

# BIOINFORMATIC WORKFLOW TO ANALYZE BEHAVIORAL VIDEO RECORDINGS



**CARLOS GARCÍA PERAL**

INSTITUTO DE NEUROCIENCIAS DE  
CASTILLA Y LEÓN (UNIVERSIDAD DE  
SALAMANCA)

**CONTRIBUTORS:**

GISELDA EUNICE CABRAL PEREIRA

JUAN LÓPEZ LÓPEZ

JAIME GONÇALVES SÁNCHEZ

JOSE ANTONIO CORTES DE OLIVEIRA

NORBERTO GARCÍA CAIRASCO

DOLORES E. LÓPEZ GARCÍA

# ***INTRODUCTION***


## LABORATORY WORK

- The study of animal behavior has been widely used to evaluate the effect of drugs, depression, learning, instinct, among others.
- Routinely, we record seizures in an animal model of audiogenic epilepsy at different stages and conditions. That produces a lot of video recordings
- Afterwards, we evaluate and compare the behavioral patterns graphically in ethograms



# ***INTRODUCTION***

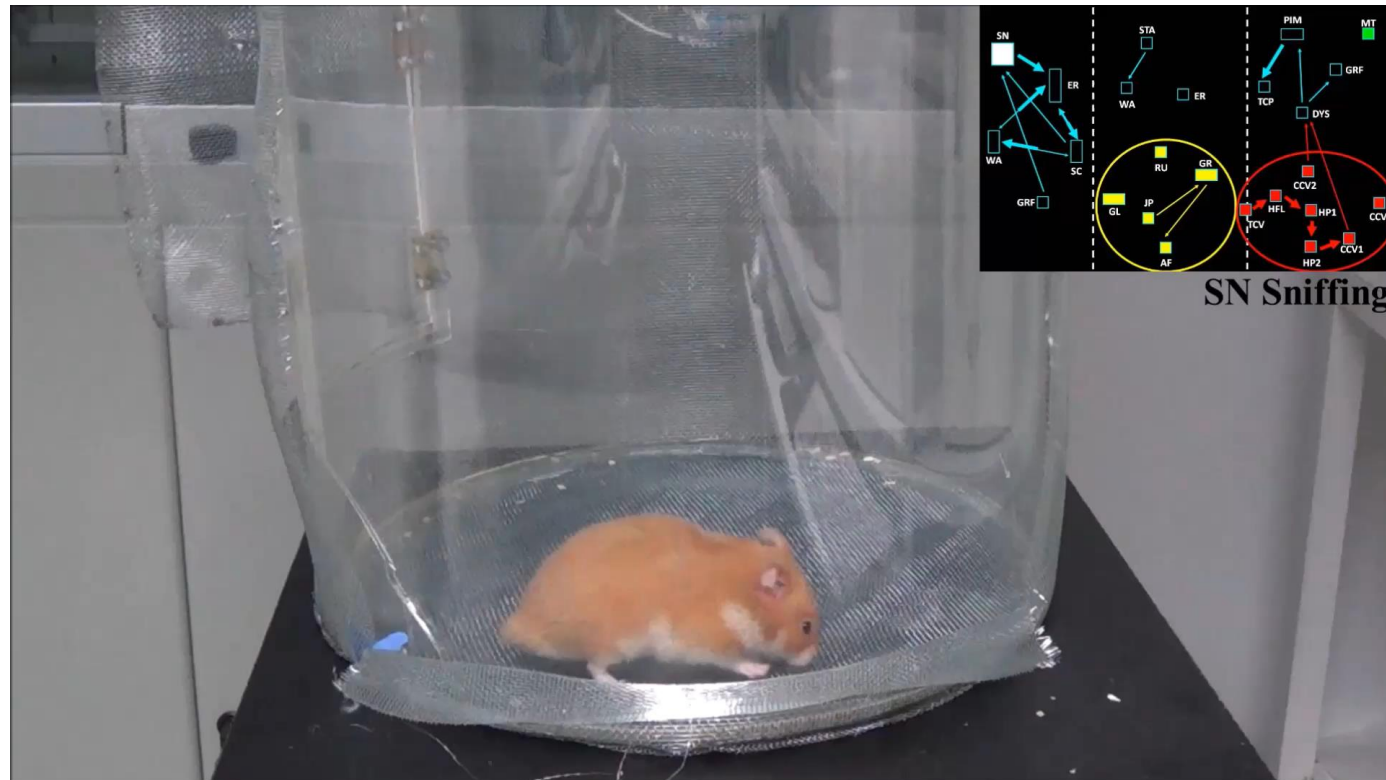
## WHAT IS AN ETHOGRAM?

- GRAPHIC REPRESENTATION OF ALL BEHAVIORS OF INTEREST OBSERVED IN THE STUDY SPECIES (FREQUENCY, INTENSITY AND BEHAVIOR RELATIONSHIP)
- EACH OF THESE BEHAVIORS MUST BE DISTINCT AND INDEPENDENT FROM ONE ANOTHER IN ORDER COLLECT DATA ACCURATELY. FOR THAT REASON, IT'S VERY IMPORTANT TO HAVE THESE BEHAVIORS DEFINED IN A LIST 
- MANY WAYS TO REPRESENT AN ETHOGRAM
- WE HAVE USED THE ONE DESIGNED BY (GARCIA-CAIRASCO ET AL, 1992)

Description		Categorization
<b>In nest</b>		
licking/grooming	dam touches the pup's body with her tongue, dam handles the pup's body with her forepaws or nose	caring behavior
active nursing	dam presents an upright dorsal arch posture with the depressed head posture over the pups which are attached to the nipples	caring behavior
passive nursing	dam lies immobile on pups and has her eyes open or closed	caring behavior
nest building	dam collects and/or handles nesting material around the pups with mouth or forepaws	caring behavior

# ***AIM OF THE BIOINFORMATIC WORKFLOW***

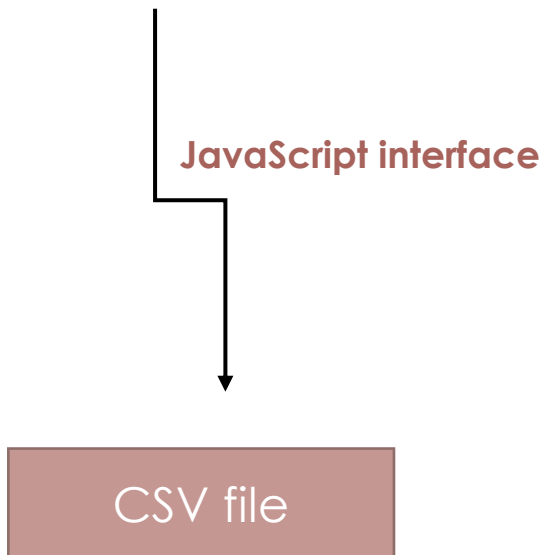
- Process semi-automatically video recordings
- Generate ethograms automatically from acquired data
- Speed up and ease the analyze of multiple recordings
- Widely useful for analyzing behaviors in multiple laboratory species. That allows us to compare seizures between different models and to evaluate the severity of that seizures in the same animal



# ***BIOINFORMATIC METHODOLOGY AND RESULTS***

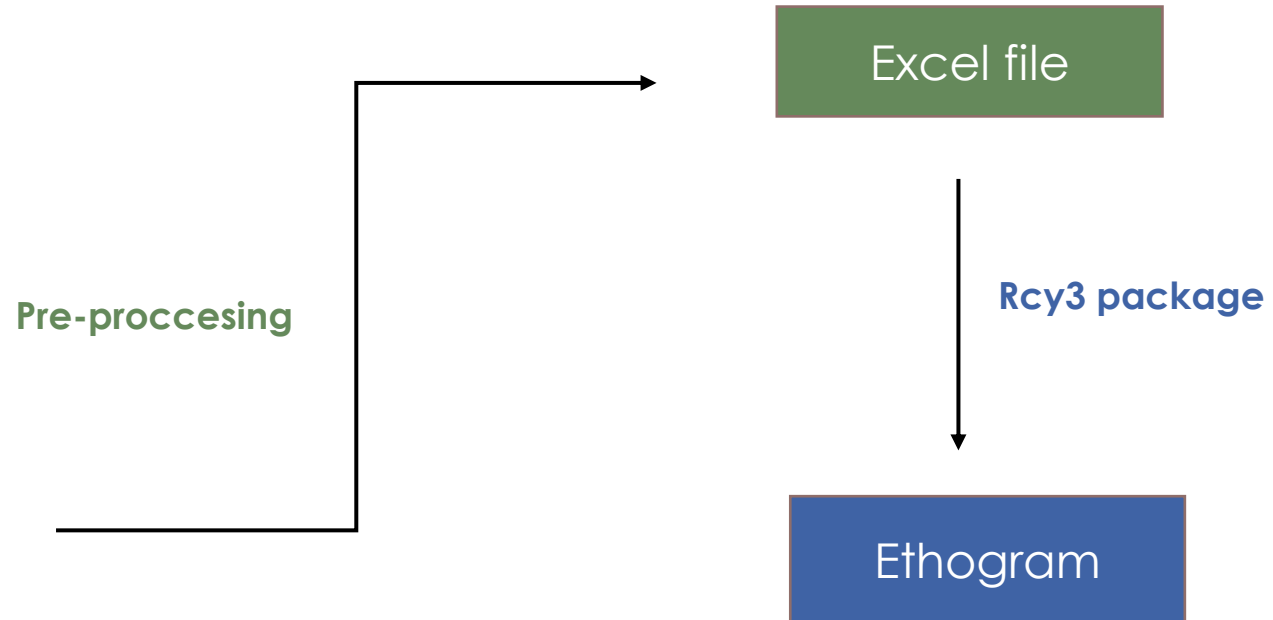
## **DATA ACQUISITION**

ETHOMATIC: JAVASCRIPT PROGRAM



## **PRE-PROCCESING AND GRAPH PLOTING**

R SCRIPT: RCY3 PACKAGE (CYTOSCAPE)





# BIOINFORMATIC METHODOLOGY AND RESULTS

## DATA ACQUISITION

Administración de archivos

00:00:00 | 3840 x 2160

Archivo Inicio Compartir Vista Herramientas de

Este equipo > Datos (D:) > Doctorado

Buscar en Doctorado

Nombre	Fecha de modificación	Tipo	Tamaño
PitNE1s-RNA_seq_b5_paired-202111151161352Z-UU1	15/11/2021 17:14	Archivo de almacenamiento ZIP	37.401 KB
GASH_musculo_G2	15/11/2021 2:13	Hoja de cálculo de Microsoft Excel	15 KB
IMAGE_microscop	15/11/2021 2:13	Documento de Microsoft Word	58.261 KB
Modelo CV-Solicitante_0-1_firmado_y_con_certificado_vida_laboral (1) (1) (1)	14/11/2021 20:51	Documento Adobe Acrobat	235 KB
rev2-lopez5.10 CV-Director_editado	14/11/2021 2:25	Documento Adobe Acrobat	281 KB
Modelo CV-Solicitante_0-1_firmado_y_con_certificado_vida_laboral	13/11/2021 20:54	Documento Adobe Acrobat	672 KB
Impreso Solicitud_Programa III_11	08/11/2021 18:58	Documento Adobe Acrobat	228 KB
GASH_musculo_G1	23/10/2021 20:55	Hoja de cálculo de Microsoft Excel	37 KB
P7-RNA-seq-alineamiento (3)	25/06/2021 22:50	Documento Adobe Acrobat	2.030 KB
GenomeAnalysisTK	12/12/2016 17:23	Executable Jar File	13.541 KB
download	02/07/2015 7:57	Archivo	847 KB
HAMSTER1_S16_2_Dup.bam.parts	06/06/2022 16:49	Carpeta de archivos	
Ethogram-s-design-9th-International-Conference-on-Bioinformatics-and-Biomedical-Engineering-main (1)	05/06/2022 14:26	Carpeta de archivos	
Mesocricetus_auratus-GCA_017639785.1-unmasked.fa	01/06/2022 21:23	Carpeta de archivos	
genome_assemblies_genome_gff (2)	25/05/2022 12:36	Carpeta de archivos	
genome_assemblies_all_files	25/05/2022 3:10	Carpeta de archivos	
genome_assemblies_trans_cds	25/05/2022 2:29	Carpeta de archivos	
genome_assemblies_cds_fasta	25/05/2022 1:38	Carpeta de archivos	
genome_assemblies_prot_fasta	25/05/2022 1:32	Carpeta de archivos	
genome_assemblies_genome_gtf	25/05/2022 1:25	Carpeta de archivos	
fiji-win64 (1)	23/05/2022 18:50	Carpeta de archivos	
genome_assemblies_genome_gtf (1)	17/05/2022 21:50	Carpeta de archivos	
genome_assemblies_genome_gff (1)	17/05/2022 21:45	Carpeta de archivos	
snpEff_v5_0_MesAur1.0.99	17/05/2022 14:35	Carpeta de archivos	
gatk_CNV	17/05/2022 14:27	Carpeta de archivos	
gatk-4.2.6.1	16/05/2022 20:49	Carpeta de archivos	

461 elementos 1 elemento seleccionado 771 KB

Windows Taskbar: Escribe aquí para buscar | 27°C | 18:57 | 06/06/2022

# BIOINFORMATIC METHODOLOGY AND RESULTS

## GRAPH PLOTING

The screenshot displays the RStudio environment with the following components:

- Source Editor:** Contains R code for setting Cytoscape defaults and processing Excel files. The code includes comments in Spanish and defines variables for file paths and processing.
- Environment Pane:** Lists objects in the Global Environment, including enrichment results and data frames.
- Console:** Shows the execution of R commands, including file processing and library loading.

**R Code in Source Editor:**

```
192 setEdgeTargetColorDefault("#000000")
193 setNodeFontSizeDefault(10)
194 setEdgeLineStyleDefault("SOLID")
195 setBackgroundColorDefault("#000000")
196 setNodeLabelColorDefault("#000000")
197
198 # Define several animals behaviours (normal exploratory behaviours, epileptic crisis behaviour)
199
200 fill_blue= c("POLH","SN","ER","WA","SC","STA","PIM","TCP","STR","GRF","DYS","GRH","LIC","IM")
201 fill_green= c("MT","MYO","GALO","MYOg","MYoh","MYot","MYO1","MYO2","MYOo")
202
203 # Tell the path where the excel are saved and chose those of interest.
204
205 ruta= readline(prompt = "Dime tu ruta: ") #D:/Documents/ETOGRAMA2/
206 all_files = list.files(ruta, recursive = T)
207 xls.files = grep("resultado.xls", all_files, value = T)
208
209 # Change files order. That step is necessary to set proper edge width in Cytoscape's graph,
210 # placing files with multiples edge's width at the end, and files with only one edge width first.
211 # For that we use the hash dictionary and readxl to read excel files.
212 xls.files_hojas=c()
213
226:1 (Top Level)
```

**Environment Pane Table:**

Name	Type	Length	Size	Value
x2	enrichRes...	1	14 MB	Large enrichResult ( ...
x2_BP_ITRAQ...	enrichRes...	1	80.9 MB	Large enrichResult ( ...
x2_MF_ITRAQ...	enrichRes...	1	13.3 MB	Large enrichResult ( ...
X41398_2021...	data.frame	53	6.4 MB	12599 obs. of 53 vari...
xassetCounter...	data.frame	9	373.4 MB	2613357 obs. of 9 var...
xls.files	character	8	992 B	chr [1:8] "ETOGRAMA/AGUD...
xls.files_h...	character	3	400 B	chr [1:3] "ETOGRAMA/SEM2...
xls.files_n...	character	5	656 B	chr [1:5] "ETOGRAMA/AGUD...

**Console Output:**

```
> xls.files_hojas=c()
> xls.files_no_hojas=c()
> for (b in xls.files){
+   hojas=excel_sheets(paste0(ruta,b))
+   if ("flechas" %in% hojas == TRUE){xls.files_hojas=c(xls.files_hojas,b)}
+   else {xls.files_no_hojas=c(xls.files_no_hojas,b)}
+ }
> library(readxl)
> library(hash)
>
```

# ETHOGRAM COMPARISION EXAMPLE

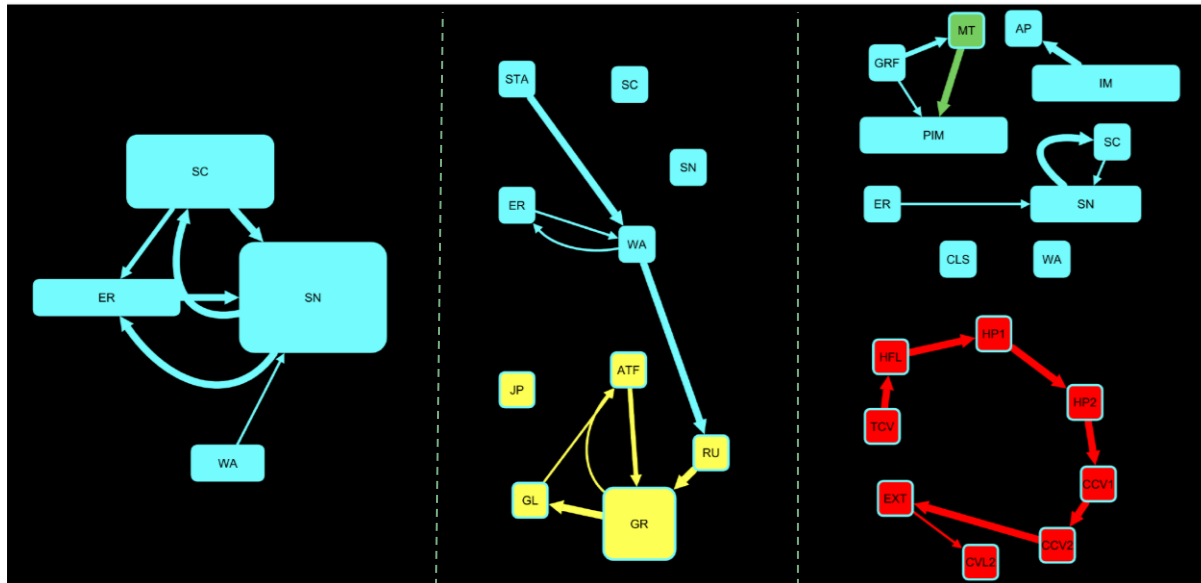
ACUTE TREATMENT

CHRONIC TREATMENT

PRE-SOUND

SOUND

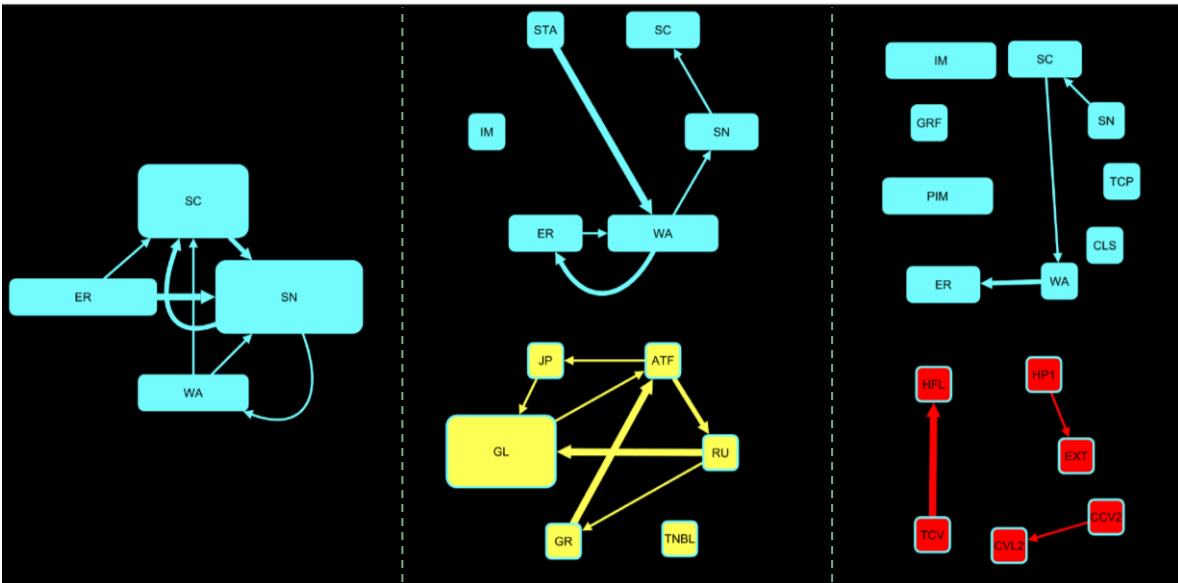
POST-SOUND



PRE-SOUND

SOUND

POST-SOUND





# ***DISCUSSION***

## ETHOMATIC VS MATCHING LEARNING METHODS: ADVANTAGES AND DISAVANTAGES OF OUR PROGRAM

- More time consuming: must select behaviors while watching recordings



- 100% accuracy: based on your personal experience assessing animal behaviors



# ***BIBLIOGRAPHY***

**N. Garcia-Cairasco; M.C. Doretto; R.P. Prado; B.P.D. Jorge; V.C. Terra; J.A.C. Oliveira (1992). *New insights into behavioral evaluation of audiogenic seizures. A comparison of two ethological methods.* , 48(1), 49–56. doi:10.1016/s0166-4328(05)80138-x**

THANK YOU SO MUCH FOR  
YOUR ATTENTION

