Supplementary material for "Precise time-matching in chimpanzee allogrooming does not occur after a short delay"

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1 Alternative event-pairing results

Our event-pairing procedure pairs events together within a dyad whenever the direction of grooming changes, and in the manuscript we pair together the most recent event before the direction change. During the review process, Michio Nakamura correctly pointed out that this is an arbitrary decision, and that we could equally well have chosen, e.g. the earliest event in the same direction. In light of this comment, we reran our analysis with this alternative pairing procedure. The results are presented below using plots in an identical format to the original manuscript, and the windowed time-matching results are summarised in Table 1. As can be seen, the alternative pairing procedure does not alter our conclusion that time-matching does not occur after a delay.

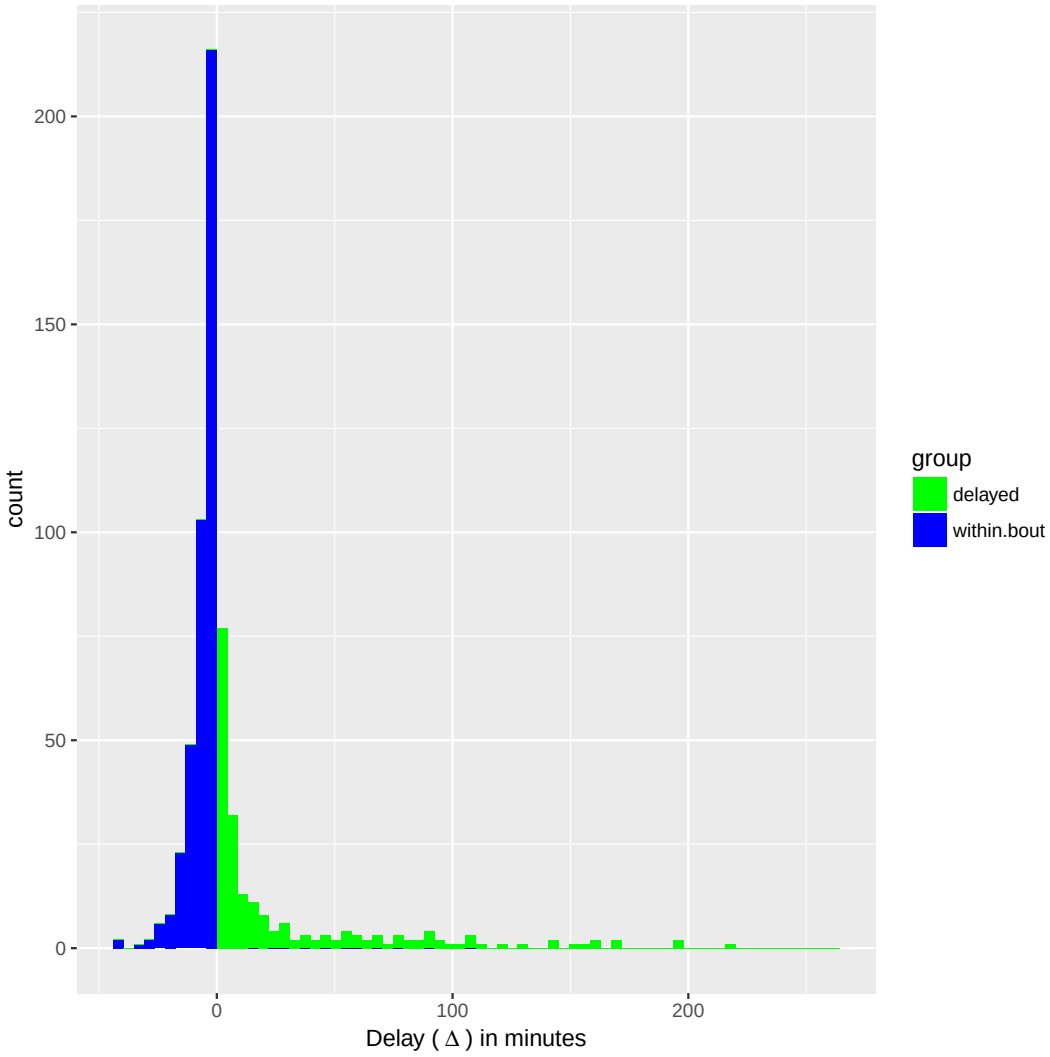


Figure 1: Histogram of Δ measured in minutes.

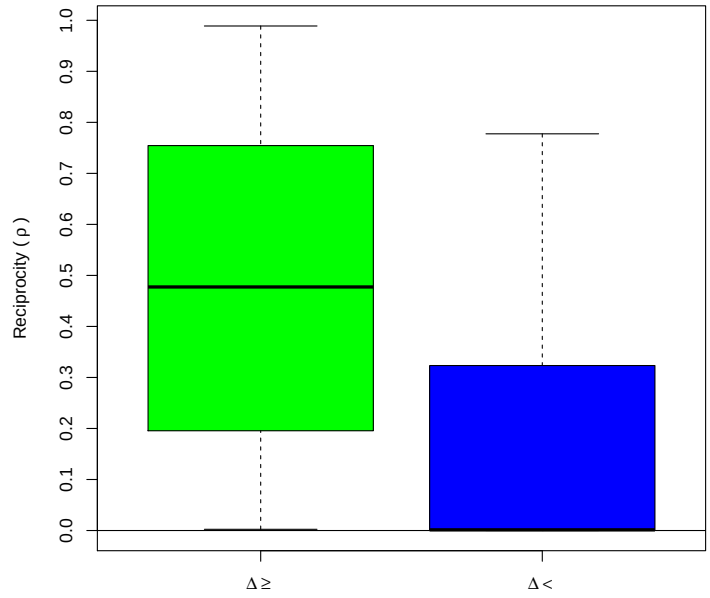
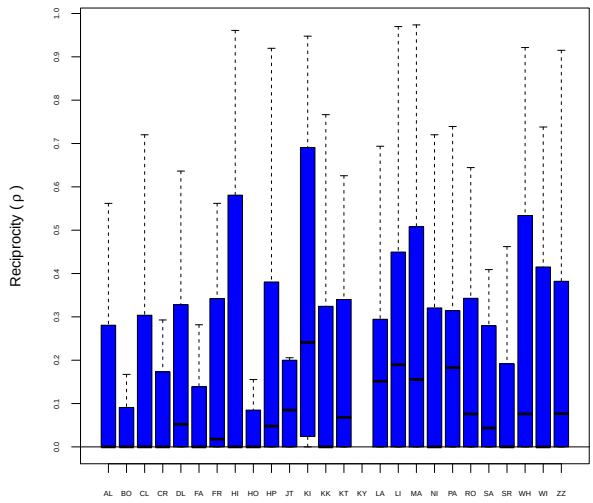


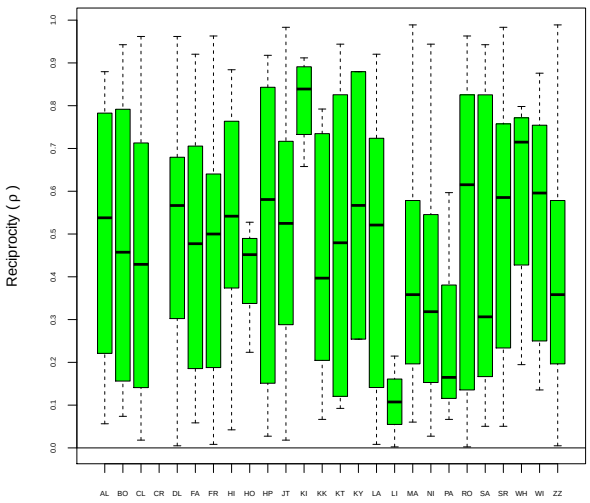
Figure 2: Box plots for the reciprocity measure $\rho = |X-Y|/(X+Y)$ by comparison condition. Delayed grooming $\Delta \geq 0$ is shown on the left ($n = 555$), and within-bout grooming $\Delta < 0$ on the right ($n = 277$).

Window size (minutes)	Comparison group	$\widetilde{P}$	lower P_{crit}	upper P_{crit}
20	**delayed**	0.53	(0.46)	(0.60)
40	**delayed**	0.45	(0.45)	(0.59)
60	**delayed**	0.49	(0.45)	(0.59)
240	**delayed**	0.46	(0.44)	(0.58)
20	**within-bout**	0.00	(0.45)	(0.56)
40	**within-bout**	0.00	(0.43)	(0.55)
60	**within-bout**	0.00	(0.43)	(0.55)
240	**within-bout**	0.00	(0.42)	(0.54)

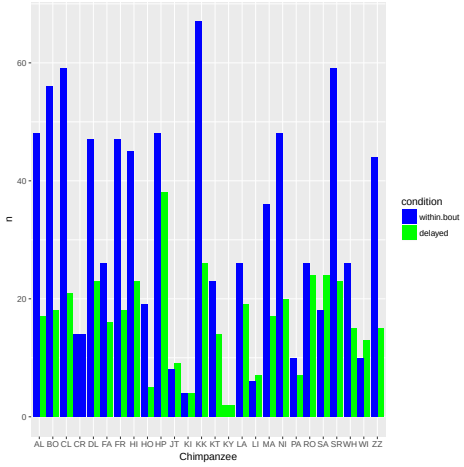
Table 1: Median of the windowed reciprocity metric P computed across all window-dyads. This is compared against 95% lower and upper critical values obtained by bootstrapping from a null model in which grooming durations are independently and identically randomly-distributed for each individual. Lower values of P indicate superior time-matching when grooming durations are summed over the time windows of the specified duration. We used 10^5 bootstrap replications. All results for the within-bout comparison group are significant at $p < 0.05$, however we are unable to reject the null hypothesis for delayed grooming.



(a) Reciprocity by chimpanzee - $\Delta < 0$



(b) Reciprocity by chimpanzee - $\Delta \geq 0$



(c) Number of paired events by chimpanzee

Figure 3: Box plots for the reciprocity measure $\rho = |X - Y|/(X + Y)$ grouped by individuals. Figure a) above is restricted to within-bout grooming — i.e. $\Delta < 0$ — whereas b) below illustrates the delayed case $\Delta \geq 0$. The corresponding sample sizes are summarised underneath in c).

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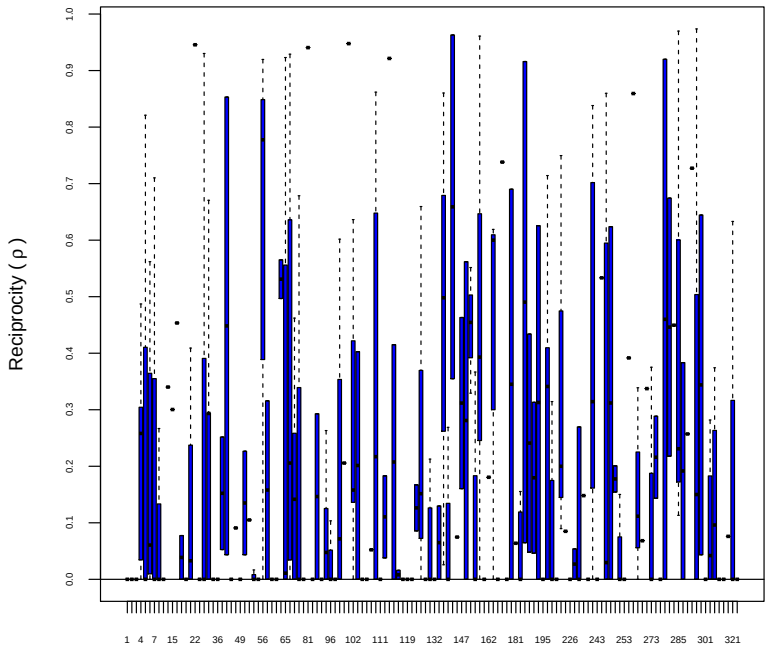
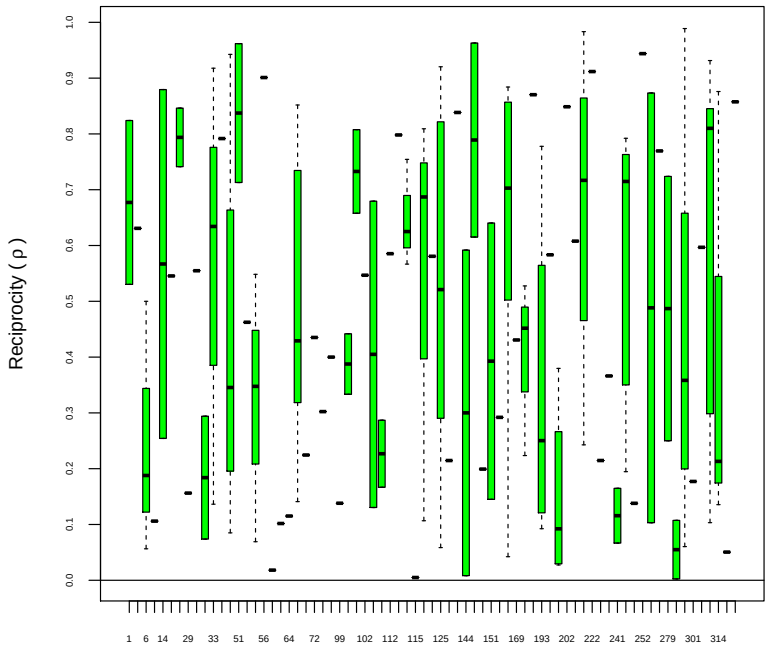
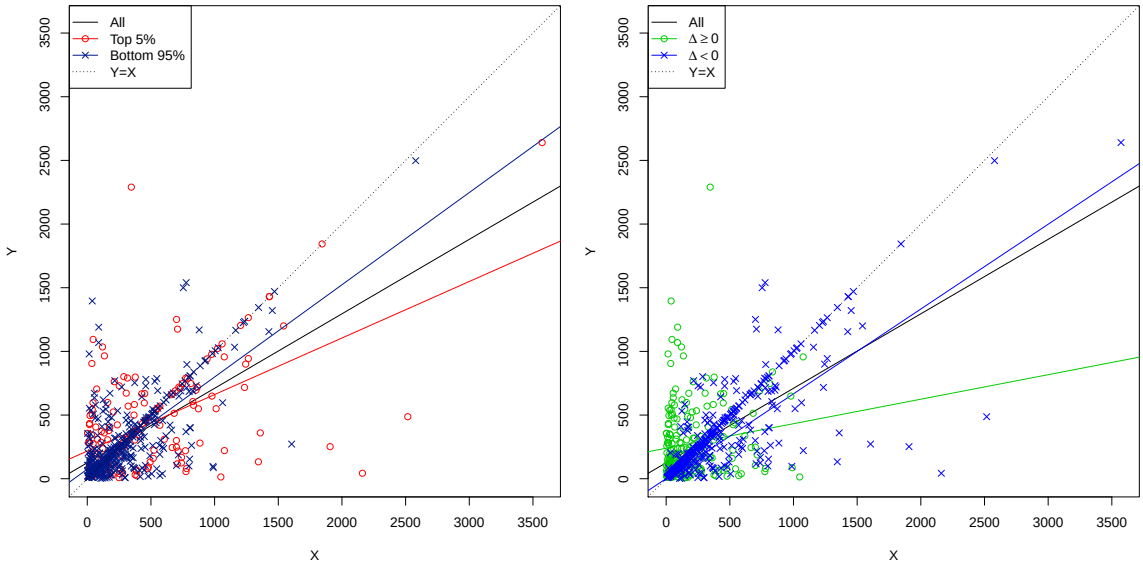


(a) Reciprocity by dyad - $\Delta < 0$



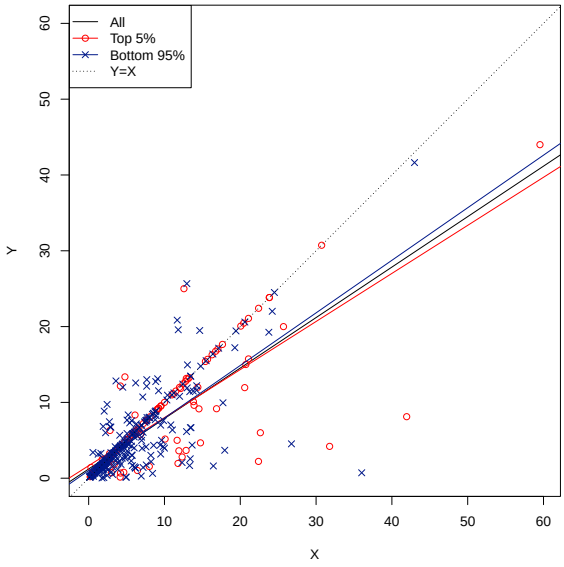
(b) Reciprocity by dyad - $\Delta \geq 0$

Figure 4: Box plots for the reciprocity measure ρ grouped by dyad. Figure a) above is restricted to within-bout grooming — i.e. $\Delta < 0$ — whereas b) below illustrates the delayed case $\Delta \geq 0$.

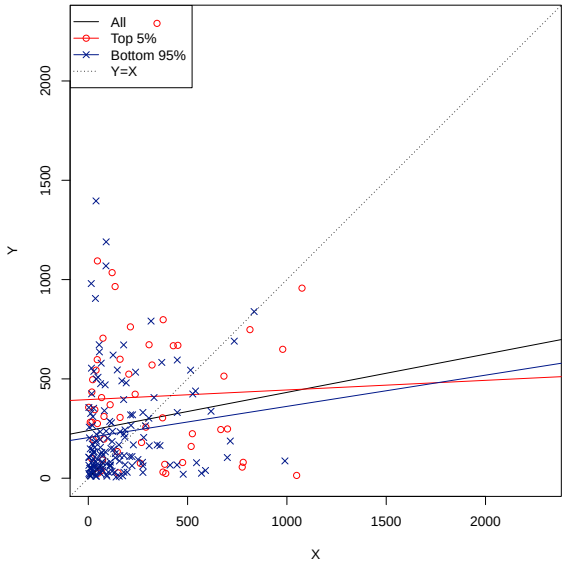


(a) Time-matching (all)

(b) Time-matching by Δ



(c) Within-bout time-matching $\Delta < 0$



(d) Delayed time-matching $\Delta \geq 0$

Figure 5: Longitudinal time-matching in minutes, showing: overall time-matching (top-left), color-coded according to delay (top-right), within-bout only (bottom-left) and delayed only (bottom-right). Each point on the scatter-plots below represents a pair of grooming events for a single dyad $\{A, B\}$. The x-axis represents the number of minutes that A spent grooming B, and the y-axis represents the time invested by B in grooming A.

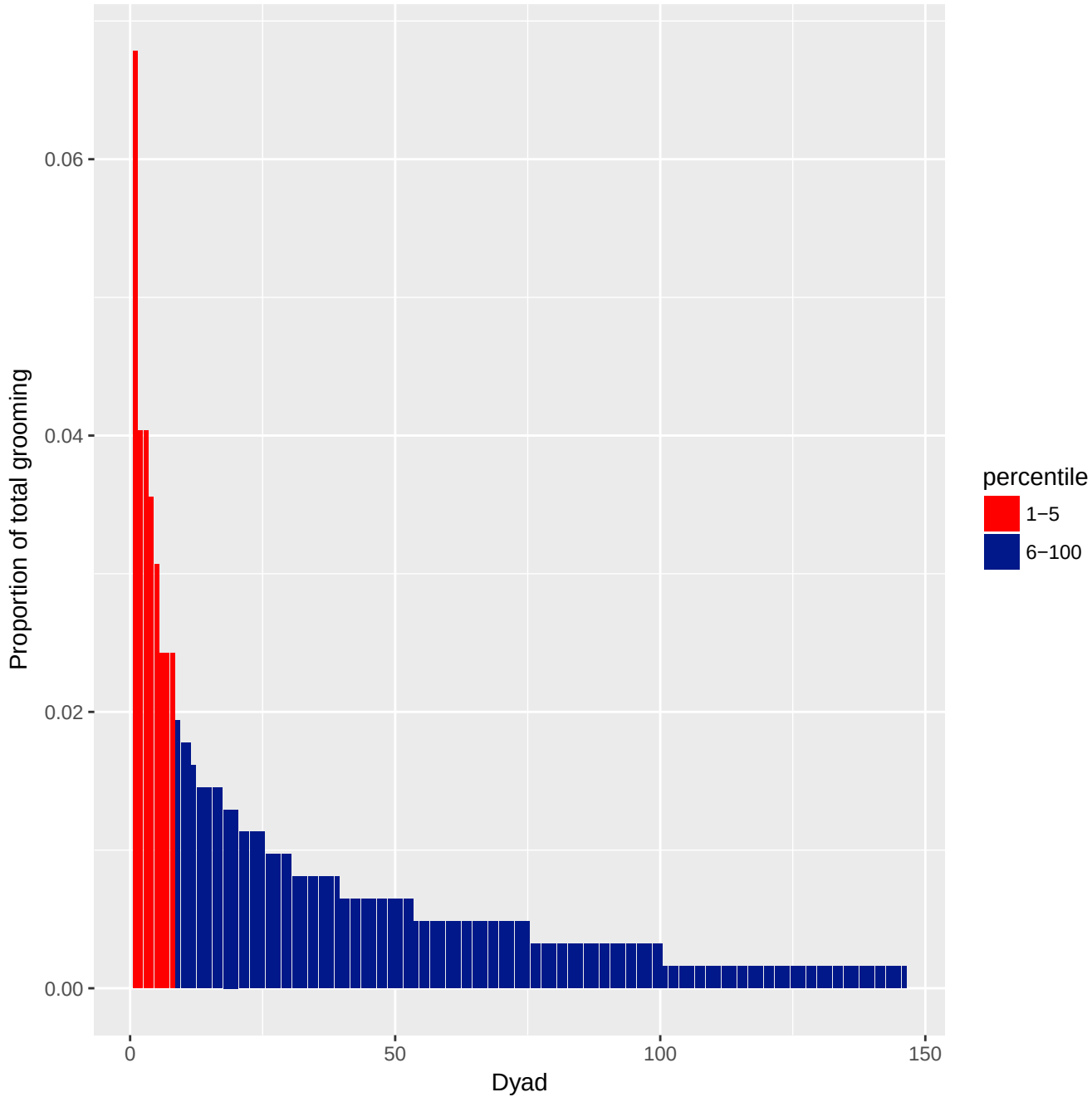
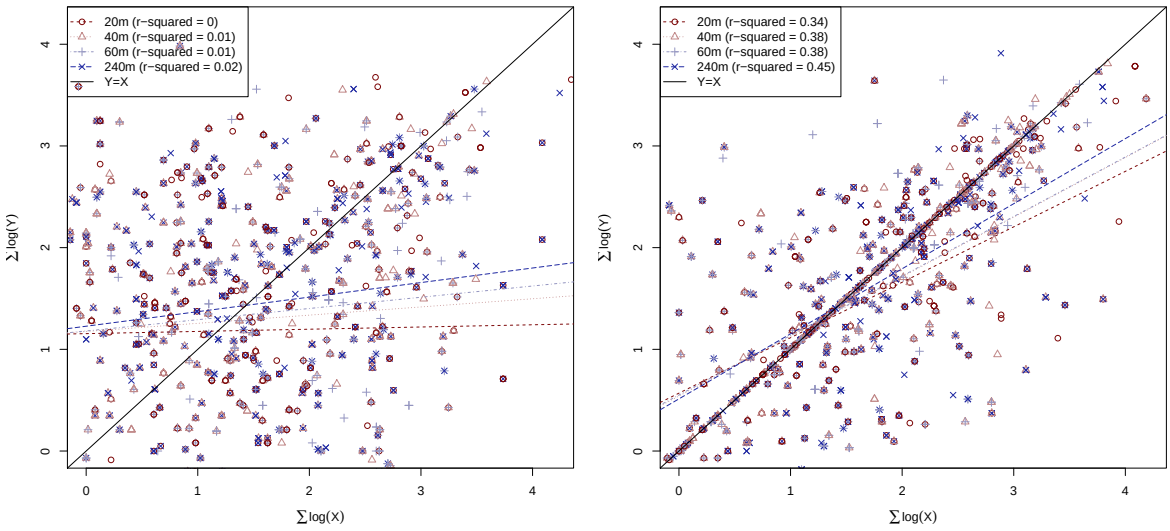
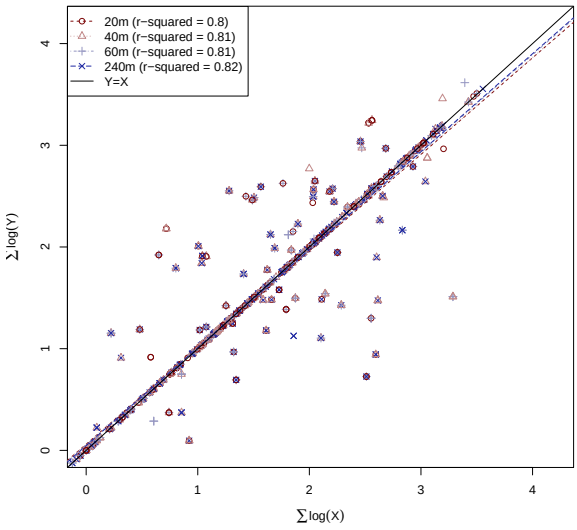


Figure 6: Distribution of total grooming duration over dyads. The dyads in the top five percentiles ($\{AL, WH\}$, $\{BO, RO\}$, $\{DL, SA\}$, $\{HI, HP\}$, $\{KI, SR\}$, $\{KK, NI\}$, $\{KY, SA\}$, $\{SA, WI\}$) are highlighted in red.

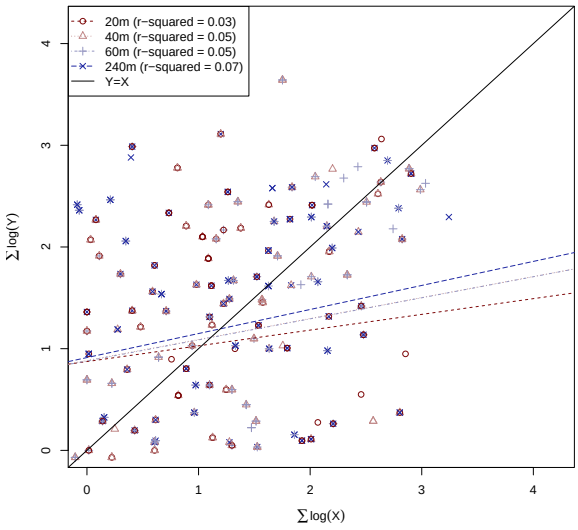


(a) Null model ($\bar{R}^2 = 0.07$)

(b) Entire dataset ($\bar{R}^2 = 0.55$)



(c) Within-bout $\Delta < 0$ ($\bar{R}^2 = 0.79$)



(d) Delayed $\Delta \geq 0$ ($\bar{R}^2 = 0.08$)

Figure 7: Windowed time-matching. The above plots illustrate time-matching when grooming durations are summed over time windows of 20 minutes, 40 minutes, 1 hour and 4 hours. The $\bar{R}^2$ values in parentheses in the caption beneath each figure shows the average of the R^2 values over each regression within the comparison group. Plot (a) shows windowed time-matching of a null model in which grooming durations for each animal are independent and identically-distributed random variables. Plot (b) shows the empirical summed durations without distinguishing between within-bout or extra-bout reciprocation. When we separate the data according to the delay Δ we see that most of this time-matching is accounted for by within-bout activity (c). When we restrict attention to delayed time-matching, the effect largely disappears (d).

2 Reciprocity over different delay periods

Michio Nakamura also suggested that although reciprocity might not occur after a very long delay due to memory decay, if we restrict attention to shorter delays then we might find evidence of time-matching. We examined this question in a previous version of the manuscript, and we present the results here. We used a 20-minute moving time-window over Δ, and perform time-matching regressions on data within the data, showing the regression slope (Figure 8) and fit (Figure 9). As can be seen, there is no evidence of time-matching once the window excludes data from $\Delta \leq 0$.

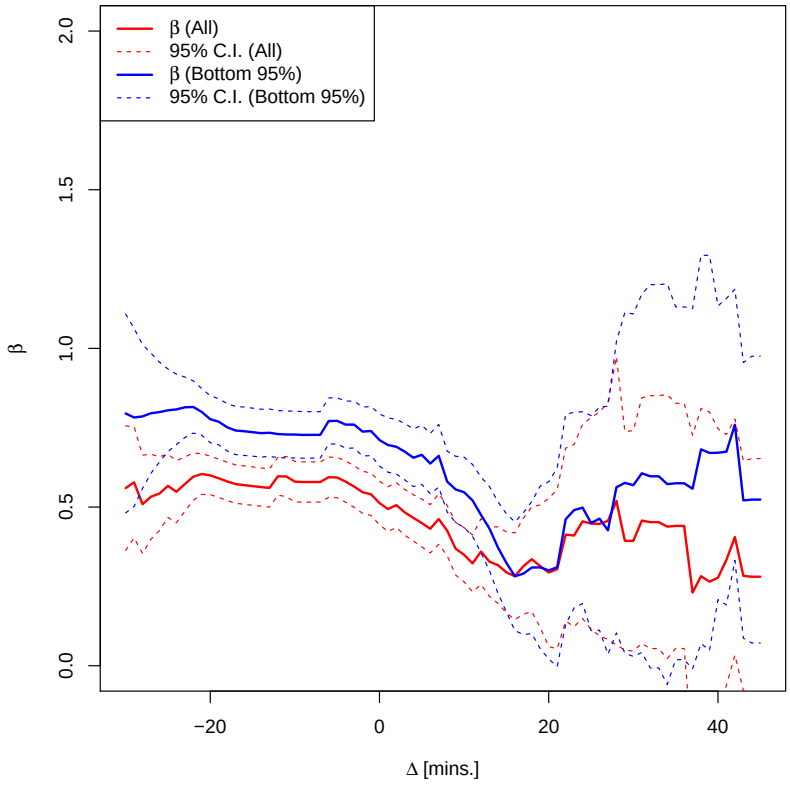


Figure 8: Time-matching regression results for a 20 minute moving window of Δ showing slope and associate confidence intervals as the delay changes. Results are not statistically significant once the window moves beyond the 0-20 minute period.

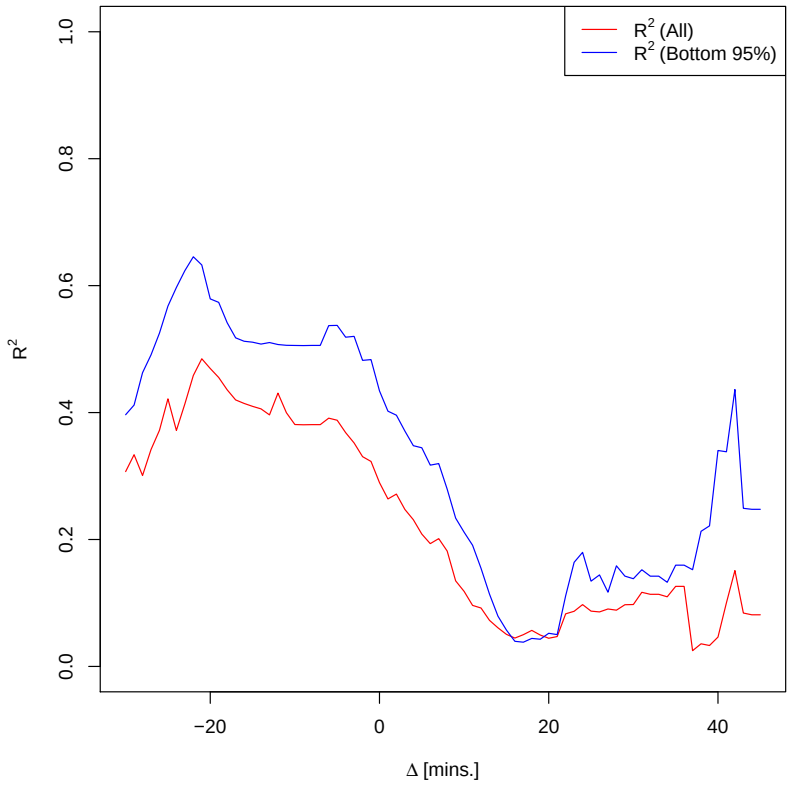


Figure 9: Time-matching regression results for a 20 minute moving window of Δ showing R^2. The fit becomes very poor once the window moves beyond the 0-20 minute period.