Fitting adjunctive behaviour

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Introduction: adjunctive behaviour (AB)

- **Adjunctive (schedule-induced) behaviour** (Falk, 1961): non-contingent behaviour maintained by some other response (producted by a stimulus) that acquired a reinforcing effect.
- Traditional assumption: no contingency with incentives, **induction** instead of **reinforcement**.
- Key principle of association: proximity between response and reinforcer (intra-session time *t*) (Killeen & Pellón, 2013).
- First the AB is maintained by **induction**, then by backward chaining with other **behaviours**.
- Can we describe the induction and chaining processes by a unified model?

Objectives

<u>Acquisition phase</u>: find a model for **induction** (licks ***L*** as a function of previous pellet ***n***).

<u>Asymptotic phase</u>: find a model for **backward chaining** (licks ***L*** as a function of lever presses ***P*** and lever presses ***P*** as a function of previous pellet ***n***).

Experimento (López Tolsa Gómez, 2018)

8 male Wistar rats.

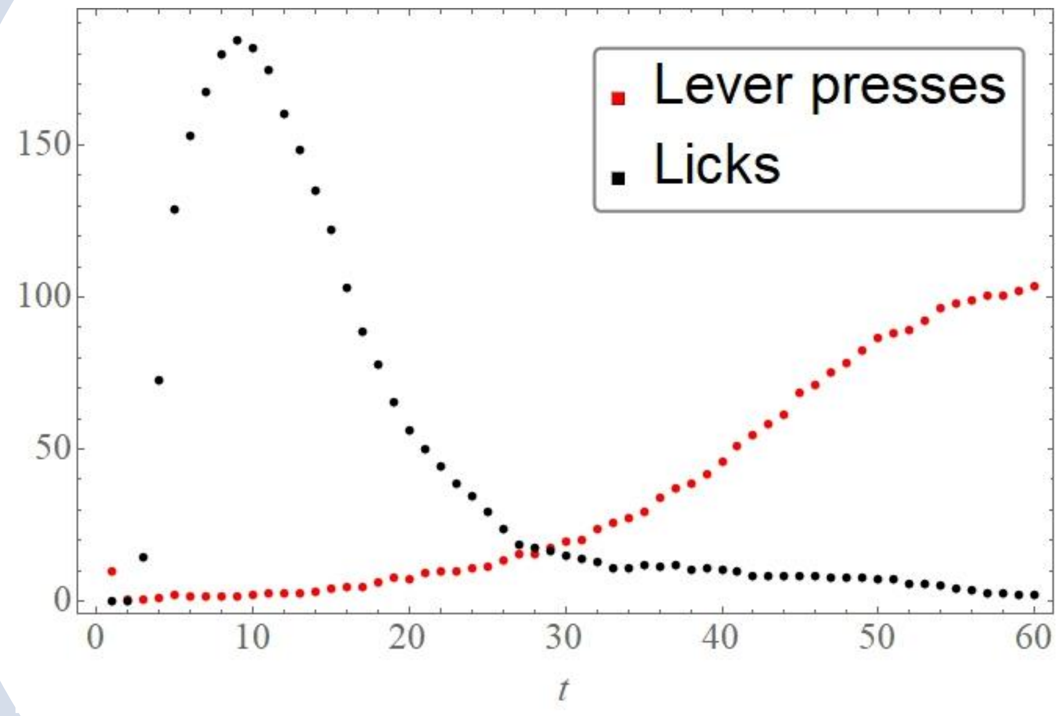
Incentive: food pellet. Access to wáter. Behaviours: licking ***L*** and lever pressing ***P***.

30 sessions 60 s long.

Average of last 5 sessions

Regime where behaviour is stable (smooth data).

1. Find fits for lever presses ***P*** and licks ***L*** separately as functions of intra-session time: ***P(t)***, ***L(t)***.
2. Invert ***P(t)*** $\longrightarrow$ ***t(P)***.
3. Find ***L(P)***.
4. Compare with independent fit ***L(P)***.
5. Compare with fit ***P(L)***.



P(t)

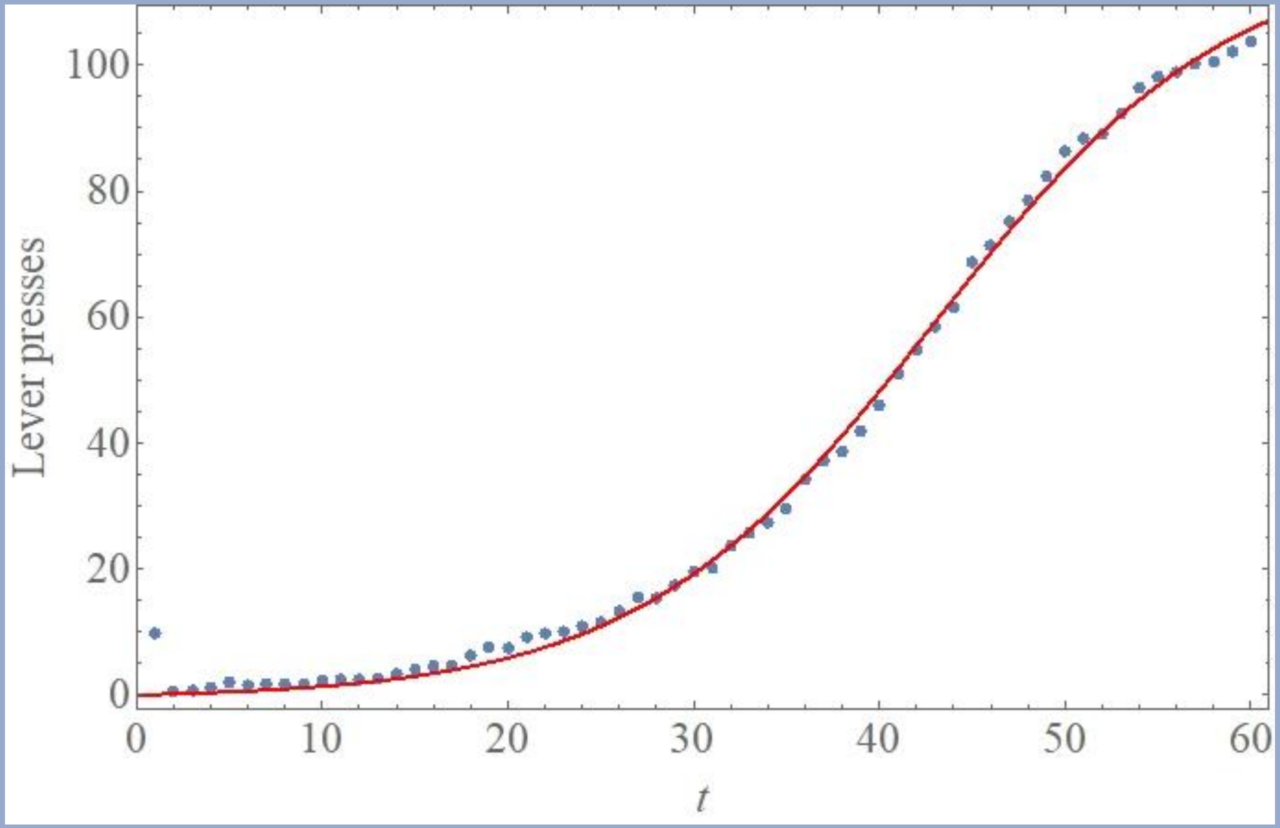
$$P(t) = A_1 \frac{e^{at} - 1}{e^{at} + A_2}$$

a = 0.125 $(p = 10^{-40})$

A_1 = 118.3 $(p = 10^{-50})$

A_2 = 212.9 $(p = 10^{-11})$

σ = 3.7



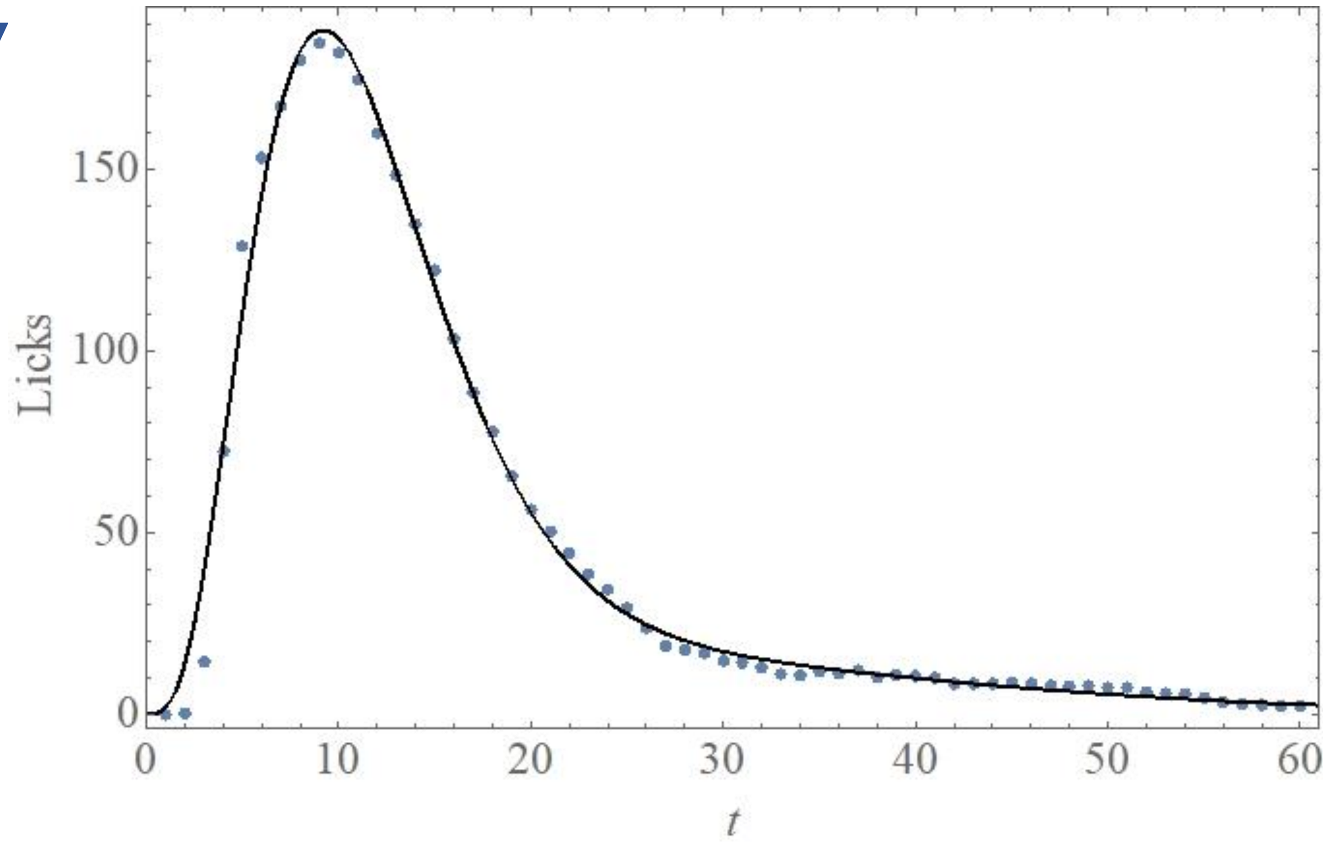
L(t)

$$L(t) = t^b\,(B_1\,e^{ac_1t} + B_2e^{ac_2t})$$

b = 3.532 $(p = 10^{-32})$
c_1 = 1.087 $(p = 10^{-12})$
c_2 = 3.116 $(p = 10^{-31})$
B_1 = 0.005 $(p = 0.02)$
B_2 = 2.617 $(p = 10^{-7})$

σ = 26.9

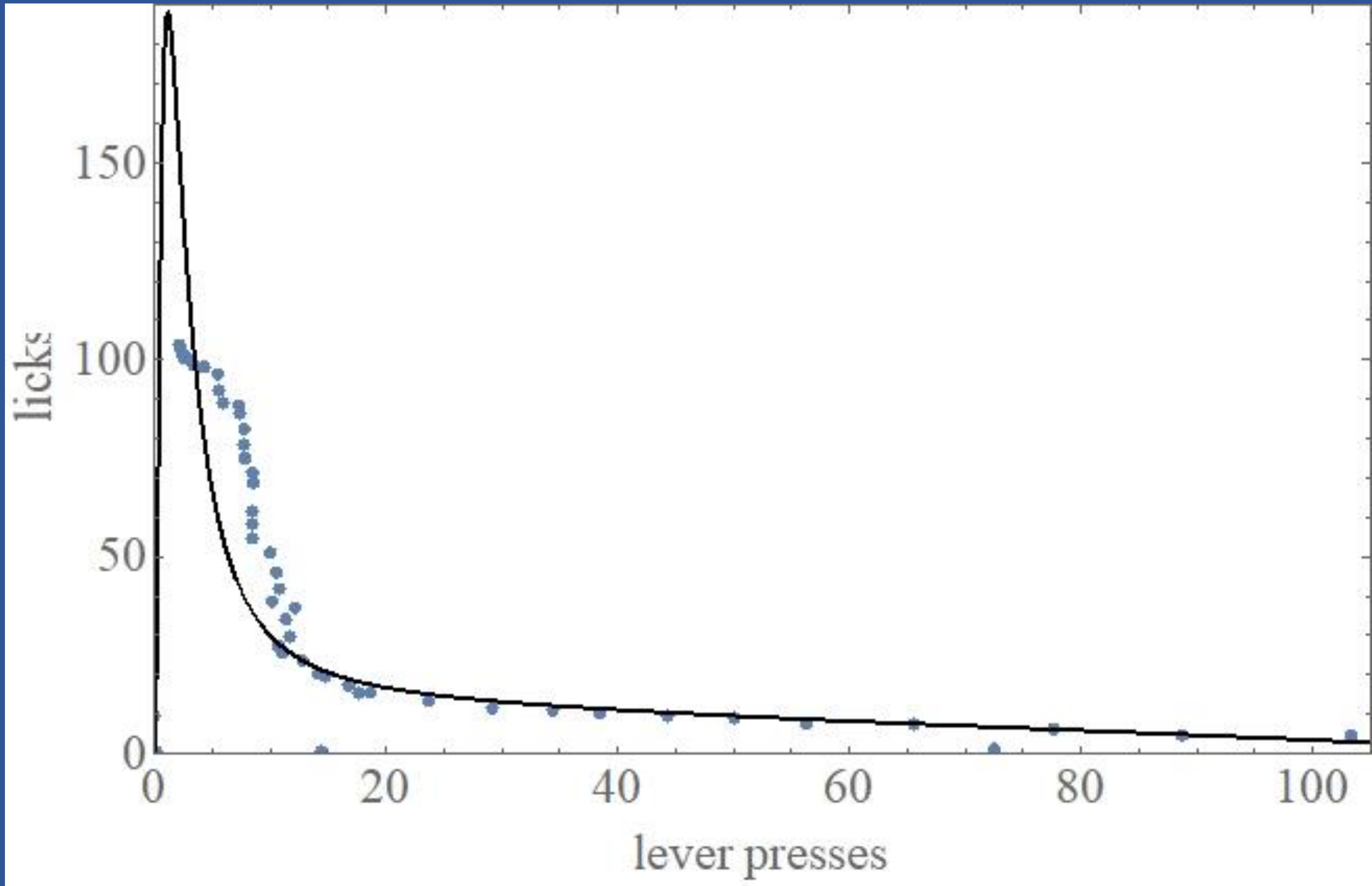
This is not the best fit *L(t)*, but it is the simplest for our purpose…



Backward chaining?

$$L(P) = \left[\ln\left(\frac{A_1 + A_2 P}{A_1 - P}\right)^{\frac{1}{a}}\right]^b \left[B_1\left(\frac{A_1 - P}{A_1 + A_2 P}\right)^{c_1} + B_2\left(\frac{A_1 - P}{A_1 + A_2 P}\right)^{c_2}\right]$$

A mess, and the fit is poor at low t



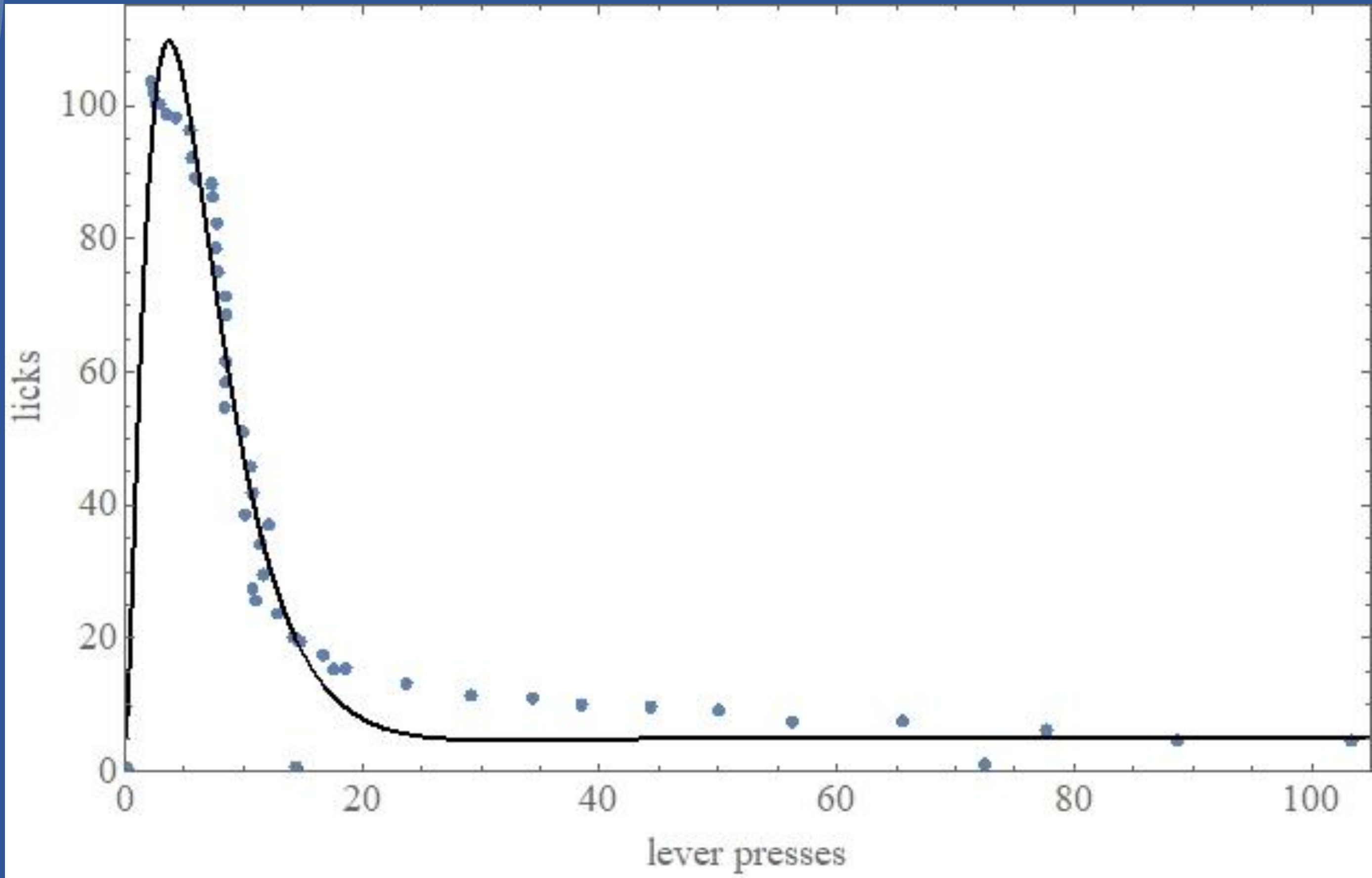
A better fit for *L(P)*

$$L(P) = \alpha P^2 e^{-P^{\beta}} + \gamma$$

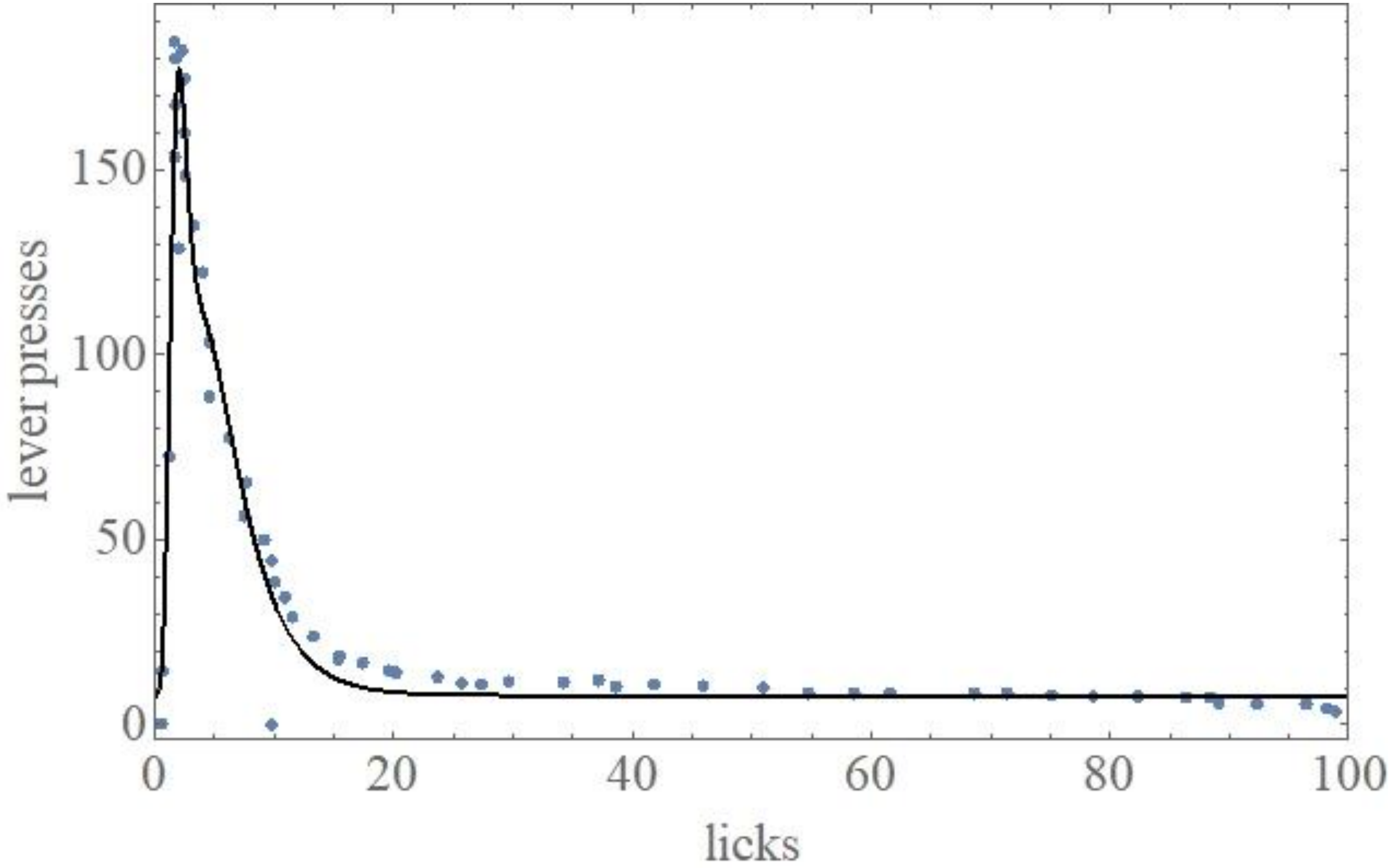
α = 109.2, β = 0.745, γ = 4.939

From this one can get ***L(t)=L[P(t)]***
(ugly to see, but it's a good fit!)

Backward chaining



P(L)



$$P(L) = A\,L^{a}\left(e^{-b\,L^{c}} + e^{-L^{d}}\right) + B$$

A = 115.03, B = 8.45, a = 4.467, b = 2.496, c = 0.677, d = 1.608

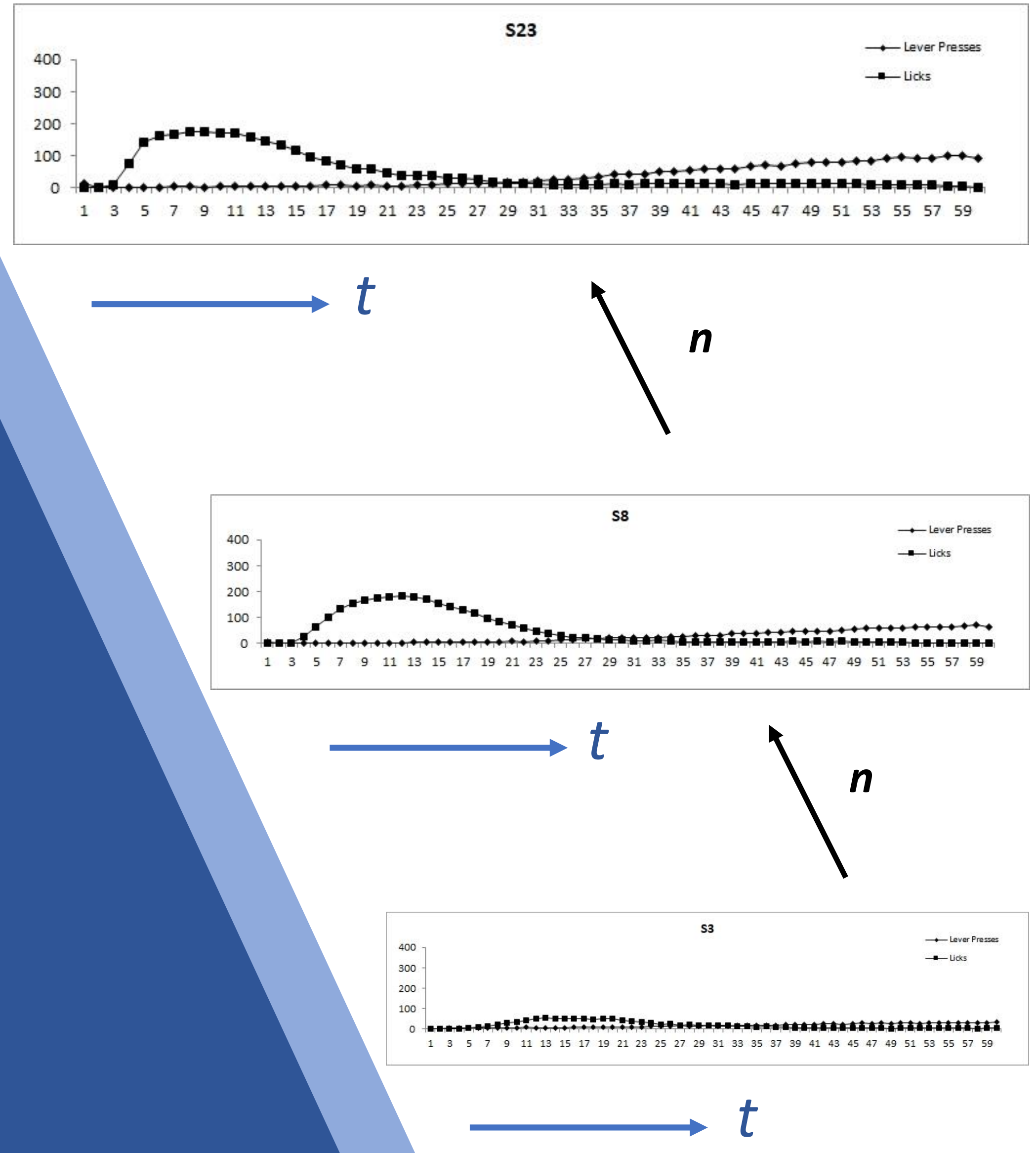
$\sigma = 132.6,\ p < 10^{-4}$

Psychological interpretation?

Acquisition

Promoting constants *c* to *n*-dependent parameters c_n:

1. For each session, fit ***P(t,c)*** and ***L(t,c)*** from ***(P,t)*** and ***(L,t)*** data, as before.
2. Find fits for $\boldsymbol{c_n}$ from ***(c,n)*** data.
3. Final model: $\boldsymbol{L(P,c_n)}$.



And the answer is…

... I didn’t have time!

Conclusions (preliminary)

- In this (a?) behavioral chain, fitting from the last link to the first is better than fitting the first and the last link separately and then combining them.
- Model fitting does *not* determine the causal arrow. A psychological model will decide whether we are interested in ***L(P)*** or ***P(L)***.
- Best fits of the session dependence of the parameters *in progress*.

ご清聴ありがとうございました

Muchas gracias

Grazie