1 Introduction

Since Darwin's theory of species evolution was put forward there

was some trouble to explain cooperative traits on animals and

humans. For that the Darwin's theory incorporate two novels kinds

of extension. The genetically kinship theory that Hamilton

grounded mathematically (Hamilton,64) and the reciprocation

theory (Trivers, 71). Both appended theory able explanation of

social altruism behavior through natural selection. In

evolutionary biology, reciprocal altruism is a behavior whereby

organism perform costly act that benefit the recipient with

expectation that the other organism act similar manners at later

time o in next generation.

The kinship theory that after landed on kin Selection and Maynar

Smith use in first time (Smith,64), talk about, on knowledge of

the genetic relationships of the organism involved, how

altruistic behavior between closed related individuals can being

selected though the natural selection. This theory does not

include the altruist act among distantly related organism and so

that Trivers' theory does it. The term “reciprocal altruism” was

use for Trivers for cover this type of behavior and give

explanation about how the selection favors the altruistic

behaviors in long run when in population there are reciprocity.

Some of most relevant and reliable examples about this type of

cooperation are the Wilkinson studies in reciprocal foods sharing

behavior in vampires bats, rotundus, (Wilkinson,1984) wheres they

share a part of harvested food only a partner that previously

being shared. Other about it, ....

Different conditions must be fulfilled to warranted that

reciprocally altruistic behaviors will be selected for. Wilkinson

make a clear brief of conditions must be satisfied to assure that

the selection favor reciprocal altruism behavior: (1) the

behavior must reduce a donor’s fitness relative to the selfish

alternative, (2) the fitness of the recipient must be elevated

relative to a non-recipient, (3) performance of the behavior must

not depend on receipt of an immediate benefit, (4) a mechanism

for detecting individuals who receive benefits but never pay

altruistic costs has to exist, and (5) a large but indefinite

number of opportunities to exchange aid must exist within each

individual’s lifetime (Wilkinson, 1987).

Research on cooperative behaviors along non-related organism gain

a new impulse since Trivers connect reciprocal altruism behaviors

with famous mathematical Prisoner's Dilemma (PD) game (framed by

Merrill Flood and Melvin Dresher 1950). The PD game is one class

of 2x2 game that involve two players who must to choose between

two options, generally called cooperation and defection. The size

of reward to delivered is according both player's choice. For

example, if both chose cooperation options both get pay-off R

(reward), if both choice defection each other get pay-off P

(Punishment) and if one choose cooperation and the second player

choose defection the first get pay-off S (sucker) and other

pay-off T (temptation) where pay-off matrix maintain inequality

T>R>P>S.

Both iPD and Evolutionary Stable Strategies (von Neumann and

Morgenstern, 1944, and Nash, 1949) predict, or give a sign, what

behavior (strategy) is likely to happen whether it is adopt by

the population, in such a way, no minority using a another

strategy can invade (M. Smith, 1974). When the 2x2 prisoner's

dilemma is playing for once the unique ESS es Defeat strategy.

Nevertheless, when use pay-off matrix that meets 2R>T+P and play

indefinite numbers of times the best strategy is mutual

cooperation. It does not means that if one does not cooperate the

option remains be the best option but it is the worst option.

Axelrod and Hamilton (1981) expose that some organism's symbiosis

can be understand through reciprocal altruism's model and when

organisms can remember at least one previous interaction,

outcomes and they are able to distinguish partner's difference

then the strategies situation becomes much richer set of

possibilities. They present a ESS for iterated PD that gather

robustness and stability and initial viability, called TIT FOR

TAT. It was arise as the winner strategy, submitted by Anatol

Rapoport in the Robert Axelrod's computer tournament, because an

individual that used it can survive invades to other strategies.

The highly simple strategy roots inside that one cooperate on the

first move and then doing whatever the oponent did on the

preceding move.

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Thus, many experimenters have tried to understand different

aspects of reciprocal altruism behavior in animals and whether

non-human animals with less ability can solve iPD. Basically we

want to comprise what abilities are essential for. Green, Price

and Hamburger (1995) assess iterated prisoner's dilemma game over

pigeons and observed that birds are so impulsive and prefer small

immediate outcomes rather than big long-term delayed outcomes.

Stevens and Stephens (2003) use Blue jays on four different

pay-off matrix, where one of them is the iPD matrix, over special

dual operant box. This study found little cooperation in

prisoner's dilemma treatment and this findings suggest that jays

don't cooperate when immediate benefit is available (defect

only), even if a long-term benefit may exist. Then in Steven et

al. (2002 and 2005) inspired by low level of cooperation (Gardner

et all. 1984, Clements and Stephens 1995, Flood et al. 1983,

Green et al. 1995) proposed payoff accumulation and temporal

clumping to iPD game using blue jays in a kind of apparatus that

consisted of side by side V-shaped compartment. They found that

combined both accumulation and clumping treatment birds show a

level of cooperation over chance choice. But in Danchin et. al.

(2006) criticized these treatment arguing that iPD payoff matrix

becomes stag hung matrix after each accumulation blocks. Adams

and Mesterton-Gibbons points out that in Stevens et al. (2002)

found that birds care less about the immediacy of reward if seeds

accumulation in a transparent food tray for some time before

being deliver.

Moreover, Mendres and Waal(2000) and Waal(2000), used a pulling

task over Capuchin monkeys (cebus apella) and a chamber divided

for mesh to tests cooperation. They got that monkeys can adjust

pulling task behavior according to their partner's presence and

the food shared behavior depend of quality of own and partner

foods.

Moreover, Mendres and Waal(2000) and Waal(2000) tested

cooperation aspects using a pulling task over Capuchin monkeys

(cebus apella). They use a chamber that was partitioned by means

of a mesh with two food bowl on a external tray. The monkeys can

get foods pulling sticks attached at the side of the tray, one

for each. They got that monkeys can adjust pulling task behavior

according to their partner's presence and the food shared

behavior depend of quality of own and partner foods. Similarly,

using a pulling task to give food to a partner and receive from a

altruistic partner Hause et al.(2003) evaluated altruistic food

giving behavior where share food through mesh was not allowed

over genetically unrelated cotton-top tamarin mokeys and showed

that monkeys give more or less foods to partner taking into

account what was altruistic and what not.

Knowing that primates have high psychological capability we can

expect that these kind of animals can able to learn reciprocal

altruism despite of they not perform this behavior in wild, but

the interesting question is whether animals with less

capabilities can learn reciprocal altruism. For the same way that

monkeys experiments, Rutte and Taborsky (2007) assess generalized

reciprocity in female rats (Rattus norvegicus) by means of a

alternating pulling task in which either the focal rats adopt a

role of either helper to give food to a partner or a receiver

food from a partner over a like-Wall&Menders chamber scaled for

rats. Generalized reciprocity is kind of reciprocal altruism

between unrelated individuals where individual make altruistic

behavior by previous social experience irrespective of partner

identity. Experiment was carried out with two phase. The first,

pre-training phase in which a humans experimenter taught focal

rats to perform alternating reciprocal task and second on

experiment phase that after receive help or not for several days

from differents partners were paired with a new partner in role

of potential helper. They observe the rats pull more frequently

when previously received interaction with food-givers partner. We

could make a comment about this last experiment over the

perspective of operant conditioning owing to they has assessed

extinction rate of pulling behavior after focal rats has or not

received food for several days rather than rise the frequency of

behavior by interaction between players. Then, Rutte and Taborsky

(2008) evaluates direct versus generalized reciprocity using the

same experiment set up. Direct reciprocity is a kind of

reciprocate interaction in which a subject A cooperate with B on

account of B previously cooperate with A. They observe that rats

the pull rate is higher and its delay to pull is lower on direct

reciprocity than generalized. This means that know opponent is a

more powers stimulus than unknown. Taborsky et al. (2012) shown

that rats reduced pulling rate with increasing resistance to pull

and Dolivo and Taborsky (2015) evince that rats take account the

quality of foods received from opponent to future

cooperation(pulling).

-creo que este párrafo no va----In our search of altruistic

behavior over non-humans and non-primate animals we maybe demur

that rats behavior in taborsky's experiment didn't meet all

conditions for reciprocal altruistic behavior rather that they

assessed a type of reciprocity, because rats don't receive

punishment for either punishment or temptation outcomes-----

Reciprocal altruism is widely tested by iterating prisoner

dilemma, iPD, and the individual's decision rules size up by

transition vector t, r, p, s that reflect the probability of

cooperation when the previous trials resulted in outcomes of R,

T, S or P, respectively (stevens and stephens,2004). if all

component of vector are 0.5, the agent's decision rule is

randomly irrespective last outcome. Part of all experiment set

developed by Wood et al. (2016) was measure reciprocal altruism

in long-evans male and female rats using iPD in operant chamber

divide half by removable mesh equipped with retractable lever and

stimulus light. The best result show that cooperative behavior on

male rats is a little over the chance near to 60%.

To test whether the rat has ability to solve the iPD game when

faced to altruist opponent we need to force TIT FOR TAT mimic

behavior on the opponent (stevens & stephens 2002, St-Pierre,

Larose & Dubois 2009, viana, Gordo, Sucena & Moita 2010). In

Moita et al. using a mimic tit-for-tat strategy on the opponent

in a double T-maze chamber and neither reach a high level of

cooperation. Our further analysis over their markov chain diagram

gave evidence that strategy performed by rat was more selfish

than cooperative because its adopts a alternating decision's rule

among sucker and temptation outcomes.

The rats often develop on social groups and studies have

demostrated that they prefer social reward rather that along or

have a tendency to performed pro-social acts over the chance

(Moita 2015 and Kalenscher 2015).

But why all iPD-base studies haven't found high level of

reciprocity? We considering about previous result in which the

rat don't reach learn iPD and think that is maybe due to the test

box and stimulus contingency are inadequate for its natural

expectation, i.e. the rat maybe has ability to achieve a

approximated optimal solution but for example the length of time

used for made contingency is longer that rats can keep in mind or

maybe don't realized the real difference within payoff matrix

amounts. As a result, we found that combining iterated Prisoner's

Dilemma matrix payoff and delay's penalty for released

reciprocation and tit for tat opponent's strategy achieve high

level of reciprocal altruism behavior in rats.

2 Material and Method

2.1 Subjects and Housing

Two group of long-Evans rats (Charles Rivers....) were used.

Twelves males were used like subjects and six (Nstooge=6)

identical rats like opponents. At weaning time all subject were

housed in group of two rats per cage to addressing social

interaction and each stooge in single individual cage. We had 12

cage altogether. All rats were food deprivation schedule, and to

subject rats daily food intake was restricted to keep animals at

between 90-95% of free feeding body weight and to stooge rats at

between 80-85% of free feeding body weight. The housing room had

an average temperature of 22°C and 12:12h light:dark cycle on at

20:00 hours.

We used two opposite standard operant chamber by Med-Association

(Product ENV-008) in such manner that each rats can make

olfactory and eye contact through metal windows (FIGURA 1 CAJAS).

Each standard chamber was equipped with two side by side lever

and two stimulus light over each lever and a feeder in the

center.

2.2 Experimental Setup

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2.3 Experimental Design

2.3.1 General Task Design

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2.3.2 Typical Trial Structure

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2.4 Analysis

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3 Results

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4 Discussion

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5 Reference