Supplementary Material

Differences in persistence between dogs and wolves in an unsolvable task in the absence of humans.

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# Supplementary results

Table 1: Descriptive statistics of each correlate in dogs and wolves.

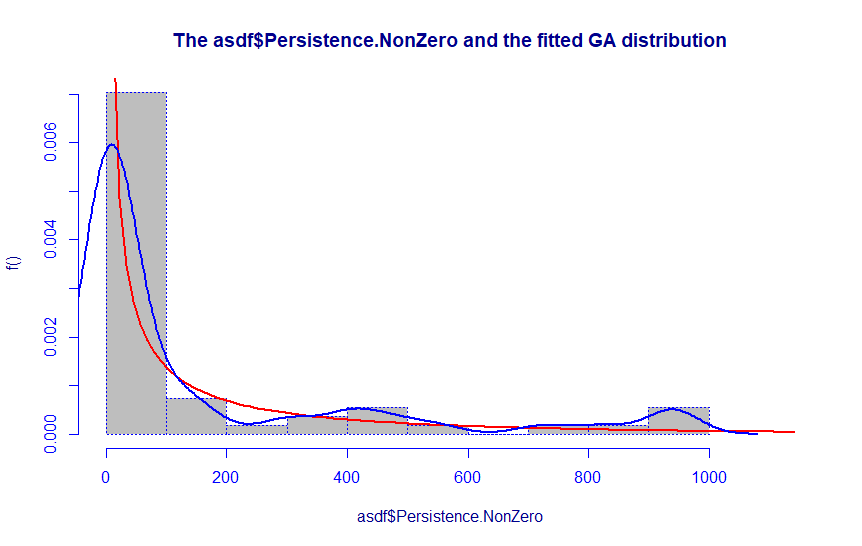
|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | | **Ball** | | **Pipe** | |
| **Dogs** | **Wolves** | **Dogs** | **Wolves** |
| Contact Latency (Seconds) | Min | 0.6 | 0.4 | 0.6 | 0.2 |
| Max | 2.0 | 2.0 | 2.4 | 3.2 |
| Mean | 1.0 | 1.2 | 1.1 | 1.3 |
| Median | 0.9 | 1.2 | 1.0 | 1.0 |
| Std. Dev | 0.4 | 0.7 | 0.5 | 0.9 |
| Persistence (Seconds) | Min | 0.0 | 14.6 | 0.0 | 0.2 |
| Max | 282.8 | 940.8 | 821.4 | 950.6 |
| Mean | 29.4 | 319.0 | 97.3 | 239.9 |
| Median | 4.1 | 169.2 | 2.4 | 45.7 |
| Std. Dev | 73.3 | 299.2 | 244.2 | 356.8 |
| Behavioural Variety | Min | 0 | 6 | 0 | 1 |
| Max | 13 | 17 | 14 | 14 |
| Mean | 3 | 10 | 3 | 7 |
| Median | 3 | 9 | 2 | 6 |
| Std. Dev | 3 | 3 | 4 | 5 |

# Complete GAMLSS model information

## Persistence models

### Full model

Data Distribution: Gamma (Supplementary Figure 1)



**Supplementary Figure 1.** This figure shows the best fitting distribution for the persistence data (after addition of a miniscule constant to all values). The grey bars show a histogram, the blue line shows a kernel density estimate and the red line shows the fit distribution.

#### Output – Initial model

Model Formula: gamlss(Persistence.NonZero ~ Species \* Object,   
family = "GA", random = ~1 | Individual)

Fitting method : RS()

Mu link function : log

Mu Coefficients :

Estimate Std. Error t value Pr(>|t|)

(Intercept) 3.3798 0.5019 6.734 1.71e-08 \*\*\*

SpeciesWolf 2.3856 0.7863 3.034 0.00386 \*\*

ObjectPipe 1.1979 0.7215 1.660 0.10326

SpeciesWolf:ObjectPipe -1.4831 1.1058 -1.341 0.18603

Sigma link function: log

Sigma Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 0.69691 0.07488 9.307 2.06e-12 \*\*\*

Significance codes: ‘\*\*\*’: P < 0.001, ‘\*\*’: P < 0.01, ‘\*’: P < 0.05

No. of observations in the fit : 54

Degrees of Freedom for the fit : 5

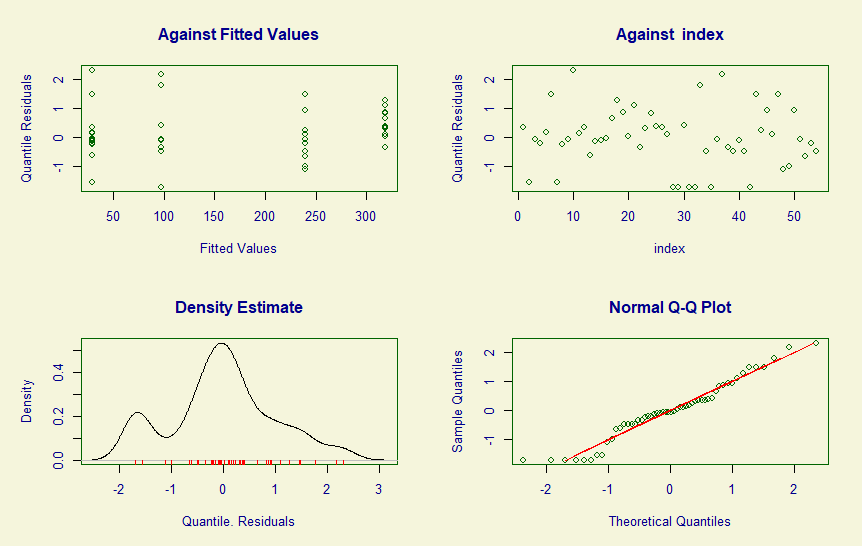
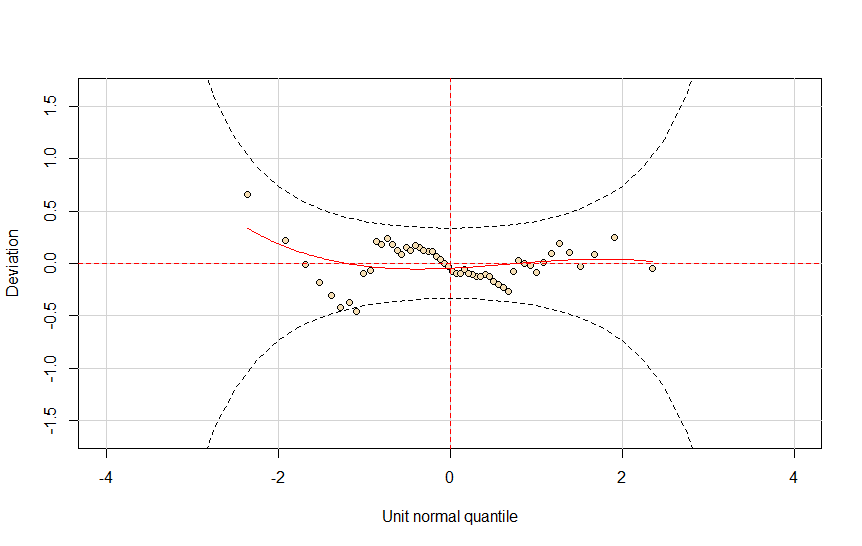
Residual Deg. of Freedom : 49

at cycle : 2

Global Deviance : 475.2195

AIC : 485.2195

SBC : 495.1644



**Supplementary Figure 2.** Diagnostic Residual QQ Plots (above) and detrended QQ Plot / Worm Plot (Below) for the full persistence model.

#### Output – after reduction

Model Formula: gamlss(Persistence.NonZero ~ Species + Object,  
family = "GA", random = ~1 | Individual)

Fitting method : RS()

Mu link function : log

Mu Coefficients :

Estimate Std. Error t value Pr(>|t|)

(Intercept) 3.7299 0.5193 7.183 3.1e-09 \*\*\*

SpeciesWolf 1.6782 0.5883 2.853 0.00629 \*\*

ObjectPipe 0.5733 0.5817 0.986 0.32909

Sigma link function: log

Sigma Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 0.70674 0.07477 9.452 1.03e-12 \*\*\*

Significance codes: ‘\*\*\*’: P < 0.001, ‘\*\*’: P < 0.01, ‘\*’: P < 0.05

No. of observations in the fit : 54

Degrees of Freedom for the fit : 4

Residual Deg. of Freedom : 50

at cycle : 2

Global Deviance : 476.9758

AIC : 484.9758

SBC : 492.9317

### Model for Dogs

Model Formula: gamlss(Persistence.NonZero ~ Object,  
family = "GA", random = ~1 | Individual)

Fitting method : RS()

Mu link function : log

Mu Coefficients :

Estimate Std. Error t value Pr(>|t|)

(Intercept) 3.3798 0.5800 5.827 2.92e-06 \*\*\*

ObjectPipe 1.1979 0.8338 1.437 0.162

Sigma link function: log

Sigma Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 0.84161 0.09691 8.684 1.97e-09 \*\*\*

Significance codes: ‘\*\*\*’: P < 0.001, ‘\*\*’: P < 0.01, ‘\*’: P < 0.05

No. of observations in the fit : 31

Degrees of Freedom for the fit : 3

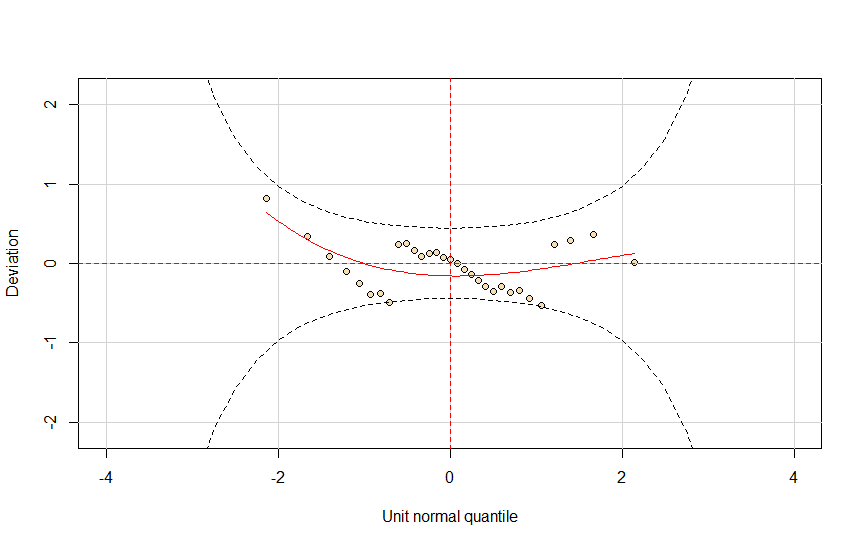
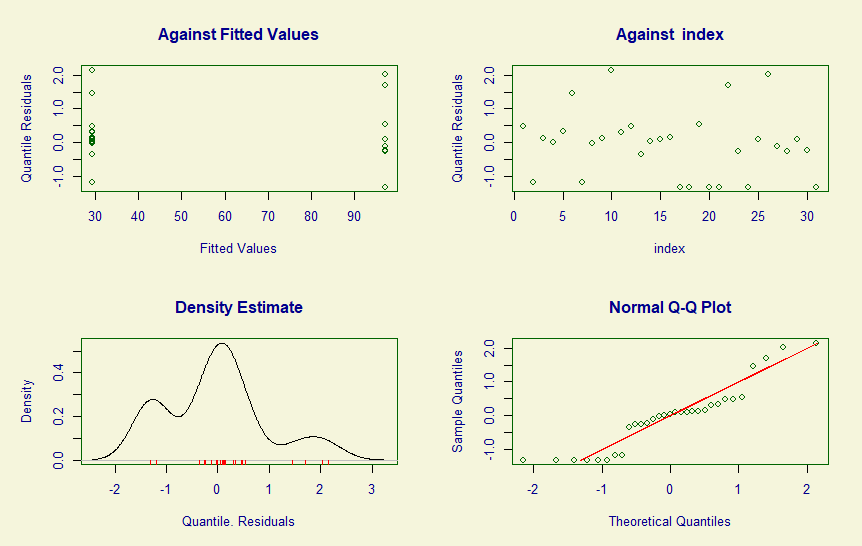
Residual Deg. of Freedom : 28

at cycle : 2

Global Deviance : 173.4407

AIC : 179.4407

SBC : 183.7426



**Supplementary Figure 3.** Diagnostic Residual QQ Plots (above) and detrended QQ Plot / Worm Plot (Below) for the persistence model for dogs.

### Model for Wolves

Model Formula: gamlss(Persistence.NonZero ~ Object,  
family = "GA", random = ~1 | Individual)

Fitting method : RS()

Mu link function : log

Mu Coefficients :

Estimate Std. Error t value Pr(>|t|)

(Intercept) 5.7653 0.4347 13.262 2.28e-11 \*\*\*

ObjectPipe -0.2853 0.6019 -0.474 0.641

Sigma link function: log

Sigma Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 0.3659 0.1213 3.017 0.00681 \*\*

Significance codes: ‘\*\*\*’: P < 0.001, ‘\*\*’: P < 0.01, ‘\*’: P < 0.05

No. of observations in the fit : 23

Degrees of Freedom for the fit : 3

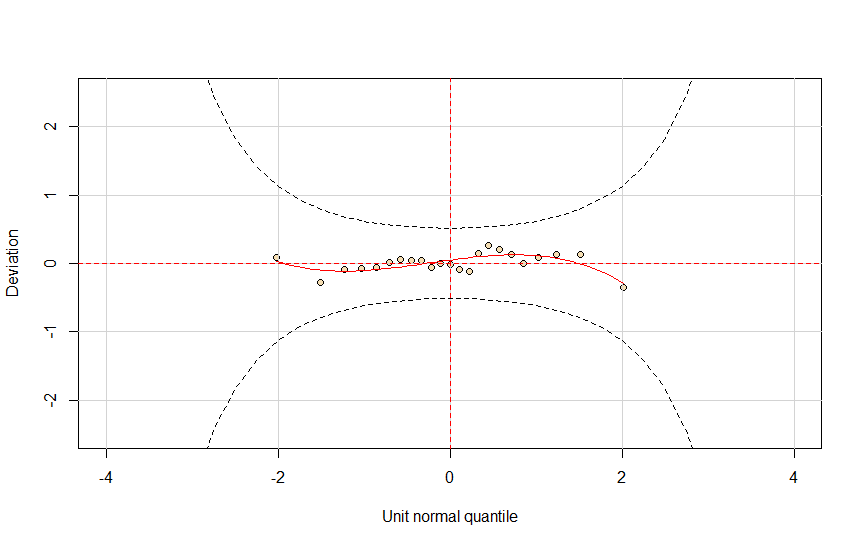
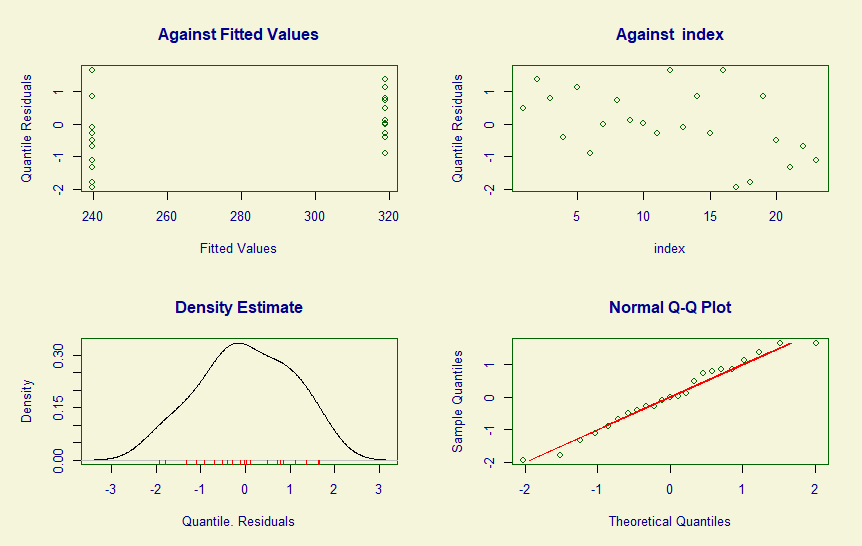
Residual Deg. of Freedom : 20

at cycle : 2

Global Deviance : 293.0476

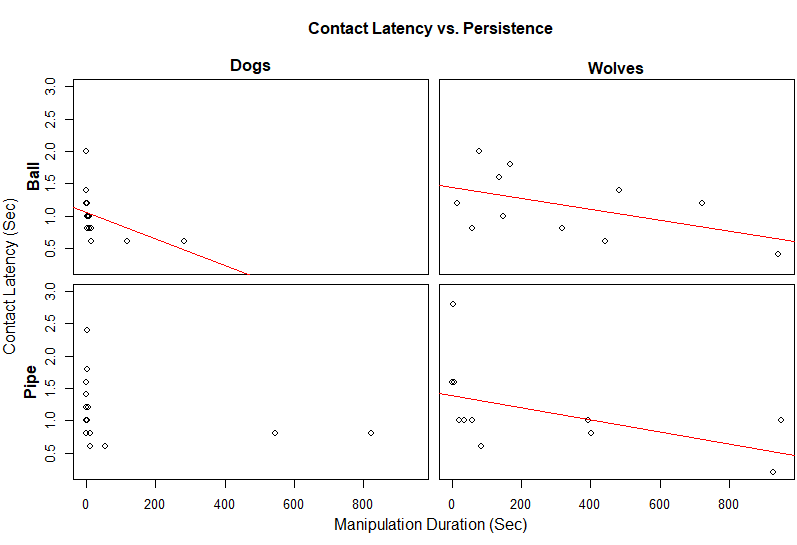
AIC : 299.0476

SBC : 302.454



**Supplementary Figure 4.** Diagnostic Residual QQ Plots (above) and detrended QQ Plot / Worm Plot (Below) for the persistence model for wolves.

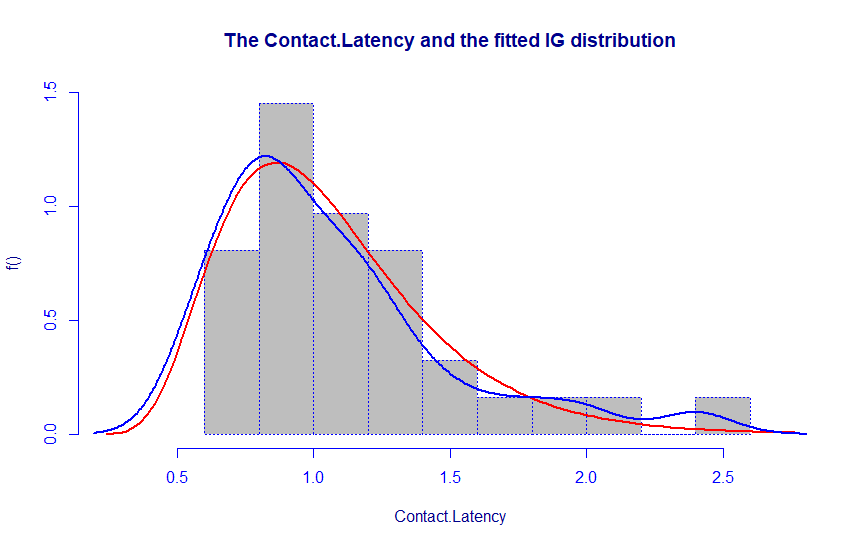
## Contact Latency models



**Supplementary Figure 5.** Scatter plots showing the relationship between persistence and contact latency in dogs and wolves. Red lines show statistically significant trends.

### Model for Dogs (both objects)

Data Distribution: Inverse Gaussian (Supplementary Figure 6)



**Supplementary Figure 6.** This figure shows the best fitting distribution for dogs’ latency data for both objects. The grey bars show a histogram, the blue line shows a kernel density estimate and the red line shows the fit distribution.

#### Output – Initial model

Model Formula: gamlss(Contact.Latency ~ Object\*Approach.Posture +   
Object\*Persistence, family = "IG", random = ~1 | Individual)

Fitting method : RS()

Mu link function : log

Mu Coefficients :

Estimate Std. Error t value Pr(>|t|)

(Intercept) -0.0047426 0.0917484 -0.052 0.9592

ObjectPipe 0.1884369 0.1344814 1.401 0.1739

Approach.PostureUnsure 0.1930160 0.2157746 0.895 0.3799

Persistence -0.0020949 0.0007516 -2.787 0.0102 \*

ObjectPipe:Approach.PostureUnsure -0.3767103 0.3901429 -0.966 0.3439

ObjectPipe:Persistence 0.0015127 0.0007711 1.962 0.0615

Sigma link function: log

Sigma Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) -1.1718 0.1319 -8.885 4.7e-09 \*\*\*

Significance codes: ‘\*\*\*’: P < 0.001, ‘\*\*’: P < 0.01, ‘\*’: P < 0.05

No. of observations in the fit : 31

Degrees of Freedom for the fit : 7

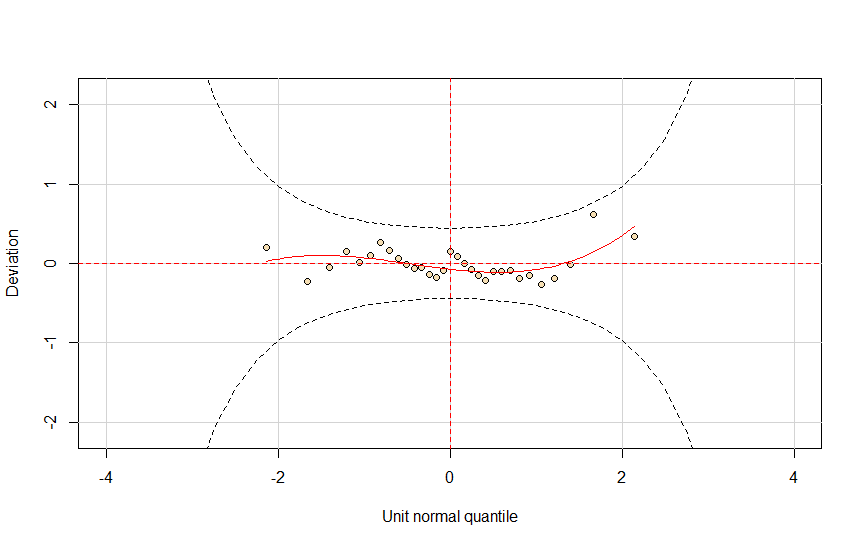
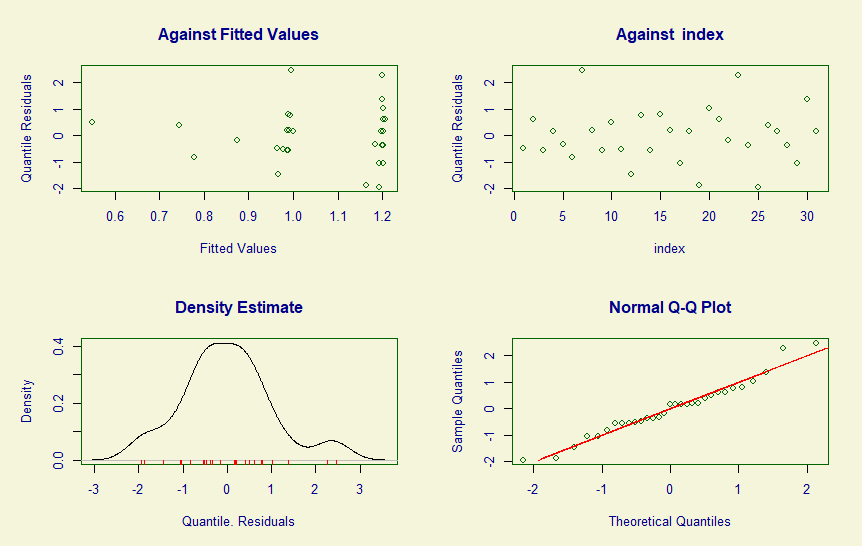
Residual Deg. of Freedom : 24

at cycle : 2

Global Deviance : 14.26868

AIC : 28.26868

SBC : 38.30659



**Supplementary Figure 7.** Diagnostic Residual QQ Plots (above) and detrended QQ Plot / Worm Plot (Below) for the latency model for dogs (both objects).

#### Output – after reduction

Model Formula: gamlss(Contact.Latency ~ Object\*Persistence,   
family = "IG", random = ~1 | Individual)

Fitting method : RS()

Mu link function : log

Mu Coefficients :

Estimate Std. Error t value Pr(>|t|)

(Intercept) 0.038841 0.084963 0.457 0.65136

ObjectPipe 0.131939 0.127902 1.032 0.31178

Persistence -0.002261 0.000751 -3.010 0.00574 \*\*

ObjectPipe:Persistence 0.001696 0.000771 2.200 0.03691 \*

Sigma link function: log

Sigma Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) -1.1532 0.1316 -8.763 3.08e-09 \*\*\*

Significance codes: ‘\*\*\*’: P < 0.001, ‘\*\*’: P < 0.01, ‘\*’: P < 0.05

No. of observations in the fit : 31

Degrees of Freedom for the fit : 5

Residual Deg. of Freedom : 26

at cycle : 2

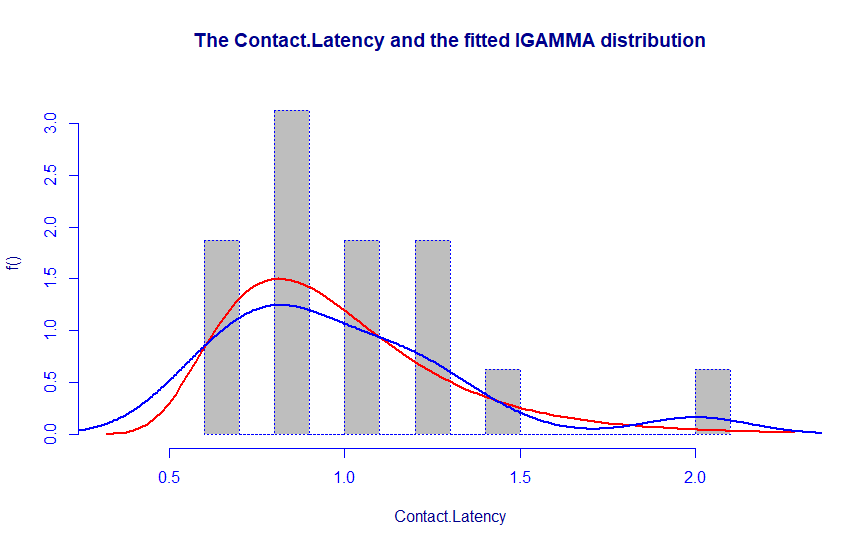
Global Deviance : 15.42009

AIC : 25.42009

SBC : 32.59003

### Model for Dogs (Ball only)

Data Distribution: Inverse Gamma (Supplementary Figure 8)



**Supplementary Figure 8.** This figure shows the best fitting distribution for dogs’ latency data with the ball. The grey bars show a histogram, the blue line shows a kernel density estimate and the red line shows the fit distribution.

Model Formula: gamlss(Contact.Latency ~ Persistence, family = "IGAMMA")

Fitting method : RS()

Mu link function : log

Mu Coefficients :

Estimate Std. Error t value Pr(>|t|)

(Intercept) -0.1070376 0.0721967 -1.483 0.1603

Persistence -0.0022034 0.0009402 -2.344 0.0344 \*

Sigma link function: log

Sigma Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) -1.322 0.165 -8.01 8.48e-07 \*\*\*

Significance codes: ‘\*\*\*’: P < 0.001, ‘\*\*’: P < 0.01, ‘\*’: P < 0.05

No. of observations in the fit : 16

Degrees of Freedom for the fit : 3

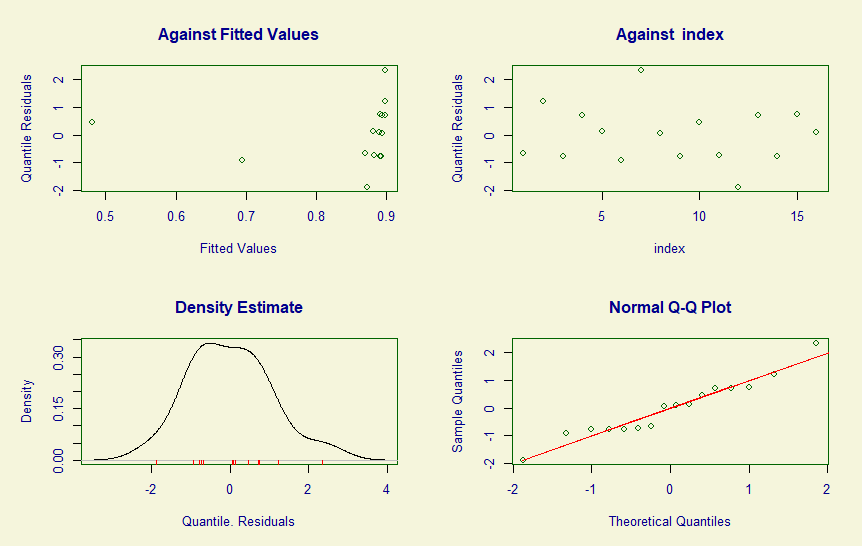
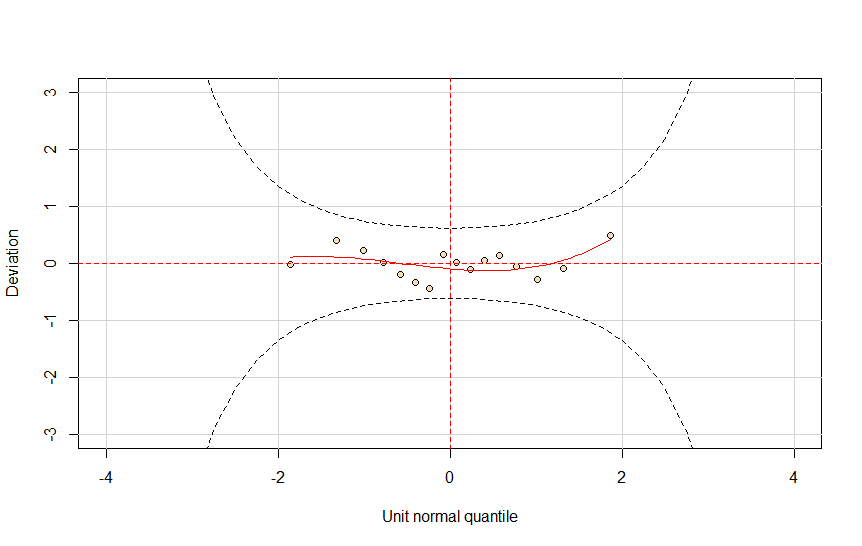
Residual Deg. of Freedom : 13

at cycle : 9

Global Deviance : 1.345757

AIC : 7.345757

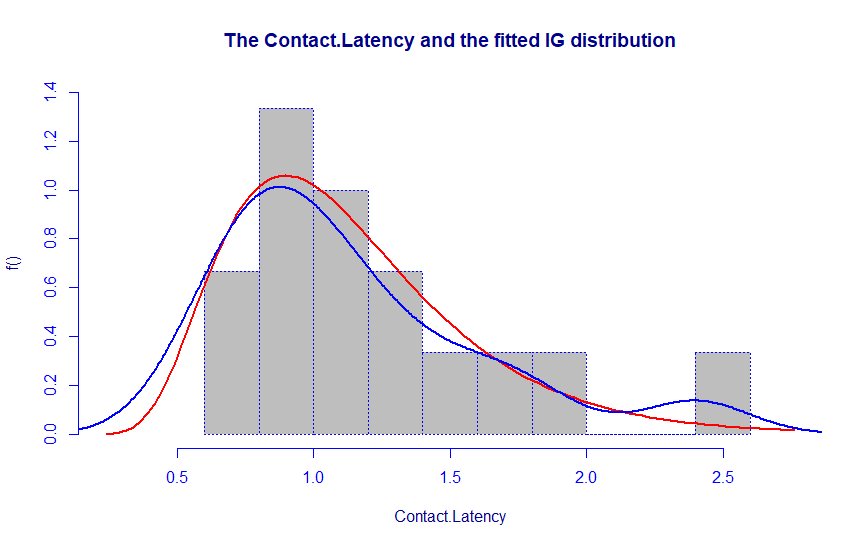
SBC : 9.663523



**Supplementary Figure 9.** Diagnostic Residual QQ Plots (above) and detrended QQ Plot / Worm Plot (Below) for the latency model for dogs with the ball.

### Model for Dogs (Pipe Only)

Data Distribution: Inverse Gaussian (Supplementary Figure 10)



**Supplementary Figure 10.** This figure shows the best fitting distribution for dogs’ latency data with the pipe. The grey bars show a histogram, the blue line shows a kernel density estimate and the red line shows the fit distribution.

Model Formula: gamlss(Contact.Latency ~ Persistence, family = "IG")

Fitting method : RS()

Mu link function : log

Mu Coefficients :

Estimate Std. Error t value Pr(>|t|)

(Intercept) 0.1707804 0.1056188 1.617 0.130

Persistence -0.0005646 0.0003470 -1.627 0.128

Sigma link function: log

Sigma Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) -1.0545 0.1826 -5.776 4.8e-05 \*\*\*

Significance codes: ‘\*\*\*’: P < 0.001, ‘\*\*’: P < 0.01, ‘\*’: P < 0.05

No. of observations in the fit : 15

Degrees of Freedom for the fit : 3

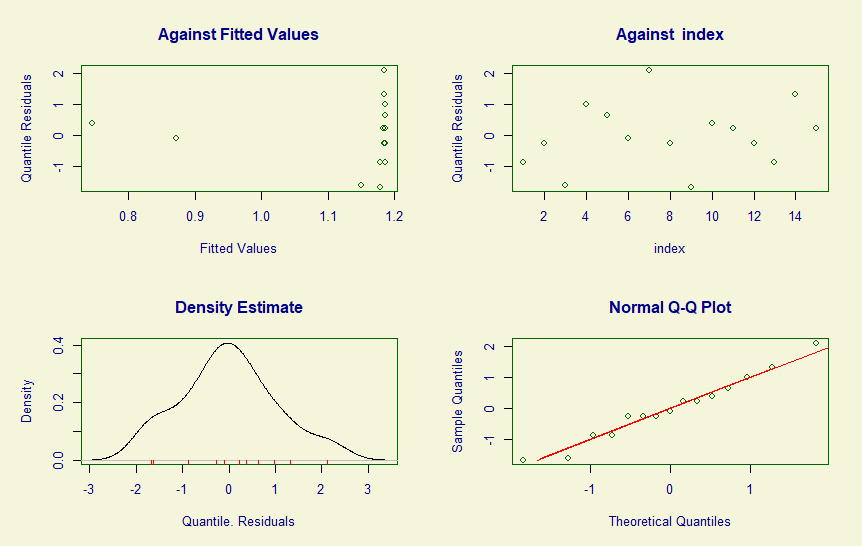
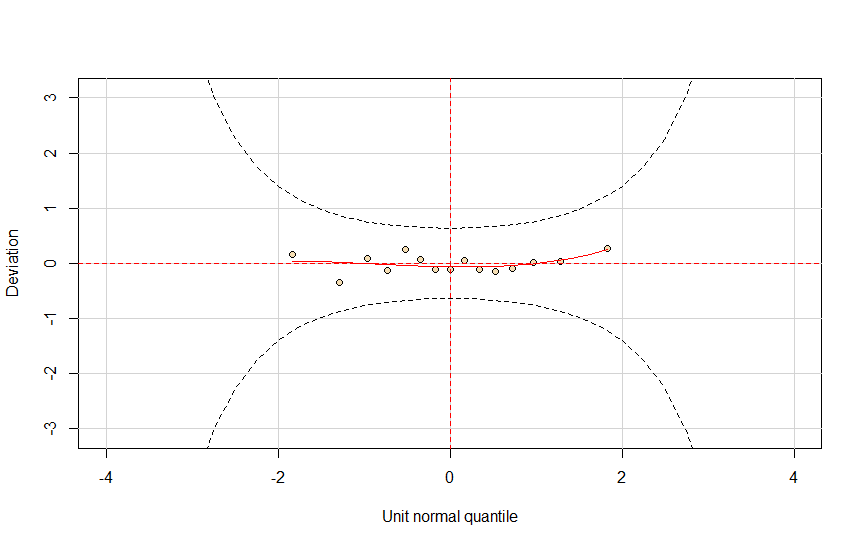
Residual Deg. of Freedom : 12

at cycle : 2

Global Deviance : 13.09385

AIC : 19.09385

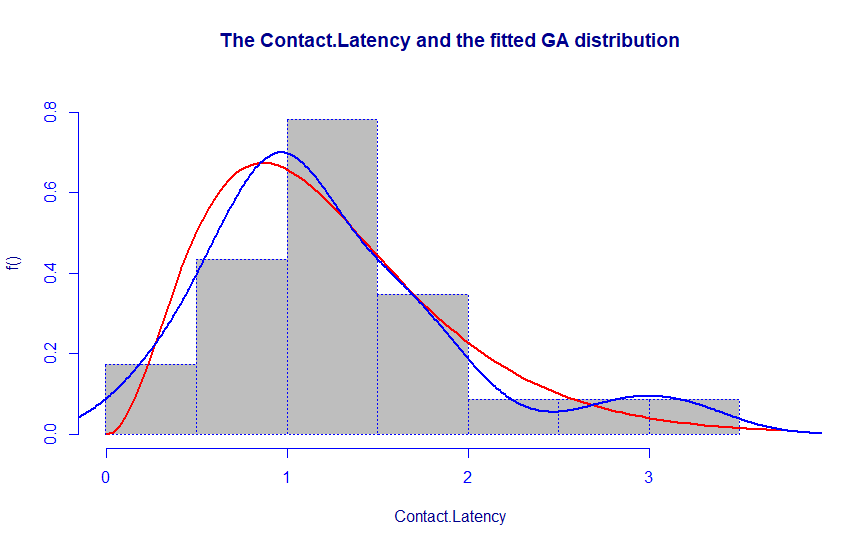
SBC : 21.218



**Supplementary Figure 11.** Diagnostic Residual QQ Plots (above) and detrended QQ Plot / Worm Plot (Below) for the latency model for dogs with the pipe.

### Model for Wolves (Both objects)

Data Distribution: Gamma (Supplementary Figure 12)



**Supplementary Figure 12.** This figure shows the best fitting distribution for wolves’ latency data for both objects. The grey bars show a histogram, the blue line shows a kernel density estimate and the red line shows the fit distribution.

#### Output – initial model

Model Formula: gamlss(Contact.Latency ~ Object\*Approach.Posture +   
Object\*Persistence, family = "GA", random = ~1 | Individual)

Fitting method : RS()

Mu link function : log

Mu Coefficients :

Estimate Std. Error t value Pr(>|t|)

(Intercept) 0.4472794 0.1998355 2.238 0.0389 \*

ObjectPipe 0.0306313 0.2509205 0.122 0.9043

Persistence -0.0008132 0.0004253 -1.912 0.0729

ObjectBall:Approach.PostureUnsure -0.4108930 0.3525895 -1.165 0.2600

ObjectPipe:Persistence -0.0003220 0.0005229 -0.616 0.5461

Sigma link function: log

Sigma Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) --0.8114 0.1463 -5.547 3.55e-05 \*\*\*

Significance codes: ‘\*\*\*’: P < 0.001, ‘\*\*’: P < 0.01, ‘\*’: P < 0.05

No. of observations in the fit : 23

Degrees of Freedom for the fit : 6

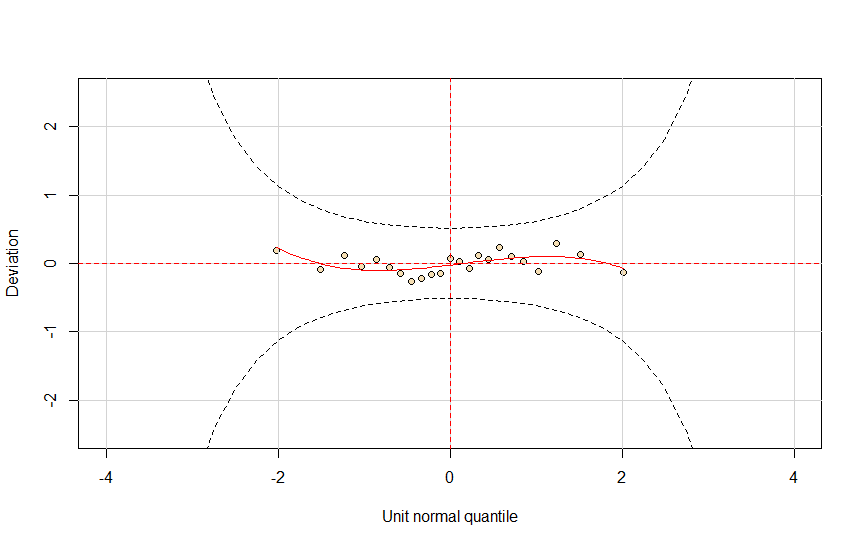
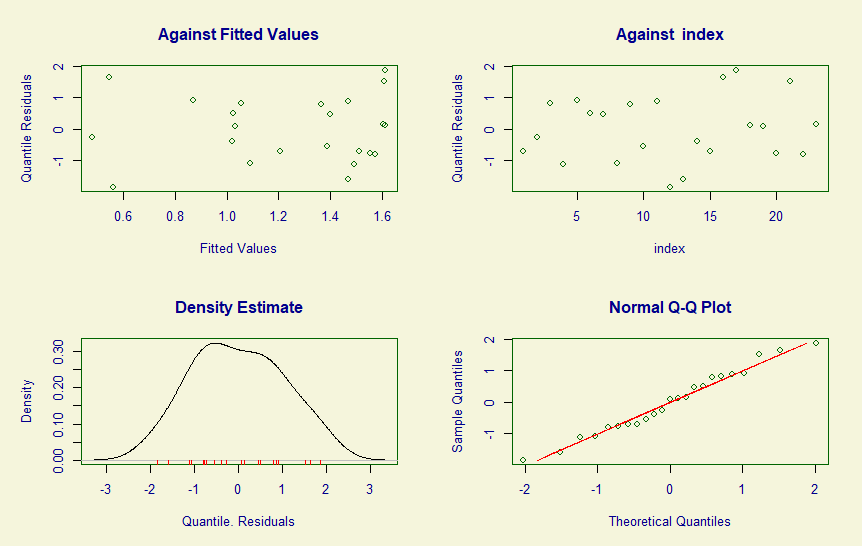
Residual Deg. of Freedom : 17

at cycle : 2

Global Deviance : 32.19387

AIC : 44.19387

SBC : 51.00683



**Supplementary Figure 13.** Diagnostic Residual QQ Plots (above) and detrended QQ Plot / Worm Plot (Below) for the latency model for wolves (both objects).

#### Output – after reduction

Model Formula: gamlss(Contact.Latency ~ Persistence,   
family = "IG", random = ~1 | Individual)

Fitting method : RS()

Mu link function : log

Mu Coefficients :

Estimate Std. Error t value Pr(>|t|)

(Intercept) 0.4578351 0.1245598 3.676 0.001500 \*\*

Persistence -0.0010453 0.0002653 -3.939 0.000811 \*\*\*

Sigma link function: log

Sigma Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) -0.7830 0.1456 -5.379 2.89e-05 \*\*\*

Significance codes: ‘\*\*\*’: P < 0.001, ‘\*\*’: P < 0.01, ‘\*’: P < 0.05

No. of observations in the fit : 23

Degrees of Freedom for the fit : 3

Residual Deg. of Freedom : 20

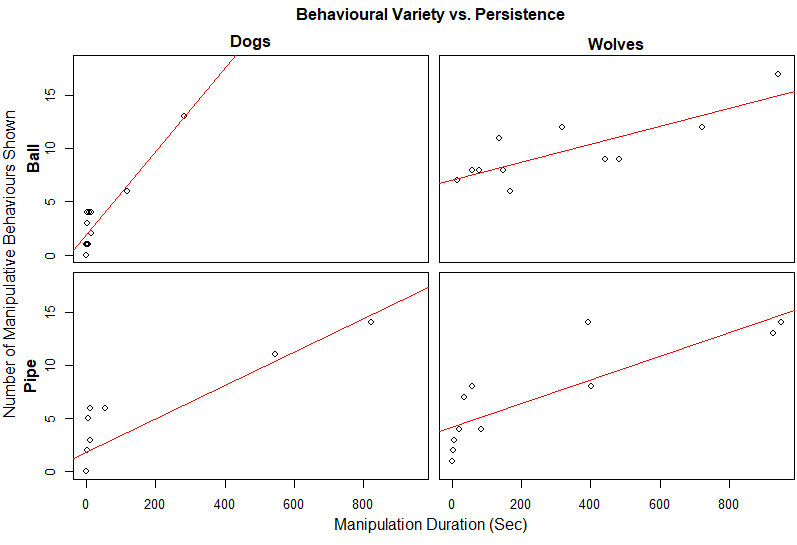
at cycle : 2

Global Deviance : 33.58641

AIC : 39.58641

SBC : 42.99289

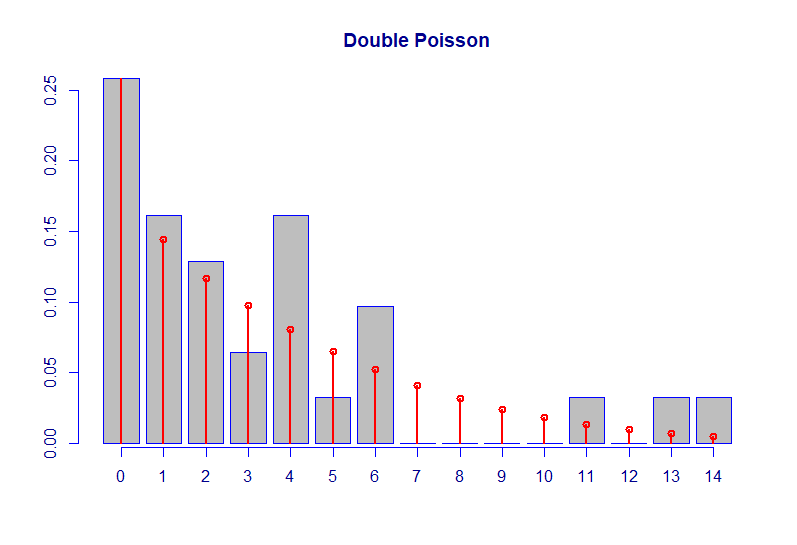
## Behavioural Variety models



**Supplementary Figure 14.** Scatter plots showing the relationship between persistence and behavioural variety in dogs and wolves. Red lines show statistically significant trends.

### Model for Dogs (Both objects)

Data Distribution: Double Poisson (Supplementary Figure 15)



**Supplementary Figure 15.** This figure shows the best fitting distribution for dogs’ behavioural variety data for both objects. The grey bars show a histogram (behavioural variety is plotted on the x axis and frequency on the y axis) and the red lines shows the fit distribution.

Model Formula: gamlss(Behavioural.Variety ~ Object\*Persistence,   
family = "DPO", random = ~1 | Individual)

Fitting method : RS()

Mu link function : log

Mu Coefficients :

Estimate Std. Error t value Pr(>|t|)

(Intercept) 0.744245 0.245678 3.029 0.00548 \*\*

ObjectPipe -0.057195 0.360233 -0.159 0.87507

Persistence 0.006681 0.001538 4.344 0.00019 \*\*\*

ObjectPipe:Persistence -0.004117 0.001600 -2.573 0.01615 \*

Sigma link function: log

Sigma Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 0.5658 0.2982 1.898 0.0689

Significance codes: ‘\*\*\*’: P < 0.001, ‘\*\*’: P < 0.01, ‘\*’: P < 0.05

No. of observations in the fit : 31

Degrees of Freedom for the fit : 5

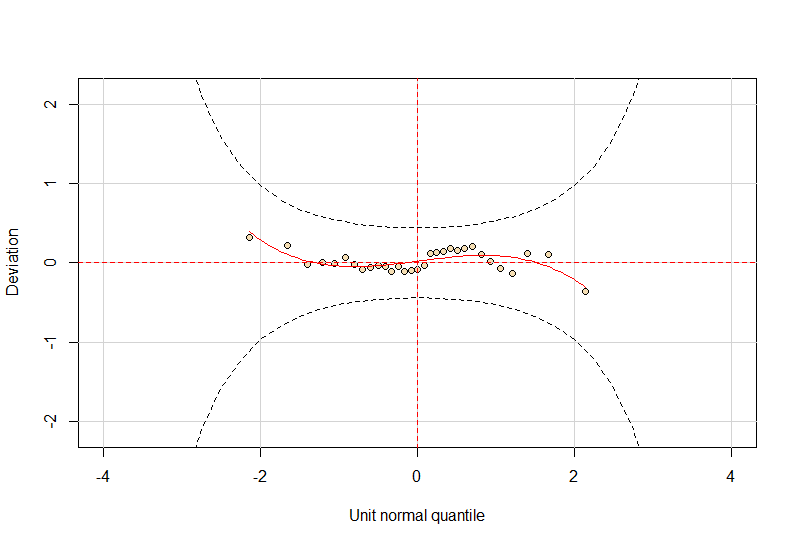
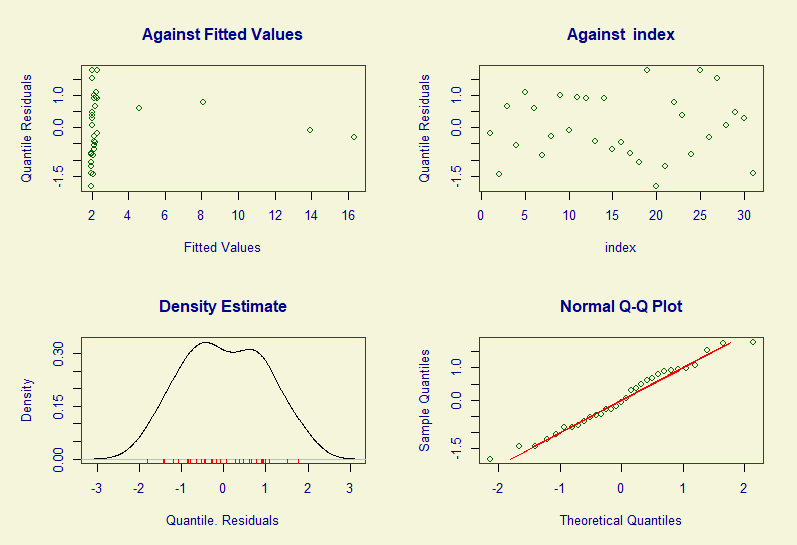
Residual Deg. of Freedom : 26

at cycle : 3

Global Deviance : 121.6563

AIC : 131.6563

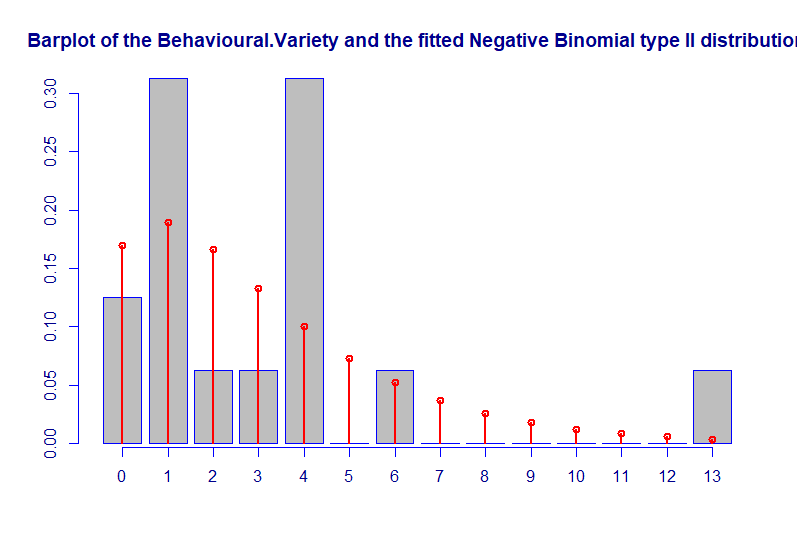
SBC : 138.8262



**Supplementary Figure 16.** Diagnostic Residual QQ Plots (above) and detrended QQ Plot / Worm Plot (Below) for the behavioural model for dogs (both objects).

### Model for Dogs (Ball only)

Data Distribution: Negative Binomial type II (Supplementary Figure 17)



**Supplementary Figure 17.** This figure shows the best fitting distribution for dogs’ behavioural variety data for the ball. The grey bars show a histogram (behavioural variety is plotted on the x axis and frequency on the y axis) and the red lines shows the fit distribution.

Model Formula: gamlss(Behavioural.Variety ~ Persistence,   
family = "NBII", random = ~1 | Individual)

Fitting method : RS()

Mu link function : log

Mu Coefficients :

Estimate Std. Error t value Pr(>|t|)

(Intercept) 0.7007885 0.0847888 8.265 9.35e-07 \*\*\*

Persistence 0.0069811 0.0003337 20.923 5.83e-12 \*\*\*

Sigma link function: log

Sigma Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) -33.72915 0.03114 -1083 <2e-16 \*\*\*

Significance codes: ‘\*\*\*’: P < 0.001, ‘\*\*’: P < 0.01, ‘\*’: P < 0.05

No. of observations in the fit : 16

Degrees of Freedom for the fit : 3

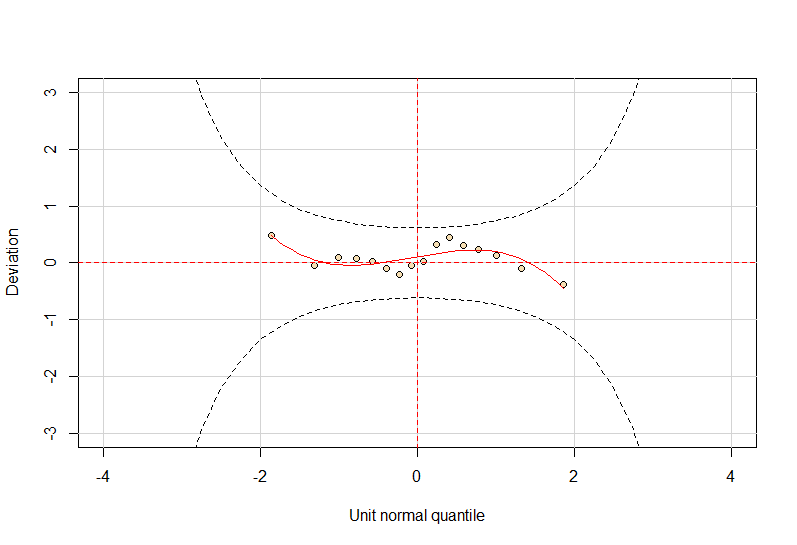
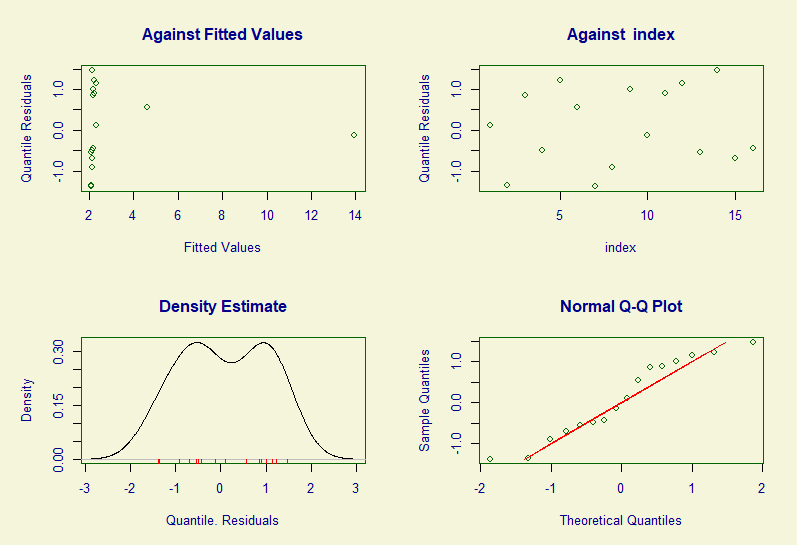
Residual Deg. of Freedom : 13

at cycle : 114

Global Deviance : 58.82094

AIC : 64.82094

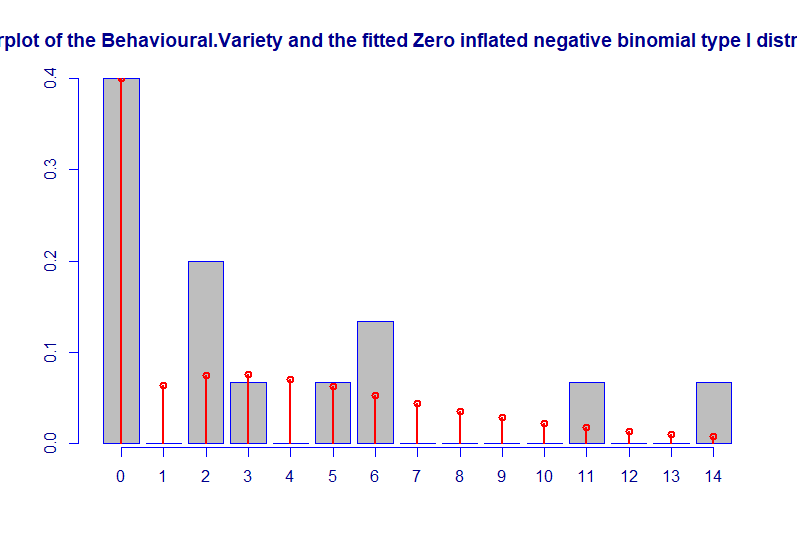
SBC : 67.13871



**Supplementary Figure 18.** Diagnostic Residual QQ Plots (above) and detrended QQ Plot / Worm Plot (Below) for the behavioural model for dogs (both objects).

### Model for Dogs (Pipe only)

Data Distribution: Zero Inflated Negative Binomial type I (Supplementary Figure 19)



**Supplementary Figure 19.** This figure shows the best fitting distribution for dogs’ behavioural variety data for the pipe. The grey bars show a histogram (behavioural variety is plotted on the x axis and frequency on the y axis) and the red lines shows the fit distribution.

Model Formula: gamlss(Behavioural.Variety ~ Object\*Persistence,   
family = "ZINBI", random = ~1 | Individual)

Fitting method : RS()

Mu link function : log

Mu Coefficients :

Estimate Std. Error t value Pr(>|t|)

(Intercept) 1.2667618 0.2293453 5.523 9.82e-05 \*\*\*

Persistence 0.0017764 0.0008244 2.155 0.0505

Sigma link function: log

Sigma Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) -36.08113 0.01872 -1927 <2e-16 \*\*\*

Significance codes: ‘\*\*\*’: P < 0.001, ‘\*\*’: P < 0.01, ‘\*’: P < 0.05

No. of observations in the fit : 15

Degrees of Freedom for the fit : 4

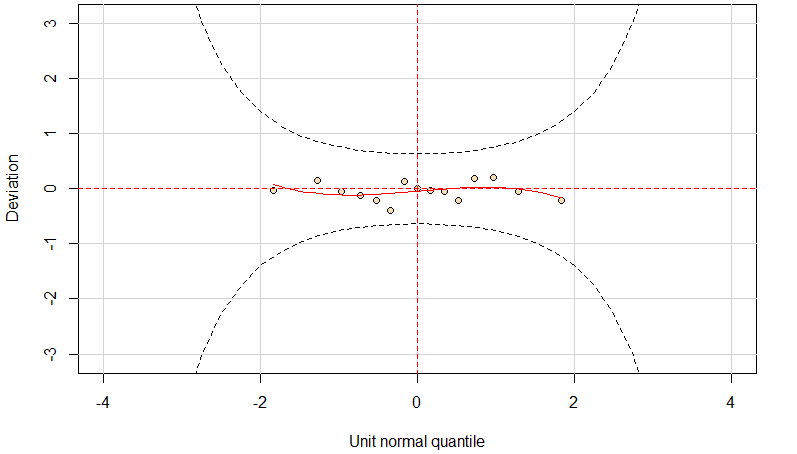
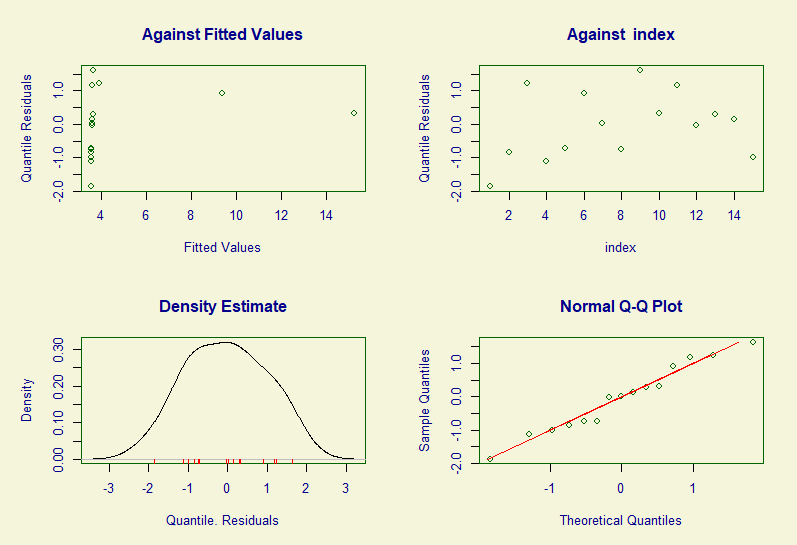
Residual Deg. of Freedom : 11

at cycle : 4

Global Deviance : 55.72675

AIC : 63.72675

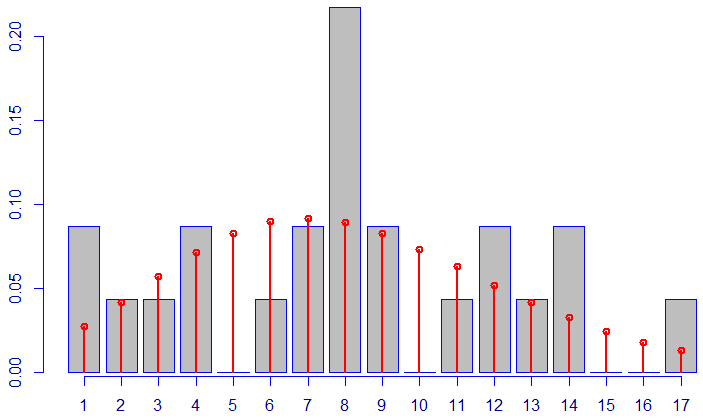
SBC : 66.55895



**Supplementary Figure 20.** Diagnostic Residual QQ Plots (above) and detrended QQ Plot / Worm Plot (Below) for the behavioural model for dogs (both objects).

### Model for Wolves (both objects)

Data Distribution: Double Poisson (Supplementary Figure 21)



**Supplementary Figure 21.** This figure shows the best fitting distribution for dogs’ behavioural variety data for both objects. The grey bars show a histogram (behavioural variety is plotted on the x axis and frequency on the y axis) and the red lines shows the fit distribution.

#### Output – initial model

Model Formula: gamlss(Behavioural.Variety ~ Object\*Persistence,   
family = "DPO", random = ~1 | Individual)

Fitting method : RS()

Mu link function : log

Mu Coefficients :

Estimate Std. Error t value Pr(>|t|)

(Intercept) 2.0067160 0.1440354 13.932 4.41e-11 \*\*\*

ObjectPipe -0.5913600 0.2088115 -2.832 0.0111 \*

Persistence 0.0007498 0.0002655 2.824 0.0112 \*

ObjectPipe:Persistence 0.0006431 0.0003387 1.898 0.0738

Sigma link function: log

Sigma Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) -0.1169 0.3101 -0.377 0.711

Significance codes: ‘\*\*\*’: P < 0.001, ‘\*\*’: P < 0.01, ‘\*’: P < 0.05

No. of observations in the fit : 23

Degrees of Freedom for the fit : 5

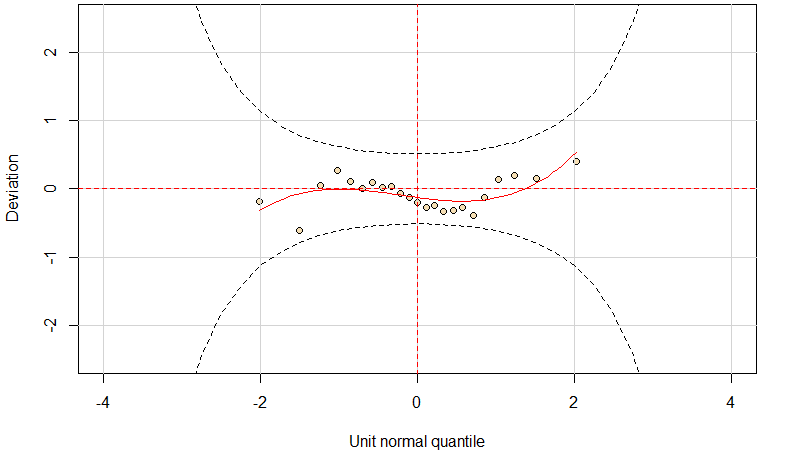
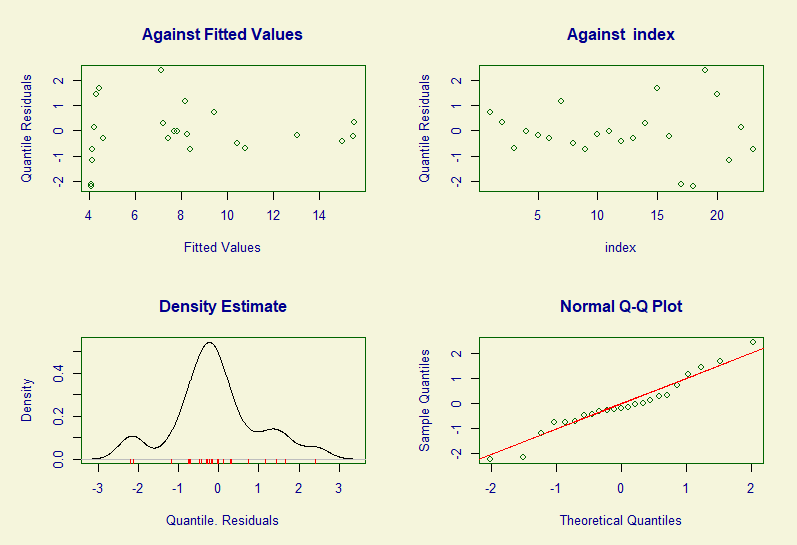
Residual Deg. of Freedom : 18

at cycle : 2

Global Deviance : 107.0752

AIC : 117.0752

SBC : 122.7526



**Supplementary Figure 22.** Diagnostic Residual QQ Plots (above) and detrended QQ Plot / Worm Plot (Below) for the behavioural model for dogs (both objects).

#### Output – after reduction

Model Formula: gamlss(Behavioural.Variety ~ Object + Persistence,   
family = "DPO", random = ~1 | Individual)

Fitting method : RS()

Mu link function : log

Mu Coefficients :

Estimate Std. Error t value Pr(>|t|)

(Intercept) 1.8593750 0.1297384 14.332 1.22e-11 \*\*\*

ObjectPipe -0.3301370 0.1466826 -2.251 0.0364 \*

Persistence 0.0011270 0.0001907 5.909 1.09e-05 \*\*\*

Sigma link function: log

Sigma Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) -0.02217 0.30976 -0.072 0.944

Significance codes: ‘\*\*\*’: P < 0.001, ‘\*\*’: P < 0.01, ‘\*’: P < 0.05

No. of observations in the fit : 23

Degrees of Freedom for the fit : 4

Residual Deg. of Freedom : 19

at cycle : 2

Global Deviance : 109.3864

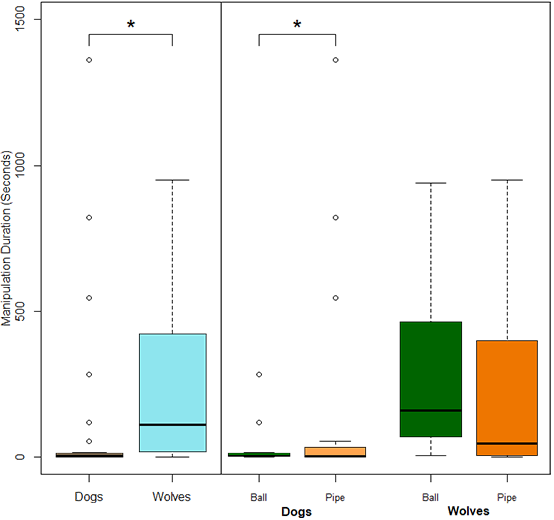
AIC : 117.3864

SBC : 121.9284

# Results for analyses for persistence including outliers

Wolves were more persistent than dogs (GAMLSS: t = 2.21, P = 0.032) in their manipulation of both objects (i.e. the interaction between species and object was not significant, GAMLSS: t = -1.82, P = 0.07). Dogs manipulated the pipe significantly longer than the ball (GAMLSS: t = 2.16, P = 0.04) but wolves’ persistence did not differ significantly between the two objects (GAMLSS: t = -0.33, P = 0.74) (Figure 23).

Figure 23: Differences in persistence between dogs and wolves

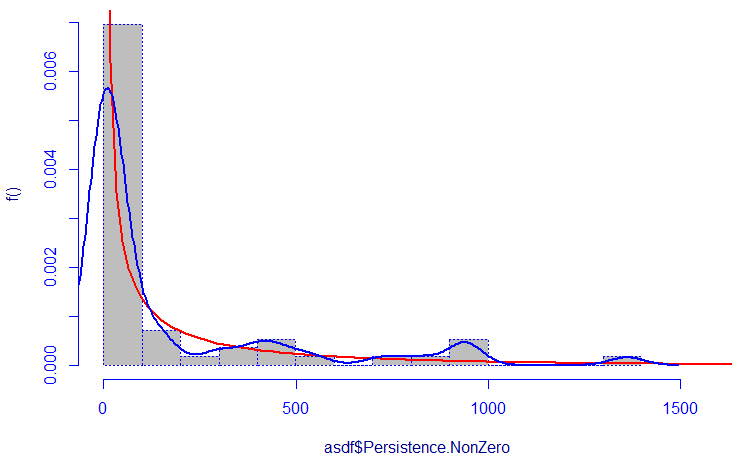


Left: Plot (including outliers) showing time (in seconds) spent manipulating both apparatuses combined for dogs and wolves. Right: Plot (including outliers) showing time (in seconds) spent manipulating each object separately for dogs and wolves. Circles indicate outliers, \* indicates a P value under 0.05 at α = 0.05.

# GAMLSS model information for persistence models including outliers

## Full model

Data Distribution: Gamma (Supplementary Figure 26)



**Supplementary Figure 26.** This figure shows the best fitting distribution for the persistence data including outliers (after addition of a miniscule constant to all values). The grey bars show a histogram, the blue line shows a kernel density estimate and the red line shows the fit distribution.

#### Output – Initial model

Model Formula: gamlss(Persistence.NonZero ~ Species \* Object,   
family = "GA", random = ~1 | Individual)

Fitting method : RS()

Mu link function : log

Mu Coefficients :

Estimate Std. Error t value Pr(>|t|)

(Intercept) 3.3798 0.5074 6.660 1.87e-08 \*\*\*

SpeciesWolf 2.3001 0.7751 2.967 0.00456 \*\*

ObjectPipe 1.7922 0.7176 2.497 0.01578 \*

SpeciesWolf:ObjectPipe -1.9921 1.0962 -1.817 0.07505

Sigma link function: log

Sigma Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 0.70792 0.07341 9.643 4.38e-13 \*\*\*

Significance codes: ‘\*\*\*’: P < 0.001, ‘\*\*’: P < 0.01, ‘\*’: P < 0.05

No. of observations in the fit : 56

Degrees of Freedom for the fit : 5

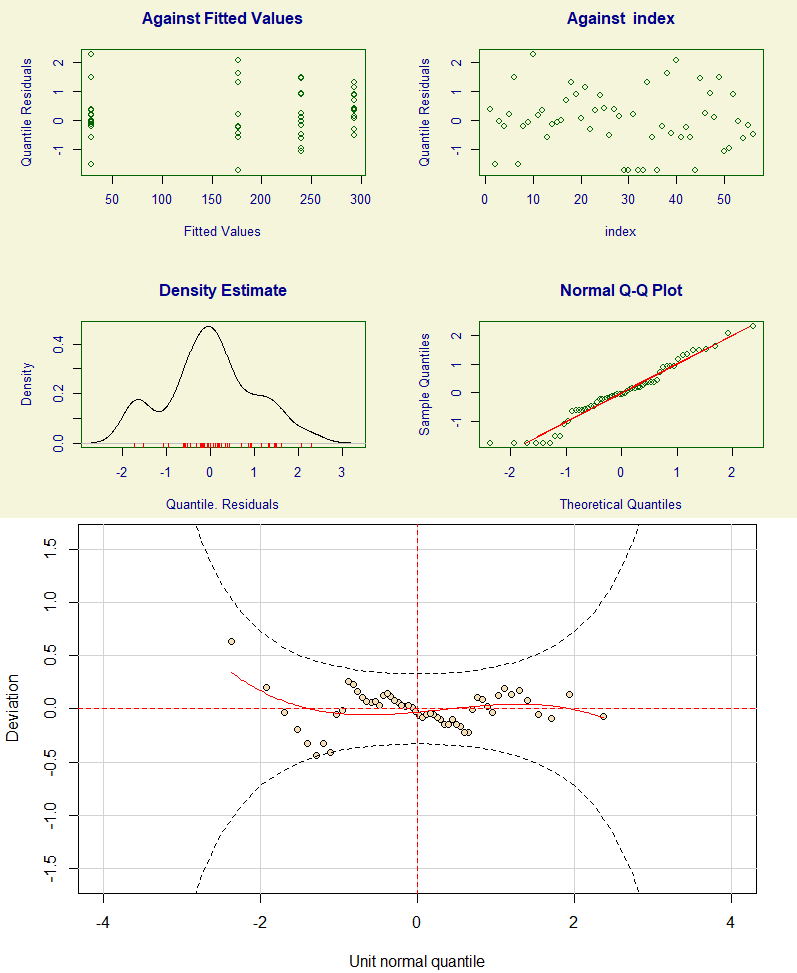
Residual Deg. of Freedom : 51

at cycle : 2

Global Deviance : 505.5419

AIC : 515.5419

SBC : 525.6687



**Supplementary Figure 27.** Diagnostic Residual QQ Plots (above) and detrended QQ Plot / Worm Plot (Below) for the full persistence model.

#### Output – after reduction

Model Formula: gamlss(Persistence.NonZero ~ Species + Object,  
family = "GA", random = ~1 | Individual)

Fitting method : RS()

Mu link function : log

Mu Coefficients :

Estimate Std. Error t value Pr(>|t|)

(Intercept) 3.8782 0.5646 6.869 8.02e-09 \*\*\*

SpeciesWolf 1.3800 0.6253 2.207 0.0317 \*

ObjectPipe 0.9631 0.6189 1.556 0.1257

Sigma link function: log

Sigma Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 0.72466 0.07323 9.895 1.49e-13 \*\*\*

Significance codes: ‘\*\*\*’: P < 0.001, ‘\*\*’: P < 0.01, ‘\*’: P < 0.05

No. of observations in the fit : 56

Degrees of Freedom for the fit : 4

Residual Deg. of Freedom : 52

at cycle : 2

Global Deviance : 508.6553

AIC : 516.6553

SBC : 524.7567

## Model for Dogs including outliers

Model Formula: gamlss(Persistence.NonZero ~ Object,  
family = "GA", random = ~1 | Individual)

Fitting method : RS()

Mu link function : log

Mu Coefficients :

Estimate Std. Error t value Pr(>|t|)

(Intercept) 3.3798 0.5856 5.771 2.99e-06 \*\*\*

ObjectPipe 1.7922 0.8282 2.164 0.0388 \*

Sigma link function: log

Sigma Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 0.85119 0.09527 8.934 7.97e-10 \*\*\*

Significance codes: ‘\*\*\*’: P < 0.001, ‘\*\*’: P < 0.01, ‘\*’: P < 0.05

No. of observations in the fit : 32

Degrees of Freedom for the fit : 3

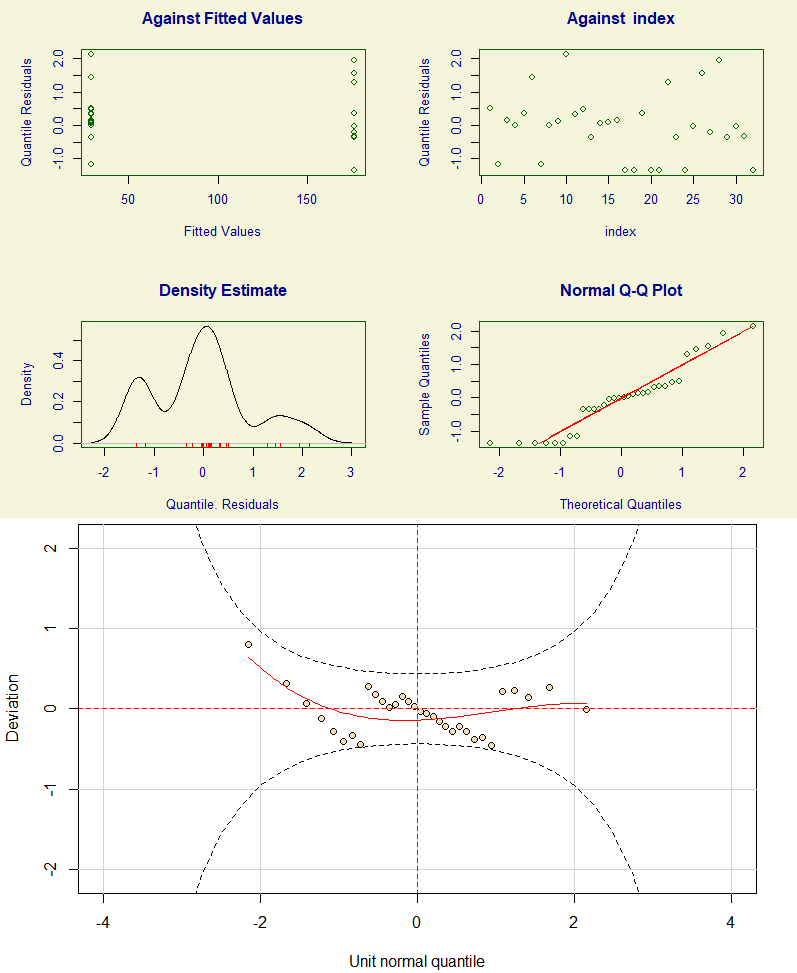
Residual Deg. of Freedom : 29

at cycle : 2

Global Deviance : 194.6167

AIC : 200.6167

SBC : 205.0139



**Supplementary Figure 28.** Diagnostic Residual QQ Plots (above) and detrended QQ Plot / Worm Plot (Below) for the persistence model for dogs including outliers.

## Model for Wolves including outliers

Model Formula: gamlss(Persistence.NonZero ~ Object,  
family = "GA", random = ~1 | Individual)

Fitting method : RS()

Mu link function : log

Mu Coefficients :

Estimate Std. Error t value Pr(>|t|)

(Intercept) 5.6799 0.4256 13.345 1e-11 \*\*\*

ObjectPipe -0.1999 0.6019 -0.332 0.743

Sigma link function: log

Sigma Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 0.3882 0.1182 3.283 0.00354 \*\*

Significance codes: ‘\*\*\*’: P < 0.001, ‘\*\*’: P < 0.01, ‘\*’: P < 0.05

No. of observations in the fit : 24

Degrees of Freedom for the fit : 3

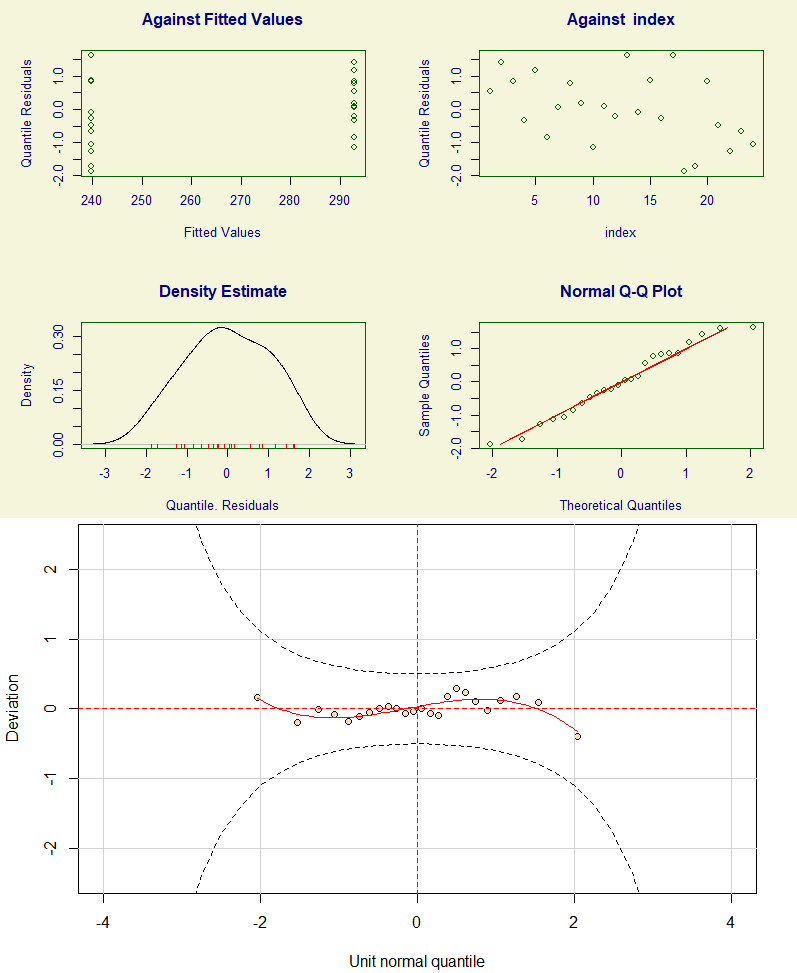
Residual Deg. of Freedom : 21

at cycle : 2

Global Deviance : 302.2474

AIC : 308.2474

SBC : 311.7816



**Supplementary Figure 29.** Diagnostic Residual QQ Plots (above) and detrended QQ Plot / Worm Plot (Below) for the persistence model for wolves.