# This is an R-based program for estimating yawn contagion recorded to the nearest minute.

# The program measures yawn contagion according to the suggestions made by Dr Stephen E. G. Lea during the review process of a manuscript eventually published in *Animal Cognition*.

#yd () counts the rate of yawn contagion from "x " to "y " and vice versa using a k-min time window.

#to run the program just copy the commands and paste them in the R console.

yd <- function(x,y,k){

x <- rev(x); y <- rev(y) # reverse the series

n <- length(x)

non <- NULL; post <- NULL # assign non-post- and post-yawn rates, up to n-k, to non

non1 <- NULL; post1 <- NULL # assign non-post- and post-yawn rates, after n-k, to non1

for(i in 1:(n-k)){

if((x[i]>=0) & all(y[i:(i+k)]==0)) non <- c(non,x[i]) else post <- c(post,x[i])

}

for(i in (n-k+1):n){

if((x[i]>=0) & all(y[i:n]==0)) non1 <- c(non1,x[i]) else post1 <- c(post1,x[i])

}

np <- c(non,non1)

pts <- c(post,post1)

tb <- c(sum(np)/length(np), sum(pts)/length(pts))

print(tb)

}

# Example

# Consider the time series for two rats (“A” and “B”) which are observed during 12 min, and that you record the min at which a yawn occurs. Suppose also that a 3-min window is used to measure yawn contagion.

> A <- c(0,0,0,1,0,0,2,0,0,0,2,1)

> B <- c(0,1,1,0,1,1,0,0,0,0,0,3)

> yd(A,B,3)

[1] 0.6666667 0.4444444

This indicates that 0.66 of the time the Rat A yawned when the Rat B had not yawned within the relevant time window, whereas 0.44 of the time it yawned when the Rat B had yawned within that time window.

> yd(B,A,3)

[1] 0.6666667 0.5555556

This indicates that 0.66 of the time the Rat B yawned when the Rat A had not yawned within the relevant time window, whereas 0.55 of the time it yawned when the Rat A had yawned within that time window.

See the main text for a further explanation of the method for measuring contagious yawning.