0-15-X	FI 15-sec	Bee 10	1=2=3<4	37.50	12.50	52.08	0.21
0-15-X	FI 15-sec	Bee 10	Complete 1=2=3<4	0	0	12.50	1
0-15-X	FI 15-sec	All	1=2=3=4	33.87	33.87	33.87	1

0-15-X	FI 15-sec	All	Complete 1=2=3=4	4.84	4.84	4.84	1
0-15-X	FI 15-sec	All	1>2>3>4	21.51	25.00	41.13	1
0-15-X	FI 15-sec	All	Complete 1>2>3>4	0	0	3.23	1
0-15-X	FI 15-sec	All	1<2<3<4	44.62	26.34	42.47	0.001
0-15-X	FI 15-sec	All	Complete 1<2<3<4	0	0	3.23	1
0-15-X	FI 15-sec	All	1=2<3<4	42.74	23.92	43.55	0.002
0-15-X	FI 15-sec	All	Complete 1=2<3<4	1.61	0	6.45	0.54
0-15-X	FI 15-sec	All	1=2=3<4	**50.27**	**26.61**	**41.67**	**0.001**
0-15-X	FI 15-sec	All	Complete 1=2=3<4	**9.68**	**0**	**11.29**	**0.004**

Honey Bee 0-15-X Ten Bin OOM

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-15-X	FI 15-sec	Bee 2	1>…>10	14.22	10.67	38.22	0.99
0-15-X	FI 15-sec	Bee 2	Complete 1>…>10	0	0	0	1
0-15-X	FI 15-sec	Bee 2	1<…<10	**33.33**	**12.00**	**36.89**	**0.01**
0-15-X	FI 15-sec	Bee 2	Complete 1<…<10	0	0	0	1
0-15-X	FI 15-sec	Bee 3	1>…>10	35.33	23.33	45.33	0.46
0-15-X	FI 15-sec	Bee 3	Complete 1>…>10	0	0	0	1
0-15-X	FI 15-sec	Bee 3	1<…<10	34.67	23.11	44.44	0.58
0-15-X	FI 15-sec	Bee 3	Complete 1<…<10	0	0	0	1
0-15-X	FI 15-sec	Bee 5	1>…>10	11.48	9.26	34.07	1
0-15-X	FI 15-sec	Bee 5	Complete 1>…>10	0	0	0	1
0-15-X	FI 15-sec	Bee 5	1<…<10	**30.74**	**10.00**	**33.33**	**0.01**
0-15-X	FI 15-sec	Bee 5	Complete 1<…<10	0	0	0	1
0-15-X	FI 15-sec	Bee 6	1>…>10	26.94	17.78	39.72	0.6
0-15-X	FI 15-sec	Bee 6	Complete 1>…>10	0	0	0	1
0-15-X	FI 15-sec	Bee 6	1<…<10	28.89	13.61	40.28	0.4
0-15-X	FI 15-sec	Bee 6	Complete 1<…<10	0	0	0	1
0-15-X	FI 15-sec	Bee 7	1>…>10	6.91	7.65	24.94	1
0-15-X	FI 15-sec	Bee 7	Complete 1>…>10	0	0	0	1
0-15-X	FI 15-sec	Bee 7	1<…<10	**24.69**	**6.42**	**25.19**	**0.001**
0-15-X	FI 15-sec	Bee 7	Complete 1<…<10	0	0	0	1
0-15-X	FI 15-sec	Bee 8	1>…>10	12.35	11.60	28.64	1
0-15-X	FI 15-sec	Bee 8	Complete 1>…>10	0	0	0	1
0-15-X	FI 15-sec	Bee 8	1<…<10	**28.40**	**9.63**	**28.89**	**0.003**
0-15-X	FI 15-sec	Bee 8	Complete 1<…<10	0	0	0	1
0-15-X	FI 15-sec	Bee 9	1>…>10	15.24	11.43	33.97	0.98
0-15-X	FI 15-sec	Bee 9	Complete 1>…>10	0	0	0	1
0-15-X	FI 15-sec	Bee 9	1<…<10	**29.21**	**11.11**	**32.06**	**0.03**
0-15-X	FI 15-sec	Bee 9	Complete 1<…<10	0	0	0	1
0-15-X	FI 15-sec	Bee 10	1>…>10	24.17	21.67	44.19	0.99
0-15-X	FI 15-sec	Bee 10	Complete 1>…>10	0	0	0	1
0-15-X	FI 15-sec	Bee 10	1<…<10	**40.83**	**18.33**	**47.5**	**0.02**
0-15-X	FI 15-sec	Bee 10	Complete 1<…<10	0	0	0	1
0-15-X	FI 15-sec	All	1>…>10	19.07	21.40	29.25	1
0-15-X	FI 15-sec	All	Complete 1>…>10	0	0	0	1
0-15-X	FI 15-sec	All	1<…<10	**31.25**	**21.15**	**30.47**	**0.001**
0-15-X	FI 15-sec	All	Complete 1<…<10	0	0	0	1

Honey Bee 0-15-X 20 Bin OOM

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-15-X	FI 15-sec	Bee 2	1>…>20	8.53	6.84	20.74	1
0-15-X	FI 15-sec	Bee 2	Complete 1>…>20	0	0	0	1
0-15-X	FI 15-sec	Bee 2	1<…<20	**19.68**	**7.47**	**21.16**	**0.01**
0-15-X	FI 15-sec	Bee 2	Complete 1<…<20	0	0	0	1
0-15-X	FI 15-sec	Bee 3	1>…>20	26.58	18.89	32.16	0.32
0-15-X	FI 15-sec	Bee 3	Complete 1>…>20	0	0	0	1
0-15-X	FI 15-sec	Bee 3	1<…<20	24.79	18.63	31.74	0.66
0-15-X	FI 15-sec	Bee 3	Complete 1<…<20	0	0	0	1
0-15-X	FI 15-sec	Bee 5	1>…>20	7.11	6.49	17.46	1
0-15-X	FI 15-sec	Bee 5	Complete 1>…>20	0	0	0	1
0-15-X	FI 15-sec	Bee 5	1<…<20	**16.93**	**6.40**	**17.89**	**0.003**
0-15-X	FI 15-sec	Bee 5	Complete 1<…<20	0	0	0	1
0-15-X	FI 15-sec	Bee 6	1>…>20	19.14	12.37	25.53	0.47
0-15-X	FI 15-sec	Bee 6	Complete 1>…>20	0	0	0	1
0-15-X	FI 15-sec	Bee 6	1<…<20	18.95	11.91	25.46	0.52
0-15-X	FI 15-sec	Bee 6	Complete 1<…<20	0	0	0	1
0-15-X	FI 15-sec	Bee 7	1>…>20	3.98	3.68	12.46	1
0-15-X	FI 15-sec	Bee 7	Complete 1>…>20	0	0	0	1
0-15-X	FI 15-sec	Bee 7	1<…<20	**12.87**	**4.50**	**12.22**	**0.001**
0-15-X	FI 15-sec	Bee 7	Complete 1<…<20	0	0	0	1
0-15-X	FI 15-sec	Bee 8	1>…>20	7.60	6.67	16.67	1
0-15-X	FI 15-sec	Bee 8	Complete 1>…>20	0	0	0	1
0-15-X	FI 15-sec	Bee 8	1<…<20	**15.50**	**7.25**	**16.55**	**0.01**
0-15-X	FI 15-sec	Bee 8	Complete 1<…<20	0	0	0	1
0-15-X	FI 15-sec	Bee 9	1>…>20	9.32	7.14	18.72	0.97
0-15-X	FI 15-sec	Bee 9	Complete 1>…>20	0	0	0	1
0-15-X	FI 15-sec	Bee 9	1<…<20	**16.24**	**6.09**	**18.42**	**0.03**
0-15-X	FI 15-sec	Bee 9	Complete 1<…<20	0	0	0	1
0-15-X	FI 15-sec	Bee 10	1>…>20	18.49	15.72	31.64	0.98
0-15-X	FI 15-sec	Bee 10	Complete 1>…>20	0	0	0	1
0-15-X	FI 15-sec	Bee 10	1<…<20	**27.37**	**15.86**	**29.74**	**0.02**
0-15-X	FI 15-sec	Bee 10	Complete 1<…<20	0	0	0	1
0-15-X	FI 15-sec	All	1>…>20	13.25	13.67	18.18	1
0-15-X	FI 15-sec	All	Complete 1>…>20	0	0	0	1
0-15-X	FI 15-sec	All	1<…<20	**19.15**	**14.32**	**18.29**	**0.001**
0-15-X	FI 15-sec	All	Complete 1<…<20	0	0	0	1

Honey Bee 0-30-X Two Bin OOM

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-30-X	FI 30-sec	Bee 1	1=2	37.50	37.50	37.50	1
0-30-X	FI 30-sec	Bee 1	Combinations 1=2	25.00	25.00	25.00	1
0-30-X	FI 30-sec	Bee 1	1>2	12.50	0	62.50	0.96
0-30-X	FI 30-sec	Bee 1	Combinations 1>2	25.00	21.88	54.69	0.99
0-30-X	FI 30-sec	Bee 1	1<2	50.00	0	62.50	0.19
0-30-X	FI 30-sec	Bee 1	Combinations 1<2	**50.00**	**23.44**	**54.69**	**0.01**
0-30-X	FI 30-sec	Bee 2	1=2	14.29	14.29	14.29	1
0-30-X	FI 30-sec	Bee 2	Combinations 1=2	18.37	18.37	18.37	1
0-30-X	FI 30-sec	Bee 2	1>2	0	0	85.71	1
0-30-X	FI 30-sec	Bee 2	Combinations 1>2	4.08	20.41	59.18	1
0-30-X	FI 30-sec	Bee 2	1<2	**85.71**	**0**	**85.71**	**0.02**
0-30-X	FI 30-sec	Bee 2	Combinations 1<2	**77.55**	**20.41**	**63.27**	**0.001**
0-30-X	FI 30-sec	Bee 7	1=2	14.29	14.29	14.29	1
0-30-X	FI 30-sec	Bee 7	Combinations 1=2	8.16	8.16	8.16	1
0-30-X	FI 30-sec	Bee 7	1>2	28.57	0	85.71	0.89
0-30-X	FI 30-sec	Bee 7	Combinations 1>2	20.41	26.53	67.35	1
0-30-X	FI 30-sec	Bee 7	1<2	57.14	0	85.71	0.35
0-30-X	FI 30-sec	Bee 7	Combinations 1<2	**71.43**	**24.49**	**65.31**	**0.001**
0-30-X	FI 30-sec	Bee 8	1=2	0	0	0	1
0-30-X	FI 30-sec	Bee 8	Combinations 1=2	5.56	5.56	5.56	1
0-30-X	FI 30-sec	Bee 8	1>2	0	0	100	1
0-30-X	FI 30-sec	Bee 8	Combinations 1>2	0	19.44	69.44	1
0-30-X	FI 30-sec	Bee 8	1<2	**100**	**0**	**100**	**0.01**
0-30-X	FI 30-sec	Bee 8	Combinations 1<2	**94.44**	**22.22**	**77.78**	**0.001**
0-30-X	FI 30-sec	Bee 9	1=2	9.09	9.09	9.09	1
0-30-X	FI 30-sec	Bee 9	Combinations 1=2	2.48	2.48	2.48	1
0-30-X	FI 30-sec	Bee 9	1>2	9.09	9.09	9.09	1
0-30-X	FI 30-sec	Bee 9	Combinations 1>2	13.22	33.88	62.81	1
0-30-X	FI 30-sec	Bee 9	1<2	**81.82**	**0**	**90.91**	**0.01**
0-30-X	FI 30-sec	Bee 9	Combinations 1<2	**84.30**	**30.58**	**63.64**	**0.001**
0-30-X	FI 30-sec	All	1=2	15.38	15.38	15.38	1
0-30-X	FI 30-sec	All	Combinations 1=2	10.12	10.12	10.12	1
0-30-X	FI 30-sec	All	1>2	10.26	20.51	69.23	1
0-30-X	FI 30-sec	All	Combinations 1>2	24.92	41.68	48.72	1
0-30-X	FI 30-sec	All	1<2	**74.36**	**17.95**	**69.23**	**0.001**
0-30-X	FI 30-sec	All	Combinations 1<2	**64.96**	**41.03**	**49.31**	**0.001**

Honey Bee 0-30-X Four Bin OOM

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-30-X	FI 30-sec	Bee 1	1=2=3=4	33.33	33.33	33.33	1
0-30-X	FI 30-sec	Bee 1	Complete 1=2=3=4	0	0	0	1
0-30-X	FI 30-sec	Bee 1	1>2>3>4	22.92	10.42	56.25	0.94
0-30-X	FI 30-sec	Bee 1	Complete 1>2>3>4	0	0	0	1
0-30-X	FI 30-sec	Bee 1	1<2<3<4	43.75	10.42	56.25	0.11
0-30-X	FI 30-sec	Bee 1	Complete 1<2<3<4	0	0	0	1
0-30-X	FI 30-sec	Bee 1	1=2<3<4	**47.92**	**12.50**	**60.42**	**0.06**
0-30-X	FI 30-sec	Bee 1	Complete 1=2<3<4	0	0	0	1
0-30-X	FI 30-sec	Bee 1	1=2=3<4	45.83	18.75	56.25	0.07
0-30-X	FI 30-sec	Bee 1	Complete 1=2=3<4	12.50	0	12.50	0.26
0-30-X	FI 30-sec	Bee 2	1=2=3=4	23.81	23.81	23.81	1
0-30-X	FI 30-sec	Bee 2	Complete 1=2=3=4	0	0	0	1
0-30-X	FI 30-sec	Bee 2	1>2>3>4	11.90	14.29	61.90	1
0-30-X	FI 30-sec	Bee 2	Complete 1>2>3>4	0	0	0	1
0-30-X	FI 30-sec	Bee 2	1<2<3<4	64.29	11.90	66.67	0.002
0-30-X	FI 30-sec	Bee 2	Complete 1<2<3<4	0	0	0	1
0-30-X	FI 30-sec	Bee 2	1=2<3<4	61.90	7.14	66.67	0.01
0-30-X	FI 30-sec	Bee 2	Complete 1=2<3<4	14.29	0	42.86	0.26
0-30-X	FI 30-sec	Bee 2	1=2=3<4	**69.05**	**9.52**	**59.52**	**0.001**
0-30-X	FI 30-sec	Bee 2	Complete 1=2=3<4	14.29	0	14.29	0.27
0-30-X	FI 30-sec	Bee 7	1=2=3=4	16.67	16.67	16.67	1
0-30-X	FI 30-sec	Bee 7	Complete 1=2=3=4	0	0	0	1
0-30-X	FI 30-sec	Bee 7	1>2>3>4	28.57	14.29	71.43	0.94
0-30-X	FI 30-sec	Bee 7	Complete 1>2>3>4	0	0	28.57	1
0-30-X	FI 30-sec	Bee 7	1<2<3<4	54.76	14.29	66.67	0.1
0-30-X	FI 30-sec	Bee 7	Complete 1<2<3<4	14.29	0	28.57	0.12
0-30-X	FI 30-sec	Bee 7	1=2<3<4	47.62	9.52	66.67	0.17
0-30-X	FI 30-sec	Bee 7	Complete 1=2<3<4	0	0	0	1
0-30-X	FI 30-sec	Bee 7	1=2=3<4	33.33	9.52	50.00	0.31
0-30-X	FI 30-sec	Bee 7	Complete 1=2=3<4	0	0	14.29	1
0-30-X	FI 30-sec	Bee 8	1=2=3=4	33.33	33.33	33.33	1
0-30-X	FI 30-sec	Bee 8	Complete 1=2=3=4	0	0	0	1
0-30-X	FI 30-sec	Bee 8	1>2>3>4	2.78	8.33	58.33	1
0-30-X	FI 30-sec	Bee 8	Complete 1>2>3>4	0	0	0	1
0-30-X	FI 30-sec	Bee 8	1<2<3<4	63.89	5.56	61.11	0.001
0-30-X	FI 30-sec	Bee 8	Complete 1<2<3<4	0	0	0	1
0-30-X	FI 30-sec	Bee 8	1=2<3<4	75.00	2.78	72.22	0.001
0-30-X	FI 30-sec	Bee 8	Complete 1=2<3<4	33.33	0	50.00	0.02
0-30-X	FI 30-sec	Bee 8	1=2=3<4	**83.33**	**8.33**	**80.56**	**0.001**

0-30-X	FI 30-sec	Bee 8	Complete 1=2=3<4	**50.00**	**0**	**50.00**	**0.02**
0-30-X	FI 30-sec	Bee 9	1=2=3=4	22.73	22.73	22.73	1
0-30-X	FI 30-sec	Bee 9	Complete 1=2=3=4	9.09	9.09	9.09	1
0-30-X	FI 30-sec	Bee 9	1>2>3>4	15.15	16.67	57.58	1
0-30-X	FI 30-sec	Bee 9	Complete 1>2>3>4	0	0	27.27	1
0-30-X	FI 30-sec	Bee 9	1<2<3<4	62.12	18.18	60.61	0.001
0-30-X	FI 30-sec	Bee 9	Complete 1<2<3<4	0	0	18.18	1
0-30-X	FI 30-sec	Bee 9	1=2<3<4	**60.61**	**15.15**	**54.55**	**0.001**
0-30-X	FI 30-sec	Bee 9	Complete 1=2<3<4	**18.18**	**0**	**27.27**	**0.01**
0-30-X	FI 30-sec	Bee 9	1=2=3<4	42.42	13.64	48.48	0.03
0-30-X	FI 30-sec	Bee 9	Complete 1=2=3<4	0	0	0	1
0-30-X	FI 30-sec	All	1=2=3=4	25.64	25.64	25.64	1
0-30-X	FI 30-sec	All	Complete 1=2=3=4	2.56	2.56	2.56	1
0-30-X	FI 30-sec	All	1>2>3>4	16.67	26.07	48.29	1
0-30-X	FI 30-sec	All	Complete 1>2>3>4	0	0	7.69	1
0-30-X	FI 30-sec	All	1<2<3<4	57.69	25.21	48.29	0.001
0-30-X	FI 30-sec	All	Complete 1<2<3<4	2.56	0	7.69	0.22
0-30-X	FI 30-sec	All	1=2<3<4	**58.12**	**23.93**	**50.85**	**0.001**
0-30-X	FI 30-sec	All	Complete 1=2<3<4	**12.82**	**0**	**10.26**	**0.001**
0-30-X	FI 30-sec	All	1=2=3<4	52.56	21.37	42.74	0.001
0-30-X	FI 30-sec	All	Complete 1=2=3<4	12.82	0	12.82	0.003

Honey Bee 0-30-X Ten Bin OOM

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-30-X	FI 30-sec	Bee 1	1>…>10	20.00	12.50	35.00	0.87
0-30-X	FI 30-sec	Bee 1	Complete 1>…>10	0	0	0	1
0-30-X	FI 30-sec	Bee 1	1<…<10	27.78	13.06	33.89	0.13
0-30-X	FI 30-sec	Bee 1	Complete 1<…<10	0	0	0	1
0-30-X	FI 30-sec	Bee 2	1>…>10	11.43	11.43	32.70	1
0-30-X	FI 30-sec	Bee 2	Complete 1>…>10	0	0	0	1
0-30-X	FI 30-sec	Bee 2	1<…<10	**32.38**	**10.48**	**32.70**	**0.001**
0-30-X	FI 30-sec	Bee 2	Complete 1<…<10	0	0	0	1
0-30-X	FI 30-sec	Bee 7	1>…>10	26.67	25.40	51.43	1
0-30-X	FI 30-sec	Bee 7	Complete 1>…>10	0	0	0	1
0-30-X	FI 30-sec	Bee 7	1<…<10	**46.98**	**23.49**	**51.43**	**0.01**
0-30-X	FI 30-sec	Bee 7	Complete 1<…<10	0	0	0	1
0-30-X	FI 30-sec	Bee 8	1>…>10	1.85	6.67	26.30	1
0-30-X	FI 30-sec	Bee 8	Complete 1>…>10	0	0	0	1
0-30-X	FI 30-sec	Bee 8	1<…<10	**30.00**	**5.93**	**25.93**	**0.001**
0-30-X	FI 30-sec	Bee 8	Complete 1<…<10	0	0	0	1
0-30-X	FI 30-sec	Bee 9	1>…>10	18.59	25.86	44.65	1
0-30-X	FI 30-sec	Bee 9	Complete 1>…>10	0	0	0	1
0-30-X	FI 30-sec	Bee 9	1<…<10	**51.72**	**23.64**	**44.44**	**0.001**
0-30-X	FI 30-sec	Bee 9	Complete 1<…<10	0	0	0	1
0-30-X	FI 30-sec	All	1>…>10	16.47	22.85	32.82	1
0-30-X	FI 30-sec	All	Complete 1>…>10	0	0	0	1
0-30-X	FI 30-sec	All	1<…<10	**39.15**	**21.88**	**33.11**	**0.001**
0-30-X	FI 30-sec	All	Complete 1<…<10	0	0	0	1

Honey Bee 0-30-X 20 Bin OOM

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-30-X	FI 30-sec	Bee 1	1>…>20	13.09	8.36	21.18	0.8
0-30-X	FI 30-sec	Bee 1	Complete 1>…>20	0	0	0	1
0-30-X	FI 30-sec	Bee 1	1<…<20	15.72	7.70	19.8	0.26
0-30-X	FI 30-sec	Bee 1	Complete 1<…<20	0	0	0	1
0-30-X	FI 30-sec	Bee 2	1>…>20	7.37	7.22	19.17	1
0-30-X	FI 30-sec	Bee 2	Complete 1>…>20	0	0	0	1
0-30-X	FI 30-sec	Bee 2	1<…<20	**19.10**	**6.24**	**18.5**	**0.001**
0-30-X	FI 30-sec	Bee 2	Complete 1<…<20	0	0	0	1
0-30-X	FI 30-sec	Bee 7	1>…>20	20.68	19.70	37.97	1
0-30-X	FI 30-sec	Bee 7	Complete 1>…>20	0	0	0	1
0-30-X	FI 30-sec	Bee 7	1<…<20	**38.65**	**19.32**	**38.27**	**0.001**
0-30-X	FI 30-sec	Bee 7	Complete 1<…<20	0	0	0	1
0-30-X	FI 30-sec	Bee 8	1>…>20	1.58	4.39	15.18	1
0-30-X	FI 30-sec	Bee 8	Complete 1>…>20	0	0	0	1
0-30-X	FI 30-sec	Bee 8	1<…<20	**18.33**	**3.95**	**15.61**	**0.001**
0-30-X	FI 30-sec	Bee 8	Complete 1<…<20	0	0	0	1
0-30-X	FI 30-sec	Bee 9	1>…>20	16.32	20.86	35.31	1
0-30-X	FI 30-sec	Bee 9	Complete 1>…>20	0	0	0	1
0-30-X	FI 30-sec	Bee 9	1<…<20	**39.14**	**20.77**	**34.31**	**0.001**
0-30-X	FI 30-sec	Bee 9	Complete 1<…<20	0	0	0	1
0-30-X	FI 30-sec	All	1>…>20	12.56	17.11	22.93	1
0-30-X	FI 30-sec	All	Complete 1>…>20	0	0	0	1
0-30-X	FI 30-sec	All	1<…<20	**27.45**	**16.87**	**22.6**	**0.001**
0-30-X	FI 30-sec	All	Complete 1<…<20	0	0	0	1

Appendix 4: Response Bin NHST Non-Parametric

Horse Two Bin NHST – Wilcoxon Signed-Rank and Sign Test

Group	Fixed Interval	Subject	Z Score	p-value	Sign Test Z Score	Sign Test p-value	(Bin 2>Bin 1) / Total
0-60-P	FI 60-sec	Horse 6	-6.175	.000*	-6.93	.000*	1
0-60-P	FI 60-sec	Horse 9	-6.026	.000*	-6.71	.000*	0.94
0-60-P	FI 60-sec	Horse 14	-6.188	.000*	-6.93	.000*	1
0-60-P	FI 60-sec	All	-10.562	.000*	-12.042	.000*	0.98
0-90-P	FI 90-sec	Horse 1	-6.128	.000*	-6.647	.000*	0.98
0-90-P	FI 90-sec	Horse 10	-5.983	.000*	-6.495	.000*	0.94
0-90-P	FI 90-sec	Horse 13	-6.109	.000*	-6.857	.000*	0.98
0-90-P	FI 90-sec	All	-10.488	.000*	-11.712	.000*	0.97
0-180-P	FI 180-sec	Horse 3	**-0.677**	**0.498**	*	**1**	**0.6**
0-60/90/180-P	FI 60-sec	Horse 4	-6.044	.000*	-6.71	.000*	0.94
0-60/90/180-P	FI 60-sec	Horse 11	-6.086	.000*	-6.784	.000*	0.96
0-60/90/180-P	FI 60-sec	All	-8.507	.000*	-9.644	.000*	0.95
0-60/90/180-P	FI 90-sec	Horse 4	65.882	.000*	-6.015	.000*	0.88
0-60/90/180-P	FI 90-sec	Horse 11	-5.991	.000*	-6.286	.000*	0.94
0-60/90/180-P	FI 90-sec	All	-8.347	.000*	-8.823	.000*	0.91
0-60/90/180-P	FI 180-sec	Horse 4	**-1**	**0.317**	*	**0.625**	**0.2**
0-60/90/180-P	FI 180-sec	Horse 11	-5.863	.000*	-6.045	.000*	0.88
0-60/90/180-P	FI 180-sec	All	-5.934	.000*	-5.515	.000*	0.82
0-60-90-180-P	FI 60-sec	Horse 2	-5.887	.000*	-6.418	.000*	0.92
0-60-90-180-P	FI 60-sec	Horse 5	-6.135	.000*	-6.647	.000*	0.98
0-60-90-180-P	FI 60-sec	Horse 7	-6.156	.000*	-6.857	.000*	0.98
0-60-90-180-P	FI 60-sec	Horse 8	-5.888	.000*	-6.495	.000*	0.94
0-60-90-180-P	FI 60-sec	All	-11.883	.000*	-13.426	.000*	0.955
0-60-90-180-P	FI 90-sec	Horse 2	-6.16	.000*	-6.93	.000*	1
0-60-90-180-P	FI 90-sec	Horse 5	-6.108	.000*	-6.857	.000*	0.98
0-60-90-180-P	FI 90-sec	Horse 7	-5.814	.000*	-6.482	.000*	0.98
0-60-90-180-P	FI 90-sec	Horse 8	-6.029	.000*	-6.647	.000*	0.98
0-60-90-180-P	FI 90-sec	All	-11.979	.000*	-13.676	.000*	0.98
0-60-90-180-P	FI 180-sec	Horse 2	-6.1	.000*	-6.857	.000*	0.98
0-60-90-180-P	FI 180-sec	Horse 5	-5.709	.000*	-6	.000*	0.92
0-60-90-180-P	FI 180-sec	Horse 7	-2.608	0.009	*	0.021	0.9
0-60-90-180-P	FI 180-sec	Horse 8	-5.747	.000*	-6	.000*	0.92
0-60-90-180-P	FI 180-sec	All	-10.373	.000*	-11.157	.000*	0.94

Horse Four Bin NHST – Friedman Test

Group	Fixed Interval	Subject	Chi^2	df	p-value
0-60-P	FI 60-sec	Horse 6	104.89	3	.000*
0-60-P	FI 60-sec	Horse 9	104.366	3	.000*
0-60-P	FI 60-sec	Horse 14	117.339	3	.000*
0-60-P	FI 60-sec	All	322.279	3	.000*
0-90-P	FI 90-sec	Horse 1	92.364	3	.000*
0-90-P	FI 90-sec	Horse 10	85.036	3	.000*
0-90-P	FI 90-sec	Horse 13	113.378	3	.000*
0-90-P	FI 90-sec	All	277.72	3	.000*
0-180-P	FI 180-sec	Horse 3	**4.024**	**3**	**0.259**
0-60/90/180-P	FI 60-sec	Horse 4	83.652	3	.000*
0-60/90/180-P	FI 60-sec	Horse 11	124.188	3	.000*
0-60/90/180-P	FI 60-sec	All	205.584	3	.000*
0-60/90/180-P	FI 90-sec	Horse 4	88.129	3	.000*
0-60/90/180-P	FI 90-sec	Horse 11	90.528	3	.000*
0-60/90/180-P	FI 90-sec	All	173.535	3	.000*
0-60/90/180-P	FI 180-sec	Horse 4	**2.556**	**3**	**0.465**
0-60/90/180-P	FI 180-sec	Horse 11	81.02	3	.000*
0-60/90/180-P	FI 180-sec	All	73.181	3	.000*
0-60-90-180-P	FI 60-sec	Horse 2	93.369	3	.000*
0-60-90-180-P	FI 60-sec	Horse 5	101.796	3	.000*
0-60-90-180-P	FI 60-sec	Horse 7	118.681	3	.000*
0-60-90-180-P	FI 60-sec	Horse 8	97.988	3	.000*
0-60-90-180-P	FI 60-sec	All	401.495	3	.000*
0-60-90-180-P	FI 90-sec	Horse 2	123.617	3	.000*
0-60-90-180-P	FI 90-sec	Horse 5	113.201	3	.000*
0-60-90-180-P	FI 90-sec	Horse 7	105.289	3	.000*
0-60-90-180-P	FI 90-sec	Horse 8	117.228	3	.000*
0-60-90-180-P	FI 90-sec	All	448.054	3	.000*
0-60-90-180-P	FI 180-sec	Horse 2	123.713	3	.000*
0-60-90-180-P	FI 180-sec	Horse 5	73.276	3	.000*
0-60-90-180-P	FI 180-sec	Horse 7	17.044	3	0.001
0-60-90-180-P	FI 180-sec	Horse 8	75.135	3	.000*
0-60-90-180-P	FI 180-sec	All	279.769	3	.000*

Horse Ten Bin NHST – Friedman Test

Group	Fixed Interval	Subject	Chi^2	df	p-value
0-60-P	FI 60-sec	Horse 6	230.193	9	.000*
0-60-P	FI 60-sec	Horse 9	209.461	9	.000*
0-60-P	FI 60-sec	Horse 14	261.497	9	.000*
0-60-P	FI 60-sec	All	686.148	9	.000*
0-90-P	FI 90-sec	Horse 1	211.428	9	.000*
0-90-P	FI 90-sec	Horse 10	187.351	9	.000*
0-90-P	FI 90-sec	Horse 13	245.042	9	.000*
0-90-P	FI 90-sec	All	600.991	9	.000*
0-180-P	FI 180-sec	Horse 3	**11.351**	**9**	**0.252**
0-60/90/180-P	FI 60-sec	Horse 4	185.377	9	.000*
0-60/90/180-P	FI 60-sec	Horse 11	243.003	9	.000*
0-60/90/180-P	FI 60-sec	All	407.32	9	.000*
0-60/90/180-P	FI 90-sec	Horse 4	198.466	9	.000*
0-60/90/180-P	FI 90-sec	Horse 11	190.916	9	.000*
0-60/90/180-P	FI 90-sec	All	370.124	9	.000*
0-60/90/180-P	FI 180-sec	Horse 4	**15.495**	**9**	**0.078**
0-60/90/180-P	FI 180-sec	Horse 11	174.824	9	.000*
0-60/90/180-P	FI 180-sec	All	167.212	9	.000*
0-60-90-180-P	FI 60-sec	Horse 2	212.443	9	.000*
0-60-90-180-P	FI 60-sec	Horse 5	238.379	9	.000*
0-60-90-180-P	FI 60-sec	Horse 7	270.631	9	.000*
0-60-90-180-P	FI 60-sec	Horse 8	214.942	9	.000*
0-60-90-180-P	FI 60-sec	All	893.221	9	.000*
0-60-90-180-P	FI 90-sec	Horse 2	320.326	9	.000*
0-60-90-180-P	FI 90-sec	Horse 5	278.271	9	.000*
0-60-90-180-P	FI 90-sec	Horse 7	226.225	9	.000*
0-60-90-180-P	FI 90-sec	Horse 8	254.681	9	.000*
0-60-90-180-P	FI 90-sec	All	1036.926	9	.000*
0-60-90-180-P	FI 180-sec	Horse 2	310.358	9	.000*
0-60-90-180-P	FI 180-sec	Horse 5	169.978	9	.000*
0-60-90-180-P	FI 180-sec	Horse 7	38.743	9	.000*
0-60-90-180-P	FI 180-sec	Horse 8	169.615	9	.000*
0-60-90-180-P	FI 180-sec	All	638.934	9	.000*

Horse 20 Bin NHST – Friedman Test

Group	Fixed Interval	Subject	Chi^2	df	p-value
0-60-P	FI 60-sec	Horse 6	329.523	19	.000*
0-60-P	FI 60-sec	Horse 9	369.087	19	.000*
0-60-P	FI 60-sec	Horse 14	412.141	19	.000*
0-60-P	FI 60-sec	All	1068.941	19	.000*
0-90-P	FI 90-sec	Horse 1	304.846	19	.000*
0-90-P	FI 90-sec	Horse 10	341.021	19	.000*
0-90-P	FI 90-sec	Horse 13	350.005	19	.000*
0-90-P	FI 90-sec	All	901.731	19	.000*
0-180-P	FI 180-sec	Horse 3	**26.161**	**19**	**0.126**
0-60/90/180-P	FI 60-sec	Horse 4	350.052	19	.000*
0-60/90/180-P	FI 60-sec	Horse 11	302.937	19	.000*
0-60/90/180-P	FI 60-sec	All	605.094	19	.000*
0-60/90/180-P	FI 90-sec	Horse 4	368.675	19	.000*
0-60/90/180-P	FI 90-sec	Horse 11	288.955	19	.000*
0-60/90/180-P	FI 90-sec	All	598.781	19	.000*
0-60/90/180-P	FI 180-sec	Horse 4	31.835	19	0.033
0-60/90/180-P	FI 180-sec	Horse 11	256.651	19	.000*
0-60/90/180-P	FI 180-sec	All	256.5	19	.000*
0-60-90-180-P	FI 60-sec	Horse 2	341.465	19	.000*
0-60-90-180-P	FI 60-sec	Horse 5	377.003	19	.000*
0-60-90-180-P	FI 60-sec	Horse 7	446.676	19	.000*
0-60-90-180-P	FI 60-sec	Horse 8	363.645	19	.000*
0-60-90-180-P	FI 60-sec	All	1423.913	19	.000*
0-60-90-180-P	FI 90-sec	Horse 2	525.719	19	.000*
0-60-90-180-P	FI 90-sec	Horse 5	462.858	19	.000*
0-60-90-180-P	FI 90-sec	Horse 7	365.779	19	.000*
0-60-90-180-P	FI 90-sec	Horse 8	399.483	19	.000*
0-60-90-180-P	FI 90-sec	All	1644.085	19	.000*
0-60-90-180-P	FI 180-sec	Horse 2	538.407	19	.000*
0-60-90-180-P	FI 180-sec	Horse 5	275.176	19	.000*
0-60-90-180-P	FI 180-sec	Horse 7	50.682	19	.000*
0-60-90-180-P	FI 180-sec	Horse 8	252.702	19	.000*
0-60-90-180-P	FI 180-sec	All	1006.2	19	.000*

Honey Bee Two Bin NHST – Wilcoxon Signed-Rank and Sign Test

Group	Fixed Interval	Subject	Z Score	p-value	Sign Test Z Score	Sign Test p-value	(Bin 2>Bin 1) / Total
0-15-X	FI 15-sec	2	-2.121	0.034	*	0.063	1
0-15-X	FI 15-sec	3	**-0.665**	**0.506**	*****	**0.754**	**0.40**
0-15-X	FI 15-sec	5	**-1.633**	**0.102**	*****	**0.25**	**0.50**
0-15-X	FI 15-sec	6	**-0.447**	**0.655**	*****	**1**	**0.38**
0-15-X	FI 15-sec	7	-2.251	0.024	*	0.031	0.67
0-15-X	FI 15-sec	8	**-1.633**	**0.102**	*****	**0.25**	**0.33**
0-15-X	FI 15-sec	9	**-1**	**0.317**	*****	**0.625**	**0.43**
0-15-X	FI 15-sec	10	**-0.957**	**0.339**	*****	**0.687**	**0.50**
0-15-X	FI 15-sec	All	-2.16	0.031	-2.932	0.003	0.50
0-30-X	FI 30-sec	1	**-0.966**	**0.334**	*****	**0.375**	**0.50**
0-30-X	FI 30-sec	2	-2.232	0.026	*	0.031	0.86
0-30-X	FI 30-sec	7	**-1.394**	**0.163**	*****	**0.687**	**0.57**
0-30-X	FI 30-sec	8	-2.232	0.026	*	0.031	1
0-30-X	FI 30-sec	9	-2.657	0.008	*	0.021	0.82
0-30-X	FI 30-sec	All	-4.364	.000*	*	0.001	0.74

Honey Bee Four Bin NHST – Friedman Test

Group	Fixed Interval	Subject	Chi^2	df	p-value
0-15-X	FI 15-sec	2	**6.538**	**3**	**0.088**
0-15-X	FI 15-sec	3	**7.67**	**3**	**0.053**
0-15-X	FI 15-sec	5	13.35	3	0.004
0-15-X	FI 15-sec	6	**2.318**	**3**	**0.509**
0-15-X	FI 15-sec	7	16.4	3	0.001
0-15-X	FI 15-sec	8	10.708	3	0.013
0-15-X	FI 15-sec	9	9.635	3	0.022
0-15-X	FI 15-sec	10	**3**	**3**	**0.392**
0-15-X	FI 15-sec	All	47.037	3	.000*
0-30-X	FI 30-sec	1	**6.726**	**3**	**0.081**
0-30-X	FI 30-sec	2	14.463	3	0.002
0-30-X	FI 30-sec	7	**2.613**	**3**	**0.455**
0-30-X	FI 30-sec	8	15	3	0.002
0-30-X	FI 30-sec	9	12.5	3	0.006
0-30-X	FI 30-sec	All	37.047	3	.000*

Honey Bee Ten Bin NHST – Friedman Test

Group	Fixed Interval	Subject	Chi^2	df	p-value
0-15-X	FI 15-sec	2	20.42	9	0.015
0-15-X	FI 15-sec	3	**12.455**	**9**	**0.189**
0-15-X	FI 15-sec	5	20.842	9	0.013
0-15-X	FI 15-sec	6	24.807	9	0.003
0-15-X	FI 15-sec	7	46.688	9	.000*
0-15-X	FI 15-sec	8	32.782	9	.000*
0-15-X	FI 15-sec	9	29.571	9	0.001
0-15-X	FI 15-sec	10	21.405	9	0.011
0-15-X	FI 15-sec	All	115.952	9	.000*
0-30-X	FI 30-sec	1	27.076	9	0.001
0-30-X	FI 30-sec	2	27.951	9	0.001
0-30-X	FI 30-sec	7	**12.444**	**9**	**0.189**
0-30-X	FI 30-sec	8	33.718	9	.000*
0-30-X	FI 30-sec	9	30.022	9	.000*
0-30-X	FI 30-sec	All	82.932	9	.000*

Honey Bee 20 Bin NHST – Friedman Test

Group	Fixed Interval	Subject	Chi^2	df	p-value
0-15-X	FI 15-sec	2	35.731	19	0.011
0-15-X	FI 15-sec	3	37.374	19	0.007
0-15-X	FI 15-sec	5	54.365	19	.000*
0-15-X	FI 15-sec	6	58.378	19	.000*
0-15-X	FI 15-sec	7	101.861	19	.000*
0-15-X	FI 15-sec	8	71.719	19	.000*
0-15-X	FI 15-sec	9	58.118	19	.000*
0-15-X	FI 15-sec	10	45.736	19	0.001
0-15-X	FI 15-sec	All	271.07	19	.000*
0-30-X	FI 30-sec	1	57.82	19	.000*
0-30-X	FI 30-sec	2	52.913	19	.000*
0-30-X	FI 30-sec	7	**25.645**	**19**	**0.14**
0-30-X	FI 30-sec	8	61.185	19	.000*
0-30-X	FI 30-sec	9	48.914	19	.000*
0-30-X	FI 30-sec	All	147.247	19	.000*

Appendix 5: Response Bin NHST Parametric

Horse Two Bin NHST – Dependent T Test

Group	Fixed Interval	Subject	Mean Difference	Standard Deviation	Cohen's d	t score	df	p-value	R^2	95% CI Lower	95% CI Upper
0-60-P	FI 60-sec	Horse 6	3.46	1.86493	1.855298	13.119	49	.000*	0.78	2.92999	3.99001
0-60-P	FI 60-sec	Horse 9	2.44	1.41652	1.722531	12.18	49	.000*	0.75	2.03743	2.84257
0-60-P	FI 60-sec	Horse 14	3.12	1.92343	1.622102	11.47	49	.000*	0.73	2.57337	3.66663
0-60-P	FI 60-sec	All	3.00667	1.78922	1.680436	20.581	149	.000*	0.74	2.71799	3.29534
0-90-P	FI 90-sec	Horse 1	4.78	2.72771	1.752386	12.391	49	.000*	0.76	4.00479	5.55521
0-90-P	FI 90-sec	Horse 10	2.34	1.62393	1.440949	10.189	49	.000*	0.68	1.87848	2.80152
0-90-P	FI 90-sec	Horse 13	5.02	2.3861	2.103851	14.876	49	.000*	0.82	4.34188	5.69812
0-90-P	FI 90-sec	All	4.04667	2.58113	1.56779	19.201	149	.000*	0.71	3.63022	4.46311
0-180-P	FI 180-sec	Horse 3	**1.8**	**5.89067**	**0.305568**	**0.683**	**4**	**0.532**	**0.10**	**-5.51423**	**9.11423**
0-60/90/180-P	FI 60-sec	Horse 4	1.94	1.26829	1.529619	10.816	49	.000*	0.70	1.57955	2.30045
0-60/90/180-P	FI 60-sec	Horse 11	3.8	1.44279	2.633786	18.624	49	.000*	0.88	3.38996	4.21004
0-60/90/180-P	FI 60-sec	All	2.87	1.6432	1.746592	17.466	99	.000*	0.75	2.54395	3.19605
0-60/90/180-P	FI 90-sec	Horse 4	1.98	1.18649	1.668788	11.8	49	.000*	0.74	1.6428	2.3172
0-60/90/180-P	FI 90-sec	Horse 11	3.72	2.41627	1.539563	10.886	49	.000*	0.71	3.0333	4.4067
0-60/90/180-P	FI 90-sec	All	2.85	2.08591	1.36631	13.663	99	.000*	0.65	2.43611	3.26389
0-60/90/180-P	FI 180-sec	Horse 4	**-0.4**	**0.89443**	**-0.447212**	**-1**	**4**	**0.374**	**0.20**	**-1.51058**	**0.71058**
0-60/90/180-P	FI 180-sec	Horse 11	3.38	2.36376	1.429925	10.111	49	.000*	0.68	2.70823	4.05177
0-60/90/180-P	FI 180-sec	All	3.03636	2.51634	1.206657	8.949	54	.000*	0.60	2.3561	3.71663
0-60-90-180-P	FI 60-sec	Horse 2	3.86	2.45	1.57551	11.105	49	.000*	0.72	3.16148	4.55852
0-60-90-180-P	FI 60-sec	Horse 5	4.88	2.99414	1.62985	11.525	49	.000*	0.73	4.02907	5.73093
0-60-90-180-P	FI 60-sec	Horse 7	2.58	1.83	1.409836	9.966	49	.000*	0.67	2.05979	3.10021
0-60-90-180-P	FI 60-sec	Horse 8	9.64	8.06798	1.194847	8.449	49	.000*	0.59	7.34711	11.93289
0-60-90-180-P	FI 60-sec	All	5.24	5.26316	0.9956	14.08	199	.000*	0.50	4.50611	5.97389
0-60-90-180-P	FI 90-sec	Horse 2	5.62	3.59075	1.565133	16.975	49	.000*	0.85	7.59952	9.64048
0-60-90-180-P	FI 90-sec	Horse 5	8	3.8492	2.078354	14.696	49	.000*	0.82	6.90607	9.09393

0-60-90-180-P	FI 90-sec	Horse 7	2.77778	1.44425	1.923337	12.902	44	.000*	0.79	2.34388	3.21168
0-60-90-180-P	FI 90-sec	Horse 8	7.78	5.71175	1.362104	9.632	49	.000*	0.65	6.15674	9.40326
0-60-90-180-P	FI 90-sec	All	6.89744	4.57467	1.507746	21.055	194	.000*	0.70	6.25132	7.54355
0-60-90-180-P	FI 180-sec	Horse 2	10.9	4.05699	2.686721	18.998	49	.000*	0.88	9.74702	12.0598
0-60-90-180-P	FI 180-sec	Horse 5	7.02	5.32415	1.31852	9.323	49	.000*	0.64	5.50689	8.53311
0-60-90-180-P	FI 180-sec	Horse 7	4.5	3.27448	1.374264	4.346	49	.000*	0.28	2.15758	6.84242
0-60-90-180-P	FI 180-sec	Horse 8	5.06	3.55947	1.42156	10.052	49	.000*	0.67	4.04841	6.07159
0-60-90-180-P	FI 180-sec	All	7.32051	4.90554	1.492294	18.639	155	.000*	0.69	6.54466	8.09636

Horse Four Bin NHST – Repeated Measures ANOVA

Group	Fixed Interval	Subject	Mauchly's W	Chi^2	df	Sphericity p-value	df	F	p-value	Eta^2
0-60-P	FI 60-sec	Horse 6	0.626	22.333	5	.000*	3, 147	90.374	.000*	0.648
0-60-P	FI 60-sec	Horse 9	0.612	23.438	5	.000*	3, 147	75.993	.000*	0.608
0-60-P	FI 60-sec	Horse 14	0.445	38.587	5	.000*	3, 147	96.684	.000*	0.664
0-60-P	FI 60-sec	All	0.599	75.635	5	.000*	3, 447	253.692	.000*	0.63
0-90-P	FI 90-sec	Horse 1	0.619	22.883	5	.000*	3, 147	56.908	.000*	0.537
0-90-P	FI 90-sec	Horse 10	0.717	15.865	5	0.007	3, 147	47.602	.000*	0.493
0-90-P	FI 90-sec	Horse 13	0.491	33.904	5	.000*	3, 147	100.321	.000*	0.672
0-90-P	FI 90-sec	All	0.78	36.654	5	.000*	3, 447	165.14	.000*	0.526
0-180-P	FI 180-sec	Horse 3	0.061	7.63	5	0.202	**3, 12**	**1.035**	**0.412**	**0.206**
0-60/90/180-P	FI 60-sec	Horse 4	0.742	14.265	5	0.014	3, 147	45.396	.000*	0.481
0-60/90/180-P	FI 60-sec	Horse 11	0.695	17.365	5	0.004	3, 147	164.766	.000*	0.711
0-60/90/180-P	FI 60-sec	All	0.871	13.495	5	0.019	3, 297	162.079	.000*	0.621
0-60/90/180-P	FI 90-sec	Horse 4	0.442	38.926	5	.000*	3, 147	57.223	.000*	0.539
0-60/90/180-P	FI 90-sec	Horse 11	0.588	25.31	5	.000*	3, 147	57.167	.000*	0.538
0-60/90/180-P	FI 90-sec	All	0.734	30.27	5	.000*	3, 297	96.469	.000*	0.494
0-60/90/180-P	FI 180-sec	Horse 4	0.506	1.853	5	0.877	**3, 12**	**1**	**0.426**	**0.2**
0-60/90/180-P	FI 180-sec	Horse 11	0.72	15.647	5	0.008	3, 147	46.157	.000*	0.485
0-60/90/180-P	FI 180-sec	All	0.776	13.373	5	0.02	3, 162	40.012	.000*	0.426
0-60-90-180-P	FI 60-sec	Horse 2	0.355	49.376	5	.000*	3, 147	70.694	.000*	0.591
0-60-90-180-P	FI 60-sec	Horse 5	0.43	40.274	5	.000*	3, 147	18.257	.000*	0.615
0-60-90-180-P	FI 60-sec	Horse 7	0.391	44.803	5	.000*	3, 147	74.088	.000*	0.602
0-60-90-180-P	FI 60-sec	Horse 8	0.599	24.441	5	.000*	3, 147	46.508	.000*	0.487
0-60-90-180-P	FI 60-sec	All	0.506	134.695	5	.000*	3, 597	147.125	.000*	0.428
0-60-90-180-P	FI 90-sec	Horse 2	0.426	40.727	5	.000*	3, 147	148.241	.000*	0.752
0-60-90-180-P	FI 90-sec	Horse 5	0.45	38.1	5	.000*	3, 147	115.816	.000*	0.703
0-60-90-180-P	FI 90-sec	Horse 7	0.65	18.416	5	0.002	3, 132	115.349	.000*	0.724
0-60-90-180-P	FI 90-sec	Horse 8	0.49	34.061	5	.000*	3, 147	71.606	.000*	0.594

0-60-90-180-P	FI 90-sec	All	0.476	143.152	5	.000*	3, 582	308.715	.000*	0.614
0-60-90-180-P	FI 180-sec	Horse 2	0.484	34.601	5	.000*	3, 147	175.208	.000*	0.781
0-60-90-180-P	FI 180-sec	Horse 5	0.834	7.924	5	0.161	3, 135	46.081	.000*	0.506
0-60-90-180-P	FI 180-sec	Horse 7	0.645	3.387	5	0.643	3, 27	12.19	.000*	0.575
0-60-90-180-P	FI 180-sec	Horse 8	0.826	9.143	5	0.104	3, 147	45.134	.000*	0.479
0-60-90-180-P	FI 180-sec	All	0.763	41.514	5	.000*	3, 465	201.824	.000*	0.566

Horse Four Bin NHST – Repeated Measures ANOVA Sphericity Corrections

Group	Fixed Interval	Subject	Greenhouse-Geisser Epsilon	df	F	p-value	Eta²	Huynh-Feldt Epislon	df	F	p-value	Eta²
0-60-P	FI 60-sec	Horse 6	0.822	2.467, 120.861	90.374	.000*	0.648	0.869	2.607, 127.759	90.374	.000*	0.648
0-60-P	FI 60-sec	Horse 9	0.783	2.348, 115.060	75.993	.000*	0.608	0.825	2.474, 121.217	75.993	.000*	0.608
0-60-P	FI 60-sec	Horse 14	0.756	2.268, 111.151	96.684	.000*	0.664	0.795	2.384, 116.828	96.684	.000*	0.664
0-60-P	FI 60-sec	All	0.815	2.445, 364.325	253.692	.000*	0.63	0.83	2.489, 370.856	253.692	.000*	0.63
0-90-P	FI 90-sec	Horse 1	0.8	2.4, 117.582	56.908	.000*	0.537	0.844	2.532, 124.057	56.908	.000*	0.537
0-90-P	FI 90-sec	Horse 10	0.806	2.417, 118.409	47.602	.000*	0.493	0.85	2.551, 124.99	47.602	.000*	0.493
0-90-P	FI 90-sec	Horse 13	0.719	2.15, 105.704	100.321	.000*	0.672	0.753	2.26, 110.737	100.321	.000*	0.672
0-90-P	FI 90-sec	All	0.875	2.624, 391.016	165.14	.000*	0.526	0.892	2.676, 398.662	165.14	.000*	0.526
0-180-P	FI 180-sec	Horse 3	**0.626**	**1.879, 7.515**	**1.035**	**0.396**	**0.206**	**1**	**3, 12**	**1.035**	**0.412**	**0.206**
0-60/90/180-P	FI 60-sec	Horse 4	0.842	2.526, 123.754	45.396	.000*	0.481	0.891	2.674, 131.033	45.396	.000*	0.481
0-60/90/180-P	FI 60-sec	Horse 11	0.805	2415, 118.313	164.766	.000*	-711	0.85	2.549, 124.881	164.766	.000*	-711
0-60/90/180-P	FI 60-sec	All	0.923	2.77, 274.208	162.079	.000*	0.621	0.952	2.857, 282.892	162.079	.000*	0.621
0-60/90/180-P	FI 90-sec	Horse 4	0.699	2.098, 102.816	57.223	.000*	0.539	0.731	2.194, 107.519	57.223	.000*	0.539
0-60/90/180-P	FI 90-sec	Horse 11	0.792	2.377, 116.488	57.167	.000*	0.538	0.836	2.507, 122.824	57.167	.000*	0.538
0-60/90/180-P	FI 90-sec	All	0.863	2.59, 256.423	96.469	.000*	0.494	0.889	2.666, 263.918	96.469	.000*	0.494
0-60/90/180-P	FI 180-sec	Horse 4	**0.762**	**2.286, 9.143**	**1**	**0.415**	**0.2**	**1**	**3, 12**	**1**	**0.426**	**0.2**
0-60/90/180-P	FI 180-sec	Horse 11	0.825	2.476, 121.306	46.157	.000*	0.485	0.873	2.618, 128.261	46.157	.000*	0.485
0-60/90/180-P	FI 180-sec	All	0.872	2.617, 141.323	40.012	.000*	0.426	0.921	2.762, 149.17	40.012	.000*	0.426
0-60-90-180-P	FI 60-sec	Horse 2	0.693	2.079, 101.884	70.694	.000*	0.591	0.724	2.176, 106.482	70.694	.000*	0.591
0-60-90-180-P	FI 60-sec	Horse 5	0.765	2.294, 112.426	18.257	.000*	0.615	0.804	2.413, 118.258	18.257	.000*	0.615
0-60-90-180-P	FI 60-sec	Horse 7	0.748	2.244, 109.959	74.088	.000*	0.602	0.786	2.357, 115.492	74.088	.000*	0.602
0-60-90-180-P	FI 60-sec	Horse 8	0.797	2.39, 117.12	46.508	.000*	0.487	0.84	2.521, 123.536	46.508	.000*	0.487
0-60-90-180-P	FI 60-sec	All	0.747	2.24, 445.755	147.125	.000*	0.428	0.756	2.267, 451.073	147.125	.000*	0.428
0-60-90-180-P	FI 90-sec	Horse 2	0.725	2.176, 106.627	148.241	.000*	0.752	0.76	2.281, 111.766	148.241	.000*	0.752
0-60-90-180-P	FI 90-sec	Horse 5	0.767	2.3, 112.713	115.816	.000*	0.703	0.807	2.42, 118.58	115.816	.000*	0.703
0-60-90-180-P	FI 90-sec	Horse 7	0.837	2.512, 110.524	115.349	.000*	0.724	0.892	2.352, 115.275	115.349	.000*	0.724

0-60-90-180-P	FI 90-sec	Horse 8	0.761	2.283, 111.888	71.606	.000*	0.594	0.8	2.401, 117.654	71.606	.000*	0.594
0-60-90-180-P	FI 90-sec	All	0.749	2.248, 436.070	308.715	.000*	0.614	0.758	2.275, 441.432	308.715	.000*	0.614
0-60-90-180-P	FI 180-sec	Horse 2	0.781	2.344, 114.863	175.208	.000*	0.781	0.823	2.469, 120.996	175.208	.000*	0.781
0-60-90-180-P	FI 180-sec	Horse 5	0.887	2.661, 119.762	46.081	.000*	0.506	0.948	2.844, 127.994	46.081	.000*	0.506
0-60-90-180-P	FI 180-sec	Horse 7	0.805	2.414, 21.726	12.19	.000*	0.575	1	3, 27	12.19	.000*	0.575
0-60-90-180-P	FI 180-sec	Horse 8	0.906	2.718, 133.198	45.134	.000*	0.479	0.965	2.894, 141.782	45.134	.000*	0.479
0-60-90-180-P	FI 180-sec	All	0.849	2.546, 394.59	201.824	.000*	0.566	0.864	2.592, 401.734	201.824	.000*	0.566

Horse Ten Bin NHST – Repeated Measures ANOVA

Group	Fixed Interval	Subject	Mauchly's W	Chi^2	df	Sphericity p-value	df	F	p-value	Eta^2
0-60-P	FI 60-sec	Horse 6	0	*	44	*	9, 441	54.393	.000*	0.526
0-60-P	FI 60-sec	Horse 9	0	*	44	*	9, 441	38.478	.000*	0.44
0-60-P	FI 60-sec	Horse 14	0	*	44	*	9, 441	62.817	.000*	0.562
0-60-P	FI 60-sec	All	0	*	44	*	9, 1341	151.041	.000*	0.503
0-90-P	FI 90-sec	Horse 1	0	*	44	*	9, 441	31.869	.000*	0.394
0-90-P	FI 90-sec	Horse 10	0.005	239.322	44	.000*	9, 441	28.917	.000*	0.371
0-90-P	FI 90-sec	Horse 13	0	371.211	44	.000*	9, 441	47.777	.000*	0.494
0-90-P	FI 90-sec	All	0.01	664.787	44	.000*	9, 1341	94.077	.000*	0.387
0-180-P	FI 180-sec	Horse 3	0	*	44	*	**9, 36**	**0.935**	**0.507**	**0.19**
0-60/90/180-P	FI 60-sec	Horse 4	0.014	197.054	44	.000*	9, 441	31.168	.000*	0.389
0-60/90/180-P	FI 60-sec	Horse 11	0	*	44	*	9, 441	68.996	.000*	0.585
0-60/90/180-P	FI 60-sec	All	0.025	353.245	44	.000*	9, 891	98.846	.000*	0.467
0-60/90/180-P	FI 90-sec	Horse 4	0.01	210.282	44	.000*	9, 441	34.986	.000*	0.417
0-60/90/180-P	FI 90-sec	Horse 11	0	*	44	*	9, 441	30.317	.000*	0.382
0-60/90/180-P	FI 90-sec	All	0.01	440.407	44	.000*	9, 891	87.85	.000*	0.369
0-60/90/180-P	FI 180-sec	Horse 4	0	*	44	*	**9, 36**	**1.701**	**0.125**	**0.298**
0-60/90/180-P	FI 180-sec	Horse 11	0.022	174.637	44	.000*	9, 441	23.446	.000*	0.324
0-60/90/180-P	FI 180-sec	All	0.092	121.126	44	.000*	9, 486	20.966	.000*	0.28
0-60-90-180-P	FI 60-sec	Horse 2	0.001	346.756	44	.000*	9, 441	35.102	.000*	0.417
0-60-90-180-P	FI 60-sec	Horse 5	0.001	315.879	44	.000*	9, 441	51.426	.000*	0.512
0-60-90-180-P	FI 60-sec	Horse 7	0	*	44	*	9, 441	45.312	.000*	0.48
0-60-90-180-P	FI 60-sec	Horse 8	0	*	44	*	9, 441	28.082	.000*	0.364
0-60-90-180-P	FI 60-sec	All	0.001	1364.83	44	.000*	9, 1791	99.993	.000*	0.334
0-60-90-180-P	FI 90-sec	Horse 2	0	*	44		9, 441	90.983	.000*	0.65
0-60-90-180-P	FI 90-sec	Horse 5	0.001	303.451	44	.000*	9, 441	62.511	.000*	0.561
0-60-90-180-P	FI 90-sec	Horse 7	0	*	44	*	9, 396	60.377	.000*	0.578

0-60-90-180-P	FI 90-sec	Horse 8	0	*	44	*	9, 441	38.352	.000*	0.439
0-60-90-180-P	FI 90-sec	All	0	1573.82	44	.000*	9, 1746	180.165	.000*	0.482
0-60-90-180-P	FI 180-sec	Horse 2	0.001	337.932	44	.000*	9, 441	86.558	.000*	0.639
0-60-90-180-P	FI 180-sec	Horse 5	0.019	165.919	44	.000*	9, 405	23.823	.000*	0.346
0-60-90-180-P	FI 180-sec	Horse 7	0	83.711	44	0.002	9, 81	5.126	.000*	0.363
0-60-90-180-P	FI 180-sec	Horse 8	0.076	118.012	44	.000*	9, 441	25.521	.000*	0.342
0-60-90-180-P	FI 180-sec	All	0.056	438.652	44	.000*	9, 1395	105.61	.000*	0.405

Horse Ten Bin NHST – Repeated Measures ANOVA Sphericity Corrections

Group	Fixed Interval	Subject	Greenhouse-Geisser Epsilon	df	F	p-value	Eta^2	Huynh-Feldt Epislon	df	F	p-value	Eta^2
0-60-P	FI 60-sec	Horse 6	0.611	5.502, 269.607	54.393	.000*	0.526	0.698	6.279, 307.656	54.393	.000*	0.526
0-60-P	FI 60-sec	Horse 9	0.688	6.194, 303.504	38.478	.000*	0.44	0.799	7.188, 352.221	38.478	.000*	0.44
0-60-P	FI 60-sec	Horse 14	0.591	5.323, 260.822	62.817	.000*	0.562	0.672	6.048, 293.336	62.817	.000*	0.562
0-60-P	FI 60-sec	All	0.683	9.150, 916.406	151.041	.000*	0.503	0.716	6.44, 960.190	151.041	.000*	0.503
0-90-P	FI 90-sec	Horse 1	0.644	5.796, 283.986	31.869	.000*	0.394	0.74	6.661, 326.386	31.869	.000*	0.394
0-90-P	FI 90-sec	Horse 10	0.616	5.541, 271.525	28.917	.000*	0.371	0.703	6.329, 310.139	28.917	.000*	0.371
0-90-P	FI 90-sec	Horse 13	0.575	5.174, 253.522	47.777	.000*	0.494	0.651	5.857, 287	47.777	.000*	0.494
0-90-P	FI 90-sec	All	0.705	6.342, 945.026	94.077	.000*	0.387	0.739	6.655, 997.577	94.077	.000*	0.387
0-180-P	FI 180-sec	Horse 3	0.239	**2.152, 8.609**	**0.935**	**0.436**	**0.19**	**0.527**	**4.741, 18.965**	**0.935**	**0.477**	**0.19**
0-60/90/180-P	FI 60-sec	Horse 4	0.626	5.634, 276.048	31.168	.000*	0.389	0.717	6.449, 316.015	31.168	.000*	0.389
0-60/90/180-P	FI 60-sec	Horse 11	0.659	5.933, 290.717	68.996	.000*	0.585	0.76	6.842, 335.241	68.996	.000*	0.585
0-60/90/180-P	FI 60-sec	All	0.724	6.518, 645.236	98.846	.000*	0.467	0.781	7.026, 695.544	98.846	.000*	0.467
0-60/90/180-P	FI 90-sec	Horse 4	0.651	5.861, 287.168	34.986	.000*	0.417	0.75	9.746, 330.566	34.986	.000*	0.417
0-60/90/180-P	FI 90-sec	Horse 11	0.655	5.898, 288.988	30.317	.000*	0.382	0.755	6.795, 332.962	30.317	.000*	0.382
0-60/90/180-P	FI 90-sec	All	-179	6.475, 641.008	87.85	.000*	0.369	0.775	6.976, 690.654	87.85	.000*	0.369
0-60/90/180-P	FI 180-sec	Horse 4	0.306	**2.757, 11.030**	**1.701**	**0.225**	**0.298**	**1**	**9, 36**	**1.701**	**0.125**	**0.298**
0-60/90/180-P	FI 180-sec	Horse 11	0.62	5.579, 273.355	23.446	.000*	0.324	0.709	6.378, 312.513	23.446	.000*	0.324
0-60/90/180-P	FI 180-sec	All	0.678	6.1, 329.413	20.966	.000*	0.28	0.744	6.963 ,375.988	20.966	.000*	0.28
0-60-90-180-P	FI 60-sec	Horse 2	0.488	4.388, 215.034	35.102	.000*	0.417	0.542	4.874, 238.811	35.102	.000*	0.417
0-60-90-180-P	FI 60-sec	Horse 5	0.516	4.64, 227.336	51.426	.000*	0.512	0.576	5.184, 254.028	51.426	.000*	0.512
0-60-90-180-P	FI 60-sec	Horse 7	0.601	5.413, 265.219	45.312	.000*	0.48	0.685	6.163	301.99	.000*	0.48
0-60-90-180-P	FI 60-sec	Horse 8	0.528	4.748, 232.631	28.082	.000*	0.364	0.591	5.319, 260.631	28.082	.000*	0.364
0-60-90-180-P	FI 60-sec	All	0.554	4.984, 991.757	99.993	.000*	0.334	0.57	5.127, 1020.293	99.993	.000*	0.334
0-60-90-180-P	FI 90-sec	Horse 2	0.474	4.263, 208.898	90.983	.000*	0.65	0.524	4.72, 231.284	90.983	.000*	0.65
0-60-90-180-P	FI 90-sec	Horse 5	0.584	5.255, 257.48	62.511	.000*	0.561	0.662	5.96, 292.054	62.511	.000*	0.561
0-60-90-180-P	FI 90-sec	Horse 7	0.522	4.698, 206.729	60.377	.000*	0.578	0.592	5.329, 234.464	60.377	.000*	0.578

0-60-90-180-P	FI 90-sec	Horse 8	0.501	4.511, 221.043	38.352	.000*	0.439	0.558	5.025, 246.222	38.352	.000*	0.439
0-60-90-180-P	FI 90-sec	All	0.546	4.913, 953.168	180.165	.000*	0.482	0.562	5.056, 980.924	180.165	.000*	0.482
0-60-90-180-P	FI 180-sec	Horse 2	0.578	5.199, 254.769	86.558	.000*	0.639	0.654	5.89, 288.591	86.558	.000*	0.639
0-60-90-180-P	FI 180-sec	Horse 5	0.681	6.128, 275.745	23.823	.000*	0.346	0.8	7.2, 323.99	23.823	.000*	0.346
0-60-90-180-P	FI 180-sec	Horse 7	0.36	3.241, 29.136	5.126	0.005	0.363	0.587	5.28, 47.523	5.126	0.001	0.363
0-60-90-180-P	FI 180-sec	Horse 8	0.7	6.297, 308.535	25.521	.000*	0.342	0.814	7.326, 358.959	25.521	.000*	0.342
0-60-90-180-P	FI 180-sec	All	0.691	6.217, 963.625	105.61	.000*	0.405	0.723	6.505, 1008.284	105.61	.000*	0.405

Horse 20 Bin NHST – Repeated Measures ANOVA

Group	Fixed Interval	Subject	Mauchly's W	Chi^2	df	Sphericity p-value	df	F	p-value	Eta^2
0-60-P	FI 60-sec	Horse 6	0	*	189	*	19, 931	30.335	.000*	0.382
0-60-P	FI 60-sec	Horse 9	0	*	189	*	19, 931	29.417	.000*	0.375
0-60-P	FI 60-sec	Horse 14	0	*	189	*	19, 931	37.409	.000*	0.433
0-60-P	FI 60-sec	All	0	*	189	*	19, 2831	94.441	.000*	0.388
0-90-P	FI 90-sec	Horse 1	0	*	189	*	19, 931	19.53	.000*	0.285
0-90-P	FI 90-sec	Horse 10	0	*	189	*	19, 931	26.497	.000*	0.351
0-90-P	FI 90-sec	Horse 13	0	*	189	*	19, 931	31.316	.000*	0.39
0-90-P	FI 90-sec	All	0	*	189	*	19, 2831	66.681	.000*	0.309
0-180-P	FI 180-sec	Horse 3	0	*	189	*	**19, 76**	**1.061**	**0.406**	**0.21**
0-60/90/180-P	FI 60-sec	Horse 4	0	*	189	*	19, 931	27.386	.000*	0.359
0-60/90/180-P	FI 60-sec	Horse 11	0	*	189	*	19, 931	29.51	.000*	0.376
0-60/90/180-P	FI 60-sec	All	0	*	189	*	19, 1881	53.999	.000*	0.353
0-60/90/180-P	FI 90-sec	Horse 4	0	*	189	*	19, 931	32.779	.000*	0.401
0-60/90/180-P	FI 90-sec	Horse 11	0	*	189	*	19, 931	21.17	.000*	0.302
0-60/90/180-P	FI 90-sec	All	0	*	189	*	19, 1881	46.031	.000*	0.317
0-60/90/180-P	FI 180-sec	Horse 4	0	*	189	*	19, 76	2.078	0.013	0.342
0-60/90/180-P	FI 180-sec	Horse 11	0	*	189	*	19, 931	14.792	.000*	0.232
0-60/90/180-P	FI 180-sec	All	0	495.352	189	.000*	19, 1026	14.491	.000*	0.212
0-60-90-180-P	FI 60-sec	Horse 2	0	*	189	*	19, 931	29.389	.000*	0.375
0-60-90-180-P	FI 60-sec	Horse 5	0	*	189	*	19, 931	33.953	.000*	0.409
0-60-90-180-P	FI 60-sec	Horse 7	0	*	189	*	19, 931	41.169	.000*	0.457
0-60-90-180-P	FI 60-sec	Horse 8	0	*	189	*	19, 931	19.763	.000*	0.287
0-60-90-180-P	FI 60-sec	All	0	3362.01	189	.000*	19, 3781	79.657	.000*	0.286
0-60-90-180-P	FI 90-sec	Horse 2	0	*	189	.000*	19, 931	53.749	.000*	0.523
0-60-90-180-P	FI 90-sec	Horse 5	0	*	189	*	19, 931	38.895	.000*	0.443
0-60-90-180-P	FI 90-sec	Horse 7	0	*	189	*	19, 836	36.304	.000*	0.452
0-60-90-180-P	FI 90-sec	Horse 8	0	*	189	*	19, 931	25.026	.000*	0.338

0-60-90-180-P	FI 90-sec	All	0	*	189	*	19, 3686	119.818	.000*	0.382
0-60-90-180-P	FI 180-sec	Horse 2	0	*	189		19, 931	50.747	.000*	0.509
0-60-90-180-P	FI 180-sec	Horse 5	0	563.691	189	.000*	19, 855	16.249	.000*	0.265
0-60-90-180-P	FI 180-sec	Horse 7	0	*	189	*	19, 171	2.664	.000*	0.228
0-60-90-180-P	FI 180-sec	Horse 8	0	429.201	189	.000*	19, 931	17.255	.000*	0.26
0-60-90-180-P	FI 180-sec	All	0	1362.05	189	.000*	19, 2945	68.923	.000*	0.308

Horse 20 Bin NHST – Repeated Measures ANOVA Sphericity Corrections

Group	Fixed Interval	Subject	Greenhouse-Geisser Epsilon	df	F	p-value	Eta^2	Huynh-Feldt Epislon	df	F	p-value	Eta^2
0-60-P	FI 60-sec	Horse 6	0.5	9.509, 465.961	30.335	.000*	0.382	0.631	11.989, 587.483	30.335	.000*	0.382
0-60-P	FI 60-sec	Horse 9	0.494	9.384, 459.831	29.417	.000*	0.375	0.621	11.794, 577.891	29.417	.000*	0.375
0-60-P	FI 60-sec	Horse 14	0.447	8.5, 416.499	37.409	.000*	0.433	0.55	10.44, 511.776	37.409	.000*	0.433
0-60-P	FI 60-sec	All	0.587	11.149, 1661.13	94.441	.000*	0.388	0.638	12.117, 1805.36	94.441	.000*	0.388
0-90-P	FI 90-sec	Horse 1	0.544	10.345, 506.889	19.53	.000*	0.285	0.702	13.329, 653.118	19.53	.000*	0.285
0-90-P	FI 90-sec	Horse 10	0.484	9.191, 450.345	26.497	.000*	0.351	0.605	11.493, 563.167	26.497	.000*	0.351
0-90-P	FI 90-sec	Horse 13	0.471	8.943, 438.188	31.316	.000*	0.39	0.585	11.112, 544.504	31.316	.000*	0.39
0-90-P	FI 90-sec	All	0.629	11.948, 1780.305	66.681	.000*	0.309	0.688	13.063, 1946.33	66.681	.000*	0.309
0-180-P	FI 180-sec	Horse 3	0.12	**2.272, 9.089**	**1.061**	**0.364**	**0.21**	**0.285**	**5.419, 21.675**	**1.061**	**0.412**	**0.21**
0-60/90/180-P	FI 60-sec	Horse 4	0.524	9.96, 488.048	27.386	.000*	0.359	0.669	12.705, 622.554	27.386	.000*	0.359
0-60/90/180-P	FI 60-sec	Horse 11	0.464	8.811, 431.728	29.51	.000*	0.376	0.574	10.912, 534.681	29.51	.000*	0.376
0-60/90/180-P	FI 60-sec	All	0.895	11.311, 1119.828	53.999	.000*	0.353	0.678	12.877, 1274.792	53.999	.000*	0.353
0-60/90/180-P	FI 90-sec	Horse 4	0.545	10.35, 507.152	32.779	.000*	0.401	0.702	13.338, 653.547	32.779	.000*	0.401
0-60/90/180-P	FI 90-sec	Horse 11	0.541	10.274, 503.425	21.17	.000*	0.302	0.695	13.213, 647.453	21.17	.000*	0.302
0-60/90/180-P	FI 90-sec	All	0.615	11.676, 1155.885	46.031	.000*	0.317	0.702	13.347, 1321.4	46.031	.000*	0.317
0-60/90/180-P	FI 180-sec	Horse 4	0.153	**2.907, 11.626**	**2.078**	**0.159**	**0.342**	0.603	11.463, 45.851	2.078	0.04	0.342
0-60/90/180-P	FI 180-sec	Horse 11	0.524	9.954, 487.744	14.792	.000*	0.232	0.668	12.695, 622.066	14.792	.000*	0.232
0-60/90/180-P	FI 180-sec	All	0.568	10.783, 582.286	14.491	.000*	0.212	0.72	13.677, 738.546	14.491	.000*	0.212
0-60-90-180-P	FI 60-sec	Horse 2	0.333	6.319, 309.647	29.389	.000*	0.375	0.387	7.356, 360.453	29.389	.000*	0.375
0-60-90-180-P	FI 60-sec	Horse 5	0.462	8.772, 429.827	33.953	.000*	0.409	0.571	10.853, 531.803	33.953	.000*	0.409
0-60-90-180-P	FI 60-sec	Horse 7	0.424	8.061, 394.967	41.169	.000*	0.457	0.516	9.796, 479.986	41.169	.000*	0.457
0-60-90-180-P	FI 60-sec	Horse 8	0.374	7.097, 347.757	19.763	.000*	0.287	0.443	8.421, 412.617	19.763	.000*	0.287
0-60-90-180-P	FI 60-sec	All	0.453	8.612, 1713.739	79.657	.000*	0.286	0.476	9.036, 1798.166	79.657	.000*	0.286
0-60-90-180-P	FI 90-sec	Horse 2	0.429	8.149, 399.291	53.749	.000*	0.523	0.522	9.925, 486.315	53.749	.000*	0.523
0-60-90-180-P	FI 90-sec	Horse 5	0.471	8.947, 438.387	38.895	.000*	0.443	0.585	11.119, 544.808	38.895	.000*	0.443
0-60-90-180-P	FI 90-sec	Horse 7	0.4	7.6, 334.407	36.304	.000*	0.452	0.492	9.341, 410.999	36.304	.000*	0.452

0-60-90-180-P	FI 90-sec	Horse 8	0.398	7.561, 370.503	25.026	.000*	0.338	0.478	9.075, 444.684	25.026	.000*	0.338
0-60-90-180-P	FI 90-sec	All	0.495	9.411, 1825.725	119.818	.000*	0.382	0.523	9.931, 1926.595	119.818	.000*	0.382
0-60-90-180-P	FI 180-sec	Horse 2	0.49	9.610, 456.205	50.747	.000*	0.509	3615	11.678, 572.246	50.747	.000*	0.509
0-60-90-180-P	FI 180-sec	Horse 5	0.556	10.563, 475.338	16.249	.000*	0.265	0.74	14.052, 632.33	16.249	.000*	0.265
0-60-90-180-P	FI 180-sec	Horse 7	0.252	4.785, 43.067	2.664	0.037	0.228	0.573	10.879, 97.91	2.664	0.005	0.228
0-60-90-180-P	FI 180-sec	Horse 8	0.601	11.413, 559.238	17.255	.000*	0.26	0.796	15.129, 741.317	17.255	.000*	0.26
0-60-90-180-P	FI 180-sec	All	0.637	12.112, 1877.395	68.923	.000*	0.308	0.695	13.21, 2047.506	68.923	.000*	0.308

Honey Bee Two Bin NHST – Dependent T Test

Group	Fixed Interval	Subject	Mean Difference	Standard Deviation	Cohen's d	t score	df	p-value	R^2	95% CI Lower	95% CI Upper
0-15-X	FI 15-sec	Bee 2	1.2	0.44721	2.683303	0.6	4	0.004	0.08	0.64471	1.75529
0-15-X	FI 15-sec	Bee 3	**-0.7**	**3.71344**	**1.1746**	**-0.596**	**9**	**0.566**	**0.03**	**-3.35636**	**1.95636**
0-15-X	FI 15-sec	Bee 5	**0.66667**	**0.8165**	**0.816497**	**2**	**5**	**0.102**	**0.44**	**-1.9019**	**1.52353**
0-15-X	FI 15-sec	Bee 6	**0.125**	**0.83452**	**0.149787**	**0.424**	**7**	**0.685**	**0.03**	**-0.57268**	**0.82268**
0-15-X	FI 15-sec	Bee 7	1	0.86603	1.154694	3.464	8	0.009	0.60	0.33431	1.66569
0-15-X	FI 15-sec	Bee 8	0.55556	0.88192	0.629944	1.89	8	0.095	0.31	-0.12235	1.23346
0-15-X	FI 15-sec	Bee 9	**0.28571**	**0.75593**	**0.377958**	**1**	**6**	**0.356**	**0.14**	**-0.4134**	**0.98483**
0-15-X	FI 15-sec	Bee 10	**1.375**	**3.02076**	**0.455183**	**1.287**	**7**	**0.239**	**0.19**	**-1.15042**	**3.90042**
0-15-X	FI 15-sec	All	**0.5**	**1.98147**	**0.252338**	**1.987**	**61**	**0.051**	**0.06**	**-0.0032**	**1.0032**
0-30-X	FI 30-sec	Bee 1	**0.5**	**1.30931**	**0.381881**	**1.08**	**7**	**0.316**	**0.14**	**-0.59461**	**1.59461**
0-30-X	FI 30-sec	Bee 2	1.42857	0.9759	1.463849	3.873	6	0.008	0.71	0.52601	2.33113
0-30-X	FI 30-sec	Bee 7	**3.71429**	**4.99047**	**0.744277**	**1.969**	**6**	**0.096**	**0.39**	**-0.90113**	**8.3297**
0-30-X	FI 30-sec	Bee 8	1.83333	0.98319	1.864675	4.568	5	0.006	0.81	0.80154	2.86513
0-30-X	FI 30-sec	Bee 9	4	3.4641	1.154701	3.83	10	0.003	0.59	1.67278	6.32722
0-30-X	FI 30-sec	All	2.4359	3.11866	0.781073	4.878	38	.000*	0.39	1.42494	3.44685

Honey Bee Four Bin NHST – Repeated Measures ANOVA

Group	Fixed Interval	Subject	Mauchly's W	Chi^2	df	Sphericity p-value	df	F	p-value	Eta^2
0-15-X	FI 15-sec	Bee 2	0.222	4.095	5	0.558	3, 12	3.826	0.039	0.489
0-15-X	FI 15-sec	Bee 3	0.391	7.242	5	0.206	**3, 27**	**2.234**	**0.107**	**0.199**
0-15-X	FI 15-sec	Bee 5	0	*	5	*	3, 15	11.579	.000*	0.698
0-15-X	FI 15-sec	Bee 6	0	*	5	*	**3, 21**	**0.747**	**0.536**	**0.096**
0-15-X	FI 15-sec	Bee 7	0.388	6.369	5	0.276	3, 24	13.6	.000*	0.63
0-15-X	FI 15-sec	Bee 8	0.364	6.788	5	0.241	3, 24	5.345	0.006	0.401
0-15-X	FI 15-sec	Bee 9	0.479	3.48	5	0.633	3, 18	5.455	0.008	0.476
0-15-X	FI 15-sec	Bee 10	0.399	5.259	5	0.391	**3, 21**	**1.247**	**0.318**	**0.151**
0-15-X	FI 15-sec	All	0.83	11.145	5	0.049	3, 183	14.955	.000*	0.197
0-30-X	FI 30-sec	Bee 1	0.285	7.176	5	0.214	3, 21	2.5	0.087	0.263
0-30-X	FI 30-sec	Bee 2	0.266	7.578	5	0.187	3, 21	9.121	.000*	0.566
0-30-X	FI 30-sec	Bee 7	0.123	9.883	5	0.084	3, 18	2.106	0.135	0.26
0-30-X	FI 30-sec	Bee 8	0.374	3.662	5	0.61	3, 15	22.818	.000*	0.82
0-30-X	FI 30-sec	Bee 9	0.501	0.027	5	0.306	3, 30	9.049	.000*	0.475
0-30-X	FI 30-sec	All	0.555	21.647	5	0.001	3, 114	15.903	.000*	0.295

Honey Bee Four Bin NHST – Repeated Measures ANOVA Sphericity Corrections

Group	Fixed Interval	Subject	Greenhouse-Geisser Epsilon	df	F	p-value	Eta^2	Huynh-Feldt Epislon	df	F	p-value	Eta^2
0-15-X	FI 15-sec	2	**0.708**	**2.124, 8.498**	**3.826**	**0.064**	**0.489**	1	3, 12	3.826	0.039	0.489
0-15-X	FI 15-sec	3	**0.7**	**2.101, 18.911**	**2.234**	**0.133**	**0.199**	**0.919**	**2.756, 24.802**	**2.234**	**0.114**	**0.199**
0-15-X	FI 15-sec	5	0.555	1.664, 8.318	11.579	0.005	0.698	0.797	2.392, 11.961	11.579	0.001	0.698
0-15-X	FI 15-sec	6	**0.476**	**1.428, 9.999**	**0.747**	**0.455**	**0.096**	**0.564**	**1.692, 11.845**	**0.747**	**0.474**	**0.096**
0-15-X	FI 15-sec	7	0.748	2.244, 17.956	13.6	.000*	0.63	1	3, 24	13.6	.000*	0.63
0-15-X	FI 15-sec	8	0.64	1.919, 15.352	5.345	0.018	0.401	0.837	2.511, 20.09	5.345	0.01	0.401
0-15-X	FI 15-sec	9	0.735	2.204, 13.227	5.455	0.017	0.476	1	3, 18	5.455	0.008	0.476
0-15-X	FI 15-sec	10	**0.737**	**2.212, 15.485**	**1.247**	**0.318**	**0.151**	**1**	**3, 21**	**1.247**	**0.318**	**0.151**
0-15-X	FI 15-sec	All	0.906	2.719, 165.853	14.955	.000*	0.197	0.953	2.858, 174.343	14.955	.000*	0.197
0-30-X	FI 30-sec	1	0.583	1.75, 12.25	2.5	0.127	0.263	0.762	2.286, 12.25	2.5	0.108	0.263
0-30-X	FI 30-sec	2	0.581	1.742, 12.197	9.121	0.005	0.566	0.757	2.271, 15.896	9.121	0.002	0.566
0-30-X	FI 30-sec	7	0.46	1.381, 8.284	2.106	0.185	0.26	0.553	1.659, 9.956	2.106	0.176	0.26
0-30-X	FI 30-sec	8	0.677	2.032, 10.158	22.818	.000*	0.82	1	3, 15	22.818	.000*	0.82
0-30-X	FI 30-sec	9	0.693	2.079, 20.794	9.049	0.001	0.475	0.878	2.635, 26.353	9.049	.000*	0.475
0-30-X	FI 30-sec	All	0.705	2.114, 80.345	15.903	.000*	0.295	0.747	2.242, 85.2	15.903	.000*	0.295

Honey Bee Ten Bin NHST – Repeated Measures ANOVA

Group	Fixed Interval	Subject	Mauchly's W	Chi^2	df	Sphericity p-value	df	F	p-value	Eta^2
0-15-X	FI 15-sec	2	0	*	44	*	9, 36	3.619	0.003	0.475
0-15-X	FI 15-sec	3	0.001	42.188	44	0.797	**9, 81**	**1.488**	**0.166**	**0.142**
0-15-X	FI 15-sec	5	0	*	44	*	9, 45	3.143	0.005	0.386
0-15-X	FI 15-sec	6	0	*	44	*	9, 63	3.701	0.001	0.346
0-15-X	FI 15-sec	7	0	*	44	*	9, 72	11.443	.000*	0.589
0-15-X	FI 15-sec	8	0	*	44	*	9, 72	5.439	.000*	0.405
0-15-X	FI 15-sec	9	0	*	44	*	9, 54	5.308	.000*	0.469
0-15-X	FI 15-sec	10	0	*	44	*	9, 63	2.426	0.02	0.257
0-15-X	FI 15-sec	All	0.244	81.557	44	0.001	9, 549	12.693	.000*	0.172
0-30-X	FI 30-sec	1	0	*	44	*	9, 63	3.617	0.001	0.341
0-30-X	FI 30-sec	2	0	*	44	*	9, 63	5.416	.000*	0.436
0-30-X	FI 30-sec	7	0	*	44	*	**9, 54**	**1.477**	**0.18**	**0.198**
0-30-X	FI 30-sec	8	0	*	44	*	9, 45	9.626	.000*	0.658
0-30-X	FI 30-sec	9	0	63.397	44	0.072	9, 90	4.737	.000*	0.321
0-30-X	FI 30-sec	All	0.11	76.782	44	0.002	9, 342	9.495	.000*	0.2

Honey Bee Ten Bin NHST – Repeated Measures ANOVA Sphericity Corrections

Group	Fixed Interval	Subject	Greenhouse-Geisser Epsilon	df	F	p-value	Eta^2	Huynh-Feldt Epislon	df	F	p-value	Eta^2
0-15-X	FI 15-sec	2	0.276	2.481, 9.926	3.619	0.059	0.475	0.761	6.853, 27.414	3.619	0.007	0.475
0-15-X	FI 15-sec	3	**0.541**	**4.873, 43.856**	**1.488**	**0.214**	**0.142**	**1**	**9, 81**	**1.488**	**0.166**	**0.142**
0-15-X	FI 15-sec	5	0.336	3.025, 15.123	3.143	0.056	0.386	0.908	8.175, 40.875	3.143	0.007	0.386
0-15-X	FI 15-sec	6	0.378	3.4, 23.797	3.701	0.022	0.346	0.778	6.998, 48.989	3.701	0.003	0.346
0-15-X	FI 15-sec	7	0.454	4.082, 32.655	11.443	.000*	0.589	0.985	8.866, 70.927	11.443	.000*	0.589
0-15-X	FI 15-sec	8	0.449	4.037, 32.296	5.439	0.002	0.405	0.963	8.663, 69.035	5.439	.000*	0.405
0-15-X	FI 15-sec	9	0.32	2.877, 17.26	5.308	0.01	0.469	0.645	5.807, 34.839	5.305	0.001	0.469
0-15-X	FI 15-sec	10	**0.368**	**3.316, 23.215**	**2.426**	**0.086**	**0.257**	0.74	6.66, 46.62	2.426	0.035	0.257
0-15-X	FI 15-sec	All	0.788	7.091, 432.555	12.693	.000*	0.172	0.902	8.118, 495.214	12.693	.000*	0.172
0-30-X	FI 30-sec	1	0.364	3.274, 22.918	3.617	0.026	0.341	0.721	6.493, 45.449	3.617	0.004	0.341
0-30-X	FI 30-sec	2	0.36	3.239, 22.67	5.416	0.005	0.436	0.706	6.356, 44.494	5.416	.000*	0.436
0-30-X	FI 30-sec	7	**0.301**	**2.71, 16.257**	**1.477**	**0.258**	**0.198**	**0.573**	**5.156, 30.939**	**1.477**	**0.225**	**0.198**
0-30-X	FI 30-sec	8	0.265	2.384, 11.92	9.626	0.002	0.658	0.523	4.703, 23.517	9.626	.000*	0.658
0-30-X	FI 30-sec	9	0.585	5.263, 52.629	4.737	0.001	0.321	1	9, 90	4.737	.000*	0.321
0-30-X	FI 30-sec	All	0.658	5.92, 224.946	9.495	.000*	0.2	0.793	7.134, 271.097	9.495	.000*	0.2

Honey Bee 20 Bin NHST – Repeated Measures ANOVA

Group	Fixed Interval	Subject	Mauchly's W	Chi^2	df	Sphericity p-value	df	F	p-value	Eta^2
0-15-X	FI 15-sec	2	0	*	189	*	19, 76	2.411	0.004	0.376
0-15-X	FI 15-sec	3	0	*	189	*	19, 171	2.111	0.006	0.19
0-15-X	FI 15-sec	5	0	*	189	*	19, 95	4.3558	.000*	0.477
0-15-X	FI 15-sec	6	0	*	189	*	19, 133	4.365	.000*	0.384
0-15-X	FI 15-sec	7	0	*	189	*	19, 152	12.461	.000*	0.609
0-15-X	FI 15-sec	8	0	*	189	*	19, 152	5.779	.000*	0.419
0-15-X	FI 15-sec	9	0	*	189	*	19, 114	4.657	.000*	0.437
0-15-X	FI 15-sec	10	0	*	189	*	19, 133	2.92	.000*	0.294
0-15-X	FI 15-sec	All	0.004	304.579	189	.000*	19, 1159	17.432	.000*	0.222
0-30-X	FI 30-sec	1	0	*	189	*	19, 133	4.772	.000*	0.405
0-30-X	FI 30-sec	2	0	*	189	*	19, 114	4.474	.000*	0.427
0-30-X	FI 30-sec	7	0	*	189	*	**19, 114**	**1.118**	**0.343**	**0.157**
0-30-X	FI 30-sec	8	0	*	189	*	19, 95	5.792	.000*	0.537
0-30-X	FI 30-sec	9	0	*	189	*	19, 190	3.078	.000*	0.235
0-30-X	FI 30-sec	All	0	308.9	189	.000*	19, 722	7.735	.000*	0.169

Honey Bee Ten Bin NHST – Repeated Measures ANOVA Sphericity Corrections

Group	Fixed Interval	Subject	Greenhouse-Geisser Epsilon	df	F	p-value	Eta^2	Huynh-Feldt Epislon	df	F	p-value	Eta^2
0-15-X	FI 15-sec	2	0.188	**3.579, 14.315**	**2.411**	**0.102**	**0.376**	1	19, 76	2.411	0.004	0.376
0-15-X	FI 15-sec	3	0.303	**5.761, 51.848**	**2.111**	**0.07**	**0.19**	0.904	17.168, 154.5111	2.111	0.009	0.19
0-15-X	FI 15-sec	5	0.159	3.028, 15.141	4.558	0.018	0.477	0.432	8.2, 41	4.558	.000*	0.477
0-15-X	FI 15-sec	6	0.272	5.159, 36.114	4.365	0.003	0.384	1	19, 133	4.365	.000*	0.384
0-15-X	FI 15-sec	7	0.254	4.817, 38.536	12.461	.000*	0.609	0.684	12.992, 103.936	12.461	.000*	0.609
0-15-X	FI 15-sec	8	0.258	4.903, 39.223	5.779	.000*	0.419	0.716	13.602, 108.813	5.779	.000*	0.419
0-15-X	FI 15-sec	9	0.195	3.705, 22.230	4.657	0.008	0.437	0.549	10.429, 62.576	4.657	.000*	0.437
0-15-X	FI 15-sec	10	0.253	4.807, 33.646	2.92	0.028	0.294	0.875	16.619, 116.336	2.92	.000*	0.294
0-15-X	FI 15-sec	All	0.667	12.681, 773.558	17.432	.000*	0.222	0.854	16.231, 990.063	17.432	.000*	0.222
0-30-X	FI 30-sec	1	0.243	4.616, 32.299	4.772	0.003	0.405	0.77	14.634, 102.435	4.772	.000*	0.405
0-30-X	FI 30-sec	2	0.203	3.857, 23.139	4.474	0.009	0.427	0.614	11.661, 69.967	4.474	.000*	0.427
0-30-X	FI 30-sec	7	**0.166**	**3.159, 18.954**	**1.118**	**0.369**	**0.157**	**0.373**	**7.079, 42.475**	**1.118**	**0.37**	**0.157**
0-30-X	FI 30-sec	8	0.147	2.788, 13.941	5.792	0.01	0.537	0.351	6.66, 33.293	5.792	.000*	0.537
0-30-X	FI 30-sec	9	0.335	6.366, 63.663	3.078	0.009	0.235	0.985	18.722, 187.22	3.078	.000*	0.235
0-30-X	FI 30-sec	All	0.502	9.529, 362.09	7.735	.000*	0.169	0.683	12.982, 493.322	7.735	.000*	0.169

Appendix 6: Quarter Life Descriptive Statistics

Descriptive Statistics of Horse and Honey Bee Quarter Lives

Group	Fixed Interval	Subject	Mean (sec)	Mean % of Fixed Interval	Median (sec)	Median % of Fixed Interval	Standard Deviation
0-60-P	FI 60-sec	6	31.78	52.96	32.21	53.67	9.09
0-60-P	FI 60-sec	9	28.63	47.71	27.52	45.86	11.54
0-60-P	FI 60-sec	14	37.46	62.43	38.74	64.56	8.27
0-60-P	FI 60-sec	All	32.94	54.90	33.34	55.56	9.88
0-90-P	FI 90-sec	1	45.03	50.03	43.16	47.80	13.54
0-90-P	FI 90-sec	10	46.71	51.90	42.01	46.68	14.92
0-90-P	FI 90-sec	13	51.68	57.42	51.53	57.26	12.16
0-90-P	FI 90-sec	All	47.94	53.27	45.60	50.67	13.54
0-180-P	FI 180-sec	3	77.15	42.86	54.82	30.46	49.91
0-60/90/180-P	FI 60-sec	4	24.98	41.63	21.81	36.35	9.73
0-60/90/180-P	FI 60-sec	11	29.14	48.57	29.34	48.89	7.08
0-60/90/180-P	FI 60-sec	All	27.98	46.63	26.66	44.44	8.04
0-60/90/180-P	FI 90-sec	4	41.02	45.57	39.12	43.47	14.13
0-60/90/180-P	FI 90-sec	11	45.85	50.94	45.74	50.82	13.07
0-60/90/180-P	FI 90-sec	All	44.87	49.85	44.07	48.96	13.30
0-60/90/180-P	FI 180-sec	4	32.32	17.95	32.32	17.95	3.46
0-60/90/180-P	FI 180-sec	11	77.15	42.86	77.02	42.79	20.43
0-60/90/180-P	FI 180-sec	All	75.07	41.71	76.10	42.28	22.11
0-60-90-180-P	FI 60-sec	2	31.65	52.75	31.65	52.75	8.21
0-60-90-180-P	FI 60-sec	5	35.87	59.78	37.74	62.90	12.48
0-60-90-180-P	FI 60-sec	7	35.65	59.41	34.98	58.30	10.52
0-60-90-180-P	FI 60-sec	8	36.79	61.32	36.66	61.11	11.93
0-60-90-180-P	FI 60-sec	All	34.99	58.32	35.36	58.93	11.11
0-60-90-180-P	FI 90-sec	2	56.10	62.33	57.64	64.04	11.03
0-60-90-180-P	FI 90-sec	5	59.74	66.37	61.36	68.17	14.58
0-60-90-180-P	FI 90-sec	7	50.54	56.16	53.51	59.46	12.63
0-60-90-180-P	FI 90-sec	8	61.62	68.47	65.02	72.25	15.55
0-60-90-180-P	FI 90-sec	All	58.17	64.63	58.87	65.41	13.96
0-60-90-180-P	FI 180-sec	2	111.46	61.92	112.26	62.36	20.42
0-60-90-180-P	FI 180-sec	5	83.89	46.60	83.24	46.25	21.32
0-60-90-180-P	FI 180-sec	7	76.20	42.33	79.32	44.06	20.77
0-60-90-180-P	FI 180-sec	8	87.57	48.65	95.91	53.28	36.81
0-60-90-180-P	FI 180-sec	All	94.10	52.28	96.37	53.54	29.50
0-15-X	FI 15-sec	2	7.14	47.60	3.57	23.81	*
0-15-X	FI 15-sec	3	3.64	24.27	2.63	17.55	2.20
0-15-X	FI 15-sec	5	*	*	0.01	0.03	*
0-15-X	FI 15-sec	6	1.03	6.88	0.84	5.57	0.40

0-15-X	FI 15-sec	7	*	*	0.01	0.05	*
0-15-X	FI 15-sec	8	2.95	19.63	2.28	15.21	0.94
0-15-X	FI 15-sec	9	3.91	26.04	1.96	13.05	*
0-15-X	FI 15-sec	10	4.17	27.80	1.84	12.29	3.87
0-15-X	FI 15-sec	All	3.22	21.50	2.22	14.79	2.75
0-30-X	FI 30-sec	1	5.73	19.10	1.33	4.42	8.14
0-30-X	FI 30-sec	2	5.06	16.87	2.90	9.67	3.20
0-30-X	FI 30-sec	7	11.22	37.39	7.57	25.24	6.06
0-30-X	FI 30-sec	8	*	*	0.01	0.03	*
0-30-X	FI 30-sec	9	12.40	41.34	12.11	40.37	4.03
0-30-X	FI 30-sec	All	9.56	31.87	8.69	28.96	6.10

Appendix 7: Quarter Life OOM

Quarter Life OOM

Group Comparison	Ordinal Prediction	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-60-P; 0-90-P; 0-180-P	FI 60-sec < FI 90-sec	81.29	48.31	51.89	0.001
0-60-P; 0-90-P; 0-180-P	FI 60-sec < FI 180-sec	97.30	41.55	59.12	0.001
0-60-P; 0-90-P; 0-180-P	FI 90-sec < FI 180-sec	73.87	40.77	57.66	0.001
0-60/90/180-P	FI 60-sec < FI 90-sec	85.82	46.87	52.73	0.001
0-60/90/180-P	FI 60-sec < FI 180-sec	96.11	46.97	52.76	0.001
0-60/90/180-P	FI 90-sec < FI 180-sec	89.36	46.86	53.57	0.001
0-60-90-180-P	FI 60-sec < FI 90-sec	90.90	48.91	51.18	0.001
0-60-90-180-P	FI 60-sec < FI 180-sec	95.28	48.95	51.23	0.001
0-60-90-180-P	FI 90-sec < FI 180-sec	87.13	48.87	51.11	0.001
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec < FI 90-sec	86.05	49.35	50.65	0.001
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec < FI 180-sec	95.48	49.00	51.00	0.001
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 90-sec < FI 180-sec	88.16	49.03	50.72	0.001
0-15-X; 0-30-X	FI 15-sec < FI 30-sec	81.14	42.86	56.14	0.001

Appendix 8: Quarter Life NHST Non-Parametric

Quarter Life NHST - Mann-Whitney U

Group Comparison	Pairwise Comparison	Shorter Fixed Interval Median	Longer Fixed Interval Median	U	Z Score	p-value
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 90-sec	33.34	45.60	1537	-7.203	.000*
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 180-sec	33.34	54.82	8	-3.171	0.002
0-60-P; 0-90-P; 0-180-P	FI 90-sec vs FI 180-sec	**45.60**	**54.82**	**116**	**-1.618**	**0.106**
0-60/90/180-P	FI 60-sec vs FI 90-sec	26.66	44.07	467	-6.613	.000*
0-60/90/180-P	FI 60-sec vs FI 180-sec	26.66	76.10	102	-7.984	.000*
0-60/90/180-P	FI 90-sec vs FI 180-sec	44.07	76.10	247	-6.637	.000*
0-60-90-180-P	FI 60-sec vs FI 90-sec	35.36	57.98	1715	-11.687	.000*
0-60-90-180-P	FI 60-sec vs FI 180-sec	35.36	95.78	842	-12.781	.000*
0-60-90-180-P	FI 90-sec vs FI 180-sec	57.98	95.78	2817	-11.042	.000*
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 90-sec	34.45	53.90	7262.5	-13.26	.000*
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 180-sec	34.45	95.78	1326	-14.476	.000*
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 90-sec vs FI 180-sec	53.90	95.78	4608.5	-12.849	.000*
0-15-X; 0-30-X	FI 15-sec vs FI-30 sec	2.22	8.69	132	-3.844	.000*

Quarter Life NHST - Kruskal-Wallis Test

Group Comparison	Omnibus Comparison	Chi^2	df	p-value	Median Test Chi^2	Median Test df	Median Test p-value
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	56.498	2	.000*	43.861	2	.000*
0-60/90/180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	95.428	2	.000*	82.627	2	.000*
0-60-90-180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	260.504	2	.000*	217.865	2	.000*
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	343.314	2	.000*	260.886	2	.000*

Appendix 9: Quarter Life NHST Parametric

Quarter Life NHST – Levene's Test

Group Comparison	Pairwise Comparison	Shorter Fixed Interval Mean	Longer Fixed Interval Mean	Shorter Fixed Interval Standard Deviation	Longer Fixed Interval Standard Deviation	Levene F value	Levene p-value
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 90-sec	32.9419	47.9415	9.88167	13.53501	8.638	0.004
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 180-sec	32.9419	77.1498	9.88167	49.90898	52.725	.000*
0-60-P; 0-90-P; 0-180-P	FI 90-sec vs FI 180-sec	47.9415	77.1498	13.53501	49.90898	33.505	.000*
0-60/90/180-P	FI 60-sec vs FI 90-sec	27.9793	44.8654	8.04262	13.30217	13.286	.000*
0-60/90/180-P	FI 60-sec vs FI 180-sec	27.9793	75.0691	8.04262	22.11125	14.961	.000*
0-60/90/180-P	FI 90-sec vs FI 180-sec	44.8654	75.0691	13.30217	22.11125	2.938	0.09
0-60-90-180-P	FI 60-sec vs FI 90-sec	34.9929	58.1659	11.11247	13.95994	5.83	0.016
0-60-90-180-P	FI 60-sec vs FI 180-sec	34.9929	94.1032	11.11247	29.49791	64.055	.000*
0-60-90-180-P	FI 90-sec vs FI 180-sec	58.1659	94.1032	13.95994	29.49791	50.228	.000*
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 90-sec	34.2264	53.8507	10.68994	14.65699	25.5	.000*
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 180-sec	34.2264	93.645	10.68994	30.08146	110.617	.000*
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 90-sec vs FI 180-sec	53.8507	93.645	14.65699	30.08146	72.729	.000*
0-15-X; 0-30-X	FI 15-sec vs FI-30 sec	3.224	9.562	2.746	6.097	19.248	.000*

Quarter Life NHST – Independent T Test

Group Comparison	Pairwise Comparison	t value	df	p-value	Cohen's d	95% Confidence Interval Lower Limit	95% Confidence Interval Upper Limit
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 90-sec	-8.704	181.441	.000*	-1.229	-18.4001	-11.59927
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 180-sec	**-1.77**	**3.013**	**0.175**	**-3.189**	**-123.519**	**35.10287**
0-60-P; 0-90-P; 0-180-P	FI 90-sec vs FI 180-sec	**-1.169**	**3.016**	**0.326**	**-1.868**	**-108.493**	**50.0763**
0-60/90/180-P	FI 60-sec vs FI 90-sec	-8.108	84.99	.000*	-1.559	-21.0269	-12.74537
0-60/90/180-P	FI 60-sec vs FI 180-sec	-13.356	49.896	.000*	-3.044	-51.1717	-40.00793
0-60/90/180-P	FI 90-sec vs FI 180-sec	-8.328	95	.000*	-1.702	-37.4037	-23.0036
0-60-90-180-P	FI 60-sec vs FI 90-sec	-15.354	273.848	.000*	-1.816	-26.1443	-20.20169
0-60-90-180-P	FI 60-sec vs FI 180-sec	-22.281	188.08	.000*	-2.580	-64.3438	-53.87686
0-60-90-180-P	FI 90-sec vs FI 180-sec	-13.279	201.529	.000*	-1.571	-64.3438	-53.87686
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 90-sec	-16.621	458.569	.000*	-1.498	-21.9445	-17.30412
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 180-sec	-22.97	174.899	.000*	-2.794	-64.524	-54.31341
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 90-sec vs FI 180-sec	-15.116	187.028	.000*	-1.850	-44.9879	-34.6008
0-15-X; 0-30-X	FI 15-sec vs FI-30 sec	-4.782	32.537	.000*	-1.367	-9.035	-3.639

Quarter Life NHST – One-Way ANOVA

Group Comparison	Omnibus Comparison	Levene F value	df	Levene p-value	Sums of Squares Between	Sums of Squares Within	F value	p-value	eta^2
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	27.145	2, 186	.000*	14843.07	34752.587	39.721	.000*	0.427107
0-60/90/180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	9.149	2, 155	.000*	56163.92	33793.361	128.804	.000*	1.661981
0-60-90-180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	50.257	2, 417	.000*	239949.3	169043.854	295.955	.000*	1.419449
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	79.056	2, 606	.000*	304029.9	211816.346	434.91	.000*	1.4353467

Appendix 10: Index of Curvature Descriptive Statistics

Descriptive Statistics of Horse and Honey Bee Indices of Curvature (IOC)

Group	Fixed Interval	Subject	Mean Discrete Response Tally	Median Discrete Response Tally	SD IOC Discrete Response Tally	Mean IOC Continuous Response Tally	Median Continuous Response Tally	SD IOC Continuous Response Tally	Mean Response Duration IOC	Median Response Duration IOC	SD Response Duration IOC
0-60-P	FI 60-sec	6	64.57	55.60	49.46	31.66	25.25	52.82	180.13	142.40	239.52
0-60-P	FI 60-sec	9	49.43	48.55	19.90	10.84	9.48	21.78	10.14	**-4.11**	59.43
0-60-P	FI 60-sec	14	71.02	72.58	31.37	36.47	37.40	38.00	14.25	9.80	30.85
0-60-P	FI 60-sec	All	61.67	54.15	36.61	26.32	19.04	40.90	68.17	22.23	163.26
0-90-P	FI 90-sec	1	125.06	121.91	73.90	78.53	76.01	78.42	384.29	392.26	269.62
0-90-P	FI 90-sec	10	68.77	66.54	41.42	15.39	13.39	44.40	147.22	48.87	273.42
0-90-P	FI 90-sec	13	150.09	142.44	70.11	95.48	87.30	65.70	429.46	458.07	258.43
0-90-P	FI 90-sec	All	61.67	54.15	36.61	26.32	19.04	40.90	68.17	22.23	163.26
0-180-P	FI 180-sec	3	132.74	97.21	290.23	**-21.73**	3.78	197.79	488.71	201.75	691.39
0-60/90/180-P	FI 60-sec	4	36.71	43.46	52.16	**-4.31**	0.00	66.24	**-23.90**	**-11.60**	129.21
0-60/90/180-P	FI 60-sec	11	75.07	74.12	15.06	42.99	42.40	15.31	112.45	111.51	58.29
0-60/90/180-P	FI 60-sec	All	55.89	61.46	42.79	19.34	27.28	53.41	44.28	38.16	121.00
0-60/90/180-P	FI 90-sec	4	72.64	60.73	82.26	13.87	2.76	82.65	-28.40	-29.81	84.24
0-60/90/180-P	FI 90-sec	11	100.59	97.42	65.85	53.99	53.91	74.17	171.40	153.01	161.74
0-60/90/180-P	FI 90-sec	All	86.62	70.55	75.45	33.93	18.55	80.68	71.50	24.63	162.91
0-60/90/180-P	FI 180-sec	4	**-18.14**	10.14	104.18	**-90.07**	**-118.32**	179.98	384.93	68.51	838.81
0-60/90/180-P	FI 180-sec	11	121.59	145.20	193.16	**-3.68**	32.68	228.24	2630.72	1633.94	5033.02
0-60/90/180-P	FI 180-sec	All	111.24	136.67	190.98	**-10.08**	29.05	224.76	2464.37	1599.97	4879.73
0-60-90-180-P	FI 60-sec	2	67.42	65.95	66.23	20.36	26.76	68.85	69.63	70.03	160.29
0-60-90-180-P	FI 60-sec	5	89.60	81.54	44.94	56.66	47.22	45.96	53.36	45.53	59.02
0-60-90-180-P	FI 60-sec	7	56.88	56.74	22.42	25.22	22.71	32.42	35.91	13.96	79.00
0-60-90-180-P	FI 60-sec	8	180.16	177.12	126.25	148.10	146.51	127.13	96.65	103.32	79.26
0-60-90-180-P	FI 60-sec	All	98.51	72.75	89.44	62.59	36.67	92.58	63.89	52.46	103.78
0-60-90-180-P	FI 90-sec	2	251.06	240.92	142.71	202.99	190.86	139.94	516.81	557.21	225.38

0-60-90-180-P	FI 90-sec	5	222.63	227.41	86.71	172.80	177.48	84.73	203.02	184.15	146.02
0-60-90-180-P	FI 90-sec	7	90.44	95.35	31.56	39.73	44.53	33.89	83.07	38.45	164.50
0-60-90-180-P	FI 90-sec	8	243.60	228.21	142.73	195.95	181.97	145.08	199.31	193.48	146.45
0-60-90-180-P	FI 90-sec	All	204.79	194.00	128.34	155.77	144.58	128.55	254.85	194.75	236.20
0-60-90-180-P	FI 180-sec	2	583.64	625.64	236.22	491.18	534.14	239.50	1880.51	2044.29	850.53
0-60-90-180-P	FI 180-sec	5	371.74	315.92	272.06	255.56	212.32	278.78	357.72	315.51	315.27
0-60-90-180-P	FI 180-sec	7	300.28	304.34	97.46	207.90	213.76	97.58	610.35	506.96	376.93
0-60-90-180-P	FI 180-sec	8	246.57	234.73	222.20	146.12	144.00	228.88	171.23	149.70	190.33
0-60-90-180-P	FI 180-sec	All	395.57	389.86	273.82	293.50	295.83	280.57	803.46	401.02	919.81
0-15-X	FI 15-sec	2	12.28	14.77	4.49	**-0.49**	2.45	6.13	**-21.64**	**-13.93**	26.19
0-15-X	FI 15-sec	3	28.17	27.57	28.45	18.11	16.45	27.08	16.37	17.80	19.94
0-15-X	FI 15-sec	5	9.56	14.06	9.17	**-6.75**	2.56	18.23	**-69.97**	**-47.42**	91.83
0-15-X	FI 15-sec	6	12.84	16.45	9.01	1.77	3.80	8.11	18.68	9.41	31.33
0-15-X	FI 15-sec	7	12.96	14.63	7.39	**-1.02**	0.00	6.18	**-61.69**	**-66.50**	36.53
0-15-X	FI 15-sec	8	10.95	11.16	5.54	**-1.79**	**-1.02**	5.09	**-43.09**	**-47.29**	28.62
0-15-X	FI 15-sec	9	11.99	13.48	5.58	**-0.10**	**-0.30**	4.41	**-29.68**	**-29.44**	21.29
0-15-X	FI 15-sec	10	30.73	31.51	19.62	17.99	18.90	17.95	37.64	36.51	38.10
0-15-X	FI 15-sec	All	18.05	36.19	23.76	5.21	25.82	23.14	**-18.35**	23.01	17.11
0-30-X	FI 30-sec	1	14.25	12.49	15.87	**-7.10**	**-5.32**	17.60	**-11.74**	**-19.70**	68.53
0-30-X	FI 30-sec	2	16.70	19.88	15.64	**-5.52**	**-3.42**	18.91	**-17.35**	**-7.22**	52.67
0-30-X	FI 30-sec	7	67.52	34.77	83.32	46.69	16.18	84.62	21.79	60.77	67.77
0-30-X	FI 30-sec	8	32.38	31.66	10.67	11.52	10.71	11.16	**-80.87**	**-79.49**	73.28
0-30-X	FI 30-sec	9	75.17	79.77	43.49	55.88	60.22	43.13	73.45	87.28	72.19
0-30-X	FI 30-sec	All	44.16	28.12	49.25	23.43	9.49	50.29	6.81	7.53	82.89

Correlations between Horse and Honey Bee Indices of Curvature (IOC)

Species	IOC Tally Discrete vs IOC Tally Continuous	IOC Tally Discrete vs IOC Duration	IOC Tally Continuous vs IOC Duration
Horses	0.96	0.21	0.16
Honey Bees	0.99	0.53	0.57

Appendix 11: Index of Curvature OOM

Index of Curvature OOM – Discrete Response Tally Index of Curvature

Group Comparison	Ordinal Prediction	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-60-P; 0-90-P; 0-180-P	FI 60-sec < FI 90-sec	76.18	48.97	51.04	0.001
0-60-P; 0-90-P; 0-180-P	FI 60-sec < FI 180-sec	54.50	43.50	56.50	0.01
0-60-P; 0-90-P; 0-180-P	FI 90-sec < FI 180-sec	**46.17**	**43.67**	**57.67**	**0.97**
0-60/90/180-P	FI 60-sec < FI 90-sec	64.59	48.50	51.78	0.001
0-60/90/180-P	FI 60-sec < FI 180-sec	69.04	47.96	52.17	0.001
0-60/90/180-P	FI 90-sec < FI 180-sec	61.70	48.04	51.76	0.001
0-60-90-180-P	FI 60-sec < FI 90-sec	77.68	49.09	50.79	0.001
0-60-90-180-P	FI 60-sec < FI 180-sec	87.89	49.07	50.52	0.001
0-60-90-180-P	FI 90-sec < FI 180-sec	76.05	48.90	50.97	0.001
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec < FI 90-sec	76.03	49.51	50.47	0.001
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec < FI 180-sec	88.59	49.42	50.92	0.001
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 90-sec < FI 180-sec	79.93	49.31	50.67	0.001
0-15-X; 0-30-X	FI 15-sec < FI 30-sec	67.86	46.33	53.14	0.001

Index of Curvature OOM – Continuous Response Tally Index of Curvature

Group Comparison	Ordinal Prediction	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-60-P; 0-90-P; 0-180-P	FI 60-sec < FI 90-sec	66.18	48.44	50.40	0.001
0-60-P; 0-90-P; 0-180-P	FI 60-sec < FI 180-sec	**47.67**	**43.00**	**56.00**	**0.91**
0-60-P; 0-90-P; 0-180-P	FI 90-sec < FI 180-sec	38.00	44.17	57.50	1
0-60/90/180-P	FI 60-sec < FI 90-sec	**49.94**	**48.10**	**51.38**	**0.36**
0-60/90/180-P	FI 60-sec < FI 180-sec	**50.15**	**47.37**	**51.72**	**0.37**
0-60/90/180-P	FI 90-sec < FI 180-sec	**47.85**	**47.83**	**52.43**	**1**
0-60-90-180-P	FI 60-sec < FI 90-sec	73.27	48.39	50.11	0.001
0-60-90-180-P	FI 60-sec < FI 180-sec	81.54	49.00	80.98	0.001
0-60-90-180-P	FI 90-sec < FI 180-sec	69.55	48.96	50.7	0.001
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec < FI 90-sec	69.54	48.87	49.75	0.001
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec < FI 180-sec	82.62	49.24	50.50	0.001
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 90-sec < FI 180-sec	73.71	49.22	50.61	0.001
0-15-X; 0-30-X	FI 15-sec < FI 30-sec	58.22	46.60	52.70	0.001

Index of Curvature OOM – Response Duration Index of Curvature

Group Comparison	Ordinal Prediction	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-60-P; 0-90-P; 0-180-P	FI 60-sec < FI 90-sec	86.6	48.88	51.26	0.001
0-60-P; 0-90-P; 0-180-P	FI 60-sec < FI 180-sec	82.83	44.83	55.83	0.001
0-60-P; 0-90-P; 0-180-P	FI 90-sec < FI 180-sec	**39.33**	**42.50**	**56.67**	**1**
0-60/90/180-P	FI 60-sec < FI 90-sec	**48.22**	**48.56**	**51.81**	**1**
0-60/90/180-P	FI 60-sec < FI 180-sec	80.54	48.04	52.33	0.001
0-60/90/180-P	FI 90-sec < FI 180-sec	80.35	47.87	51.96	0.001
0-60-90-180-P	FI 60-sec < FI 90-sec	75.32	49.15	50.93	0.001
0-60-90-180-P	FI 60-sec < FI 180-sec	84.00	49.18	50.83	0.001
0-60-90-180-P	FI 90-sec < FI 180-sec	68.01	48.91	50.96	0.001
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec < FI 90-sec	80.85	49.61	50.51	0.001
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec < FI 180-sec	83.79	49.22	50.67	0.001
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 90-sec < FI 180-sec	61.87	49.24	50.73	0.001
0-15-X; 0-30-X	FI 15-sec < FI 30-sec	59.86	46.46	53.23	0.001

Appendix 12: Index of Curvature NHST Non-Parametric

Index of Curvature NHST – Discrete Response Tally Index of Curvature– Mann-Whitney U

Group Comparison	Pairwise Comparison	Shorter Fixed Interval Median	Longer Fixed Interval Median	U	Z Score	p-value
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 90-sec	54.15	105.91	5360	-7.84	.000*
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 180-sec	**54.15**	**97.21**	**273**	**-0.307**	**.759**
0-60-P; 0-90-P; 0-180-P	FI 90-sec vs FI 180-sec	**105.91**	**97.21**	**277**	**-0.261**	**.794**
0-60/90/180-P	FI 60-sec vs FI 90-sec	61.46	70.55	3541	-3.565	.000*
0-60/90/180-P	FI 60-sec vs FI 180-sec	61.46	136.67	1672	-3.892	.000*
0-60/90/180-P	FI 90-sec vs FI 180-sec	**70.55**	**136.67**	**2068**	**-2.393**	**.017**
0-60-90-180-P	FI 60-sec vs FI 90-sec	72.75	194.00	8703	-9.517	.000*
0-60-90-180-P	FI 60-sec vs FI 180-sec	72.75	389.86	3753	-12.249	.000*
0-60-90-180-P	FI 90-sec vs FI 180-sec	194.00	389.86	7238	-8.375	.000*
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 90-sec	62.71	119.57	53465	-12.067	.000*
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 180-sec	62.71	301.39	16401	-13.688	.000*
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 90-sec vs FI 180-sec	119.57	301.39	25359	-9.657	.000*
0-15-X; 0-30-X	FI 15-sec vs FI-30 sec	15.09	28.12	727	-2.972	.003

Index of Curvature NHST – Discrete Response Tally Index of Curvature – Kruskal-Wallis Test

Group Comparison	Omnibus Comparison	Chi^2	df	p-value	Median Test Chi^2	Median Test df	Median Test p-value
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	60.375	2	.000*	36.053	2	.000*
0-60/90/180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	22.181	2	.000*	14.84	2	.001
0-60-90-180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	200.713	2	.000*	174.013	2	.000*
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	277.481	2	.000*	257.285	2	.000*

Index of Curvature NHST – Continuous Response Tally Index of Curvature – Mann-Whitney U

Group Comparison	Pairwise Comparison	Shorter Fixed Interval Median	Longer Fixed Interval Median	U	Z Score	p-value
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 90-sec	19.04	55.14	7452	-5.061	.000*
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 180-sec	**19.04**	**3.78**	**286**	**-0.159**	**.873**
0-60-P; 0-90-P; 0-180-P	FI 90-sec vs FI 180-sec	**55.14**	**3.78**	**228**	**-0.818**	**.413**
0-60/90/180-P	FI 60-sec vs FI 90-sec	**27.28**	**18.55**	**4981.5**	**-0.045**	**.964**
0-60/90/180-P	FI 60-sec vs FI 180-sec	**27.28**	**29.05**	**2688**	**-0.045**	**.964**
0-60/90/180-P	FI 90-sec vs FI 180-sec	**18.55**	**29.05**	**2587.5**	**-0.426**	**.67**
0-60-90-180-P	FI 60-sec vs FI 90-sec	36.67	144.58	10176	-8.226	.000*
0-60-90-180-P	FI 60-sec vs FI 180-sec	36.67	295.83	5675	-10.25	.000*
0-60-90-180-P	FI 90-sec vs FI 180-sec	144.58	295.83	9180	-6.31	.000*
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 90-sec	28.03	69.88	68084	-8.292	.000*
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 180-sec	28.03	188.55	24836	-10.031	.000*
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 90-sec vs FI 180-sec	69.88	188.55	32333.5	-6.601	.000*
0-15-X; 0-30-X	FI 15-sec vs FI-30 sec	**2.26**	**9.49**	**943**	**-1.383**	**.167**

Index of Curvature NHST – Continuous Response Tally Index of Curvature – Kruskal-Wallis Test

Group Comparison	Omnibus Comparison	Chi^2	df	p-value	Median Test Chi^2	Median Test df	Median Test p-value
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	25.566	2	.000*	23.52	2	.000*
0-60/90/180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	**0.068**	**2**	**.966**	**1.074**	**2**	**.584**
0-60-90-180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	138.471	2	.000*	126.665	2	.000*
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	139.122	2	.000*	137.441	2	.000*

Index of Curvature NHST – Response Duration Index of Curvature – Mann-Whitney U

Group Comparison	Pairwise Comparison	Shorter Fixed Interval Median	Longer Fixed Interval Median	U	Z Score	p-value
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 90-sec	22.23	418.30	3016	-10.96	.000*
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 180-sec	22.23	201.75	103	-2.238	.025
0-60-P; 0-90-P; 0-180-P	FI 90-sec vs FI 180-sec	**418.30**	**201.75**	**236**	**-0.727**	**.467**
0-60/90/180-P	FI 60-sec vs FI 90-sec	**38.16**	**24.63**	**4822**	**-0.435**	**.664**
0-60/90/180-P	FI 60-sec vs FI 180-sec	38.16	1599.97	1051	-6.244	.000*
0-60/90/180-P	FI 90-sec vs FI 180-sec	24.63	1599.97	1061	-6.206	.000*
0-60-90-180-P	FI 60-sec vs FI 90-sec	52.46	194.75	9627	-8.703	.000*
0-60-90-180-P	FI 60-sec vs FI 180-sec	52.46	401.02	4960	-10.991	.000*
0-60-90-180-P	FI 90-sec vs FI 180-sec	194.75	401.02	9670	-5.788	.000*
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 90-sec	35.53	211.75	53020	-12.182	.000*
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 180-sec	35.53	520.13	16133	-13.805	.000*
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 90-sec vs FI 180-sec	211.75	520.13	29547	-7.822	.000*
0-15-X; 0-30-X	FI 15-sec vs FI-30 sec	**-12.35**	**7.53**	**908**	**-1.641**	**.101**

Index of Curvature NHST – Response Duration Index of Curvature – Kruskal-Wallis Test

Group Comparison	Omnibus Comparison	Chi^2	df	p-value	Median Test Chi^2	Median Test df	Median Test p-value
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	121.314	2	.000*	121.347	2	.000*
0-60/90/180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	47.217	2	.000*	24.163	2	.000*
0-60-90-180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	151.742	2	.000*	132.733	2	.000*
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	266.843	2	.000*	256.608	2	.000*

Appendix 13: Index of Curvature NHST Parametric

Index of Curvature NHST – Discrete Response Tally Index of Curvature – Levene's Test

Group Comparison	Pairwise Comparison	Shorter Fixed Interval Mean	Longer Fixed Interval Mean	Shorter Fixed Interval Standard Deviation	Longer Fixed Interval Standard Deviation	Levene F value	Levene p-value
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 90-sec	61.67	114.64	36.61	71.70	46.681	.000*
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 180-sec	61.67	132.74	36.61	290.23	102.573	.000*
0-60-P; 0-90-P; 0-180-P	FI 90-sec vs FI 180-sec	114.64	132.74	71.70	290.23	33.381	.000*
0-60/90/180-P	FI 60-sec vs FI 90-sec	55.89	86.62	42.79	75.45	9.187	.003
0-60/90/180-P	FI 60-sec vs FI 180-sec	55.89	111.24	42.79	19.98	68.836	.000*
0-60/90/180-P	FI 90-sec vs FI 180-sec	86.62	111.24	75.45	19.98	37.179	.000*
0-60-90-180-P	FI 60-sec vs FI 90-sec	98.35	204.79	89.44	128.34	21.075	.000*
0-60-90-180-P	FI 60-sec vs FI 180-sec	98.35	395.57	89.44	273.82	140.343	.000*
0-60-90-180-P	FI 90-sec vs FI 180-sec	204.79	395.57	128.34	273.82	74.333	.000*
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 90-sec	76.76	147.85	69.12	113.28	97.602	.000*
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 180-sec	76.76	318.55	69.12	284.09	406.623	.000*
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 90-sec vs FI 180-sec	147.85	318.55	113.28	284.09	204.354	.000*
0-15-X; 0-30-X	FI 15-sec vs FI-30 sec	16.99	44.16	16.05	49.25	38.563	.000*

Index of Curvature NHST – Discrete Response Tally Index of Curvature – Independent T Test

Group Comparison	Pairwise Comparison	t value	df	p-value	Cohen's d	95% Confidence Interval Lower Limit	95% Confidence Interval Upper Limit
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 90-sec	-8.058	221.764	.000*	-0.930478568	-65.92452	-40.01564
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 180-sec	**-0.49**	**3.003**	**.658**	**-1.302607052**	**-532.76534**	**390.62756**
0-60-P; 0-90-P; 0-180-P	FI 90-sec vs FI 180-sec	**-0.125**	**3.01**	**.909**	**-0.221080057**	**-479.44666**	**443.24904**
0-60/90/180-P	FI 60-sec vs FI 90-sec	-3.542	156.702	.001	-1.015622449	-47.85915	-13.5939
0-60/90/180-P	FI 60-sec vs FI 180-sec	-2.102	55.89	.04	-1.603041823	-108.11703	-2.58778
0-60/90/180-P	FI 90-sec vs FI 180-sec	**-0.91**	**62.075**	**.366**	**-0.404418238**	**-78.72027**	**29.4685**
0-60-90-180-P	FI 60-sec vs FI 90-sec	-9.526	345.674	.000*	-1.67241118	-128.21912	-84.33438
0-60-90-180-P	FI 60-sec vs FI 180-sec	-12.98	179.57	.000*	-4.425910714	-342.21075	-251.89458
0-60-90-180-P	FI 90-sec vs FI 180-sec	-8.003	207.453	.000*	-1.990975432	-237.76907	-143.78276
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 90-sec	-11.317	732.9	.000*	-1.450356504	-83.41745	-58.75499
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 180-sec	-12.251	223.964	.000*	-4.244218889	-280.68058	-202.89383
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 90-sec vs FI 180-sec	-8453	244.817	.000*	-1.831683482	-210.47508	-130.9269
0-15-X; 0-30-X	FI 15-sec vs FI-30 sec	3.328	43.472	.002	-0.81004	-43.624	-10.709

Index of Curvature NHST – Discrete Response Tally Index of Curvature – One-Way ANOVA

Group Comparison	Omnibus Comparison	Levene F value	df	Levene p-value	Sums of Squares Between	Sums of Squares Within	F value	p-value	eta^2
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	51.808	2, 301	.000*	218283.466	1218450.638	26.962	.000*	0.179148387
0-60/90/180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	44.037	2, 251	.000*	115200.547	2677846.016	5.399	0.005	0.043019855
0-60-90-180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	91.58	2, 547	.000*	7774539.045	16333584.36	130.182	.000*	0.475984871
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	261.23	2, 1105	.000*	8463293.31	24953099.48	187.39	.000*	0.339168019

Index of Curvature NHST – Continuous Response Tally Index of Curvature – Levene's Test

Group Comparison	Pairwise Comparison	Shorter Fixed Interval Mean	Longer Fixed Interval Mean	Shorter Fixed Interval Standard Deviation	Longer Fixed Interval Standard Deviation	Levene F value	Levene p-value
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 90-sec	26.32	63.13	40.90	72.70	40.639	.000*
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 180-sec	26.32	-21.73	40.90	197.79	54.775	.000*
0-60-P; 0-90-P; 0-180-P	FI 90-sec vs FI 180-sec	63.13	-21.73	72.70	197.79	14.539	.000*
0-60/90/180-P	FI 60-sec vs FI 90-sec	19.34	33.93	53.41	80.68	8.438	.004
0-60/90/180-P	FI 60-sec vs FI 180-sec	19.34	-10.08	53.41	224.76	68.976	.000*
0-60/90/180-P	FI 90-sec vs FI 180-sec	33.93	-10.08	80.68	224.76	42.628	.000*
0-60-90-180-P	FI 60-sec vs FI 90-sec	62.59	155.77	92.58	128.55	19.322	.000*
0-60-90-180-P	FI 60-sec vs FI 180-sec	62.59	293.50	92.58	280.57	138.293	.000*
0-60-90-180-P	FI 90-sec vs FI 180-sec	155.77	293.50	128.55	280.57	76.913	.000*
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 90-sec	40.89	97.17	73.26	115.09	91.128	.000*
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 180-sec	40.89	210.61	73.26	298.02	379.537	.000*
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 90-sec vs FI 180-sec	97.17	210.61	115.09	298.02	201.53	.000*
0-15-X; 0-30-X	FI 15-sec vs FI-30 sec	4.43	23.43	16.38	50.29	37.446	.000*

Index of Curvature NHST – Continuous Response Tally Index of Curvature – Independent T Test

Group Comparison	Pairwise Comparison	t value	df	p-value	Cohen's d	95% Confidence Interval Lower Limit	95% Confidence Interval Upper Limit
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 90-sec	-5.404	234.73	.000*	-0.624031682	-50.22816	-23.39058
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 180-sec	**0.486**	**3.007**	**.66**	**0.978451463**	**-266.44629**	**362.55491**
0-60-P; 0-90-P; 0-180-P	FI 90-sec vs FI 180-sec	**0.857**	**3.022**	**.454**	**1.09984782**	**-229.15469**	**398.88205**
0-60/90/180-P	FI 60-sec vs FI 90-sec	**-1.508**	**171.786**	**.133**	**-0.386440788**	**-33.69337**	**4.50432**
0-60/90/180-P	FI 60-sec vs FI 180-sec	**0.947**	**56.253**	**.347**	**0.682489776**	**-32.77378**	**91.60866**
0-60/90/180-P	FI 90-sec vs FI 180-sec	**1.391**	**60.476**	**.169**	**0.675913288**	**-19.25093**	**107.27487**
0-60-90-180-P	FI 60-sec vs FI 90-sec	-8.249	352.048	.000*	-1.414505777	-115.40282	-70.96961
0-60-90-180-P	FI 60-sec vs FI 180-sec	-9.84	180.093	.000*	-3.321931737	-277.21901	-184.60487
0-60-90-180-P	FI 90-sec vs FI 180-sec	-5.657	205.15	.000*	-1.434885064	-185.72217	-89.72928
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 90-sec	-8.716	751.725	.000*	-0.623167026	-68.95398	-43.60188
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 180-sec	-8.196	224.214	.000*	-2.811052959	-210.53782	-128.91652
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 90-sec vs FI 180-sec	-5.368	242.759	.000*	-1.198149172	-155.0828	-71.81567
0-15-X; 0-30-X	FI 15-sec vs FI-30 sec	-2.279	43.468	.028	-0.554654504	-35.795	-2.189

Index of Curvature NHST – Continuous Response Tally Index of Curvature – One-Way ANOVA

Group Comparison	Omnibus Comparison	Levene F value	df	Levene p-value	Sums of Squares Between	Sums of Squares Within	F value	p-value	eta^2
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	37.027	2, 301	.000*	9232306.346	15580339.75	89.18	.000*	0.592561298
0-60/90/180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	**47.526**	**2, 251**	**.000***	**67965.246**	**3604193.994**	**2.367**	**0.096**	**0.018857266**
0-60-90-180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	92.118	2, 547	.000*	4663476.874	17034793.37	74.874	.000*	0.273761869
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	251.549	2, 1105	.000*	4165492.485	27119767.18	84.862	.000*	0.153596174

Index of Curvature NHST – Response Duration Index of Curvature – Levene's Test

Group Comparison	Pairwise Comparison	Shorter Fixed Interval Mean	Longer Fixed Interval Mean	Shorter Fixed Interval Standard Deviation	Longer Fixed Interval Standard Deviation	Levene F value	Levene p-value
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 90-sec	68.17	414.40	163.26	261.32	51.709	.000*
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 180-sec	68.17	488.71	163.26	691.39	36.044	.000*
0-60-P; 0-90-P; 0-180-P	FI 90-sec vs FI 180-sec	114.64	132.74	71.70	290.23	33.381	.000*
0-60/90/180-P	FI 60-sec vs FI 90-sec	44.28	71.50	121.00	162.91	19.428	.000*
0-60/90/180-P	FI 60-sec vs FI 180-sec	44.28	2464.37	121.00	664.05	64.074	.000*
0-60/90/180-P	FI 90-sec vs FI 180-sec	71.50	2464.37	162.91	664.05	61.591	.000*
0-60-90-180-P	FI 60-sec vs FI 90-sec	63.89	251.55	103.78	236.19	115.014	.000*
0-60-90-180-P	FI 60-sec vs FI 180-sec	63.89	803.46	103.78	919.81	322.972	.000*
0-60-90-180-P	FI 90-sec vs FI 180-sec	251.55	803.46	236.19	919.81	204.516	.000*
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 90-sec	60.96	267.43	130.11	263.11	285.116	.000*
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 180-sec	60.96	1218.62	130.11	2665.65	157.214	.000*
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 90-sec vs FI 180-sec	267.43	1218.62	263.11	2665.65	124.57	.000*
0-15-X; 0-30-X	FI 15-sec vs FI-30 sec	-17.24	6.81	52.52	82.89	12.338	.001

Index of Curvature NHST – Response Duration Index of Curvature – Independent T Test

Group Comparison	Pairwise Comparison	t value	df	p-value	Cohen's d	95% Confidence Interval Lower Limit	95% Confidence Interval Upper Limit
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 90-sec	-13.762	249.932	.000*	-1.589102813	-395.77969	-296.68083
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 180-sec	**-1.216**	**3.009**	**.311**	**-2.230073937**	**-1519.66407**	**678.58648**
0-60-P; 0-90-P; 0-180-P	FI 90-sec vs FI 180-sec	**-0.125**	**3.01**	**.909**	**-0.221080057**	**-479.44666**	**443.24904**
0-60/90/180-P	FI 60-sec vs FI 90-sec	**-1.341**	**182.741**	**.181**	**-0.318158821**	**-67.25955**	**12.81753**
0-60/90/180-P	FI 60-sec vs FI 180-sec	-3.644	53.035	.001	-24.78339849	-3752.2025	-1087.98039
0-60/90/180-P	FI 90-sec vs FI 180-sec	-3.602	53.064	.001	-18.20008618	-3725.1444	-1060.59647
0-60-90-180-P	FI 60-sec vs FI 90-sec	-10.357	264.757	.000*	-2.541244477	-227.26322	-154.65697
0-60-90-180-P	FI 60-sec vs FI 180-sec	-9.961	157.042	.000*	-9.491560976	-886.21791	-592.92349
0-60-90-180-P	FI 90-sec vs FI 180-sec	-7.238	170.195	.000*	-3.129571617	-698.22551	-398.9957
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 90-sec	-14.855	647.283	.000*	-2.237917058	-233.76261	-179.17771
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 180-sec	-6.335	212.478	.000*	-10.79553884	-1517.89965	-797.42926
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 90-sec vs FI 180-sec	-5.196	213.98	.000*	-4.394405304	-1312.0505	-590.33809
0-15-X; 0-30-X	FI 15-sec vs FI-30 sec	**-1.608**	**58.44**	**.113**	**-0.362402091**	**-53.985648**	**5.888405**

Index of Curvature NHST – Response Duration Index of Curvature – One-Way ANOVA

Group Comparison	Omnibus Comparison	Levene F value	df	Levene p-value	Sums of Squares Between	Sums of Squares Within	F value	p-value	eta^2
0-60-P; 0-90-P; 0-180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	51.808	2, 301	.000*	218283.466	1218450.638	26.962	.000*	0.179148387
0-60/90/180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	62.856	2, 251	.000*	246274944.8	1266101718	24.412	.000*	0.194514344
0-60-90-180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	255.109	2, 547	.000*	49954547.11	143259280.8	95.37	.000*	0.348700251
0-60-P; 0-90-P; 0-180-P; 0-60-90-180-P	FI 60-sec vs FI 90-sec vs FI 180-sec	141.778	2, 1105	.000*	201039932.4	1544737825	71.905	.000*	0.130145018

Appendix 14: Latency and PRP Descriptive Statistics

Descriptive Statistics of Horse and Honey Bee Latency and PRP

Group	Fixed Interval	Subject	Mean (sec) Final CRF	Median (sec) Final CRF	Standard Deviation Final CRF	Mean (sec) Final FI	Mean % of Fixed Interval	Median (sec) Final FI	Standard Deviation Final FI
0-60-P	FI 60-sec	6	22.34	21.22	13.78	39.57	65.95	36.25	16.16
0-60-P	FI 60-sec	9	11.58	2.17	14.59	43.37	72.28	38.62	25.58
0-60-P	FI 60-sec	14	25.20	23.11	11.26	50.74	84.56	46.90	22.00
0-60-P	FI 60-sec	All	19.70	21.22	14.45	44.56	74.27	36.25	21.95
0-90-P	FI 90-sec	1	39.44	41.35	24.27	43.20	48.00	38.32	17.78
0-90-P	FI 90-sec	10	28.72	28.84	10.04	54.93	61.03	51.28	29.46
0-90-P	FI 90-sec	13	28.79	27.82	11.29	65.65	72.94	50.46	98.38
0-90-P	FI 90-sec	All	32.32	30.03	17.15	54.59	60.66	45.84	60.47
0-180-P	FI 180-sec	3	22.53	21.91	20.27	78.00	43.33	61.62	47.53
0-60/90/180-P	FI 60-sec	4	13.59	15.06	9.25	43.48	72.46	33.99	44.21
0-60/90/180-P	FI 60-sec	11	19.51	17.89	10.03	30.60	51.01	30.36	8.30
0-60/90/180-P	FI 60-sec	All	16.55	15.06	10.05	43.48	72.46	33.99	32.30
0-60/90/180-P	FI 90-sec	4	13.59	15.06	9.25	57.80	64.23	57.06	22.93
0-60/90/180-P	FI 90-sec	11	19.51	17.89	10.03	52.52	58.35	47.36	32.76
0-60/90/180-P	FI 90-sec	All	16.55	15.06	10.05	57.80	64.23	57.06	28.26
0-60/90/180-P	FI 180-sec	4	13.59	15.06	9.25	23.63	13.13	27.33	14.40
0-60/90/180-P	FI 180-sec	11	19.51	17.89	10.03	76.09	42.27	72.37	44.90
0-60/90/180-P	FI 180-sec	All	16.55	15.06	10.05	23.63	13.13	27.33	45.57
0-60-90-180-P	FI 60-sec	2	26.48	23.57	11.81	46.13	76.88	36.89	58.57
0-60-90-180-P	FI 60-sec	5	30.48	33.95	16.25	37.85	63.08	38.43	16.30
0-60-90-180-P	FI 60-sec	7	32.43	32.70	21.25	54.27	90.45	53.83	17.94
0-60-90-180-P	FI 60-sec	8	20.81	20.35	9.24	38.86	64.76	37.40	22.63
0-60-90-180-P	FI 60-sec	All	27.55	25.17	15.86	44.27	73.79	41.28	34.21
0-60-90-180-P	FI 90-sec	2	26.48	23.57	11.81	53.52	59.46	51.03	23.54
0-60-90-180-P	FI 90-sec	5	30.48	33.95	16.25	57.69	64.10	60.95	19.00
0-60-90-180-P	FI 90-sec	7	32.43	32.70	21.25	69.00	76.66	70.67	19.55
0-60-90-180-P	FI 90-sec	8	20.81	20.35	9.24	62.45	69.39	63.54	21.76
0-60-90-180-P	FI 90-sec	All	27.55	25.17	15.86	60.45	67.17	59.53	21.54
0-60-90-180-P	FI 180-sec	2	26.48	23.57	11.81	98.21	54.56	99.33	26.94
0-60-90-180-P	FI 180-sec	5	30.48	33.95	16.25	79.95	44.42	70.92	42.78
0-60-90-180-P	FI 180-sec	7	32.43	32.70	21.25	67.80	37.67	76.07	23.98
0-60-90-180-P	FI 180-sec	8	20.81	20.35	9.24	85.70	47.61	81.40	47.67
0-60-90-180-P	FI 180-sec	All	27.55	25.17	15.86	86.86	48.26	84.88	39.69
0-15-X	FI 15-sec	2	1.42	0.42	2.73	4.09	27.29	3.95	1.08
0-15-X	FI 15-sec	3	0.27	0.26	0.11	0.30	2.00	0.24	0.16
0-15-X	FI 15-sec	5	0.80	0.42	0.92	6.04	40.25	6.78	4.02

0-15-X	FI 15-sec	6	1.89	0.48	2.37	0.75	5.01	0.39	1.19
0-15-X	FI 15-sec	7	3.27	3.38	1.93	9.20	61.35	9.49	4.51
0-15-X	FI 15-sec	8	5.55	5.64	2.00	6.19	41.28	6.46	3.59
0-15-X	FI 15-sec	9	4.16	4.02	1.09	3.78	25.18	3.88	0.87
0-15-X	FI 15-sec	10	0.31	0.28	0.14	1.91	12.76	0.27	3.21
0-15-X	FI 15-sec	All	1.91	0.42	2.34	3.81	25.40	3.23	3.98
0-30-X	FI 30-sec	1	1.81	0.30	2.45	4.53	15.09	3.10	5.78
0-30-X	FI 30-sec	2	1.90	1.71	0.61	4.86	16.19	5.02	4.40
0-30-X	FI 30-sec	7	0.31	0.30	0.08	3.33	11.09	3.47	2.89
0-30-X	FI 30-sec	8	1.16	0.35	2.30	25.80	85.99	24.55	8.91
0-30-X	FI 30-sec	9	4.28	2.92	3.17	3.30	11.01	3.05	1.67
0-30-X	FI 30-sec	All	2.01	1.31	1.55	7.16	23.87	3.68	10.47

Appendix 15: Latency and PRP OOM

Latency PRP – OOM – Final CRF < Final FI

Group	Fixed Interval	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-60-P	FI 60-sec	6	Final CRF < Final FI	86.24	46.48	52.84	0.001
0-60-P	FI 60-sec	9	Final CRF < Final FI	87.52	46.16	52.84	0.001
0-60-P	FI 60-sec	14	Final CRF < Final FI	87.64	46.76	53.16	0.001
0-60-P	FI 60-sec	All	Final CRF < Final FI	86.69	49.34	50.68	0.01
0-90-P	FI 90-sec	1	Final CRF < Final FI	52.60	46.72	53.00	0.004
0-90-P	FI 90-sec	10	Final CRF < Final FI	82.40	47.32	53.16	0.001
0-90-P	FI 90-sec	13	Final CRF < Final FI	88.68	46.96	52.96	0.001
0-90-P	FI 90-sec	All	Final CRF < Final FI	75.22	49.21	50.60	0.01
0-180-P	FI 180-sec	3	Final CRF < Final FI	90.40	40.00	60.80	0.001
0-60/90/180-P	FI 60-sec	4	Final CRF < Final FI	89.32	47.00	52.60	0.001
0-60/90/180-P	FI 60-sec	11	Final CRF < Final FI	84.20	46.52	53.20	0.001
0-60/90/180-P	FI 60-sec	All	Final CRF < Final FI	86.81	49.04	51.24	0.01
0-60/90/180-P	FI 90-sec	4	Final CRF < Final FI	97.48	46.40	53.36	0.001
0-60/90/180-P	FI 90-sec	11	Final CRF < Final FI	94.48	46.60	53.20	0.001
0-60/90/180-P	FI 90-sec	All	Final CRF < Final FI	96.06	48.33	50.80	0.01
0-60/90/180-P	FI 180-sec	4	Final CRF < Final FI	73.60	41.20	60.00	0.001
0-60/90/180-P	FI 180-sec	11	Final CRF < Final FI	93.32	46.84	56.32	0.001
0-60/90/180-P	FI 180-sec	All	Final CRF < Final FI	91.73	48.27	51.15	0.01
0-60-90-180-P	FI 60-sec	2	Final CRF < Final FI	76.80	46.36	53.92	0.001
0-60-90-180-P	FI 60-sec	5	Final CRF < Final FI	62.36	46.44	53.72	0.001
0-60-90-180-P	FI 60-sec	7	Final CRF < Final FI	79.76	46.36	53.76	0.001
0-60-90-180-P	FI 60-sec	8	Final CRF < Final FI	77.60	46.76	53.24	0.001
0-60-90-180-P	FI 60-sec	All	Final CRF < Final FI	73.45	49.53	50.55	0.01
0-60-90-180-P	FI 90-sec	2	Final CRF < Final FI	91.32	46.64	53.04	0.001
0-60-90-180-P	FI 90-sec	5	Final CRF <	88.04	46.28	52.64	0.001

			Final FI				
0-60-90-180-P	FI 90-sec	7	Final CRF < Final FI	89.64	46.49	53.78	0.001
0-60-90-180-P	FI 90-sec	8	Final CRF < Final FI	97.04	47.12	52.92	0.001
0-60-90-180-P	FI 90-sec	All	Final CRF < Final FI	90.26	49.38	50.77	0.01
0-60-90-180-P	FI 180-sec	2	Final CRF < Final FI	98.44	47.00	53.16	0.001
0-60-90-180-P	FI 180-sec	5	Final CRF < Final FI	90.96	46.78	53.17	0.001
0-60-90-180-P	FI 180-sec	7	Final CRF < Final FI	86.80	41.80	58.60	0.001
0-60-90-180-P	FI 180-sec	8	Final CRF < Final FI	92.56	46.68	53.36	0.001
0-60-90-180-P	FI 180-sec	All	Final CRF < Final FI	92.62	49.17	50.64	0.01
0-15-X	FI 15-sec	2	Final CRF < Final FI	85.71	22.86	74.29	0.001
0-15-X	FI 15-sec	3	Final CRF < Final FI	**51.25**	**27.5**	**68.75**	**0.41**
0-15-X	FI 15-sec	5	Final CRF < Final FI	88.89	26.67	73.33	0.001
0-15-X	FI 15-sec	6	Final CRF < Final FI	**29.69**	**28.13**	**71.88**	**1**
0-15-X	FI 15-sec	7	Final CRF < Final FI	89.58	25.00	70.83	0.001
0-15-X	FI 15-sec	8	Final CRF < Final FI	**56.25**	**31.25**	**73.44**	**0.2**
0-15-X	FI 15-sec	9	Final CRF < Final FI	**48.21**	**26.79**	**73.21**	**0.67**
0-15-X	FI 15-sec	10	Final CRF < Final FI	**51.39**	**29.17**	**65.28**	**0.26**
0-15-X	FI 15-sec	All	Final CRF < Final FI	63.76	46.91	51.78	0.001
0-30-X	FI 30-sec	1	Final CRF < Final FI	71.11	32.22	67.78	0.001
0-30-X	FI 30-sec	2	Final CRF < Final FI	64.29	26.79	67.86	0.01
0-30-X	FI 30-sec	7	Final CRF < Final FI	98.41	28.57	68.25	0.001
0-30-X	FI 30-sec	8	Final CRF < Final FI	100	22.92	79.17	0.001
0-30-X	FI 30-sec	9	Final CRF < Final FI	**42.15**	**35.54**	**64.46**	**0.96**
0-30-X	FI 30-sec	All	Final CRF < Final FI	73.88	45.80	53.55	0.001

Latency PRP – OOM – Schedule Duration

Group	Subject	Ordinal Assessment	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-60-P; 0-90-P	All	FI 60-sec < FI 90-sec	58.59	49.26	50.63	0.01
0-60-P; 0-180-P	All	FI 60-sec < FI 180-sec	74.16	45.87	55.87	0.01
0-90-P; 0-180-P	All	FI 90-sec < FI 180-sec	67.73	45.47	54.93	0.01
0-60/90/180-P	4	FI 60-sec < FI 90-sec	75.08	47.04	53.36	0.001
0-60/90/180-P	4	FI 60-sec < FI 180-sec	**32.40**	**39.20**	**58.80**	**1**
0-60/90/180-P	4	FI 90-sec < FI 180-sec	**9.20**	**40.40**	**58.80**	**1**
0-60/90/180-P	11	FI 60-sec < FI 90-sec	81.36	47.16	53.56	0.001
0-60/90/180-P	11	FI 60-sec < FI 180-sec	92.08	47.20	52.72	0.001
0-60/90/180-P	11	FI 90-sec < FI 180-sec	77.20	46.48	53.76	0.001
0-60/90/180-P	All	FI 60-sec < FI 90-sec	77.96	48.25	51.82	0.001
0-60/90/180-P	All	FI 60-sec < FI 180-sec	82.73	48.00	52.02	0.001
0-60/90/180-P	All	FI 90-sec < FI 180-sec	67.13	47.95	51.52	0.001
0-60-90-180-P	2	FI 60-sec < FI 90-sec	73.52	46.88	53.36	0.001
0-60-90-180-P	2	FI 60-sec < FI 180-sec	94.08	46.68	53.08	0.001
0-60-90-180-P	2	FI 90-sec < FI 180-sec	91.92	46.28	53.00	0.001
0-60-90-180-P	5	FI 60-sec < FI 90-sec	81.48	46.72	53.60	0.001
0-60-90-180-P	5	FI 60-sec < FI 180-sec	86.65	45.83	53.17	0.001
0-60-90-180-P	5	FI 90-sec < FI 180-sec	67.43	47.13	53.3	0.001
0-60-90-180-P	7	FI 60-sec < FI 90-sec	71.07	46.89	53.87	0.001
0-60-90-180-P	7	FI 60-sec < FI 180-sec	69.40	44.00	56.8	0.001
0-60-90-180-P	7	FI 90-sec < FI 180-sec	**49.56**	**42.00**	**57.56**	**0.59**
0-60-90-180-P	8	FI 60-sec < FI 90-sec	77.84	46.08	53.32	0.001
0-60-90-180-P	8	FI 60-sec < FI 180-sec	80.52	46.8	52.76	0.001
0-60-90-180-P	8	FI 90-sec < FI 180-sec	64.84	46.76	53.04	0.001
0-60-90-180-P	All	FI 60-sec < FI 90-sec	73.96	49.42	50.67	0.01
0-60-90-180-P	All	FI 60-sec <	84.41	49.20	50.74	0.01

0-60-90-180-P	All	FI 180-sec FI 90-sec < FI 180-sec	72.34	49.23	50.74	0.01
0-15-X; 0-30-X	All	FI 15-sec < FI 30sec	60.85	46.88	52.87	0.001

Appendix 16: Latency and PRP NHST Non-Parametric

Latency PRP NHST - Mann-Whitney U – Last CRF vs Last FI

Group Comparison	Subject	Fixed Interval	CRF Median	FI Median	U	Z	p-value
0-60-P	6	FI 60-sec	21.22	36.25	334	-6.246	.000*
0-60-P	9	FI 60-sec	2.17	38.62	312	-6.466	.000*
0-60-P	14	FI 60-sec	23.11	46.90	309	-6.487	.000*
0-60-P	All	FI 60-sec	21.22	36.25	2994.5	-10.989	.000*
0-90-P	1	FI 90-sec	**38.32**	**41.35**	**1185**	**-0.448**	**0.654**
0-90-P	10	FI 90-sec	28.84	51.28	440	-5.584	.000*
0-90-P	13	FI 90-sec	27.82	50.46	283	-6.666	.000*
0-90-P	All	FI 90-sec	30.03	45.84	5575	-7.554	.000*
0-180-P	3	FI 180-sec	21.91	61.62	24	-2.957	0.003
0-60/90/180-P	4	FI 60-sec	15.06	33.99	267	-6.777	.000*
0-60/90/180-P	11	FI 60-sec	17.89	30.36	395	-5.894	.000*
0-60/90/180-P	All	FI 60-sec	15.06	33.99	1319	-8.994	.000*
0-60/90/180-P	4	FI 90-sec	15.06	57.06	63	-8.183	.000*
0-60/90/180-P	11	FI 90-sec	17.89	47.36	138	-7.666	.000*
0-60/90/180-P	All	FI 90-sec	15.06	57.06	394	-11.254	.000*
0-60/90/180-P	4	FI 180-sec	**15.06**	**27.33**	**66**	**-1.727**	**0.084**
0-60/90/180-P	11	FI 180-sec	17.89	72.37	167	-7.466	.000*
0-60/90/180-P	All	FI 180-sec	15.06	27.33	455	-8.583	.000*
0-60-90-180-P	2	FI 60-sec	23.57	36.89	580	-4.619	.000*
0-60-90-180-P	5	FI 60-sec	33.95	38.43	887	-2.502	0.012
0-60-90-180-P	7	FI 60-sec	32.70	53.83	959	-2.006	0.045
0-60-90-180-P	8	FI 60-sec	20.35	37.40	349	-6.211	.000*
0-60-90-180-P	All	FI 60-sec	25.17	41.28	10618	-8.115	.000*
0-60-90-180-P	2	FI 90-sec	23.57	51.03	217	-7.121	.000*
0-60-90-180-P	5	FI 90-sec	33.95	60.95	299	-6.556	.000*
0-60-90-180-P	7	FI 90-sec	32.70	70.67	233	-6.649	.000*
0-60-90-180-P	8	FI 90-sec	20.35	63.54	74	-8.107	.000*
0-60-90-180-P	All	FI 90-sec	25.17	59.53	3800	-13.839	.000*
0-60-90-180-P	2	FI 180-sec	23.57	99.33	39	-8.348	.000*
0-60-90-180-P	5	FI 180-sec	33.95	70.92	270	-6.756	.000*
0-60-90-180-P	7	FI 180-sec	32.70	76.07	66	-3.65	.000*
0-60-90-180-P	8	FI 180-sec	20.35	81.40	186	-7.335	.000*
0-60-90-180-P	All	FI 180-sec	25.17	84.88	2302	-13.803	.000*
0-15-X	2	FI 15-sec	0.42	3.95	5	-2.034	0.048
0-15-X	3	FI 15-sec	**0.26**	**0.24**	**38.5**	**-1.34**	**0.897**
0-15-X	5	FI 15-sec	0.42	6.78	5	-2.33	0.019
0-15-X	6	FI 15-sec	**0.48**	**0.39**	**19.5**	**-1.318**	**0.195**

0-15-X	7	FI 15-sec	3.38	9.49	5	-2.453	0.013
0-15-X	8	FI 15-sec	**5.64**	**6.46**	**28**	**-0.42**	**0.721**
0-15-X	9	FI 15-sec	**4.02**	**3.88**	**27**	**-0.116**	**0.955**
0-15-X	10	FI 15-sec	**0.28**	**0.27**	**32.5**	**-0.339**	**0.743**
0-15-X	All	FI 15-sec	0.50	3.23	1475	-1.965	0.049
0-30-X	1	FI 30-sec	**0.30**	**3.10**	**26**	**-1.551**	**0.133**
0-30-X	2	FI 30-sec	**1.71**	**5.02**	**19.5**	**-0.985**	**0.336**
0-30-X	7	FI 30-sec	0.30	3.47	1	-3.231	.000*
0-30-X	8	FI 30-sec	0.36	24.55	0	-3.098	0.001
0-30-X	9	FI 30-sec	**2.92**	**3.05**	**51**	**-0.624**	**0.562**
0-30-X	All	FI 30-sec	1.31	3.68	481.5	-3.813	.000*

Latency PRP NHST - Mann-Whitney U – Schedule Comparison

Group Comparison	Subject	Pairwise Comparison	Shorter FI Median	Longer FI Median	U	Z	p-value
0-60-P; 0-90-P	All	FI 60-sec vs FI 90-sec	41.54	45.84	9317	-2.573	0.01
0-60-P; 0-180-P	All	FI 60-sec vs FI 180-sec	**41.54**	**61.62**	**194**	**-1.833**	**0.067**
0-90-P; 0-180-P	All	FI 90-sec vs FI 180-sec	**45.84**	**61.62**	**242**	**-1.347**	**0.178**
0-60/90/180-P	4	FI 60-sec vs FI 90-sec	33.99	57.06	623	-4.322	.000*
0-60/90/180-P	4	FI 60-sec vs FI 180-sec	**33.99**	**27.33**	**81**	**-1.288**	**0.21**
0-60/90/180-P	4	FI 90-sec vs FI 180-sec	57.06	27.33	23	-2.986	0.001
0-60/90/180-P	11	FI 60-sec vs FI 90-sec	30.36	47.36	466	-5.405	.000*
0-60/90/180-P	11	FI 60-sec vs FI 180-sec	30.36	72.37	198	-7.252	.000*
0-60/90/180-P	11	FI 90-sec vs FI 180-sec	47.36	72.37	570	-4.688	.000*
0-60/90/180-P	All	FI 60-sec vs FI 90-sec	33.99	57.06	2204	-6.832	.000*
0-60/90/180-P	All	FI 60-sec vs FI 180-sec	33.99	27.33	950	-6.732	.000*
0-60/90/180-P	All	FI 90-sec vs FI 180-sec	57.06	27.33	1808	-3.523	.000*
0-60-90-180-P	2	FI 60-sec vs FI 90-sec	36.89	51.03	662	-4.054	.000*
0-60-90-180-P	2	FI 60-sec vs FI 180-sec	36.89	99.33	148	-7.597	.000*
0-60-90-180-P	2	FI 90-sec vs FI 180-sec	51.03	99.33	202	-7.225	.000*
0-60-90-180-P	5	FI 60-sec vs FI 90-sec	38.43	60.95	463	-5.425	.000*
0-60-90-180-P	5	FI 60-sec vs FI 180-sec	38.43	70.92	307	-6.183	.000*
0-60-90-180-P	5	FI 90-sec vs FI 180-sec	60.95	70.92	749	-2.941	0.003
0-60-90-180-P	7	FI 60-sec vs FI 90-sec	53.83	70.67	651	-3.533	.000*
0-60-90-180-P	7	FI 60-sec vs FI 180-sec	**53.83**	**76.07**	**153**	**-1.924**	**0.054**
0-60-90-180-P	7	FI 90-sec vs FI 180-sec	**70.67**	**76.07**	**223**	**-0.044**	**0.965**
0-60-90-180-P	8	FI 60-sec vs FI 90-sec	37.40	63.54	554	-4.798	.000*
0-60-90-180-P	8	FI 60-sec vs FI 180-sec	37.40	81.40	487	-5.26	.000*
0-60-90-180-P	8	FI 90-sec vs FI 180-sec	63.54	81.40	879	-2.558	0.011
0-60-90-180-P	All	FI 60-sec vs FI 90-sec	41.28	59.53	10156	-8.237	.000*
0-60-90-180-P	All	FI 60-sec vs	41.28	84.88	4862.5	-11.145	.000*

		FI 180-sec					
0-60-90-180-P	All	FI 90-sec vs FI 180-sec	59.53	84.88	8414	-7.194	.000*
0-60-P; 0-90-P; 0-60-90-180-P	All	FI 60-sec vs FI 90-sec	41.30	53.77	39559	-7.866	.000*
0-60-P; 0-180-P; 0-60-90-180-P	All	FI 60-sec vs FI 180-sec	41.30	84.55	9220.5	-12.224	.000*
0-90-P; 0-180-P; 0-60-90-180-P	All	FI 90-sec vs FI 180-sec	53.77	84.55	14053	-8.956	.000*
0-15-X; 0-30-X	All	FI 15-sec vs FI 30sec	**3.23**	**3.68**	**946**	**-1.847**	**0.065**

Appendix 17: Latency and PRP NHST Parametric

Latency PRP NHST – Levene's Test – Last CRF vs Last FI

Group Comparison	Subject	Fixed Interval	CRF Mean	FI Mean	CRF Standard Deviation	FI Standard Deviation	Levene F	Levene p-value
0-60-P	6	FI 60-sec	22.34	39.57	13.78	16.16	5.22	0.024
0-60-P	9	FI 60-sec	11.58	43.70	14.59	25.58	**1.756**	**0.188**
0-60-P	14	FI 60-sec	25.20	50.74	11.26	22.00	12.257	0.001
0-60-P	All	FI 60-sec	19.71	44.56	14.45	21.95	11.045	0.001
0-90-P	1	FI 90-sec	39.44	43.20	24.27	17.78	4.899	0.029
0-90-P	10	FI 90-sec	28.72	54.93	10.04	29.46	37.551	.000*
0-90-P	13	FI 90-sec	28.79	65.65	11.29	98.38	**3.248**	**0.075**
0-90-P	All	FI 90-sec	32.32	54.59	17.15	60.47	4.798	0.029
0-180-P	3	FI 180-sec	22.53	78.00	20.27	47.53	13.335	0.001
0-60/90/180-P	4	FI 60-sec	13.59	43.48	9.25	44.21	8.92	0.004
0-60/90/180-P	11	FI 60-sec	19.51	30.60	10.03	8.30	**0.009**	**0.926**
0-60/90/180-P	All	FI 60-sec	16.55	37.04	10.05	32.30	6.953	0.009
0-60/90/180-P	4	FI 90-sec	13.59	57.80	9.25	22.93	21.933	.000*
0-60/90/180-P	11	FI 90-sec	19.51	52.52	10.03	32.76	10.063	0.002
0-60/90/180-P	All	FI 90-sec	16.55	55.16	10.05	28.26	28.699	.000*
0-60/90/180-P	4	FI 180-sec	13.59	23.63	9.25	14.40	**1.278**	**0.263**
0-60/90/180-P	11	FI 180-sec	19.51	76.09	10.03	44.90	11.936	0.001
0-60/90/180-P	All	FI 180-sec	16.55	71.32	10.05	45.57	27.419	.000*
0-60-90-180-P	2	FI 60-sec	26.48	46.13	11.81	58.57	**3.227**	**0.076**
0-60-90-180-P	5	FI 60-sec	30.48	38.40	16.25	14.24	**3.075**	**0.083**
0-60-90-180-P	**7**	FI 60-sec	32.43	21.25	39.57	21.21	**0.1**	**0.752**
0-60-90-180-P	8	FI 60-sec	20.81	46.55	46.55	29.89	22.102	.000*
0-60-90-180-P	All	FI 60-sec	27.55	44.27	15.86	34.04	5.175	0.023
0-60-90-180-P	2	FI 90-sec	26.48	53.52	11.81	23.54	4.319	0.04
0-60-90-180-P	5	FI 90-sec	30.48	57.69	16.25	19.00	**0.044**	**0.833**

0-60-90-180-P	7	FI 90-sec	32.43	69.00	39.57	19.55	**0.084**	**0.773**
0-60-90-180-P	8	FI 90-sec	20.81	62.45	46.55	21.76	34.241	.000*
0-60-90-180-P	All	FI 90-sec	27.55	60.45	15.86	21.67	12.178	0.001
0-60-90-180-P	2	FI 180-sec	26.48	98.21	11.81	29.94	23.687	.000*
0-60-90-180-P	5	FI 180-sec	30.48	77.05	16.25	42.87	12.734	0.001
0-60-90-180-P	7	FI 180-sec	32.43	67.80	39.57	23.98	**0.257**	**0.614**
0-60-90-180-P	8	FI 180-sec	20.81	85.70	46.55	49.67	62.931	.000*
0-60-90-180-P	All	FI 180-sec	27.55	86.86	15.86	39.90	85.619	.000*
0-15-X	2	FI 15-sec	1.42	4.09	2.73	1.08	**1.087**	**0.322**
0-15-X	3	FI 15-sec	0.27	0.30	0.11	0.16	**0.647**	**0.433**
0-15-X	5	FI 15-sec	0.80	6.04	0.92	4.02	**7.1**	**0.021**
0-15-X	6	FI 15-sec	1.89	2.37	0.75	1.19	**4.361**	**0.056**
0-15-X	7	FI 15-sec	3.27	9.20	1.93	4.51	9.539	0.009
0-15-X	8	FI 15-sec	5.55	6.19	2.00	3.59	**1.5**	**0.241**
0-15-X	**9**	FI 15-sec	4.16	3.78	1.09	0.87	**0.088**	**0.771**
0-15-X	10	FI 15-sec	0.31	1.91	0.14	3.21	15.782	0.001
0-15-X	All	FI 15-sec	2.14	3.81	2.40	3.98	9.432	0.003
0-30-X	1	FI 30-sec	1.81	4.53	2.45	5.78	**2.148**	**0.161**
0-30-X	2	FI 30-sec	1.90	4.86	0.61	4.40	9.142	0.01
0-30-X	7	FI 30-sec	0.31	3.33	0.08	2.89	23.256	.000*
0-30-X	8	FI 30-sec	1.16	25.80	2.30	8.91	10.964	0.006
0-30-X	9	FI 30-sec	4.28	3.30	3.17	1.67	**1.529**	**0.231**
0-30-X	All	FI 30-sec	2.01	7.16	2.51	9.15	22.527	.000*

Latency PRP NHST – Independent T Test – Last CRF vs Last FI

Group Comparison	Subject	Pairwise Comparison	t score	df	p-value	Cohen's d	95% Confidence Interval Lower Limit	95% Confidence Interval Upper Limit
0-60-P	6	FI 60-sec	-5.74	95.613	.000*	-1.148	-23.19674	-11.27486
0-60-P	9	FI 60-sec	-7.635	98	.000*	-1.543	-40.05407	-23.52805
0-60-P	14	FI 60-sec	-7.307	73.007	.000*	-1.461	-35.50717	-18.57459
0-60-P	All	FI 60-sec	-11.585	257.681	.000*	-1.338	-29.08089	-20.63094
0-90-P	1	FI 90-sec	**-0.883**	**89.833**	**0.38**	**-0.177**	**-12.20867**	**4.69551**
0-90-P	10	FI 90-sec	-5.956	60.228	.000*	-1.191	-35.01825	-17.41199
0-90-P	13	FI 90-sec	-2.632	98	0.011	-0.526	-64.64672	-9.06604
0-90-P	All	FI 90-sec	-4.34	172.829	.000*	-0.501	-32.40587	-12.14618
0-180-P	3	FI 180-sec	**-2.586**	**4.147**	**0.059**	**-2.364**	**-114.19516**	**3.26508**
0-60/90/180-P	4	FI 60-sec	-4.678	53.28	.000*	-0.936	-42.69679	-17.07385
0-60/90/180-P	11	FI 60-sec	-6.023	98	.000*	-1.205	-14.74245	-7.43507
0-60/90/180-P	All	FI 60-sec	-6.056	117.991	.000*	-0.856	-27.18643	-13.78765
0-60/90/180-P	4	FI 90-sec	-12.644	64.532	.000*	-2.529	-51.19661	-37.22767
0-60/90/180-P	11	FI 90-sec	-6.811	58.111	.000*	-1.362	-42.70385	-23.30471
0-60/90/180-P	All	FI 90-sec	-12.872	123.653	.000*	-1.820	-44.54499	-32.67143
0-60/90/180-P	4	FI 180-sec	-2.199	53	0.032	-1.031	-19.19542	-0.8823
0-60/90/180-P	11	FI 180-sec	-8.694	53.881	.000*	-1.739	-69.61926	-43.52686
0-60/90/180-P	All	FI 180-sec	-8796	56.906	.000*	-1.938	-67.23381	-42.29712
0-60-90-180-P	2	FI 60-sec	-2.325	98	0.022	-0.465	-36.41477	-2.87871
0-60-90-180-P	5	FI 60-sec	-2.59	98	0.011	-0.518	-13.97923	-1.85053
0-60-90-180-P	7	FI 60-sec	**-1.681**	**98**	**0.096**	**0.352**	**-15.5625**	**1.29046**
0-60-90-180-P	8	FI 60-sec	-5.819	58.287	.000*	-0.658	-34.59681	-16.88795
0-60-90-180-P	All	FI 60-sec	-6.297	281.459	.000*	-0.630	-21.95114	-11.49631
0-60-90-180-P	2	FI 90-sec	-7.26	72.219	.000*	-1.452	-34.46281	-19.61447
0-60-90-180-P	5	FI 90-sec	-7.695	98	.000*	-1.539	-34.22366	-20.1909
0-60-90-180-P	7	FI 90-sec	-8.696	93	.000*	-1.153	-44.91528	-28.21533
0-60-90-180-P	8	FI 90-sec	-12.454	66.114	.000*	-1.146	-48.32005	-34.96795

0-60-90-180-P	All	FI 90-sec	-17.182	355.045	.000*	-1.733	-36.66585	-29.13441
0-60-90-180-P	2	FI 180-sec	-17.242	67.176	.000*	-3.152	-80.03334	-63.42646
0-60-90-180-P	5	FI 180-sec	-7.182	62.796	.000*	-1.460	-59.52138	-33.60706
0-60-90-180-P	7	FI 180-sec	-4.706	58	.000*	-0.941	-50.41117	-20.32515
0-60-90-180-P	8	FI 180-sec	-9.449	52.678	.000*	-1.348	-78.66063	-51.10977
0-60-90-180-P	All	FI 180-sec	-17.519	193.257	.000*	-2.048	-65.99052	-52.63552
0-15-X	2	FI 15-sec	**-2.052**	**10**	**0.067**	**-1.201**	**-5.568**	**0.229**
0-15-X	3	FI 15-sec	**-0.46**	**16**	**0.652**	**-0.221**	**-0.172**	**0.11**
0-15-X	5	FI 15-sec	-2.872	4.236	0.042	-2.148	-10.185	-0.283
0-15-X	6	FI 15-sec	**1.219**	**14**	**0.243**	**-0.476**	**-0.868**	**3.153**
0-15-X	7	FI 15-sec	3.336	10.002	0.008	-1.620	-9.89	-1.969
0-15-X	8	FI 15-sec	**-0.445**	**14**	**0.663**	**-0.222**	**-3.763**	**2.47**
0-15-X	9	FI 15-sec	**7.41**	**13**	**0.472**	**0.383**	**-0.73**	**1.492**
0-15-X	10	FI 15-sec	**-1.409**	**7.025**	**0.201**	**-0.730**	**-4.282**	**1.082**
0-15-X	All	FI 15-sec	-2.784	94.051	0.006	-0.512	-2.86	-0.478
0-30-X	1	FI 30-sec	**-1.305**	**17**	**0.209**	**-0.600**	**-7.11**	**1.675**
0-30-X	2	FI 30-sec	**-1.76**	**6.205**	**0.127**	**-0.977**	**-7.029**	**1.12**
0-30-X	7	FI 30-sec	-2.759	6.008	0.033	-1.594	-5.689	-0.341
0-30-X	8	FI 30-sec	-6.609	5.503	0.001	-4.097	-33.969	-15.315
0-30-X	9	FI 30-sec	**0.901**	**20**	**0.378**	**0.384**	**-1.279**	**3.225**
0-30-X	All	FI 30-sec	-3.486	45.476	0.001	-0.784	-8.124	-2.175

Latency PRP NHST – Levene's Test – Schedule Comparison

Group Comparison	Subject	Pairwise Comparison	Shorter FI Mean	Longer FI Mean	CRF Standard Deviation	FI Standard Deviation	Levene F	Levene p-value
0-60-P; 0-90-P	All	FI 60-sec vs FI 90-sec	44.56	54.59	21.95	60.47	**2.389**	**0.123**
0-60-P; 0-180-P	All	FI 60-sec vs FI 180-sec	44.56	78.00	21.95	47.53	9.676	0.002
0-90-P; 0-180-P	All	FI 90-sec vs FI 180-sec	54.59	78.00	60.47	47.53	**0.346**	**0.557**
0-60/90/180-P	4	FI 60-sec vs FI 90-sec	43.48	57.80	44.21	22.93	**1.018**	**0.315**
0-60/90/180-P	4	FI 60-sec vs FI 180-sec	43.48	23.63	44.21	14.40	**0.583**	**0.448**
0-60/90/180-P	4	FI 90-sec vs FI 180-sec	57.80	23.63	22.93	14.40	**1.182**	**0.282**
0-60/90/180-P	11	FI 60-sec vs FI 90-sec	30.60	52.52	8.30	32.76	10.333	0.002
0-60/90/180-P	11	FI 60-sec vs FI 180-sec	30.60	76.09	8.30	44.90	12.072	0.001
0-60/90/180-P	11	FI 90-sec vs FI 180-sec	52.52	76.09	32.76	44.90	**0.898**	**0.346**
0-60/90/180-P	All	FI 60-sec vs FI 90-sec	37.04	55.16	32.30	28.26	**1.298**	**0.256**
0-60/90/180-P	All	FI 60-sec vs FI 180-sec	37.04	71.32	32.30	45.57	5.081	0.026
0-60/90/180-P	All	FI 90-sec vs FI 180-sec	55.16	71.32	28.26	45.57	**2.968**	**0.087**
0-60-90-180-P	2	FI 60-sec vs FI 90-sec	46.13	53.52	58.57	23.54	**0.959**	**0.33**
0-60-90-180-P	2	FI 60-sec vs FI 180-sec	46.13	98.21	58.57	26.94	**0.021**	**0.884**
0-60-90-180-P	2	FI 90-sec vs FI 180-sec	53.52	98.21	23.54	26.94	**3.686**	**0.058**
0-60-90-180-P	5	FI 60-sec vs FI 90-sec	37.85	57.69	16.30	19.00	**0.657**	**0.419**
0-60-90-180-P	5	FI 60-sec vs FI 180-sec	37.85	79.95	16.30	42.78	15.015	.000*
0-60-90-180-P	5	FI 90-sec vs FI 180-sec	57.69	79.95	19.00	42.78	11.42	0.001
0-60-90-180-P	7	FI 60-sec vs FI 90-sec	54.27	69.00	17.94	19.55	**0.933**	**0.337**
0-60-90-180-P	7	FI 60-sec vs FI 180-sec	54.27	67.80	17.94	23.98	**1.682**	**0.2**
0-60-90-180-P	7	FI 90-sec vs FI 180-sec	69.00	67.80	19.55	23.98	**0.57**	**0.454**
0-60-90-180-P	8	FI 60-sec vs FI 90-sec	38.86	62.45	22.63	21.76	0.089	0.766
0-60-90-180-P	8	FI 60-sec vs FI 180-sec	38.86	85.70	22.63	47.67	24.014	.000*
0-60-90-180-P	8	FI 90-sec vs FI 180-sec	62.45	85.70	21.76	47.67	23.98	.000*
0-60-90-180-P	All	FI 60-sec vs FI 90-sec	44.27	60.45	34.04	21.67	**0.102**	**0.75**
0-60-90-180-P	All	FI 60-sec vs FI 180-sec	44.27	86.86	34.04	39.90	20.088	.000*

0-60-90-180-P	All	FI 90-sec vs FI 180-sec	60.45	86.86	21.67	39.90	42.813	.000*
0-60-P; 0-90-P; 0-60-90-180-P	All	FI 60-sec vs FI 90-sec	44.40	57.90	29.44	43.10	**1.828**	**0.177**
0-60-P; 0-180-P; 0-60-90-180-P	All	FI 60-sec vs FI 180-sec	44.40	86.59	29.44	40.01	36.914	.000*
0-90-P; 0-180-P; 0-60-90-180-P	All	FI 90-sec vs FI 180-sec	57.90	86.59	43.10	40.01	11.015	0.001
0-15-X; 0-30-X	All	FI 15-sec vs FI 30sec	3.81	7.16	3.98	9.15	13.482	.000*

Latency PRP NHST – Independent T Test – Schedule Comparison

Group Comparison	Subject	Pairwise Comparison	t score	df	p-value	Cohen's d	95% Confidence Interval Lower Limit	95% Confidence Interval Upper Limit
0-60-P; 0-90-P	All	**FI 60-sec vs FI 90-sec**	**-1.91**	**298**	**0.057**	**-0.220538742**	**-20.36884**	**0.30483**
0-60-P; 0-180-P	All	FI 60-sec vs FI 180-sec	-3.2	153	0.002	-1.454814617	-57.08032	-12.7953
0-90-P; 0-180-P	All	**FI 90-sec vs FI 180-sec**	**-0.856**	**153**	**0.393**	**-0.389013498**	**-77.44287**	**30.63121**
0-60/90/180-P	4	FI 60-sec vs FI 90-sec	-2.034	98	0.045	-0.406794926	-28.30491	-0.34873
0-60/90/180-P	4	**FI 60-sec vs FI 180-sec**	**0.991**	**53**	**0.326**	**0.464826413**	**-20.32156**	**60.01448**
0-60/90/180-P	4	FI 90-sec vs FI 180-sec	3.252	53	0.002	1.525554055	13.0993	55.24726
0-60/90/180-P	11	FI 60-sec vs FI 90-sec	-4.585	55.257	.000*	-0.917038123	-31.49311	-12.3379
0-60/90/180-P	11	FI 60-sec vs FI 180-sec	-7.043	52.341	.000*	-1.408673466	-58.440741	-32.5279
0-60/90/180-P	11	FI 90-sec vs FI 180-sec	-2.998	98	0.003	-0.599641711	-39.1686	-7.96896
0-60/90/180-P	All	FI 60-sec vs FI 90-sec	-4.222	198	.000*	-0.597095696	-26.58499	-9.65735
0-60/90/180-P	All	FI 60-sec vs FI 180-sec	-4.938	84.455	.000*	-0.913485505	-48.08223	-20.4746
0-60/90/180-P	All	FI 90-sec vs FI 180-sec	-2.723	153	0.007	-0.457059838	-27.88129	-4.43322
0-60-90-180-P	2	**FI 60-sec vs FI 90-sec**	**-0.828**	**98**	**0.410**	**-0.165615064**	**-25.10645**	**10.32265**
0-60-90-180-P	2	FI 60-sec vs FI 180-sec	-5.713	98	.000*	-1.142545556	-70.1756	-33.9907
0-60-90-180-P	2	FI 90-sec vs FI 180-sec	-8.834	98	.000*	-1.766736174	-54.73104	-34.6515
0-60-90-180-P	5	FI 60-sec vs FI 90-sec	-5.605	98	.000*	-1.120924011	-26.86566	-12.8155
0-60-90-180-P	5	FI 60-sec vs FI 180-sec	-6.269	56.89	.000*	-1.321785341	-55.54529	-28.6516
0-60-90-180-P	5	FI 90-sec vs FI 180-sec	-3.247	60.973	0.002	-0.68231726	-35.96631	-8.54946
0-60-90-180-P	7	FI 60-sec vs FI 90-sec	-3.83	93	.000*	-0.786888348	-22.36896	-7.09197
0-60-90-180-P	7	FI 60-sec vs FI 180-sec	-2.056	58	0.044	-0.712196177	-26.70974	-0.3569
0-60-90-180-P	7	**FI 90-sec vs FI 180-sec**	**0.168**	**53**	**0.867**	**0.055049085**	**-13.08874**	**15.48303**
0-60-90-180-P	8	FI 60-sec vs FI 90-sec	-5.315	98	.000*	-1.062945593	-32.40844	-14.7864
0-60-90-180-P	8	FI 60-sec vs FI 180-sec	-6.277	70.015	.000*	-1.255317872	-61.72189	-31.9553
0-60-90-180-P	8	FI 90-sec vs FI 180-sec	-3.136	68.557	0.003	-0.627219921	-38.02709	-8.45531
0-60-90-180-P	All	FI 60-sec vs FI 90-sec	-5.617	393	.000*	-0.565318616	-21.83804	-10.5148
0-60-90-180-P	All	FI 60-sec vs FI 180-sec	-10.647	304.532	.000*	-1.159727227	-50.46054	-34.7181

0-60-90-180-P	All	FI 90-sec vs FI 180-sec	-7.437	226.725	.000*	-0.848855329	-33.41141	-16.4144
0-60-P; 0-90-P; 0-60-90-180-P	All	FI 60-sec vs FI 90-sec	-4.831	693	.000*	-0.366475224	-18.99655	-8.01684
0-60-P; 0-180-P; 0-60-90-180-P	All	FI 60-sec vs FI 180-sec	-11.972	242.693	.000*	-1.273584482	-47.13411	-35.2498
0-90-P; 0-180-P; 0-60-90-180-P	All	FI 90-sec vs FI 180-sec	-7.327	334.512	.000*	-0.680683841	-36.38659	-20.9839
0-15-X; 0-30-X	All	FI 15-sec vs FI 30sec	-2.207	50.599	0.032	-0.508542413	-6.408	-0.303

Appendix 18: Inter-Response Time OOM

IRT – OOM – Monotonic Decrease

Group	Fixed Interval	Subject	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-60-P	FI 60-sec	6	**56.44**	**37.22**	**60.12**	**0.02**
0-60-P	FI 60-sec	9	54.81	34.31	62.76	0.15
0-60-P	FI 60-sec	14	**58.68**	**37.43**	**61.38**	**0.01**
0-60-P	FI 60-sec	All	**56.69**	**43.79**	**55.37**	**0.001**
0-90-P	FI 90-sec	1	**53.13**	**44.24**	**56.20**	**0.05**
0-90-P	FI 90-sec	10	53.61	37.35	63.55	0.17
0-90-P	FI 90-sec	13	**61.42**	**42.31**	**58.87**	**0.001**
0-90-P	FI 90-sec	All	**55.95**	**45.50**	**55.98**	**0.001**
0-180-P	FI 180-sec	3	40.99	28.38	70.72	0.93
0-60/90/180-P	FI 60-sec	4	47.58	35.24	65.20	0.75
0-60/90/180-P	FI 60-sec	11	**63.44**	**41.56**	**58.13**	**0.001**
0-60/90/180-P	FI 60-sec	All	47.58	40.31	58.81	0.81
0-60/90/180-P	FI 90-sec	4	50.26	31.22	64.55	0.51
0-60/90/180-P	FI 90-sec	11	**55.22**	**41.63**	**57.28**	**0.03**
0-60/90/180-P	FI 90-sec	All	**54.29**	**41.36**	**57.16**	**0.03**
0-60/90/180-P	FI 180-sec	4	30.49	24.39	82.93	0.99
0-60/90/180-P	FI 180-sec	11	52.22	42.47	85.18	0.19
0-60/90/180-P	FI 180-sec	All	52.42	44.27	55.64	0.08
0-60-90-180-P	FI 60-sec	2	**58.18**	**40.12**	**60.30**	**0.01**
0-60-90-180-P	FI 60-sec	5	54.03	40.67	57.60	0.07
0-60-90-180-P	FI 60-sec	7	56.52	37.39	62.61	0.08
0-60-90-180-P	FI 60-sec	8	**53.31**	**44.95**	**55.27**	**0.02**
0-60-90-180-P	FI 60-sec	All	**53.56**	**46.03**	**54.35**	**0.001**
0-60-90-180-P	FI 90-sec	2	**57.49**	**45.05**	**54.40**	**0.001**
0-60-90-180-P	FI 90-sec	5	51.53	42.96	57.08	0.23
0-60-90-180-P	FI 90-sec	7	**60.09**	**32.29**	**61.43**	**0.01**
0-60-90-180-P	FI 90-sec	8	**53.92**	**43.60**	**56.23**	**0.01**
0-60-90-180-P	FI 90-sec	All	**54.63**	**46.56**	**53.61**	**0.001**
0-60-90-180-P	FI 180-sec	2	**55.54**	**44.42**	**54.77**	**0.001**
0-60-90-180-P	FI 180-sec	5	51.09	44.24	56.14	0.26
0-60-90-180-P	FI 180-sec	7	48.12	35.71	63.91	0.67
0-60-90-180-P	FI 180-sec	8	**54.42**	**42.37**	**56.25**	**0.02**
0-60-90-180-P	FI 180-sec	All	**53.32**	**46.81**	**52.84**	**0.001**
0-60-P; 0-60-90-180-P	FI 60-sec	All	**56.63**	**47.07**	**53.64**	**0.001**
0-90-P; 0-60-90-180-P	FI 90-sec	All	**54.96**	**47.46**	**52.98**	**0.001**
0-180-P; 0-60-90-180-P	FI 180-sec	All	**52.86**	**47.04**	**52.27**	**0.001**
0-15-X	FI 15-sec	2	27.78	11.11	94.44	0.97

0-15-X	FI 15-sec	3	48.02	37.30	59.79	0.64
0-15-X	FI 15-sec	5	26.67	6.67	93.33	0.97
0-15-X	FI 15-sec	6	35.80	27.16	71.60	0.97
0-15-X	FI 15-sec	7	33.33	0	100	0.91
0-15-X	FI 15-sec	8	14.29	9.52	95.24	1
0-15-X	FI 15-sec	9	45.45	13.64	86.36	0.72
0-15-X	FI 15-sec	10	50.60	27.38	66.67	0.43
0-15-X	FI 15-sec	All	46.05	41.27	57.63	0.88
0-30-X	FI 30-sec	1	28.95	28.95	75.00	1
0-30-X	FI 30-sec	2	37.21	23.26	83.72	0.94
0-30-X	FI 30-sec	7	48.71	38.19	63.65	0.6
0-30-X	FI 30-sec	8	**90.00**	**0**	**100**	**0.03**
0-30-X	FI 30-sec	9	**53.67**	**41.24**	**54.43**	**0.002**
0-30-X	FI 30-sec	All	**54.58**	**42.26**	**57.02**	**0.03**

IRT – OOM – Monotonic Increase

Group	Fixed Interval	Subject	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-60-P	FI 60-sec	6	43.56	40.08	59.51	0.98
0-60-P	FI 60-sec	9	45.19	34.73	65.27	0.89
0-60-P	FI 60-sec	14	41.32	10.12	62.87	1
0-60-P	FI 60-sec	All	43.13	43.13	56.78	1
0-90-P	FI 90-sec	1	46.82	3.41	56.31	0.94
0-90-P	FI 90-sec	10	46.39	37.95	64.46	0.85
0-90-P	FI 90-sec	13	38.58	43.13	57.32	1
0-90-P	FI 90-sec	All	43.99	45.59	54.75	1
0-180-P	FI 180-sec	3	57.46	29.82	66.67	0.07
0-60/90/180-P	FI 60-sec	4	52.42	36.12	61.67	0.3
0-60/90/180-P	FI 60-sec	11	36.56	40.63	57.81	1
0-60/90/180-P	FI 60-sec	All	52.42	39.21	59.25	0.23
0-60/90/180-P	FI 90-sec	4	49.74	35.98	65.61	0.55
0-60/90/180-P	FI 90-sec	11	44.78	40.41	58.50	0.98
0-60/90/180-P	FI 90-sec	All	45.71	40.97	57.26	0.97
0-60/90/180-P	FI 180-sec	4	**69.51**	**25.61**	**81.71**	**0.01**
0-60/90/180-P	FI 180-sec	11	47.78	42.97	57.10	0.85
0-60/90/180-P	FI 180-sec	All	48.98	43.83	58.33	0.69
0-60-90-180-P	FI 60-sec	2	41.82	39.81	58.18	1
0-60-90-180-P	FI 60-sec	5	45.97	42.51	58.64	0.94
0-60-90-180-P	FI 60-sec	7	43.48	34.35	63.04	0.94
0-60-90-180-P	FI 60-sec	8	47.08	45.38	56.03	0.96
0-60-90-180-P	FI 60-sec	All	46.40	45.15	53.90	1
0-60-90-180-P	FI 90-sec	2	42.47	44.66	55.91	1
0-60-90-180-P	FI 90-sec	5	48.47	44.19	56.03	0.82
0-60-90-180-P	FI 90-sec	7	39.91	36.77	65.02	0.99
0-60-90-180-P	FI 90-sec	8	46.08	43.12	55.78	0.99
0-60-90-180-P	FI 90-sec	All	45.35	46.54	53.40	1
0-60-90-180-P	FI 180-sec	2	44.42	44.9	55.06	1
0-60-90-180-P	FI 180-sec	5	48.84	44.88	54.44	0.76
0-60-90-180-P	FI 180-sec	7	51.88	38.53	63.91	0.31
0-60-90-180-P	FI 180-sec	8	45.58	43.24	56.80	0.98
0-60-90-180-P	FI 180-sec	All	46.67	47.16	53.39	1
0-60-P; 0-60-90-180-P	FI 60-sec	All	46.32	46.22	53.79	1
0-90-P; 0-60-90-180-P	FI 90-sec	All	45.03	47.71	53.06	1
0-180-P; 0-60-90-180-P	FI 180-sec	All	47.13	46.97	52.88	1
0-15-X	FI 15-sec	2	72.22	11.11	88.89	0.06
0-15-X	FI 15-sec	3	50.40	37.83	60.05	0.39
0-15-X	FI 15-sec	5	73.33	6.67	100	0.08

0-15-X	FI 15-sec	6	**64.20**	**28.40**	**75.31**	**0.03**
0-15-X	FI 15-sec	7	66.67	0	100	0.28
0-15-X	FI 15-sec	8	**85.71**	**9.52**	**90.48**	**0.003**
0-15-X	FI 15-sec	9	54.55	13.64	90.91	0.42
0-15-X	FI 15-sec	10	47.62	32.14	68.45	0.64
0-15-X	FI 15-sec	All	52.57	42.37	58.64	0.14
0-30-X	FI 30-sec	1	**71.05**	**28.95**	**72.37**	**0.004**
0-30-X	FI 30-sec	2	62.79	20.93	81.40	0.12
0-30-X	FI 30-sec	7	50.55	36.9	63.10	0.41
0-30-X	FI 30-sec	8	10.00	10.00	100	1
0-30-X	FI 30-sec	9	41.77	40.65	54.23	0.99
0-30-X	FI 30-sec	All	44.91	41.55	58.31	0.98

Appendix 19: Trial Duration Descriptive Statistics

Descriptive Statistics of Horse and Honey Bee Trial Duration

Group	Fixed Interval	Subject	First FI Session Mean	First FI Session Median	First FI Session Standard Deviation	Last FI Session Mean	Last FI Session Median	Last FI Session Standard Deviation
0-60-P	FI 60-sec	6	18.03	11.68	20.03	9.86	4.65	12.62
0-60-P	FI 60-sec	9	11.34	6.77	15.63	17.19	11.37	19.00
0-60-P	FI 60-sec	14	17.61	13.45	19.61	9.25	4.21	12.31
0-60-P	FI 60-sec	All	15.66	9.42	18.66	12.10	6.40	15.30
0-90-P	FI 90-sec	1	15.64	8.32	25.32	8.38	4.91	8.93
0-90-P	FI 90-sec	10	20.36	13.16	17.48	16.77	11.79	15.66
0-90-P	FI 90-sec	13	13.20	12.07	10.56	19.23	3.71	90.66
0-90-P	FI 90-sec	All	16.40	11.33	18.89	10.15	5.38	12.06
0-180-P	FI 180-sec	3	108.27	74.14	107.46	19.93	14.44	18.23
0-60/90/180-P	FI 60-sec	4	27.16	13.14	43.78	*	*	*
0-60/90/180-P	FI 60-sec	11	4.16	3.08	2.98	*	*	*
0-60/90/180-P	FI 60-sec	All	15.66	6.12	32.96	*	*	*
0-60/90/180-P	FI 90-sec	4	29.90	26.34	22.29	*	*	*
0-60/90/180-P	FI 90-sec	11	14.49	6.29	23.24	*	*	*
0-60/90/180-P	FI 90-sec	All	22.20	14.45	23.94	*	*	*
0-60/90/180-P	FI 180-sec	4	26.27	4.78	59.26	*	*	*
0-60/90/180-P	FI 180-sec	11	70.54	30.65	97.93	*	*	*
0-60/90/180-P	FI 180-sec	All	48.40	13.88	83.55	*	*	*
0-60-90-180-P	FI 60-sec	2	30.95	14.67	83.84	22.26	3.30	58.05
0-60-90-180-P	FI 60-sec	5	6.12	4.60	5.83	5.88	3.58	7.00
0-60-90-180-P	FI 60-sec	7	15.39	13.02	13.28	9.70	7.77	8.71
0-60-90-180-P	FI 60-sec	8	16.55	9.60	20.68	4.45	1.29	8.63
0-60-90-180-P	FI 60-sec	All	17.25	8.71	44.35	10.57	3.48	30.47
0-60-90-180-P	FI 90-sec	2	8.71	4.92	8.96	5.25	2.99	12.36
0-60-90-180-P	FI 90-sec	5	8.30	6.49	8.13	2.86	2.65	2.06
0-60-90-180-P	FI 90-sec	7	13.19	9.21	13.83	10.69	8.25	13.57
0-60-90-180-P	FI 90-sec	8	7.56	2.61	12.13	5.30	2.86	8.72
0-60-90-180-P	FI 90-sec	All	9.50	5.82	11.22	6.02	3.31	10.53
0-60-90-180-P	FI 180-sec	2	7.15	3.63	11.94	6.52	4.29	10.55
0-60-90-180-P	FI 180-sec	5	7.67	5.77	7.73	15.01	5.81	29.45
0-60-90-180-P	FI 180-sec	7	11.12	7.80	14.17	4.77	2.93	5.09
0-60-90-180-P	FI 180-sec	8	19.39	11.24	22.74	20.90	11.53	28.70
0-60-90-180-P	FI 180-sec	All	11.34	5.66	15.83	13.61	5.80	24.46
0-15-X	FI 15-sec	2	4.58	3.92	4.01	5.63	4.38	4.26
0-15-X	FI 15-sec	3	2.93	0.70	4.02	1.08	0.63	0.97
0-15-X	FI 15-sec	5	20.13	5.55	24.21	12.76	5.94	18.58
0-15-X	FI 15-sec	6	6.94	5.61	6.92	1.34	1.70	0.84

0-15-X	FI 15-sec	7	5.48	3.77	6.07	6.50	6.54	4.38
0-15-X	FI 15-sec	8	4.76	4.02	4.67	4.81	4.21	3.89
0-15-X	FI 15-sec	9	6.30	3.99	7.19	2.82	1.36	3.70
0-15-X	FI 15-sec	10	3.82	0.58	6.15	1.53	1.30	1.68
0-15-X	FI 15-sec	All	5.61	2.47	8.62	4.13	2.13	6.61
0-30-X	FI 30-sec	1	12.50	15.22	8.40	9.37	9.28	6.92
0-30-X	FI 30-sec	2	7.45	6.65	4.85	9.11	5.60	8.87
0-30-X	FI 30-sec	7	19.77	1.38	38.33	5.30	2.09	6.60
0-30-X	FI 30-sec	8	18.71	7.11	23.76	4.77	4.21	4.25
0-30-X	FI 30-sec	9	19.32	14.42	15.84	1.34	1.10	1.25
0-30-X	FI 30-sec	All	17.88	7.83	26.29	5.63	2.86	6.38

Appendix 20: Trial Duration OOM

Trial Duration – OOM – First Fixed Interval Session > Last Fixed Interval Session

Group	Fixed Interval	Subject	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-60-P	FI 60-sec	6	**66.68**	**46.56**	**53.24**	**0.001**
0-60-P	FI 60-sec	9	34.16	46.32	53.12	1.00
0-60-P	FI 60-sec	14	**65.48**	**46.96**	**53.44**	**0.001**
0-60-P	FI 60-sec	All	**55.81**	**49.07**	**51.00**	**0.001**
0-90-P	FI 90-sec	1	**60.8**	**46.48**	**54.44**	**0.001**
0-90-P	FI 90-sec	10	**56.84**	**46.88**	**52.84**	**0.001**
0-90-P	FI 90-sec	13	**73.36**	**46.68**	**53.00**	**0.001**
0-90-P	FI 90-sec	All	**63.24**	**48.80**	**51.00**	**0.001**
0-180-P	FI 180-sec	3	**90.00**	**25.00**	**75.00**	**0.001**
0-60-90-180-P	FI 60-sec	2	**68.64**	**46.96**	**52.72**	**0.001**
0-60-90-180-P	FI 60-sec	5	**53.36**	**46.52**	**52.84**	**0.001**
0-60-90-180-P	FI 60-sec	7	**62.36**	**45.96**	**53.24**	**0.001**
0-60-90-180-P	FI 60-sec	8	**71.68**	**47.12**	**52.92**	**0.001**
0-60-90-180-P	FI 60-sec	All	**64.62**	**49.29**	**50.82**	**0.001**
0-60-90-180-P	FI 90-sec	2	**66.84**	**47.24**	**53.56**	**0.001**
0-60-90-180-P	FI 90-sec	5	**72.64**	**46.68**	**52.80**	**0.001**
0-60-90-180-P	FI 90-sec	7	**57.84**	**47.00**	**53.12**	**0.001**
0-60-90-180-P	FI 90-sec	8	50.92	46.76	53.76	0.19
0-60-90-180-P	FI 90-sec	All	**61.84**	**49.28**	**50.79**	**0.001**
0-60-90-180-P	FI 180-sec	2	43.68	46.72	53.04	1.00
0-60-90-180-P	FI 180-sec	5	47.92	47.20	52.96	0.97
0-60-90-180-P	FI 180-sec	7	**71.11**	**42.00**	**57.11**	**0.001**
0-60-90-180-P	FI 180-sec	8	49.12	46.68	53.64	0.81
0-60-90-180-P	FI 180-sec	All	49.69	49.14	50.84	0.87
0-15-X	FI 15-sec	2	36.67	23.33	76.67	0.94
0-15-X	FI 15-sec	3	53.97	31.75	69.84	0.33
0-15-X	FI 15-sec	5	52.00	20.00	84.00	0.51
0-15-X	FI 15-sec	6	**76.19**	**26.19**	**76.19**	**0.001**
0-15-X	FI 15-sec	7	37.50	30.56	66.67	0.98
0-15-X	FI 15-sec	8	47.22	33.33	70.83	0.72
0-15-X	FI 15-sec	9	**72.22**	**22.22**	**83.33**	**0.01**
0-15-X	FI 15-sec	10	48.21	30.36	67.86	0.67
0-15-X	FI 15-sec	All	**53.56**	**47.44**	**52.48**	**0.001**
0-30-X	FI 30-sec	1	**60.49**	**32.10**	**67.90**	**0.04**
0-30-X	FI 30-sec	2	46.67	26.67	80.00	0.71
0-30-X	FI 30-sec	7	52.38	21.43	73.81	0.45
0-30-X	FI 30-sec	8	**73.81**	**26.19**	**73.81**	**0.001**

0-30-X	FI 30-sec	9	**100**	**30.68**	**65.91**	**0.001**
0-30-X	FI 30-sec	All	**70.29**	**46.61**	**53.12**	**0.001**

Appendix 21: Response Duration OOM

Response Duration – OOM – Monotonic Decrease

Group	Fixed Interval	Subject	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-60-P	FI 60-sec	6	**56.85**	**40.29**	**59.30**	**0.02**
0-60-P	FI 60-sec	9	**61.09**	**35.56**	**64.44**	**0.01**
0-60-P	FI 60-sec	14	41.32	39.22	62.28	0.99
0-60-P	FI 60-sec	All	52.92	43.22	56.21	0.08
0-90-P	FI 90-sec	1	50.16	44.24	56.53	0.48
0-90-P	FI 90-sec	10	53.92	36.45	62.05	0.18
0-90-P	FI 90-sec	13	**60.69**	**41.86**	**56.78**	**0.001**
0-90-P	FI 90-sec	All	**54.10**	**45.8**	**54.50**	**0.001**
0-180-P	FI 180-sec	3	42.67	29.33	73.33	0.89
0-60/90/180-P	FI 60-sec	4	**59.91**	**34.36**	**66.96**	**0.01**
0-60/90/180-P	FI 60-sec	11	52.5	41.56	58.28	0.19
0-60/90/180-P	FI 60-sec	All	**54.44**	**41.41**	**57.79**	**0.03**
0-60/90/180-P	FI 90-sec	4	**61.38**	**35.98**	**66.14**	**0.01**
0-60/90/180-P	FI 90-sec	11	54.13	42.23	58.13	0.06
0-60/90/180-P	FI 90-sec	All	**55.48**	**43.83**	**56.76**	**0.01**
0-60/90/180-P	FI 180-sec	4	40300	23.53	80.00	0.88
0-60/90/180-P	FI 180-sec	11	**54.30**	**42.75**	**56.81**	**0.03**
0-60/90/180-P	FI 180-sec	All	**54.16**	**44.54**	**57.55**	**0.01**
0-60-90-180-P	FI 60-sec	2	**56.64**	**41.20**	**60.19**	**0.01**
0-60-90-180-P	FI 60-sec	5	49.88	41.82	58.41	0.51
0-60-90-180-P	FI 60-sec	7	49.57	36.96	62.14	0.57
0-60-90-180-P	FI 60-sec	8	50.90	44.70	54.60	0.24
0-60-90-180-P	FI 60-sec	All	51.26	45.96	54.62	0.14
0-60-90-180-P	FI 90-sec	2	50.05	44.48	55.91	0.49
0-60-90-180-P	FI 90-sec	5	51.40	43.58	56.21	0.2
0-60-90-180-P	FI 90-sec	7	**65.02**	**36.77**	**64.57**	**0.001**
0-60-90-180-P	FI 90-sec	8	**56.13**	**43.50**	**55.20**	**0.001**
0-60-90-180-P	FI 90-sec	All	**52.99**	**46.09**	**52.98**	**0.001**
0-60-90-180-P	FI 180-sec	2	51.30	45.66	55.54	0.21
0-60-90-180-P	FI 180-sec	5	**54.41**	**44.96**	**55.14**	**0.003**
0-60-90-180-P	FI 180-sec	7	53.38	37.59	61.84	0.2
0-60-90-180-P	FI 180-sec	8	50.62	42.65	56.34	0.35
0-60-90-180-P	FI 180-sec	All	**52.37**	**46.73**	**52.34**	**0.001**
0-60-P; 0-60-90-180-P	FI 60-sec	All	**51.73**	**46.76**	**52.98**	**0.05**
0-90-P; 0-60-90-180-P	FI 90-sec	All	**53.48**	**47.16**	**52.42**	**0.001**
0-180-P; 0-60-90-180-P	FI 180-sec	All	**52.33**	**47.00**	**53.18**	**0.001**
0-15-X	FI 15-sec	2	22.22	16.67	88.89	0.99

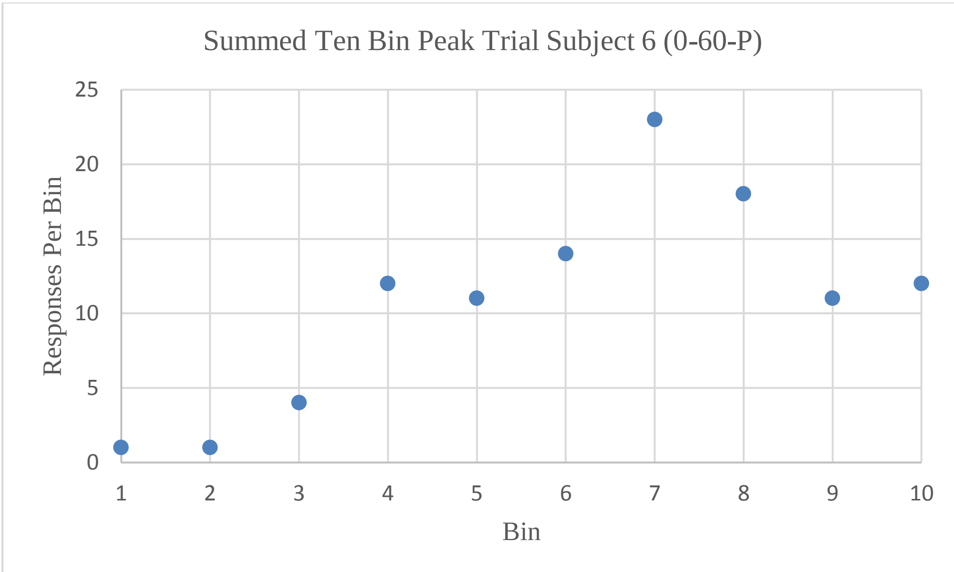
0-15-X	FI 15-sec	3	30.42	39.42	59.92	1
0-15-X	FI 15-sec	5	40.00	6.67	93.33	0.8
0-15-X	FI 15-sec	6	24.69	22.22	74.07	1
0-15-X	FI 15-sec	7	22.22	0	100	0.98
0-15-X	FI 15-sec	8	9.52	4.76	85.71	1
0-15-X	FI 15-sec	9	30.00	5.00	90.00	0.97
0-15-X	FI 15-sec	10	36.31	33.93	70.83	0.99
0-15-X	FI 15-sec	All	30.42	41.54	59.10	1
0-30-X	FI 30-sec	1	39.47	27.63	69.74	0.92
0-30-X	FI 30-sec	2	27.91	20.93	79.07	0.99
0-30-X	FI 30-sec	7	43.54	37.64	61.81	0.92
0-30-X	FI 30-sec	8	20.00	0	100	0.99
0-30-X	FI 30-sec	9	38.21	37.66	63.45	1
0-30-X	FI 30-sec	All	39.90	41.26	56.59	1

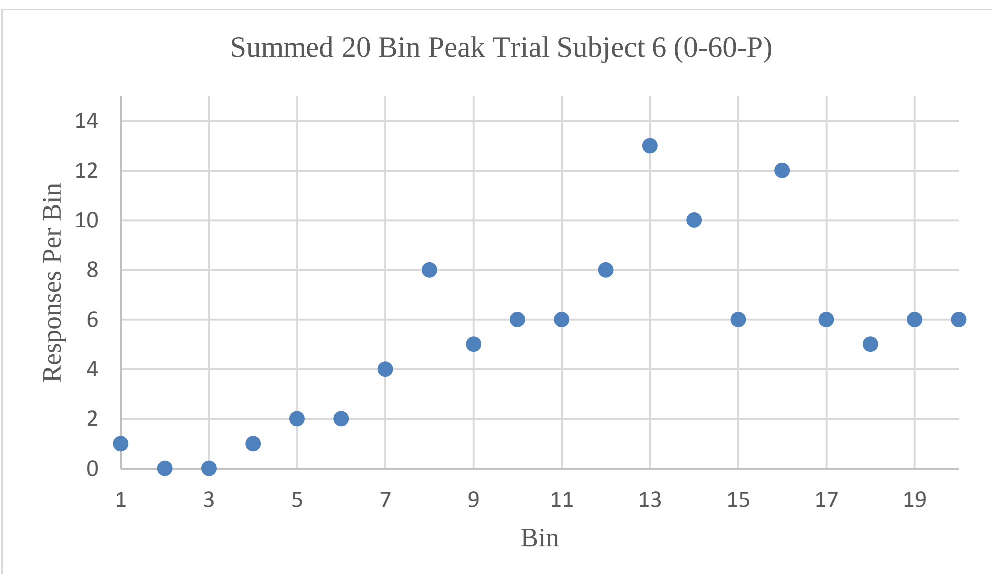
Response Duration – OOM – Monotonic Increase

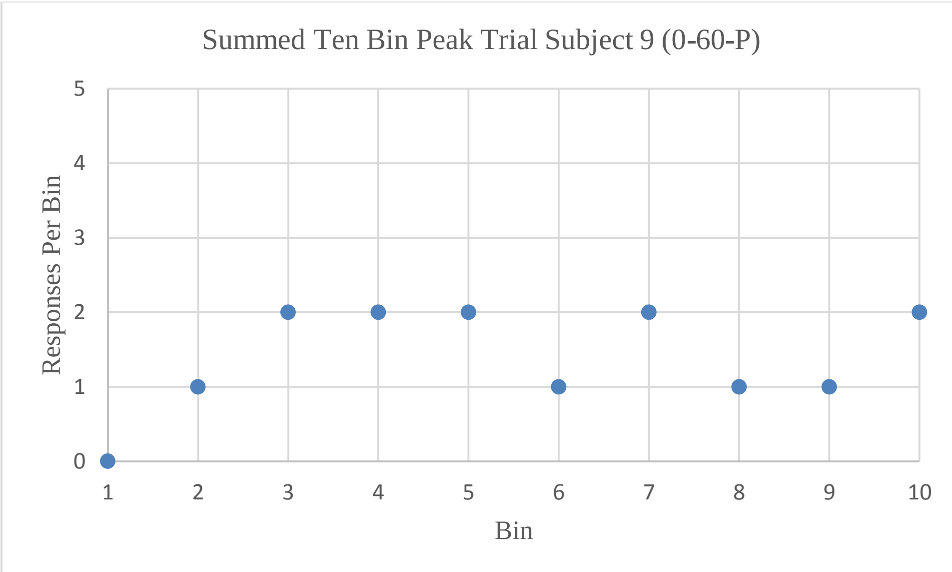
Group	Fixed Interval	Subject	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-60-P	FI 60-sec	6	43.15	39.88	59.92	0.99
0-60-P	FI 60-sec	9	38.91	35.98	64.85	0.99
0-60-P	FI 60-sec	14	**58.68**	**38.62**	**62.28**	**0.01**
0-60-P	FI 60-sec	All	47.08	42.47	56.03	0.91
0-90-P	FI 90-sec	1	49.78	43.08	57.57	0.54
0-90-P	FI 90-sec	10	46.08	38.25	60.24	0.88
0-90-P	FI 90-sec	13	39.31	42.40	59.69	1
0-90-P	FI 90-sec	All	45.87	44.97	54.50	1
0-180-P	FI 180-sec	3	56.20	27.52	66.67	0.19
0-60/90/180-P	FI 60-sec	4	49.09	38.77	63.00	0.99
0-60/90/180-P	FI 60-sec	11	47.50	42.19	85.28	0.83
0-60/90/180-P	FI 60-sec	All	45.56	42.56	57.21	0.97
0-60/90/180-P	FI 90-sec	4	38.62	34.39	65.08	0.99
0-60/90/180-P	FI 90-sec	11	45.75	42.11	59.83	0.94
0-60/90/180-P	FI 90-sec	All	44.42	41.46	57.06	0.99
0-60/90/180-P	FI 180-sec	4	60.00	20.00	75.29	0.15
0-60/90/180-P	FI 180-sec	11	45.70	41.82	56.53	0.97
0-60/90/180-P	FI 180-sec	All	45.80	44.45	56.62	0.99
0-60-90-180-P	FI 60-sec	2	43.06	41.67	59.10	0.99
0-60-90-180-P	FI 60-sec	5	50.00	42.05	58.64	0.49
0-60-90-180-P	FI 60-sec	7	50.43	37.83	65.65	0.48
0-60-90-180-P	FI 60-sec	8	48.98	44.80	55.32	0.71
0-60-90-180-P	FI 60-sec	All	48.61	45.83	54.04	0.83
0-60-90-180-P	FI 90-sec	2	49.91	42.76	55.34	0.48
0-60-90-180-P	FI 90-sec	5	48.43	42.83	55.29	0.8
0-60-90-180-P	FI 90-sec	7	34.98	38.12	63.23	1
0-60-90-180-P	FI 90-sec	8	43.81	44.18	56.09	1
0-60-90-180-P	FI 90-sec	All	46.93	46.27	52.77	1
0-60-90-180-P	FI 180-sec	2	48.70	45.25	55.49	0.8
0-60-90-180-P	FI 180-sec	5	45.54	44.04	55.21	0.99
0-60-90-180-P	FI 180-sec	7	46.62	38.16	63.16	0.81
0-60-90-180-P	FI 180-sec	8	49.29	44.25	56.21	0.62
0-60-90-180-P	FI 180-sec	All	47.59	46.11	52.65	0.99
0-60-P; 0-60-90-180-P	FI 60-sec	All	48.16	46.71	52.87	0.95
0-90-P; 0-60-90-180-P	FI 90-sec	All	46.45	47.21	52.60	1
0-180-P; 0-60-90-180-P	FI 180-sec	All	47.64	46.99	53.19	0.99
0-15-X	FI 15-sec	2	**77.78**	**5.56**	**94.44**	**0.04**
0-15-X	FI 15-sec	3	**68.65**	**37.83**	**59.13**	**0.001**
0-15-X	FI 15-sec	5	60.00	6.67	86.67	0.32

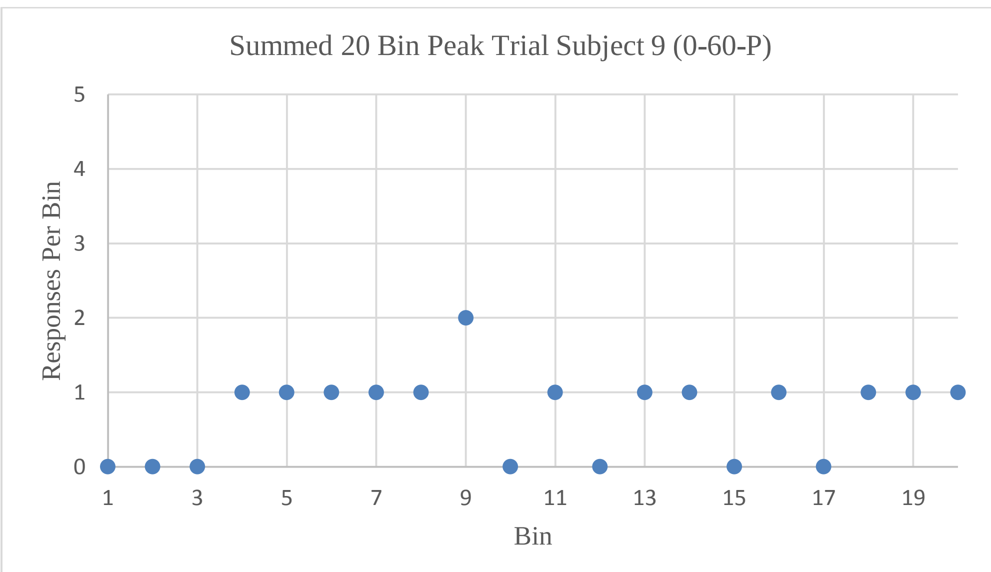
0-15-X	FI 15-sec	6	**74.07**	**28.40**	**72.84**	**0.001**
0-15-X	FI 15-sec	7	77.78	0	100	0.09
0-15-X	FI 15-sec	8	**90.48**	**9.52**	**85.71**	**0.001**
0-15-X	FI 15-sec	9	70.00	15.00	90.00	0.1
0-15-X	FI 15-sec	10	**63.69**	**32.74**	**70.83**	**0.01**
0-15-X	FI 15-sec	All	**68.84**	**39.61**	**58.09**	**0.001**
0-30-X	FI 30-sec	1	59.21	27.63	73.68	0.12
0-30-X	FI 30-sec	2	**72.09**	**18.60**	**76.74**	**0.01**
0-30-X	FI 30-sec	7	54.80	36.90	64.94	0.09
0-30-X	FI 30-sec	8	80.00	0	100	0.06
0-30-X	FI 30-sec	9	61.10	39.03	60.00	0.001
0-30-X	FI 30-sec	All	**59.03**	**40.90**	**56.73**	**0.001**

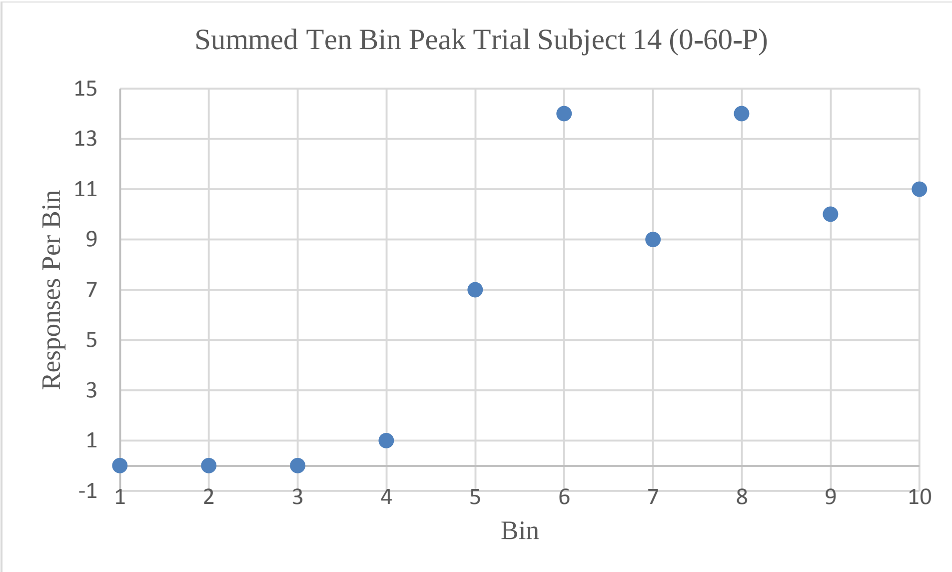
Appendix 22: Peak Procedure Figures

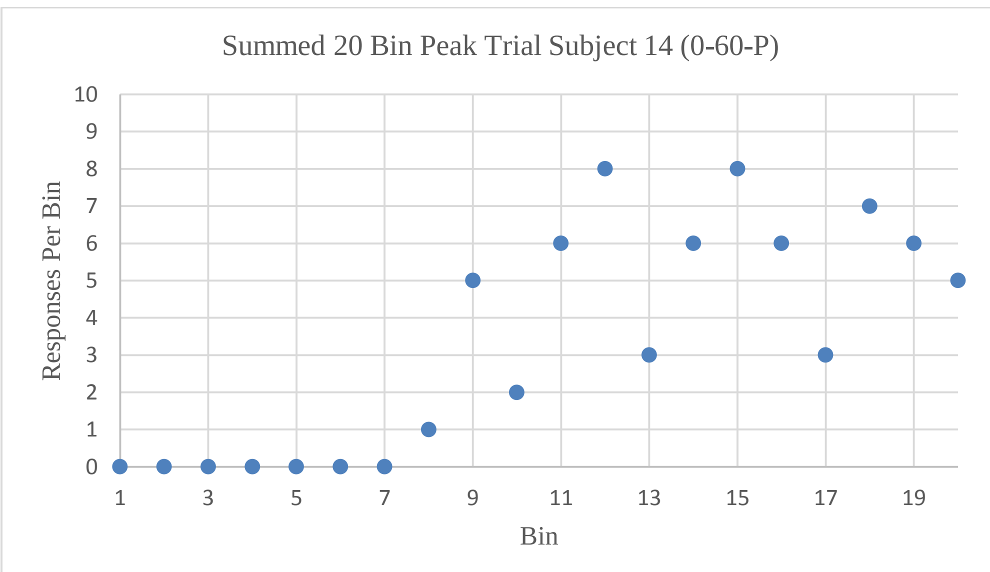


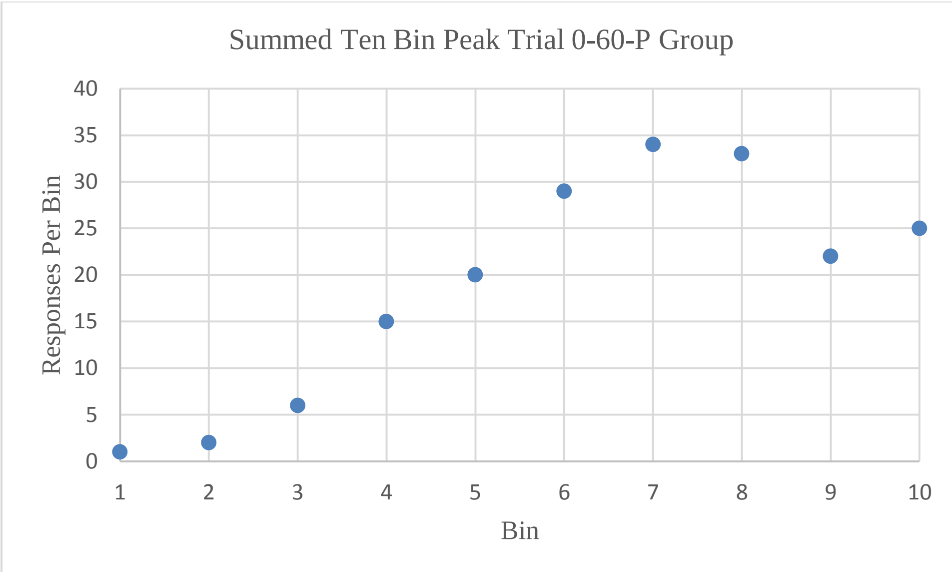


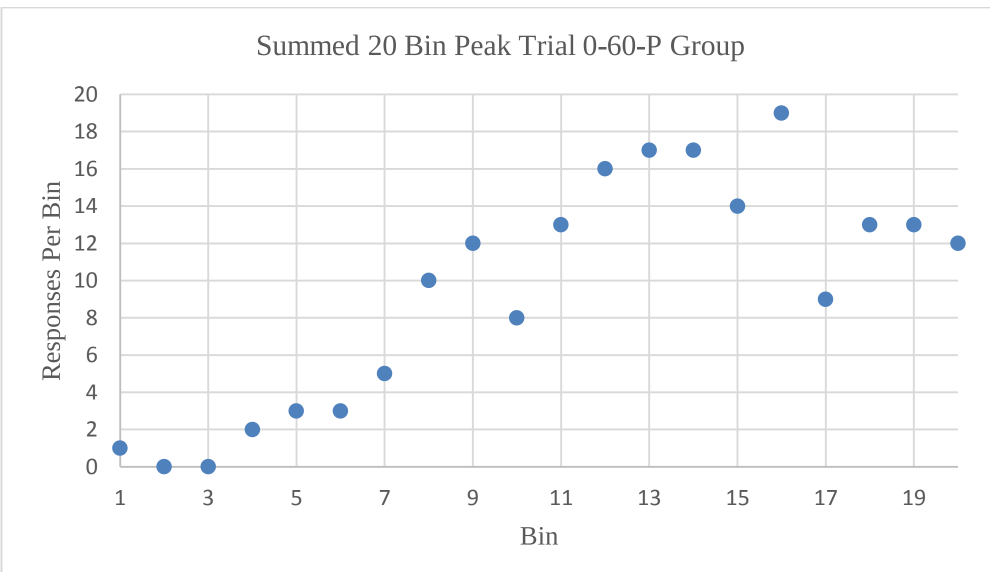

Summed Ten Bin Peak Trial Subject 9 (0-60-P)
Responses Per Bin
0
1
2
3
4
5
1
2
3
4
5
6
7
8
9
10
Bin

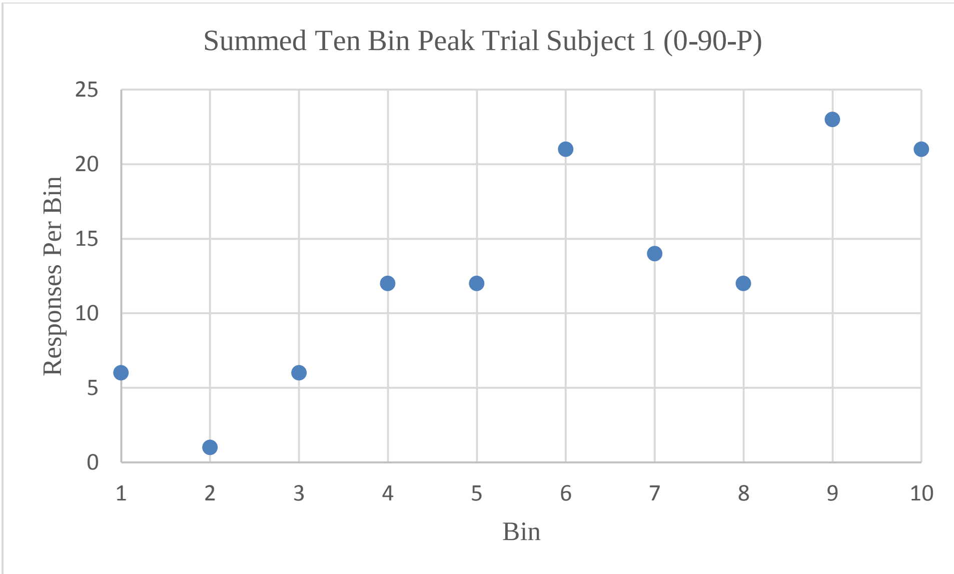

Summed 20 Bin Peak Trial Subject 9 (0-60-P)
Responses Per Bin
0
1
2
3
4
5
1
3
5
7
9
11
13
15
17
19
Bin

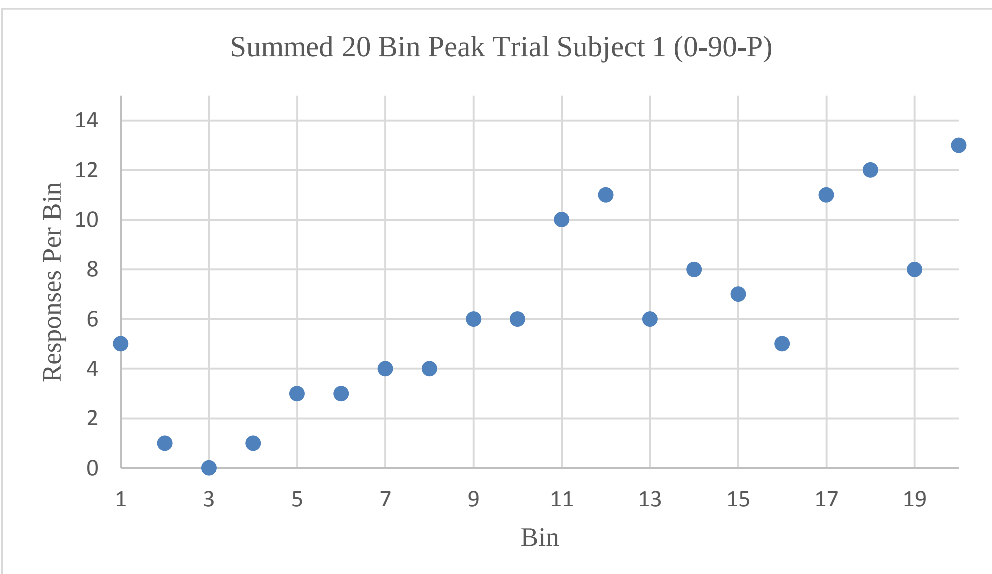

Summed Ten Bin Peak Trial Subject 14 (0-60-P)
Responses Per Bin
15
13
11
9
7
5
3
1
-1
1
2
3
4
5
6
7
8
9
10
Bin

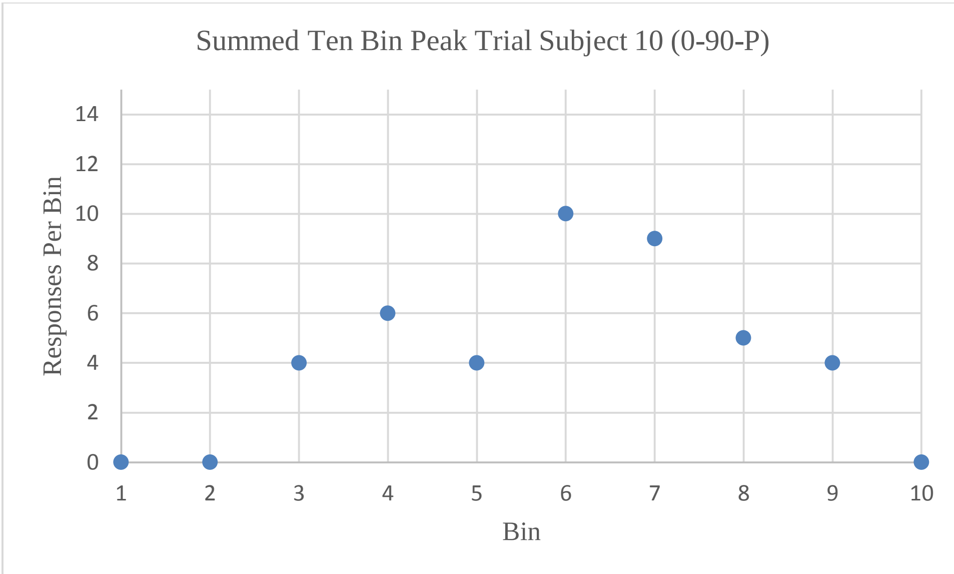

Summed 20 Bin Peak Trial Subject 14 (0-60-P)
Responses Per Bin
10
9
8
7
6
5
4
3
2
1
0
1
3
5
7
9
11
13
15
17
19
Bin

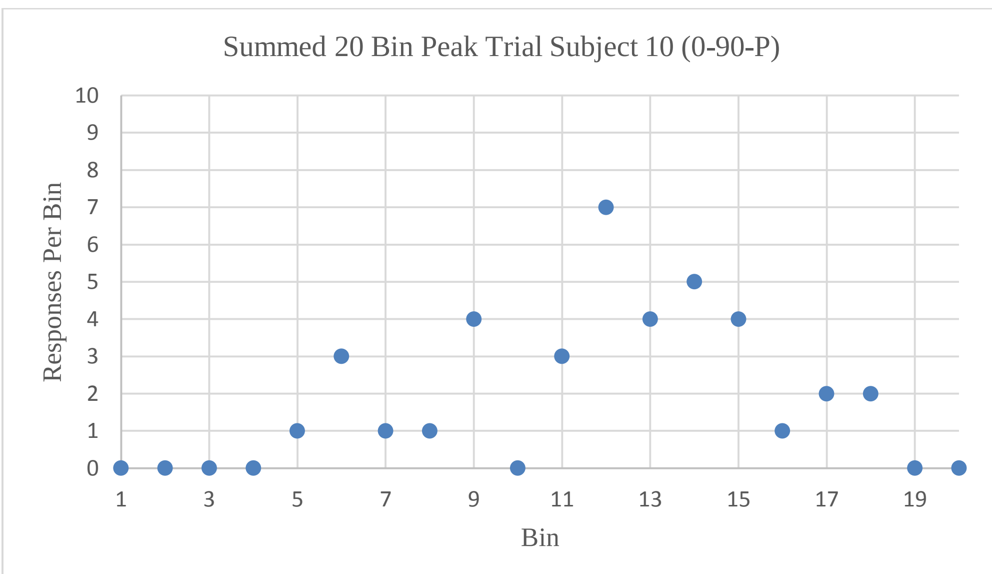

Summed Ten Bin Peak Trial 0-60-P Group
Responses Per Bin
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
8
9
10
Bin

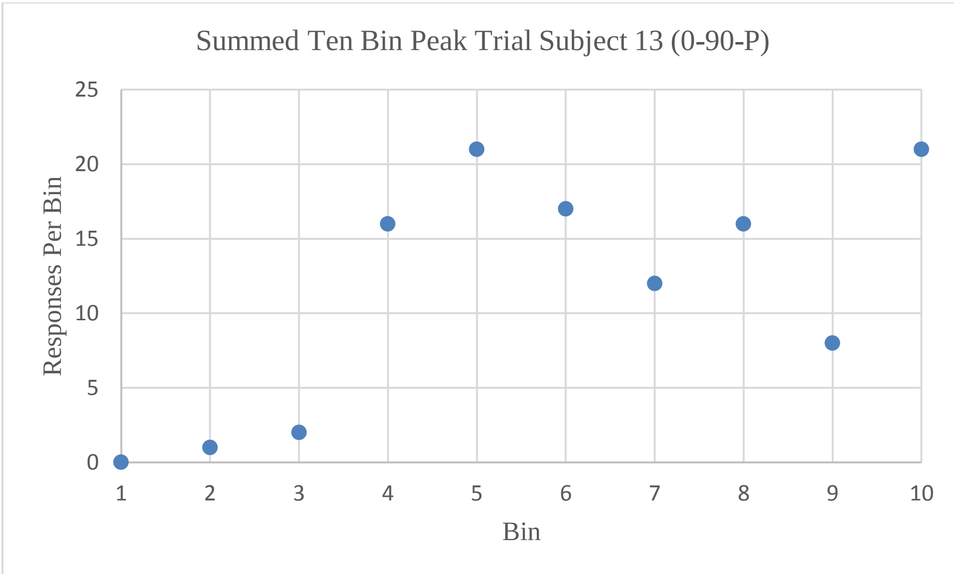

Summed 20 Bin Peak Trial 0-60-P Group
Responses Per Bin
20
18
16
14
12
10
8
6
4
2
0
1
3
5
7
9
11
13
15
17
19
Bin

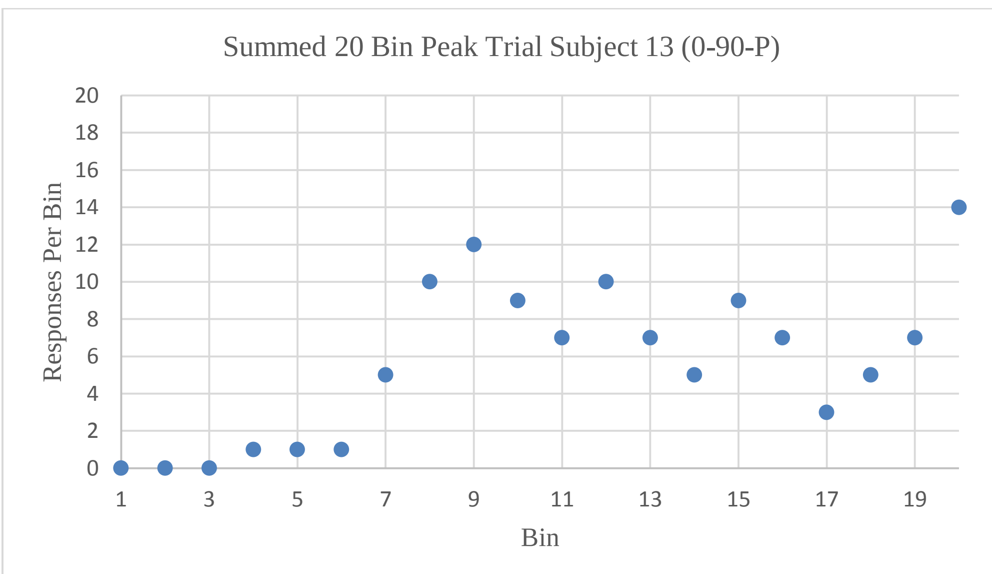

Summed Ten Bin Peak Trial Subject 1 (0-90-P)
Responses Per Bin
0
5
10
15
20
25
1
2
3
4
5
6
7
8
9
10
Bin

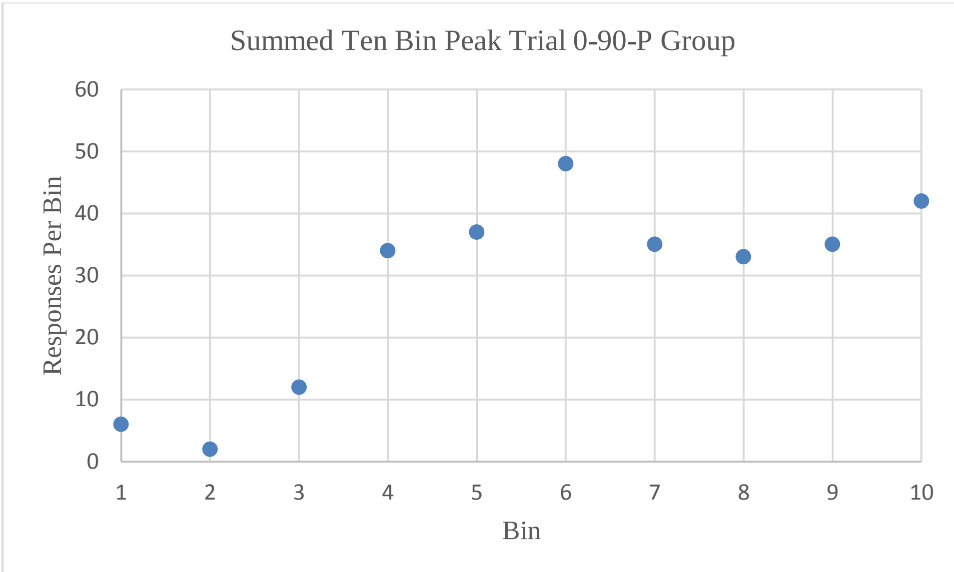

Summed 20 Bin Peak Trial Subject 1 (0-90-P)
Responses Per Bin
0
2
4
6
8
10
12
14
1
3
5
7
9
11
13
15
17
19
Bin

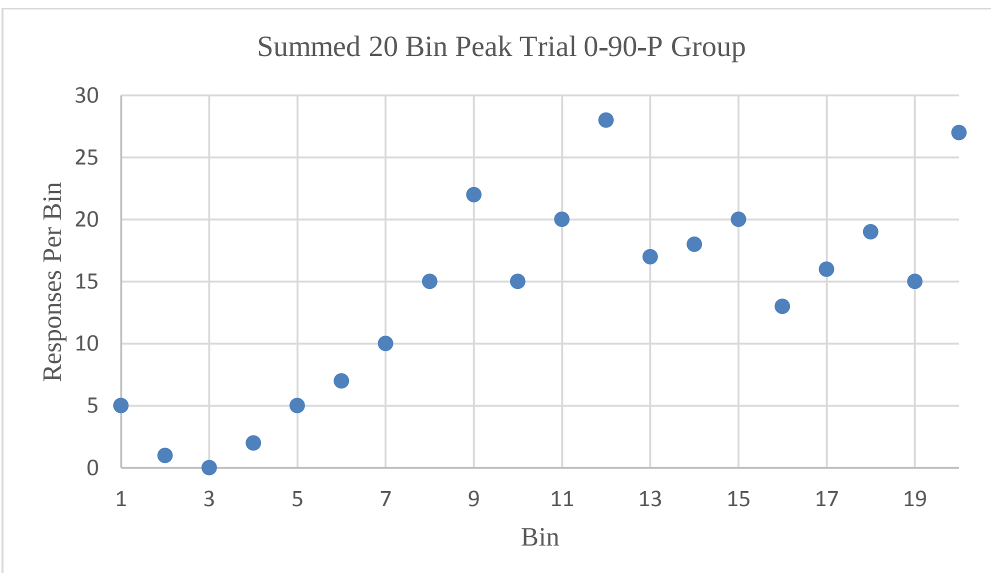

Summed Ten Bin Peak Trial Subject 10 (0-90-P)
Responses Per Bin
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
8
9
10
Bin

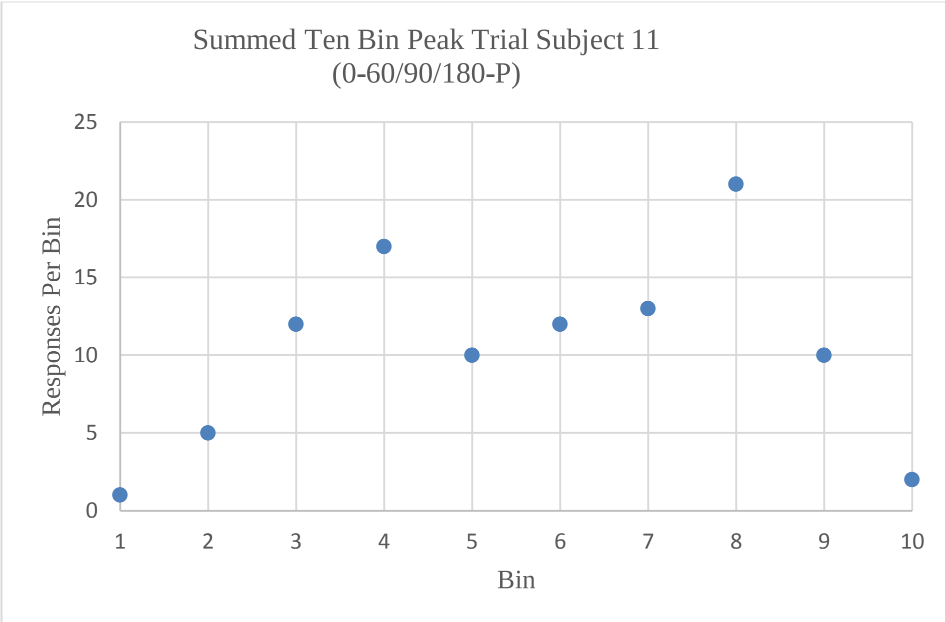

Summed 20 Bin Peak Trial Subject 10 (0-90-P)
Responses Per Bin
10
9
8
7
6
5
4
3
2
1
0
1
3
5
7
9
11
13
15
17
19
Bin

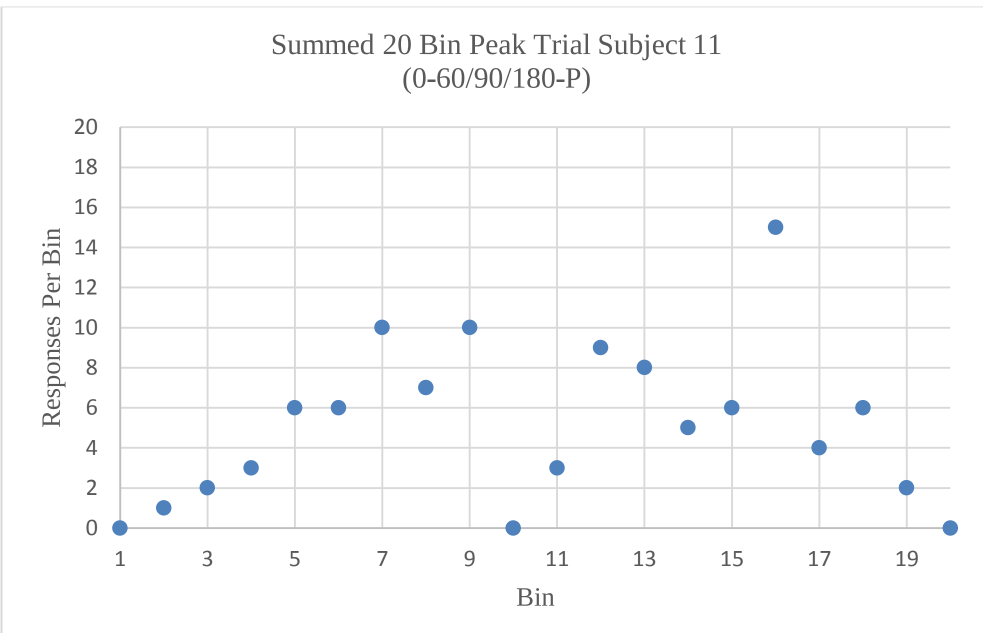

Summed Ten Bin Peak Trial Subject 13 (0-90-P)
Responses Per Bin
0
5
10
15
20
25
1
2
3
4
5
6
7
8
9
10
Bin

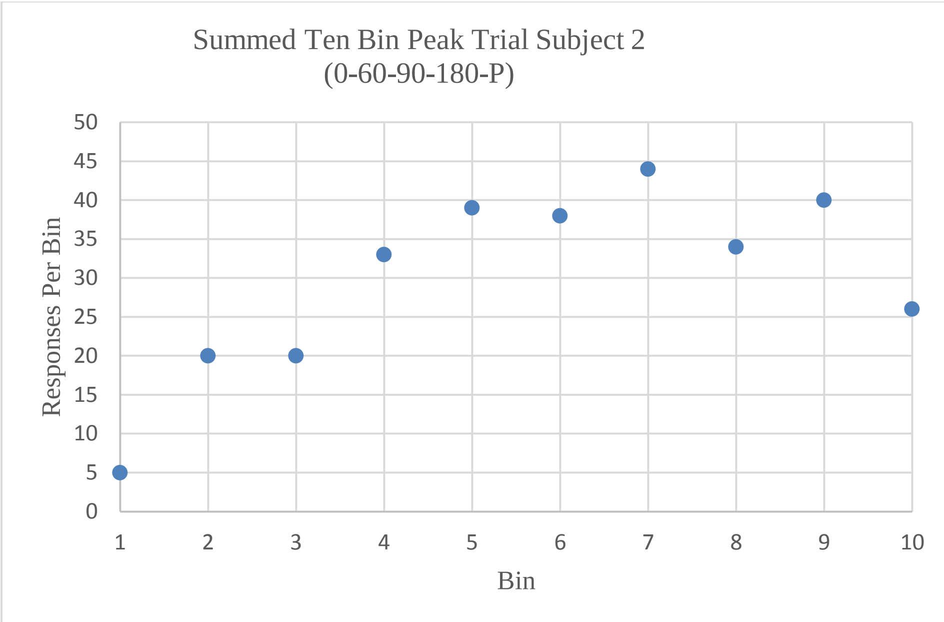

Summed 20 Bin Peak Trial Subject 13 (0-90-P)
Responses Per Bin
0
2
4
6
8
10
12
14
16
18
20
1
3
5
7
9
11
13
15
17
19
Bin

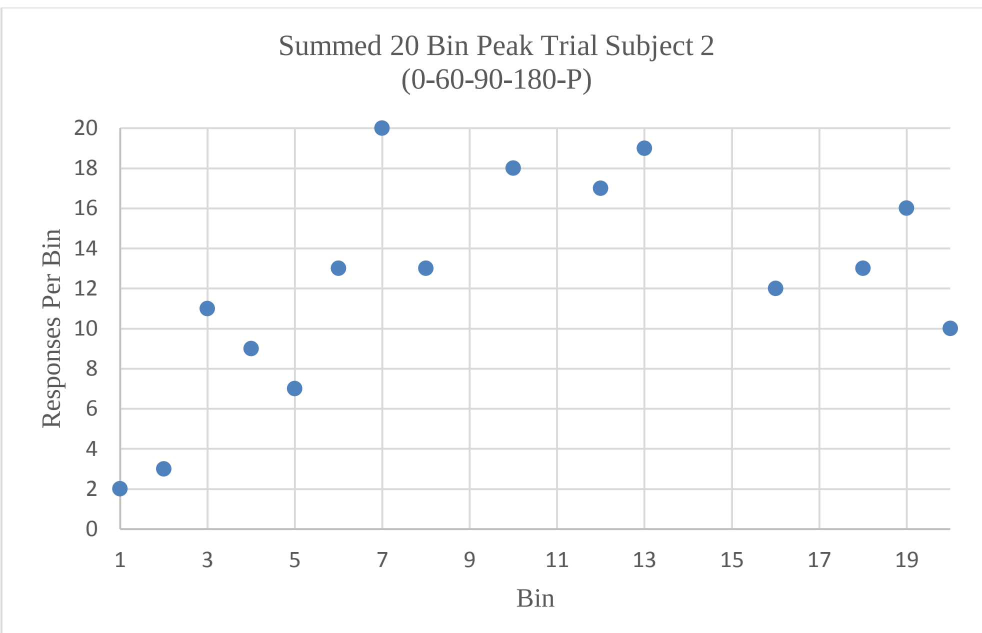

Summed Ten Bin Peak Trial 0-90-P Group
Responses Per Bin
0
10
20
30
40
50
60
1
2
3
4
5
6
7
8
9
10
Bin

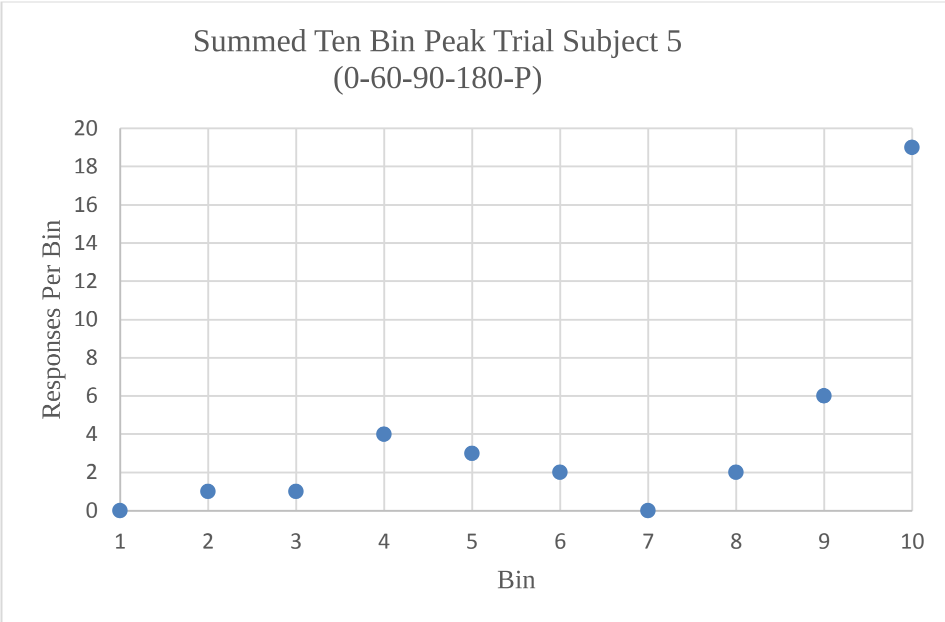

Summed 20 Bin Peak Trial 0-90-P Group
Responses Per Bin
0
5
10
15
20
25
30
1
3
5
7
9
11
13
15
17
19
Bin


Summed Ten Bin Peak Trial Subject 11
(0-60/90/180-P)
Responses Per Bin
25
20
15
10
5
0
1
2
3
4
5
6
7
8
9
10
Bin

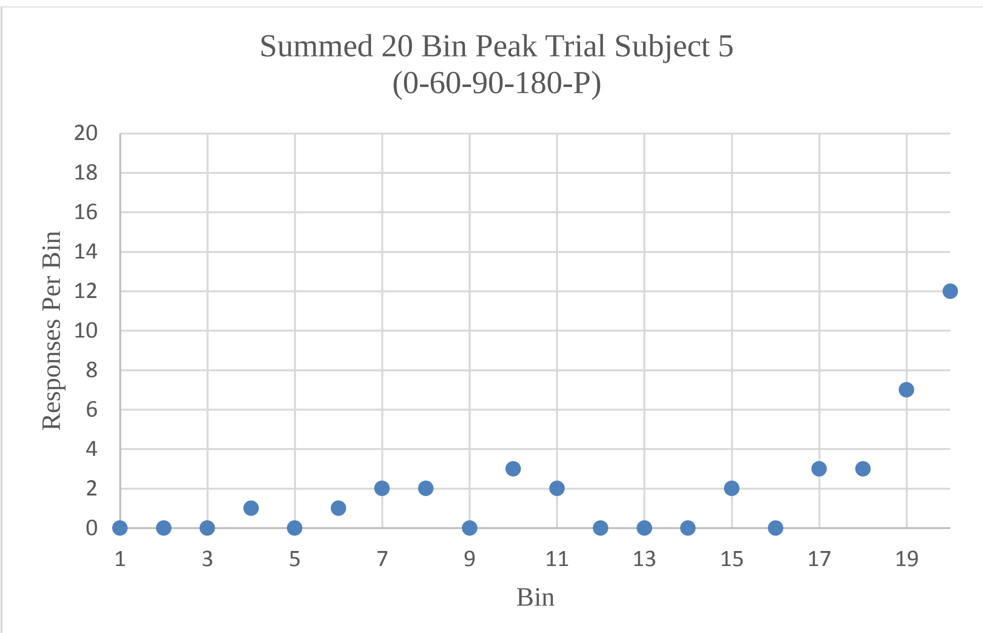

Summed 20 Bin Peak Trial Subject 11
(0-60/90/180-P)
Responses Per Bin
20
18
16
14
12
10
8
6
4
2
0
1
3
5
7
9
11
13
15
17
19
Bin


Summed Ten Bin Peak Trial Subject 2
(0-60-90-180-P)
Responses Per Bin
50
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
8
9
10
Bin

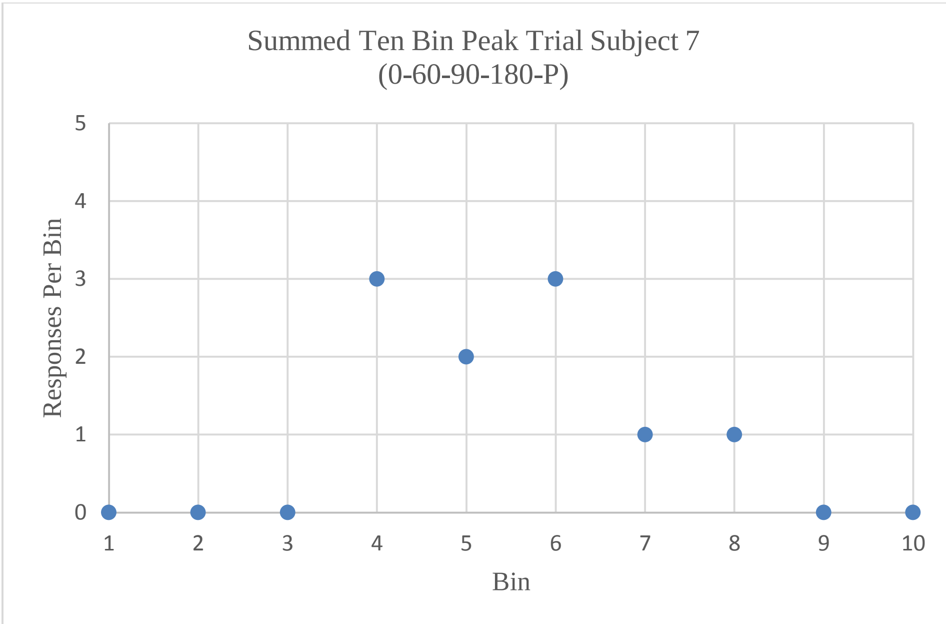

Summed 20 Bin Peak Trial Subject 2
(0-60-90-180-P)
Responses Per Bin
20
18
16
14
12
10
8
6
4
2
0
1
3
5
7
9
11
13
15
17
19
Bin

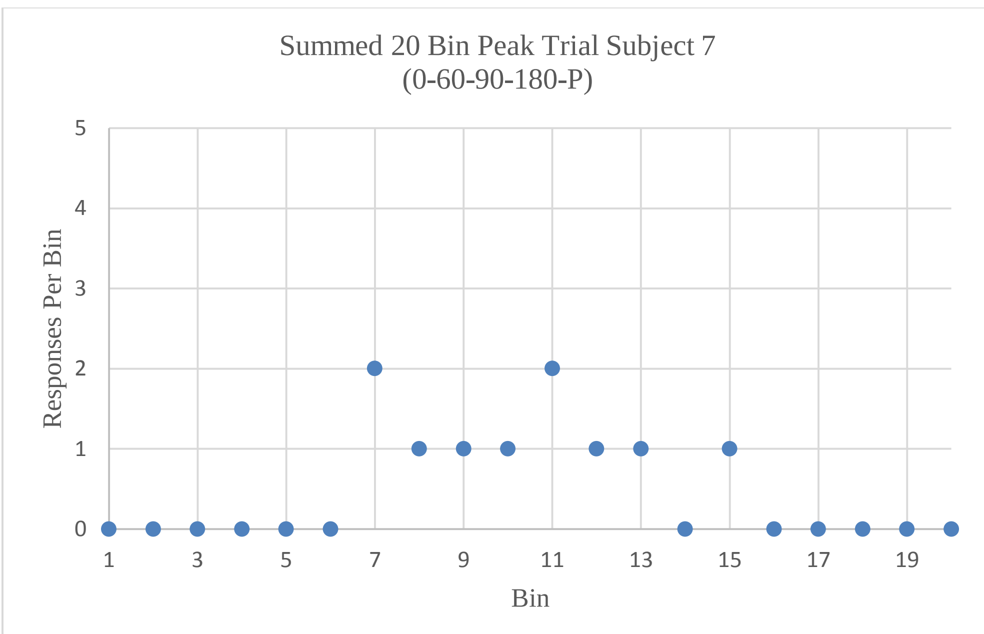


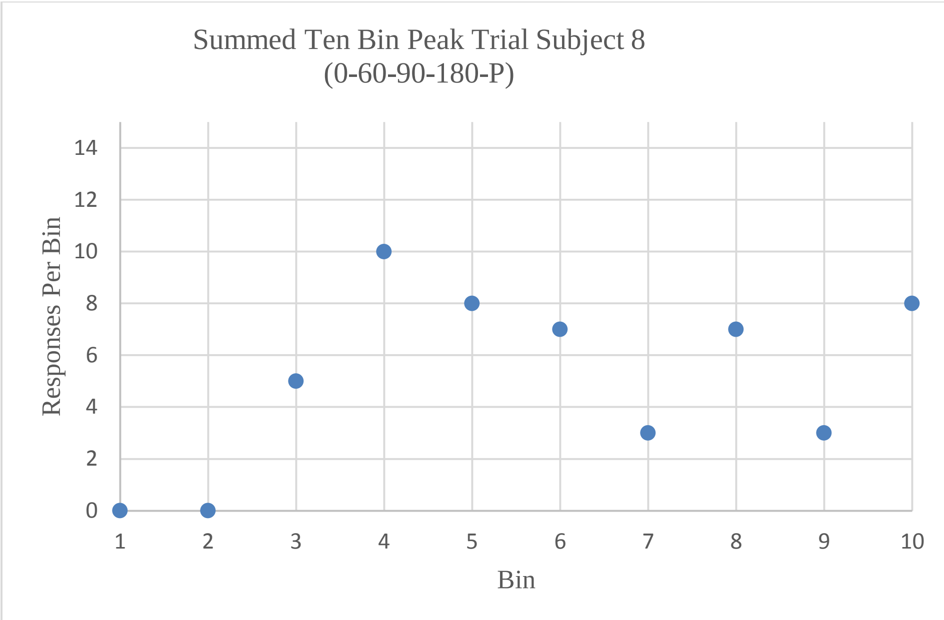
Summed Ten Bin Peak Trial Subject 5
(0-60-90-180-P)
Responses Per Bin
Bin

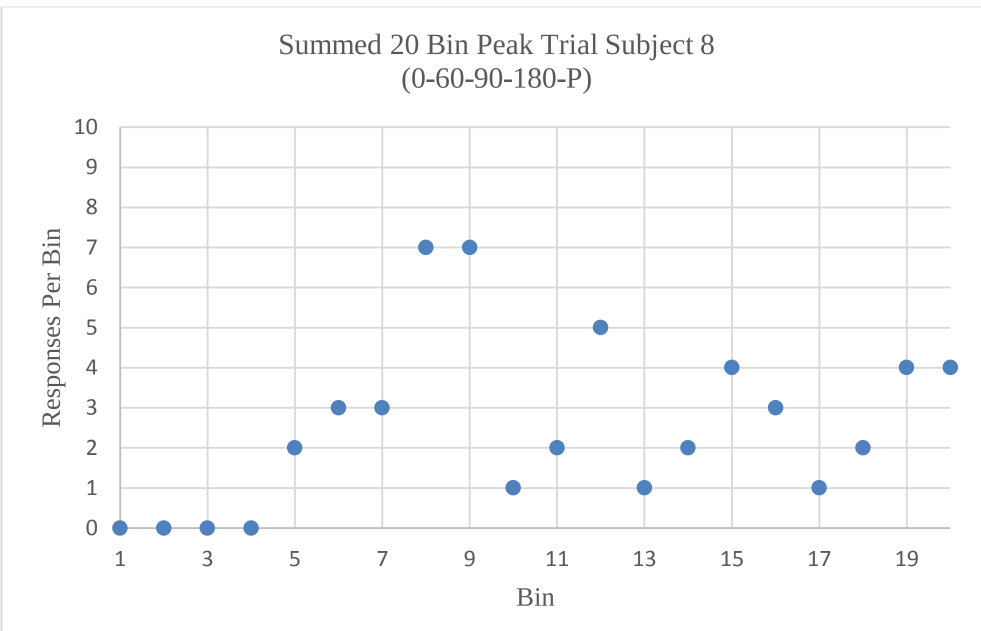


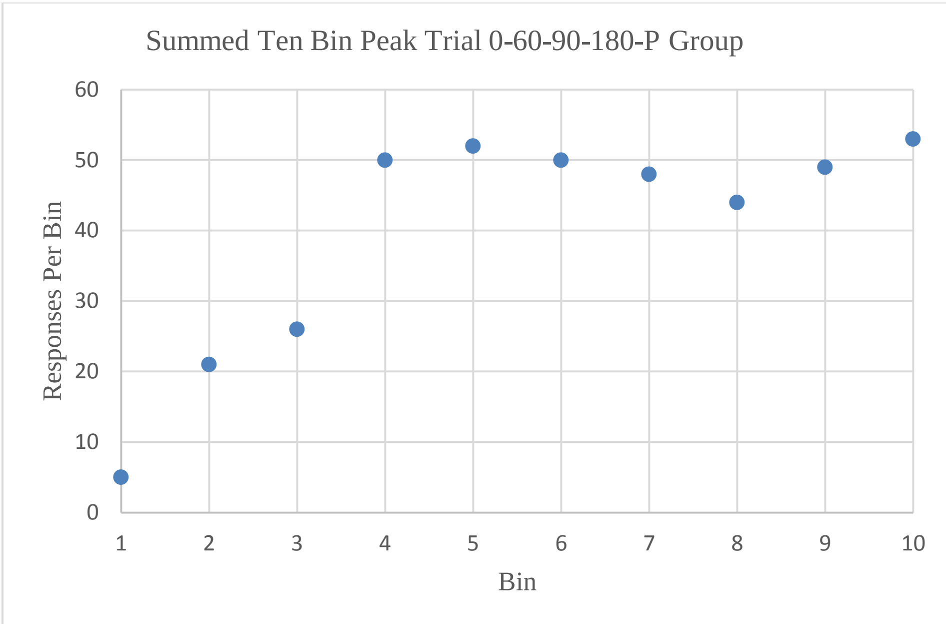
Summed 20 Bin Peak Trial Subject 5
(0-60-90-180-P)
Responses Per Bin
Bin

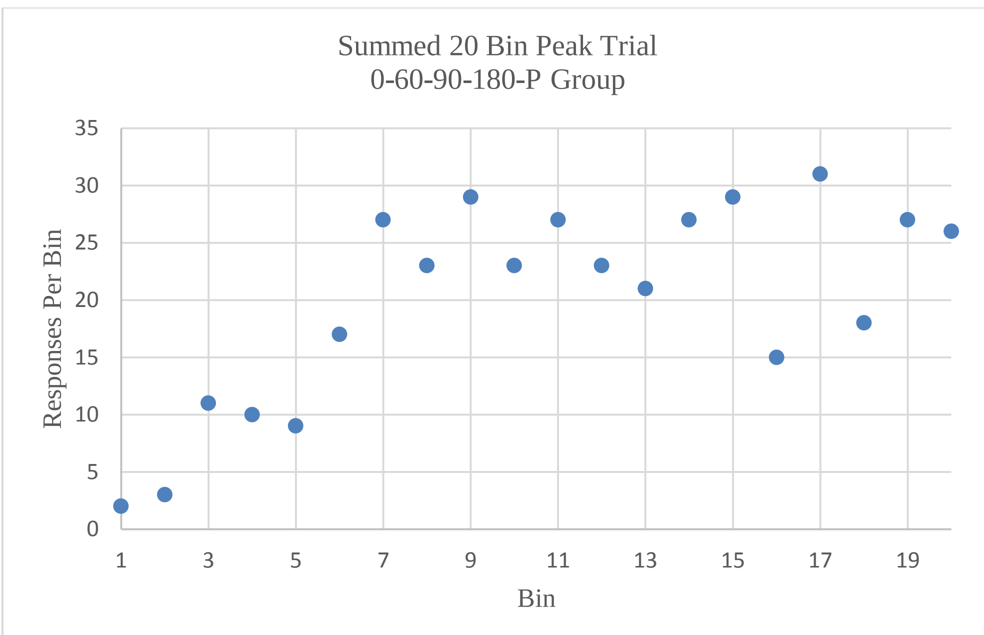

Summed Ten Bin Peak Trial Subject 7
(0-60-90-180-P)
Responses Per Bin
0
1
2
3
4
5
1
2
3
4
5
6
7
8
9
10
Bin


Summed 20 Bin Peak Trial Subject 7
(0-60-90-180-P)
Responses Per Bin
0
1
2
3
4
5
1
3
5
7
9
11
13
15
17
19
Bin


Summed Ten Bin Peak Trial Subject 8
(0-60-90-180-P)
Responses Per Bin
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
8
9
10
Bin


Summed 20 Bin Peak Trial Subject 8
(0-60-90-180-P)
Responses Per Bin
10
9
8
7
6
5
4
3
2
1
0
1
3
5
7
9
11
13
15
17
19
Bin


Summed Ten Bin Peak Trial 0-60-90-180-P Group
Responses Per Bin
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
Bin


Summed 20 Bin Peak Trial
0-60-90-180-P Group
Responses Per Bin
35
30
25
20
15
10
5
0
1
3
5
7
9
11
13
15
17
19
Bin

Appendix 23: Peak Procedure OOM

Peak Procedure – OOM – Ten Bin Analysis Bin 1 – Bins 5

Group	Peak Interval	Subject	Ordinal Prediction	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-60-P	120-sec	6	Bin 1 > … > Bin 5	8.00	8.00	40.00	1
0-60-P	120-sec	6	Bin 1 < … < Bin 5	**42.00**	**7.00**	**40.00**	**0.001**
0-60-P	120-sec	9	Bin 1 > … > Bin 5	20.00	3.33	60.00	0.9
0-60-P	120-sec	9	Bin 1 < … < Bin 5	43.33	0	63.33	0.15
0-60-P	120-sec	14	Bin 1 > … > Bin 5	1.00	0	20.00	1
0-60-P	120-sec	14	Bin 1 < … < Bin 5	**19.00**	**1.00**	**19.00**	**0.004**
0-60-P	120-sec	All	Bin 1 > … > Bin 5	6.52	8.70	29.57	1
0-60-P	120-sec	All	Bin 1 < … < Bin 5	**32.17**	**9.57**	**29.13**	**0.001**
0-90-P	180-sec	1	Bin 1 > … > Bin 5	15.00	8.00	35.00	0.92
0-90-P	180-sec	1	Bin 1 < … < Bin 5	27.00	8.00	33.00	0.12
0-90-P	180-sec	10	Bin 1 > … > Bin 5	5.00	0	40.00	0.95
0-90-P	180-sec	10	Bin 1 < … < Bin 5	35.00	0	40.00	0.09
0-90-P	180-sec	13	Bin 1 > … > Bin 5	2.00	10.00	39.00	1
0-90-P	180-sec	13	Bin 1 < … < Bin 5	**49.00**	**11.00**	**40.00**	**0.001**
0-90-P	180-sec	All	Bin 1 > … > Bin 5	8.18	13.64	34.09	1
0-90-P	180-sec	All	Bin 1 < … < Bin 5	**37.73**	**11.82**	**33.18**	**0.001**
0-60/90/180-P	360-sec	11	Bin 1 > … > Bin 5	18.75	17.50	58.75	1
0-60/90/180-P	360-sec	11	Bin 1 < … < Bin 5	**60.00**	**16.25**	**60.00**	**0.001**
0-60-90-180-P	360-sec	2	Bin 1 > … > Bin 5	17.00	17.00	52.00	1
0-60-90-180-P	360-sec	2	Bin 1 < … < Bin 5	**47.00**	**14.00**	**49.00**	**0.003**
0-60-90-180-P	360-sec	5	Bin 1 > … > Bin 5	10.00	0	50.00	0.97
0-60-90-180-P	360-sec	5	Bin 1 < … < Bin 5	40.00	0	50.00	0.06
0-60-90-180-P	360-sec	7	Bin 1 > … > Bin 5	10.00	0	70.00	0.96
0-60-90-180-P	360-sec	7	Bin 1 < … < Bin 5	60.00	0	70.00	0.16
0-60-90-180-P	360-sec	8	Bin 1 > … > Bin 5	3.33	6.67	66.67	1
0-60-90-180-P	360-sec	8	Bin 1 < … < Bin 5	**66.67**	**6.67**	**66.67**	**0.002**
0-60-90-180-P	360-sec	All	Bin 1 > … > Bin 5	12.94	20.00	46.47	1
0-60-90-180-P	360-sec	All	Bin 1 < … < Bin 5	**50.00**	**16.47**	**44.71**	**0.001**
0-60/90/180-P; 0-60-90-180-P	360-sec	All	Bin 1 > … > Bin 5	14.80	22.00	45.60	1
0-60/90/180-P; 0-60-90-180-P	360-sec	All	Bin 1 < … < Bin 5	**53.20**	**20.00**	**44.40**	**0.001**
0-60-P; 0-90-P; 0-60/90/180-P; 0-60-90-180-P	120-sec; 180-sec; 360-sec	All	Bin 1 > … > Bin 5	10.00	19.43	31.71	1
0-60-P; 0-90-P; 0-60/90/180-P; 0-60-90-180-P	120-sec; 180-sec; 360-sec	All	Bin 1 < … < Bin 5	**41.43**	**19.57**	**31.86**	**0.001**

Peak Procedure – OOM – Ten Bin Analysis Bin 6 – Bins 10

Group	Peak Interval	Subject	Ordinal Prediction	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-60-P	120-sec	6	Bin 6 > … > Bin 10	39.00	15.00	49.00	0.15
0-60-P	120-sec	6	Bin 6 < … < Bin 10	26.00	16.00	48.00	0.91
0-60-P	120-sec	9	Bin 6 > … > Bin 10	20.00	0	46.67	0.7
0-60-P	120-sec	9	Bin 6 < … < Bin 10	26.67	0	46.67	0.43
0-60-P	120-sec	14	Bin 6 > … > Bin 10	35.00	17.00	48.00	0.32
0-60-P	120-sec	14	Bin 6 < … < Bin 10	29.00	16.00	48.00	0.72
0-60-P	120-sec	All	Bin 6 > … > Bin 10	37.78	19.57	41.30	0.17
0-60-P	120-sec	All	Bin 6 < … < Bin 10	27.39	20.43	43.04	0.86
0-90-P	180-sec	1	Bin 6 > … > Bin 10	32.00	17.00	51.00	0.75
0-90-P	180-sec	1	Bin 6 < … < Bin 10	39.00	20.00	54.00	0.3
0-90-P	180-sec	10	Bin 6 > … > Bin 10	**90.00**	**5.00**	**85.00**	**0.001**
0-90-P	180-sec	10	Bin 6 < … < Bin 10	0	10.00	85.00	1
0-90-P	180-sec	13	Bin 6 > … > Bin 10	34.00	15.00	50.00	0.38
0-90-P	180-sec	13	Bin 6 < … < Bin 10	30.00	11.00	55.00	0.68
0-90-P	180-sec	All	Bin 6 > … > Bin 10	38.18	24.09	47.73	0.19
0-90-P	180-sec	All	Bin 6 < … < Bin 10	31.36	23.18	45.91	0.84
0-60/90/180-P	360-sec	11	Bin 6 > … > Bin 10	41.25	13.75	51.25	0.09
0-60/90/180-P	360-sec	11	Bin 6 < … < Bin 10	23.75	12.50	53.75	0.93
0-60-90-180-P	360-sec	2	Bin 6 > … > Bin 10	47.00	18.00	58.00	0.15
0-60-90-180-P	360-sec	2	Bin 6 < … < Bin 10	34.00	20.00	60.00	0.88
0-60-90-180-P	360-sec	5	Bin 6 > … > Bin 10	16.67	3.33	53.33	0.9
0-60-90-180-P	360-sec	5	Bin 6 < … < Bin 10	40.00	3.33	56.67	0.16
0-60-90-180-P	360-sec	7	Bin 6 > … > Bin 10	**80.00**	**0**	**80.00**	**0.03**
0-60-90-180-P	360-sec	7	Bin 6 < … < Bin 10	0	0	80.00	1
0-60-90-180-P	360-sec	8	Bin 6 > … > Bin 10	40.00	6.67	63.33	0.43
0-60-90-180-P	360-sec	8	Bin 6 < … < Bin 10	33.33	3.33	70.00	0.68
0-60-90-180-P	360-sec	All	Bin 6 > … > Bin 10	42.35	24.71	52.94	0.14
0-60-90-180-P	360-sec	All	Bin 6 < … < Bin 10	32.94	24.12	51.76	0.86
0-60/90/180-P; 0-60-90-180-P	360-sec	All	Bin 6 > … > Bin 10	**42.00**	**25.20**	**48.00**	**0.05**
0-60/90/180-P; 0-60-90-180-P	360-sec	All	Bin 6 < … < Bin 10	30.00	25.60	48.40	0.95
0-60-P; 0-90-P; 0-60/90/180-P; 0-60-90-180-P	120-sec; 180-sec; 360-sec	All	Bin 6 > … > Bin 10	**38.43**	**26.57**	**40.29**	**0.02**
0-60-P; 0-90-P; 0-60/90/180-P; 0-60-90-180-P	120-sec; 180-sec; 360-sec	All	Bin 6 < … < Bin 10	29.57	27.57	40.57	0.98

Peak Procedure – OOM – 20 Bin Analysis Bin 1 – Bins 10

Group	Peak Interval	Subject	Ordinal Prediction	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-60-P	120-sec	6	Bin 1 > … > Bin 10	7.56	8.00	26.22	1
0-60-P	120-sec	6	Bin 1 < … < Bin 10	**29.33**	**10.44**	**26.89**	**0.001**
0-60-P	120-sec	9	Bin 1 > … > Bin 10	13.33	2.96	34.81	0.83
0-60-P	120-sec	9	Bin 1 < … < Bin 10	22.96	5.19	33.33	0.17
0-60-P	120-sec	14	Bin 1 > … > Bin 10	0.89	1.33	10.89	1
0-60-P	120-sec	14	Bin 1 < … < Bin 10	**12.22**	**1.78**	**11.33**	**0.001**
0-60-P	120-sec	All	Bin 1 > … > Bin 10	5.41	8.70	17.29	1
0-60-P	120-sec	All	Bin 1 < … < Bin 10	**21.06**	**8.31**	**18.45**	**0.001**
0-90-P	180-sec	1	Bin 1 > … > Bin 10	11.11	6.67	22.22	0.9
0-90-P	180-sec	1	Bin 1 < … < Bin 10	17.11	6.44	20.00	0.1
0-90-P	180-sec	10	Bin 1 > … > Bin 10	7.78	1.11	33.33	0.97
0-90-P	180-sec	10	Bin 1 < … < Bin 10	**27.78**	**1.11**	**33.33**	**0.04**
0-90-P	180-sec	13	Bin 1 > … > Bin 10	3.78	12.67	29.11	1
0-90-P	180-sec	13	Bin 1 < … < Bin 10	**36.67**	**11.11**	**28.89**	**0.001**
0-90-P	180-sec	All	Bin 1 > … > Bin 10	7.47	12.02	22.42	1
0-90-P	180-sec	All	Bin 1 < … < Bin 10	**26.97**	**12.53**	**23.03**	**0.001**
0-60/90/180-P	360-sec	11	Bin 1 > … > Bin 10	18.33	18.61	40.56	1
0-60/90/180-P	360-sec	11	Bin 1 < … < Bin 10	**39.17**	**15.56**	**38.61**	**0.001**
0-60-90-180-P	360-sec	2	Bin 1 > … > Bin 10	15.56	16.67	39.11	1
0-60-90-180-P	360-sec	2	Bin 1 < … < Bin 10	**40.44**	**18.89**	**40.89**	**0.001**
0-60-90-180-P	360-sec	5	Bin 1 > … > Bin 10	8.15	3.70	28.89	0.97
0-60-90-180-P	360-sec	5	Bin 1 < … < Bin 10	**24.44**	**0.74**	**30.37**	**0.03**
0-60-90-180-P	360-sec	7	Bin 1 > … > Bin 10	6.67	0	60.00	0.99
0-60-90-180-P	360-sec	7	Bin 1 < … < Bin 10	**53.33**	**0**	**57.78**	**0.02**
0-60-90-180-P	360-sec	8	Bin 1 > … > Bin 10	11.11	12.59	51.85	1
0-60-90-180-P	360-sec	8	Bin 1 < … < Bin 10	**54.81**	**15.56**	**51.85**	**0.001**
0-60-90-180-P	360-sec	All	Bin 1 > … > Bin 10	12.94	18.95	34.77	1
0-60-90-180-P	360-sec	All	Bin 1 < … < Bin 10	**40.92**	**19.35**	**33.86**	**0.001**
0-60/90/180-P; 0-60-90-180-P	360-sec	All	Bin 1 > … > Bin 10	14.67	21.24	36.53	1
0-60/90/180-P; 0-60-90-180-P	360-sec	All	Bin 1 < … < Bin 10	**40.36**	**21.16**	**36.27**	**0.001**
0-60-P; 0-90-P; 0-60/90/180-P; 0-60-90-180-P	120-sec; 180-sec; 360-sec	All	Bin 1 > … > Bin 10	9.37	16.16	22.63	1
0-60-P; 0-90-P; 0-60/90/180-P; 0-60-90-180-P	120-sec; 180-sec; 360-sec	All	Bin 1 < … < Bin 10	**29.81**	**16.19**	**22.92**	**0.001**

Peak Procedure – OOM – 20 Bin Analysis Bin 1 – Bins 10

Group	Peak Interval	Subject	Ordinal Prediction	Observed PCC Value	Minimum Randomization	Maximum Randomization	c-value
0-60-P	120-sec	6	Bin 11 > … > Bin 20	**37.33**	**19.56**	**41.78**	**0.01**
0-60-P	120-sec	6	Bin 11 < … < Bin 20	25.33	19.33	44.22	0.96
0-60-P	120-sec	9	Bin 11 > … > Bin 20	14.81	1.48	31.11	0.65
0-60-P	120-sec	9	Bin 11 < … < Bin 20	18.52	2.22	31.11	0.4
0-60-P	120-sec	14	Bin 11 > … > Bin 20	25.78	16.22	34.89	0.37
0-60-P	120-sec	14	Bin 11 < … < Bin 20	23.33	14.22	33.78	0.7
0-60-P	120-sec	All	Bin 11 > … > Bin 20	29.37	19.52	33.24	0.09
0-60-P	120-sec	All	Bin 11 < … < Bin 20	23.57	17.87	33.04	0.92
0-90-P	180-sec	1	Bin 11 > … > Bin 20	25.11	19.78	40.89	0.95
0-90-P	180-sec	1	Bin 11 < … < Bin 20	**36.22**	**21.11**	**42.67**	**0.05**
0-90-P	180-sec	10	Bin 11 > … > Bin 20	**63.33**	**11.11**	**67.78**	**0.001**
0-90-P	180-sec	10	Bin 11 < … < Bin 20	15.56	15.56	64.44	1
0-90-P	180-sec	13	Bin 11 > … > Bin 20	30.44	16.00	38.22	0.12
0-90-P	180-sec	13	Bin 11 < … < Bin 20	23.11	18.22	38.44	0.88
0-90-P	180-sec	All	Bin 11 > … > Bin 20	31.01	22.53	37.17	0.26
0-90-P	180-sec	All	Bin 11 < … < Bin 20	28.38	22.32	36.87	0.73
0-60/90/180-P	360-sec	11	Bin 11 > … > Bin 20	**32.50**	**14.72**	**36.39**	**0.05**
0-60/90/180-P	360-sec	11	Bin 11 < … < Bin 20	20.56	16.67	36.67	0.95
0-60-90-180-P	360-sec	2	Bin 11 > … > Bin 20	40.89	24.44	47.78	0.1
0-60-90-180-P	360-sec	2	Bin 11 < … < Bin 20	31.33	24.44	46.89	0.9
0-60-90-180-P	360-sec	5	Bin 11 > … > Bin 20	10.37	5.93	37.78	0.98
0-60-90-180-P	360-sec	5	Bin 11 < … < Bin 20	**34.07**	**4.44**	**37.78**	**0.01**
0-60-90-180-P	360-sec	7	Bin 11 > … > Bin 20	**57.78**	**0**	**57.78**	**0.002**
0-60-90-180-P	360-sec	7	Bin 11 < … < Bin 20	2.22	0	60.00	1
0-60-90-180-P	360-sec	8	Bin 11 > … > Bin 20	28.15	10.37	49.63	0.57
0-60-90-180-P	360-sec	8	Bin 11 < … < Bin 20	29.63	9.63	50.37	0.48
0-60-90-180-P	360-sec	All	Bin 11 > … > Bin 20	34.25	23.27	40.39	0.2
0-60-90-180-P	360-sec	All	Bin 11 < … < Bin 20	29.80	24.71	39.74	0.79
0-60/90/180-P; 0-60-90-180-P	360-sec	All	Bin 11 > … > Bin 20	33.69	23.11	37.24	0.06
0-60/90/180-P; 0-60-90-180-P	360-sec	All	Bin 11 < … < Bin 20	26.84	23.64	37.51	0.95
0-60-P; 0-90-P; 0-60/90/180-P; 0-60-90-180-P	120-sec; 180-sec; 360-sec	All	Bin 11 > … > Bin 20	**31.43**	**24.63**	**32.54**	**0.02**
0-60-P; 0-90-P; 0-60/90/180-P; 0-60-90-180-P	120-sec; 180-sec; 360-sec	All	Bin 11 < … < Bin 20	26.25	25.78	32.79	0.98

Appendix 24: Fixed Interval Measures

Fixed Interval Measures – OOM

Group	Fixed Interval	Subject	Cumulative Curve	2 Bins	4 Bins	10 Bins	20 Bins	PRP: CRF vs FI
0-60-P	FI 60-sec	6	Break-And-Run	1<2	1=2<3<4	1<...<10	1<...<20	CRF < FI
0-60-P	FI 60-sec	9	Break-And-Run	1<2	1=2=3<4	1<...<10	1<...<20	CRF < FI
0-60-P	FI 60-sec	14	Break-And-Run	1<2	1=2=3<4	1<...<10	1<...<20	CRF < FI
0-60-P	FI 60-sec	All	*	1<2	1=2=3<4	1<...<10	1<...<20	CRF < FI
0-90-P	FI 90-sec	1	**Steady State**	1<2	1<2<3<4	1<...<10	1<...<20	CRF < FI
0-90-P	FI 90-sec	10	Break-And-Run	1<2	1=2=3<4	1<...<10	1<...<20	CRF < FI
0-90-P	FI 90-sec	13	Break-And-Run	1<2	1=2<3<4	1<...<10	1<...<20	CRF < FI
0-90-P	FI 90-sec	All	*	1<2	1=2<3<4	1<...<10	1<...<20	CRF < FI
0-180-P	FI 180-sec	3	**Steady State**	**No Match**	**No Match**	**No Match**	1<...<20	CRF < FI
0-60/90/180-P	FI 60-sec	4	**Steady State**	1<2	1=2=3<4	1<...<10	1<...<20	CRF < FI
0-60/90/180-P	FI 60-sec	11	Break-And-Run	1<2	1=2<3<4	1<...<10	1<...<20	CRF < FI
0-60/90/180-P	FI 60-sec	All	*	1<2	1=2<3<4	1<...<10	1<...<20	CRF < FI
0-60/90/180-P	FI 90-sec	4	**Steady State**	1<2	1=2=3<4	1<...<10	1<...<20	CRF < FI
0-60/90/180-P	FI 90-sec	11	Break-And-Run	1<2	1=2<3<4	1<...<10	1<...<20	CRF < FI
0-60/90/180-P	FI 90-sec	All	*	1<2	1=2<3<4	1<...<10	1<...<20	CRF < FI
0-60/90/180-P	FI 180-sec	4	**Inconsistent**	**No Match**	**No Match**	**No Match**	**No Match**	CRF < FI
0-60/90/180-P	FI 180-sec	11	**Inconsistent**	1<2	1=2<3<4	1<...<10	1<...<20	CRF < FI
0-60/90/180-P	FI 180-sec	All	*	1<2	1=2<3<4	1<...<10	1<...<20	CRF < FI
0-60-90-180-P	FI 60-sec	2	Break-And-Run	1<2	1=2<3<4	1<...<10	1<...<20	CRF < FI
0-60-90-180-P	FI 60-sec	5	Break-And-Run	1<2	1=2<3<4	1<...<10	1<...<20	CRF < FI
0-60-90-180-P	FI 60-sec	7	Break-And-Run	1<2	1=2=3<4	1<...<10	1<...<20	CRF < FI
0-60-90-180-P	FI 60-sec	8	Break-And-Run	1<2	1=2<3<4	1<...<10	1<...<20	CRF < FI
0-60-90-180-P	FI 60-sec	All	*	1<2	1=2=3<4	1<...<10	1<...<20	CRF < FI
0-60-90-180-P	FI 90-sec	2	Break-And-Run	1<2	1=2<3<4	1<...<10	1<...<20	CRF < FI
0-60-90-180-P	FI 90-sec	5	Break-And-Run	1<2	1=2<3<4	1<...<10	1<...<20	CRF < FI

0-60-90-180-P	FI 90-sec	7	Break-And-Run	1<2	1=2=3<4	1<...<10	1<...<20	CRF < FI
0-60-90-180-P	FI 90-sec	8	Break-And-Run	1<2	1=2=3<4	1<...<10	1<...<20	CRF < FI
0-60-90-180-P	FI 90-sec	All	*	1<2	1=2=3<4	1<...<10	1<...<20	CRF < FI
0-60-90-180-P	FI 180-sec	2	Break-And-Run	1<2	1=2<3<4	1<...<10	1<...<20	CRF < FI
0-60-90-180-P	FI 180-sec	5	**Inconsistent**	1<2	1<2<3<4	1<...<10	1<...<20	CRF < FI
0-60-90-180-P	FI 180-sec	7	Break-And-Run	1<2	1<2<3<4	1<...<10	1<...<20	CRF < FI
0-60-90-180-P	FI 180-sec	8	**Inconsistent**	1<2	1=2<3<4	1<...<10	1<...<20	CRF < FI
0-60-90-180-P	FI 180-sec	All	*	1<2	1=2<3<4	1<...<10	1<...<20	CRF < FI
0-15-X	FI 15-sec	2	**Steady State**	1<2	1<2<3<4	1<...<10	1<...<20	CRF < FI
0-15-X	FI 15-sec	3	**Inconsistent**	**No Match**	1=2=3<4	**No Match**	**No Match**	No Match
0-15-X	FI 15-sec	5	**Steady State**	1<2	1=2=3<4	1<...<10	1<...<20	CRF < FI
0-15-X	FI 15-sec	6	**Steady State**	**No Match**	**No Match**	**No Match**	**No Match**	No Match
0-15-X	FI 15-sec	7	**Steady State**	1<2	1=2=3<4	1<...<10	1<...<20	CRF < FI
0-15-X	FI 15-sec	8	**Steady State**	1<2	1=2=3<4	1<...<10	1<...<20	No Match
0-15-X	FI 15-sec	9	**Steady State**	1<2	1=2=3<4	1<...<10	1<...<20	No Match
0-15-X	FI 15-sec	10	**Inconsistent**	1<2	**No Match**	1<...<10	1<...<20	No Match
0-15-X	FI 15-sec	All	*	1<2	1=2=3<4	1<...<10	1<...<20	CRF < FI
0-30-X	FI 30-sec	1	**Steady State**	1<2	1=2<3<4	**No Match**	**No Match**	CRF < FI
0-30-X	FI 30-sec	2	**Steady State**	1<2	1=2=3<4	1<...<10	1<...<20	CRF < FI
0-30-X	FI 30-sec	7	**Inconsistent**	1<2	**No Match**	1<...<10	1<...<20	CRF < FI
0-30-X	FI 30-sec	8	**Steady State**	1<2	1=2=3<4	1<...<10	1<...<20	CRF < FI
0-30-X	FI 30-sec	9	**Inconsistent**	1<2	1=2<3<4	1<...<10	1<...<20	No Match
0-30-X	FI 30-sec	All	*	1<2	1=2<3<4	1<...<10	1<...<20	CRF < FI

Fixed Interval Measures – OOM Continued

Group	Fixed Interval	Subject	IoC Discrete	IoC Continuous	IoC Duration	IRT	Response Duration	Trial Duration	Peak Figure	OOM Peak 20 Bin
0-60-P	FI 60-sec	6	Positive	Positive	Positive	>	>	First FI > Last FI	Yes	Yes
0-60-P	FI 60-sec	9	Positive	Positive	Positive	**No Match**	>	**No Match**	Yes	**No**
0-60-P	FI 60-sec	14	Positive	Positive	Positive	>	<	First FI > Last FI	**No**	**No**
0-60-P	FI 60-sec	All	Positive	Positive	Positive	>	>	First FI > Last FI	**No**	**No**
0-90-P	FI 90-sec	1	Positive	Positive	Positive	>	**No Match**	First FI > Last FI	**No**	**No**
0-90-P	FI 90-sec	10	Positive	Positive	Positive	**No Match**	**No Match**	First FI > Last FI	Yes	Yes
0-90-P	FI 90-sec	13	Positive	Positive	Positive	>	>	First FI > Last FI	Yes	**No**
0-90-P	FI 90-sec	All	Positive	Positive	Positive	>	>	First FI > Last FI	Yes	**No**
0-180-P	FI 180-sec	3	Positive	**Negative**	Positive	**No Match**	**No Match**	First FI > Last FI	*	*
0-60/90/180-P	FI 60-sec	4	Positive	**Negative**	**Negative**	**No Match**	>	*	*	*
0-60/90/180-P	FI 60-sec	11	Positive	Positive	Positive	>	**No Match**	*	*	*
0-60/90/180-P	FI 60-sec	All	Positive	Positive	Positive	**No Match**	>	*	*	*
0-60/90/180-P	FI 90-sec	4	Positive	Positive	**Negative**	**No Match**	>	*	*	*
0-60/90/180-P	FI 90-sec	11	Positive	Positive	Positive	>	**No Match**	*	*	*
0-60/90/180-P	FI 90-sec	All	Positive	Positive	Positive	>	>	*	*	*
0-60/90/180-P	FI 180-sec	4	**Negative**	**Negative**	Positive	**No Match**	**No Match**	*	*	*
0-60/90/180-P	FI 180-sec	11	Positive	**Negative**	Positive	**No Match**	>	*	**No**	Yes
0-60/90/180-P	FI 180-sec	All	Positive	**Negative**	Positive	**No Match**	>	*	*	*
0-60-90-180-P	FI 60-sec	2	Positive	Positive	Positive	>	>	First FI > Last FI	*	*
0-60-90-180-P	FI 60-sec	5	Positive	Positive	Positive	**No Match**	**No Match**	First FI > Last FI	*	*
0-60-90-180-P	FI 60-sec	7	Positive	Positive	Positive	**No Match**	**No Match**	First FI > Last FI	*	*
0-60-90-180-P	FI 60-sec	8	Positive	Positive	Positive	>	**No Match**	First FI > Last FI	*	*
0-60-90-180-P	FI 60-sec	All	Positive	Positive	Positive	>	**No Match**	First FI > Last FI	*	*
0-60-90-180-P	FI 90-sec	2	Positive	Positive	Positive	>	**No Match**	First FI > Last FI	*	*
0-60-90-180-P	FI 90-sec	5	Positive	Positive	Positive	**No Match**	**No Match**	First FI > Last FI	*	*
0-60-90-180-P	FI 90-sec	7	Positive	Positive	Positive	>	>	First FI > Last FI	*	*

0-60-90-180-P	FI 90-sec	8	Positive	Positive	Positive	>	>	**No Match**	*	*
0-60-90-180-P	FI 90-sec	All	Positive	Positive	Positive	>	>	First FI > Last FI	*	*
0-60-90-180-P	FI 180-sec	2	Positive	Positive	Positive	>	**No Match**	**No Match**	Yes	**No**
0-60-90-180-P	FI 180-sec	5	Positive	Positive	Positive	**No Match**	>	**No Match**	**No**	**No**
0-60-90-180-P	FI 180-sec	7	Positive	Positive	Positive	**No Match**	**No Match**	First FI > Last FI	Yes	Yes
0-60-90-180-P	FI 180-sec	8	Positive	Positive	Positive	>	**No Match**	**No Match**	Yes	**No**
0-60-90-180-P	FI 180-sec	All	Positive	Positive	Positive	>	>	**No Match**	**No**	**No**
0-15-X	FI 15-sec	2	Positive	**Negative**	**Negative**	**No Match**	<	**No Match**	*	*
0-15-X	FI 15-sec	3	Positive	Positive	Positive	**No Match**	<	**No Match**	*	*
0-15-X	FI 15-sec	5	Positive	**Negative**	**Negative**	**No Match**	**No Match**	**No Match**	*	*
0-15-X	FI 15-sec	6	Positive	Positive	Positive	**No Match**	<	First FI > Last FI	*	*
0-15-X	FI 15-sec	7	Positive	**Negative**	**Negative**	**No Match**	**No Match**	**No Match**	*	*
0-15-X	FI 15-sec	8	Positive	**Negative**	**Negative**	**No Match**	<	**No Match**	*	*
0-15-X	FI 15-sec	9	Positive	**Negative**	**Negative**	**No Match**	**No Match**	First FI > Last FI	*	*
0-15-X	FI 15-sec	10	Positive	Positive	Positive	**No Match**	<	**No Match**	*	*
0-15-X	FI 15-sec	All	Positive	Positive	**Negative**	**No Match**	<	First FI > Last FI	*	*
0-30-X	FI 30-sec	1	Positive	**Negative**	**Negative**	**No Match**	**No Match**	First FI > Last FI	*	*
0-30-X	FI 30-sec	2	Positive	**Negative**	**Negative**	**No Match**	<	**No Match**	*	*
0-30-X	FI 30-sec	7	Positive	Positive	Positive	**No Match**	**No Match**	**No Match**	*	*
0-30-X	FI 30-sec	8	Positive	Positive	**Negative**	>	**No Match**	First FI > Last FI	*	*
0-30-X	FI 30-sec	9	Positive	Positive	Positive	>	**No Match**	First FI > Last FI	*	*
0-30-X	FI 30-sec	All	Positive	Positive	Positive	>	<	First FI > Last FI	*	*

Fixed Interval Measures – NHST Non-Parametric

Group	Fixed Interval	Subject	2 Bins	4 Bins	10 Bins	20 Bins	PRP: CRF vs FI
0-60-P	FI 60-sec	6	Significant	Significant	Significant	Significant	Significant
0-60-P	FI 60-sec	9	Significant	Significant	Significant	Significant	Significant
0-60-P	FI 60-sec	14	Significant	Significant	Significant	Significant	Significant
0-60-P	FI 60-sec	All	Significant	Significant	Significant	Significant	Significant
0-90-P	FI 90-sec	1	Significant	Significant	Significant	Significant	**Not Significant**
0-90-P	FI 90-sec	10	Significant	Significant	Significant	Significant	Significant
0-90-P	FI 90-sec	13	Significant	Significant	Significant	Significant	Significant
0-90-P	FI 90-sec	All	Significant	Significant	Significant	Significant	Significant
0-180-P	FI 180-sec	3	**Not Significant**	**Not Significant**	**Not Significant**	**Not Significant**	Significant
0-60/90/180-P	FI 60-sec	4	Significant	Significant	Significant	Significant	Significant
0-60/90/180-P	FI 60-sec	11	Significant	Significant	Significant	Significant	Significant
0-60/90/180-P	FI 60-sec	All	Significant	Significant	Significant	Significant	Significant
0-60/90/180-P	FI 90-sec	4	Significant	Significant	Significant	Significant	Significant
0-60/90/180-P	FI 90-sec	11	Significant	Significant	Significant	Significant	Significant
0-60/90/180-P	FI 90-sec	All	Significant	Significant	Significant	Significant	Significant
0-60/90/180-P	FI 180-sec	4	**Not Significant**	**Not Significant**	**Not Significant**	Significant	**Not Significant**
0-60/90/180-P	FI 180-sec	11	Significant	Significant	Significant	Significant	Significant
0-60/90/180-P	FI 180-sec	All	Significant	Significant	Significant	Significant	Significant
0-60-90-180-P	FI 60-sec	2	Significant	Significant	Significant	Significant	Significant
0-60-90-180-P	FI 60-sec	5	Significant	Significant	Significant	Significant	Significant
0-60-90-180-P	FI 60-sec	7	Significant	Significant	Significant	Significant	Significant
0-60-90-180-P	FI 60-sec	8	Significant	Significant	Significant	Significant	Significant
0-60-90-180-P	FI 60-sec	All	Significant	Significant	Significant	Significant	Significant
0-60-90-180-P	FI 90-sec	2	Significant	Significant	Significant	Significant	Significant
0-60-90-180-P	FI 90-sec	5	Significant	Significant	Significant	Significant	Significant
0-60-90-180-P	FI 90-sec	7	Significant	Significant	Significant	Significant	Significant

0-60-90-180-P	FI 90-sec	8	Significant	Significant	Significant	Significant	Significant
0-60-90-180-P	FI 90-sec	All	Significant	Significant	Significant	Significant	Significant
0-60-90-180-P	FI 180-sec	2	Significant	Significant	Significant	Significant	Significant
0-60-90-180-P	FI 180-sec	5	Significant	Significant	Significant	Significant	Significant
0-60-90-180-P	FI 180-sec	7	Significant	Significant	Significant	Significant	Significant
0-60-90-180-P	FI 180-sec	8	Significant	Significant	Significant	Significant	Significant
0-60-90-180-P	FI 180-sec	All	Significant	Significant	Significant	Significant	Significant
0-15-X	FI 15-sec	2	Significant	Significant	Significant	Significant	**Not Significant**
0-15-X	FI 15-sec	3	**Not Significant**	**Not Significant**	**Not Significant**	Significant	**Not Significant**
0-15-X	FI 15-sec	5	**Not Significant**	Significant	Significant	Significant	Significant
0-15-X	FI 15-sec	6	**Not Significant**	**Not Significant**	Significant	Significant	**Not Significant**
0-15-X	FI 15-sec	7	Significant	Significant	Significant	Significant	Significant
0-15-X	FI 15-sec	8	**Not Significant**	Significant	Significant	Significant	**Not Significant**
0-15-X	FI 15-sec	9	**Not Significant**	Significant	Significant	Significant	**Not Significant**
0-15-X	FI 15-sec	10	**Not Significant**	**Not Significant**	Significant	Significant	**Not Significant**
0-15-X	FI 15-sec	All	Significant	Significant	Significant	Significant	Significant
0-30-X	FI 30-sec	1	**Not Significant**	**Not Significant**	Significant	Significant	**Not Significant**
0-30-X	FI 30-sec	2	Significant	Significant	Significant	Significant	**Not Significant**
0-30-X	FI 30-sec	7	**Not Significant**	**Not Significant**	**Not Significant**	**Not Significant**	Significant
0-30-X	FI 30-sec	8	Significant	Significant	Significant	Significant	Significant
0-30-X	FI 30-sec	9	Significant	Significant	Significant	Significant	**Not Significant**
0-30-X	FI 30-sec	All	Significant	Significant	Significant	Significant	Significant

Fixed Interval Measures – NHST Parametric

Group	Fixed Interval	Subject	2 Bins	4 Bins	10 Bins	20 Bins	PRP: CRF vs FI
0-60-P	FI 60-sec	6	Significant	Significant	Significant	Significant	Significant
0-60-P	FI 60-sec	9	Significant	Significant	Significant	Significant	Significant
0-60-P	FI 60-sec	14	Significant	Significant	Significant	Significant	Significant
0-60-P	FI 60-sec	All	Significant	Significant	Significant	Significant	Significant
0-90-P	FI 90-sec	1	Significant	Significant	Significant	Significant	**Not Significant**
0-90-P	FI 90-sec	10	Significant	Significant	Significant	Significant	Significant
0-90-P	FI 90-sec	13	Significant	Significant	Significant	Significant	Significant
0-90-P	FI 90-sec	All	Significant	Significant	Significant	Significant	Significant
0-180-P	FI 180-sec	3	**Not Significant**	**Not Significant**	**Not Significant**	**Not Significant**	**Significant**
0-60/90/180-P	FI 60-sec	4	Significant	Significant	Significant	Significant	Significant
0-60/90/180-P	FI 60-sec	11	Significant	Significant	Significant	Significant	Significant
0-60/90/180-P	FI 60-sec	All	Significant	Significant	Significant	Significant	Significant
0-60/90/180-P	FI 90-sec	4	Significant	Significant	Significant	Significant	Significant
0-60/90/180-P	FI 90-sec	11	Significant	Significant	Significant	Significant	Significant
0-60/90/180-P	FI 90-sec	All	Significant	Significant	Significant	Significant	Significant
0-60/90/180-P	FI 180-sec	4	**Not Significant**	**Not Significant**	**Not Significant**	Significant	Significant
0-60/90/180-P	FI 180-sec	11	Significant	Significant	Significant	Significant	Significant
0-60/90/180-P	FI 180-sec	All	Significant	Significant	Significant	Significant	Significant
0-60-90-180-P	FI 60-sec	2	Significant	Significant	Significant	Significant	Significant
0-60-90-180-P	FI 60-sec	5	Significant	Significant	Significant	Significant	Significant
0-60-90-180-P	FI 60-sec	7	Significant	Significant	Significant	Significant	Significant
0-60-90-180-P	FI 60-sec	8	Significant	Significant	Significant	Significant	Significant
0-60-90-180-P	FI 60-sec	All	Significant	Significant	Significant	Significant	Significant
0-60-90-180-P	FI 90-sec	2	Significant	Significant	Significant	Significant	Significant
0-60-90-180-P	FI 90-sec	5	Significant	Significant	Significant	Significant	Significant
0-60-90-180-P	FI 90-sec	7	Significant	Significant	Significant	Significant	Significant

0-60-90-180-P	FI 90-sec	8	Significant	Significant	Significant	Significant	Significant
0-60-90-180-P	FI 90-sec	All	Significant	Significant	Significant	Significant	Significant
0-60-90-180-P	FI 180-sec	2	Significant	Significant	Significant	Significant	Significant
0-60-90-180-P	FI 180-sec	5	Significant	Significant	Significant	Significant	Significant
0-60-90-180-P	FI 180-sec	7	Significant	Significant	Significant	Significant	Significant
0-60-90-180-P	FI 180-sec	8	Significant	Significant	Significant	Significant	Significant
0-60-90-180-P	FI 180-sec	All	Significant	Significant	Significant	Significant	Significant
0-15-X	FI 15-sec	2	Significant	**Not Significant**	Significant	Significant	**Not Significant**
0-15-X	FI 15-sec	3	**Not Significant**	**Not Significant**	**Not Significant**	Significant	**Not Significant**
0-15-X	FI 15-sec	5	**Not Significant**	Significant	Significant	Significant	Significant
0-15-X	FI 15-sec	6	**Not Significant**	**Not Significant**	Significant	Significant	**Not Significant**
0-15-X	FI 15-sec	7	Significant	Significant	Significant	Significant	Significant
0-15-X	FI 15-sec	8	Significant	Significant	Significant	Significant	**Not Significant**
0-15-X	FI 15-sec	9	Significant	Significant	Significant	Significant	**Not Significant**
0-15-X	FI 15-sec	10	Significant	**Not Significant**	Significant	Significant	**Not Significant**
0-15-X	FI 15-sec	All	Significant	Significant	Significant	Significant	Significant
0-30-X	FI 30-sec	1	**Not Significant**	Significant	Significant	Significant	**Not Significant**
0-30-X	FI 30-sec	2	Significant	Significant	Significant	Significant	**Not Significant**
0-30-X	FI 30-sec	7	**Not Significant**	**Not Significant**	**Not Significant**	**Not Significant**	Significant
0-30-X	FI 30-sec	8	Significant	Significant	Significant	Significant	Significant
0-30-X	FI 30-sec	9	Significant	Significant	Significant	Significant	**Not Significant**
0-30-X	FI 30-sec	All	Significant	Significant	Significant	Significant	Significant

VITA

David Philip Arthur Craig

Candidate for the Degree of

Doctor of Philosophy

Thesis: A NEW PARADIGM TO ANALYZE EXTENSIVE POST-REINFORCEMENT OR SOCIAL REINFORCEMENT DELAYS IN FREE-FLYING HONEY BEES (A*PIS MELLIFERA*)

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Biographical:

Education:

Completed the requirements for the Doctor of Philosophy in psychology at Oklahoma State University, Stillwater, Oklahoma in May, 2015.

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Experience:

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Craig, D. P. A., Grice, J. W., Varnon, C. A., Gibson, B., Sokolowski, M. B. C., & Abramson, C. I. (2012). Social reinforcement delays in free-flying honey bees (Apis mellifera L.). PLoS One, 7, e46729.