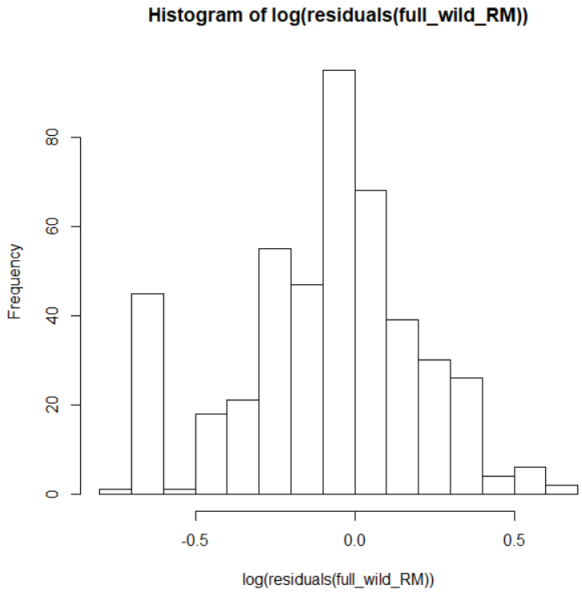
Model suggested by Roger (**full_wild_RM**): Success ~ Age + Sex + Complexity + Rarity +(1|Mother/Beggar) + (1|Food Item)+ (1|Month)

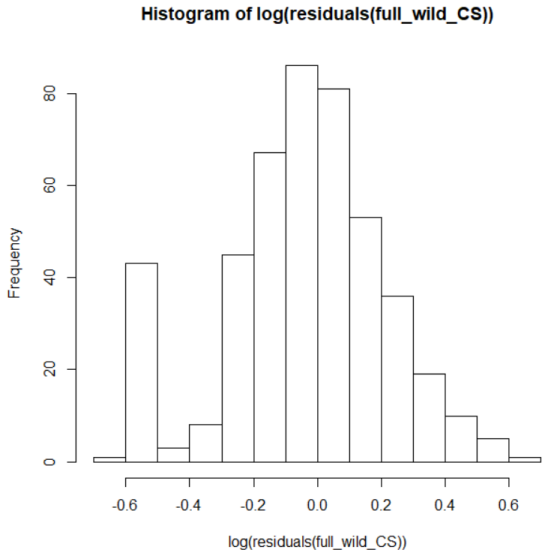
Model suggested by Caroline (**full_wild_CS**): Success ~ Age + Sex + Complexity + Rarity +(1|Mother/Beggar) + (1|Food Item)+ (1|AgeClass)

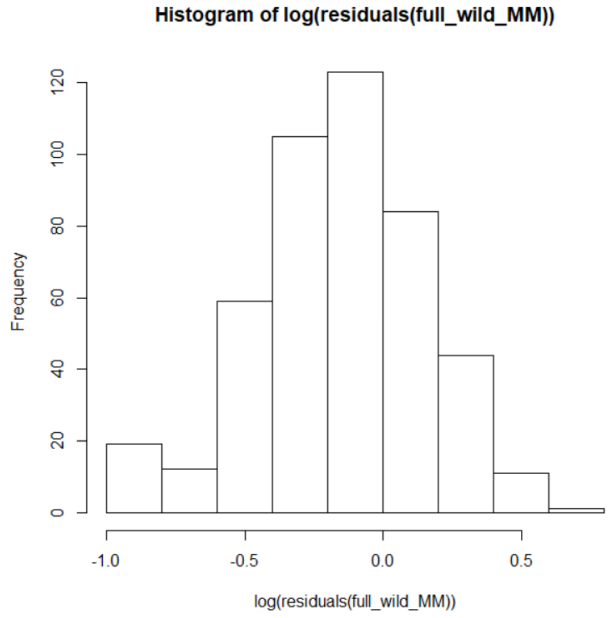
Model suggested by Miki (**full_wild_MM**): Success ~ Age + Sex + Complexity + Rarity +(1|Mother/Beggar) + (1|Food Item)+ (1|Date)

1. Visualization: compare the distribution of the model residuals

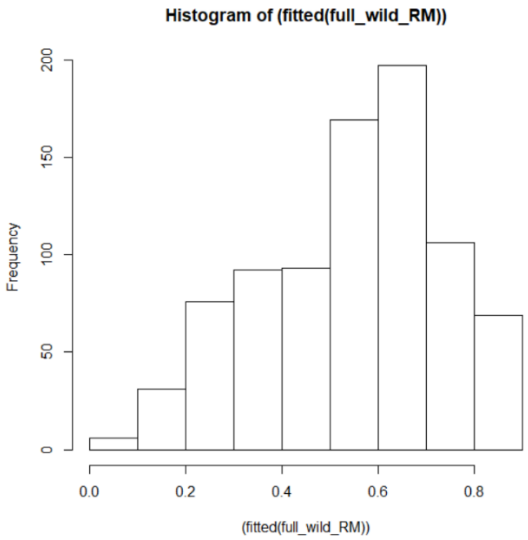
(note that model residuals are not expected to have a normal distribution in a GLMM with binomial error distribution. But the distribution of Miki's model seems the most 'normal' among them?)

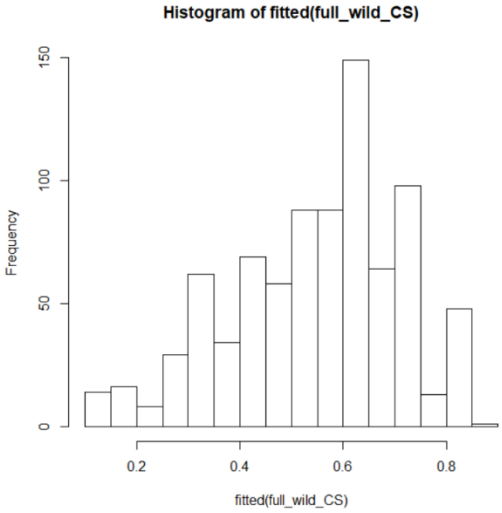


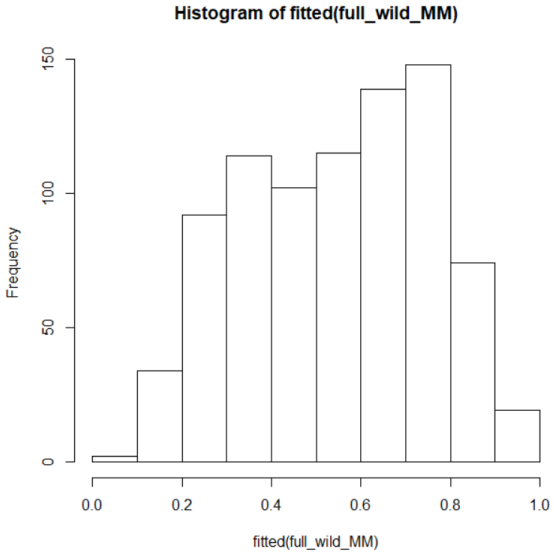




2. Visualization: compare the model fit







3. Compare the model output

Roger's

```
> print(full_wild_RM,corr = FALSE)
Generalized linear mixed model fit by maximum likelihood (Laplace
  Approximation) [glmerMod]
 Family: binomial  ( logit )
Formula:
Success ~ ExactAge + Sex + ProcessingSteps_Complexity + PopFreq_Rarity +
    (1 | Mother/Beggar) + (1 | Species_Item_Simple) + (1 | Month)
   Data: wild
      AIC       BIC    logLik  deviance  df.resid
1083.2508 1125.8407 -532.6254 1065.2508       830
Random effects:
 Groups              Name        Std.Dev.
 Species_Item_Simple (Intercept) 4.426e-01
 Month               (Intercept) 8.776e-01
 Beggar:Mother       (Intercept) 3.013e-08
 Mother              (Intercept) 1.806e-01
Number of obs: 839, groups:
Species_Item_Simple, 80; Month, 62; Beggar:Mother, 19; Mother, 12
Fixed Effects:
               (Intercept)                    ExactAge
                 -0.536963                    0.003034
                    Sexmale  ProcessingSteps_Complexity
                  0.287782                    0.169570
           PopFreq_Rarity
                  0.628620
convergence code 0; 1 optimizer warnings; 0 lme4 warnings
> summary(full_wild_RM)
Generalized linear mixed model fit by maximum likelihood (Laplace
  Approximation) [glmerMod]
 Family: binomial  ( logit )
Formula:
Success ~ ExactAge + Sex + ProcessingSteps_Complexity + PopFreq_Rarity +
    (1 | Mother/Beggar) + (1 | Species_Item_Simple) + (1 | Month)
   Data: wild
Control: glmerControl(optimizer = "bobyqa")

     AIC      BIC   logLik deviance df.resid
  1083.3   1125.8   -532.6   1065.3      830

Scaled residuals:
    Min      1Q  Median      3Q     Max
-2.5842 -0.8229  0.3870  0.7707  2.1752

Random effects:
 Groups              Name        Variance  Std.Dev.
 Species_Item_Simple (Intercept) 1.959e-01 4.426e-01
 Month               (Intercept) 7.702e-01 8.776e-01
 Beggar:Mother       (Intercept) 9.076e-16 3.013e-08
 Mother              (Intercept) 3.261e-02 1.806e-01
Number of obs: 839, groups:
Species_Item_Simple, 80; Month, 62; Beggar:Mother, 19; Mother, 12

Fixed effects:
                           Estimate Std. Error z value Pr(>|z|)
(Intercept)               -0.536963   0.414612  -1.295   0.1953
ExactAge                   0.003034   0.060321   0.050   0.9599
Sexmale                    0.287782   0.276493   1.041   0.2980
ProcessingSteps_Complexity 0.169570   0.081158   2.089   0.0367 *
PopFreq_Rarity             0.628620   2.162911   0.291   0.7713
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Correlation of Fixed Effects:
            (Intr) ExctAg Sexmal PrcS_C
ExactAge    -0.649
Sexmale     -0.609  0.311
PrcssngSt_C -0.339 -0.080 -0.040
PopFrq_Rrty -0.172  0.066  0.076 -0.114
```

Caroline's

```
> print(full_wild_CS,corr = FALSE)
Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) ['glmerMod']
 Family: binomial  ( logit )
Formula: Success ~ ExactAge + Sex + ProcessingSteps_Complexity + PopFreq_Rarity +
    (1 | Mother/Beggar) + (1 | Species_Item_Simple) + (1 | AgeClass)
   Data: wild
      AIC       BIC    logLik  deviance  df.resid
1096.6075 1139.1974 -539.3037 1078.6075       830
Random effects:
 Groups              Name        Std.Dev.
 Species_Item_Simple (Intercept) 0.4990
 Beggar:Mother       (Intercept) 0.0000
 AgeClass            (Intercept) 0.5746
 Mother              (Intercept) 0.1352
Number of obs: 839, groups:  Species_Item_Simple, 80; Beggar:Mother, 19; AgeClass, 18; Mother, 12
Fixed Effects:
               (Intercept)                   ExactAge                     Sexmale  ProcessingSteps_Complexity
                  -0.78619                    0.01948                    0.29325                     0.17564
           PopFreq_Rarity
                   0.95672
convergence code 0; 1 optimizer warnings; 0 lme4 warnings
> summary(full_wild_CS)
Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) ['glmerMod']
 Family: binomial  ( logit )
Formula: Success ~ ExactAge + Sex + ProcessingSteps_Complexity + PopFreq_Rarity +
    (1 | Mother/Beggar) + (1 | Species_Item_Simple) + (1 | AgeClass)
   Data: wild
Control: glmerControl(optimizer = "bobyqa")

     AIC      BIC   logLik deviance df.resid
  1096.6   1139.2   -539.3   1078.6      830

Scaled residuals:
    Min      1Q  Median      3Q     Max
-2.3104 -0.9094  0.4329  0.8034  2.5185

Random effects:
 Groups              Name        Variance Std.Dev.
 Species_Item_Simple (Intercept) 0.24898  0.4990
 Beggar:Mother       (Intercept) 0.00000  0.0000
 AgeClass            (Intercept) 0.33017  0.5746
 Mother              (Intercept) 0.01829  0.1352
Number of obs: 839, groups:  Species_Item_Simple, 80; Beggar:Mother, 19; AgeClass, 18; Mother, 12

Fixed effects:
                           Estimate Std. Error z value Pr(>|z|)
(Intercept)                -0.78619    0.43269  -1.817   0.0692 .
ExactAge                    0.01948    0.07822   0.249   0.8033
Sexmale                     0.29325    0.25137   1.167   0.2434
ProcessingSteps_Complexity  0.17564    0.08114   2.165   0.0304 *
PopFreq_Rarity              0.95672    2.29395   0.417   0.6766
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Correlation of Fixed Effects:
            (Intr) ExctAg Sexmal PrcS_C
ExactAge    -0.708
Sexmale     -0.424  0.170
PrcssngSt_C -0.313 -0.072 -0.044
PopFrq_Rrty -0.139  0.039  0.022 -0.106
```

Miki's

```
> print(full_wild_MM,corr = FALSE)
Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) ['glmerMod']
 Family: binomial  ( logit )
Formula: Success ~ ExactAge + Sex + ProcessingSteps_Complexity + PopFreq_Rarity +
    (1 | Mother/Beggar) + (1 | Species_Item_Simple) + (1 | Date)
   Data: wild
      AIC       BIC    logLik  deviance  df.resid
1083.5314 1126.1213 -532.7657 1065.5314       830
Random effects:
 Groups              Name        Std.Dev.
 Date                (Intercept) 1.1029
 Species_Item_Simple (Intercept) 0.4325
 Beggar:Mother       (Intercept) 0.0000
 Mother              (Intercept) 0.1699
Number of obs: 839, groups:  Date, 243; Species_Item_Simple, 80; Beggar:Mother, 19; Mother, 12
Fixed Effects:
               (Intercept)                   ExactAge                     Sexmale  ProcessingSteps_Complexity
                   -1.0350                     0.1111                      0.4209                      0.1735
            PopFreq_Rarity
                    1.4017
convergence code 0; 1 optimizer warnings; 0 lme4 warnings
> summary(full_wild_MM)
Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) ['glmerMod']
 Family: binomial  ( logit )
Formula: Success ~ ExactAge + Sex + ProcessingSteps_Complexity + PopFreq_Rarity +
    (1 | Mother/Beggar) + (1 | Species_Item_Simple) + (1 | Date)
   Data: wild
Control: glmerControl(optimizer = "bobyqa")

     AIC      BIC   logLik deviance df.resid
  1083.5   1126.1   -532.8   1065.5      830

Scaled residuals:
    Min      1Q  Median      3Q     Max
-2.2825 -0.7289  0.4275  0.6995  2.1665

Random effects:
 Groups              Name        Variance Std.Dev.
 Date                (Intercept) 1.21645  1.1029
 Species_Item_Simple (Intercept) 0.18707  0.4325
 Beggar:Mother       (Intercept) 0.00000  0.0000
 Mother              (Intercept) 0.02888  0.1699
Number of obs: 839, groups:  Date, 243; Species_Item_Simple, 80; Beggar:Mother, 19; Mother, 12

Fixed effects:
                            Estimate Std. Error z value Pr(>|z|)
(Intercept)                -1.03503    0.38750  -2.671  0.00756 **
ExactAge                    0.11108    0.05874   1.891  0.05861 .
Sexmale                     0.42086    0.30317   1.388  0.16508
ProcessingSteps_Complexity  0.17351    0.08764   1.980  0.04773 *
PopFreq_Rarity              1.40174    2.25559   0.621  0.53430
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Correlation of Fixed Effects:
            (Intr) ExctAg Sexmal PrcS_C
ExactAge    -0.596
Sexmale     -0.635  0.299
PrcssngSt_C -0.352 -0.159 -0.034
PopFrq_Rrty -0.196  0.104  0.040 -0.137
```

4. Compare the table of estimates with 95% CI

```
> #get confidence intervals (CIs) and rough estimates using the SEs
> seswild<-sqrt(diag(vcov(full_wild_RM)))
> # table of estimates with 95% CI
> tabwild<- cbind(Est= fixef(full_wild_RM), LL = fixef(full_wild_RM) - 1.96 * seswild, UL = fixef(full_wild_RM) + 1.96 *seswild)
> exp(tabwild)
                                Est         LL         UL
(Intercept)                0.5845206 0.25934339   1.317421
ExactAge                   1.0030381 0.89119183   1.128921
Sexmale                    1.3334662 0.77558014   2.292648
ProcessingSteps_Complexity 1.1847955 1.01055485   1.389079
PopFreq_Rarity             1.8750203 0.02703327 130.050914

> #get confidence intervals (CIs) and rough estimates using the SEs
> seswild<-sqrt(diag(vcov(full_wild_CS)))
> # table of estimates with 95% CI
> tabwild<- cbind(Est= fixef(full_wild_CS), LL = fixef(full_wild_CS) - 1.96 * seswild, UL = fixef(full_wild_CS) + 1.96 *seswild)
> exp(tabwild)
                                Est         LL         UL
(Intercept)                0.4555767 0.19509506   1.063841
ExactAge                   1.0196711 0.87474349   1.188610
Sexmale                    1.3407810 0.81919287   2.194469
ProcessingSteps_Complexity 1.1920073 1.01674293   1.397484
PopFreq_Rarity             2.6031499 0.02903014 233.425997
> # table of estimates with 95% CI
> tabwild<- cbind(Est= fixef(full_wild_MM), LL = fixef(full_wild_MM) - 1.96 * seswild, UL = fixef(full_wild_MM) + 1.96 *seswild)
> exp(tabwild)
                                Est         LL          UL
(Intercept)                0.3552166 0.16620518   0.7591751
ExactAge                   1.1174853 0.99596223   1.2538360
Sexmale                    1.5232722 0.84083421   2.7595905
ProcessingSteps_Complexity 1.1894745 1.00173003   1.4124061
PopFreq_Rarity             4.0622665 0.04883977 337.8805438
```

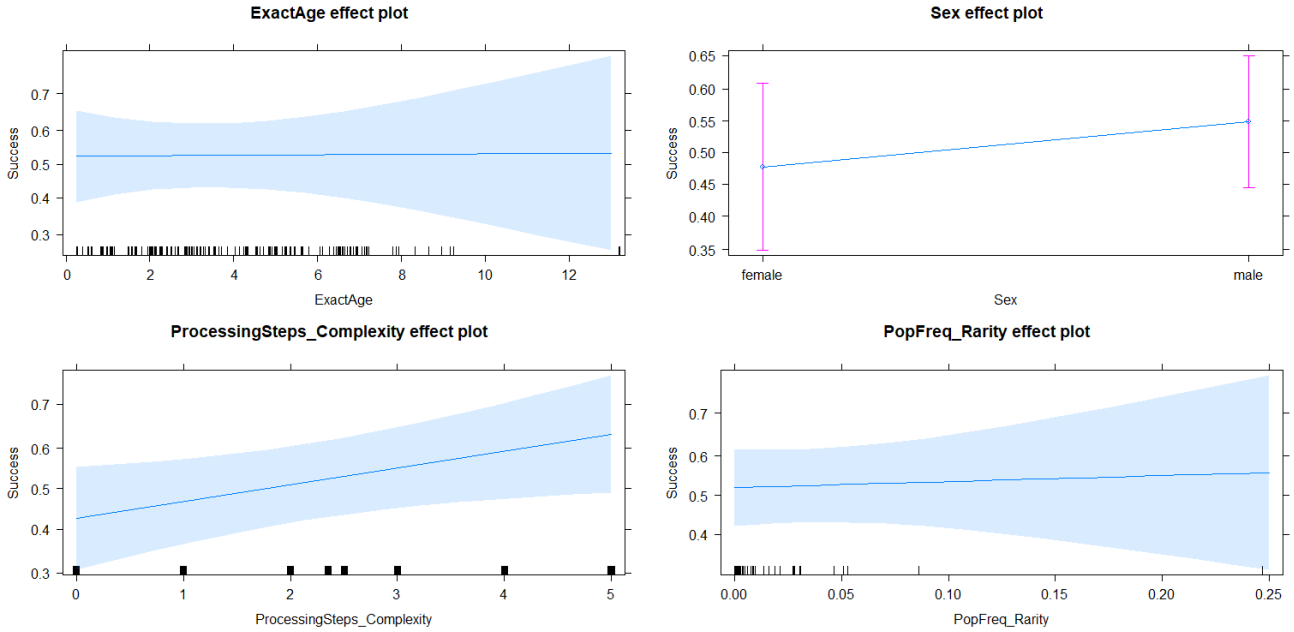
5. Compare the omnibus test result

(Note that this step is not always necessary, especially if there are a priori predictions with regards to predictor variables. Here we simply want to acknowledge the concept of an omnibus test. BUT! there is no such a priori predictions with regards to predictor variables in our models so this step is actually necessary! **And, there is an increasing model fit from Roger's - Caroline's -Miki's**)

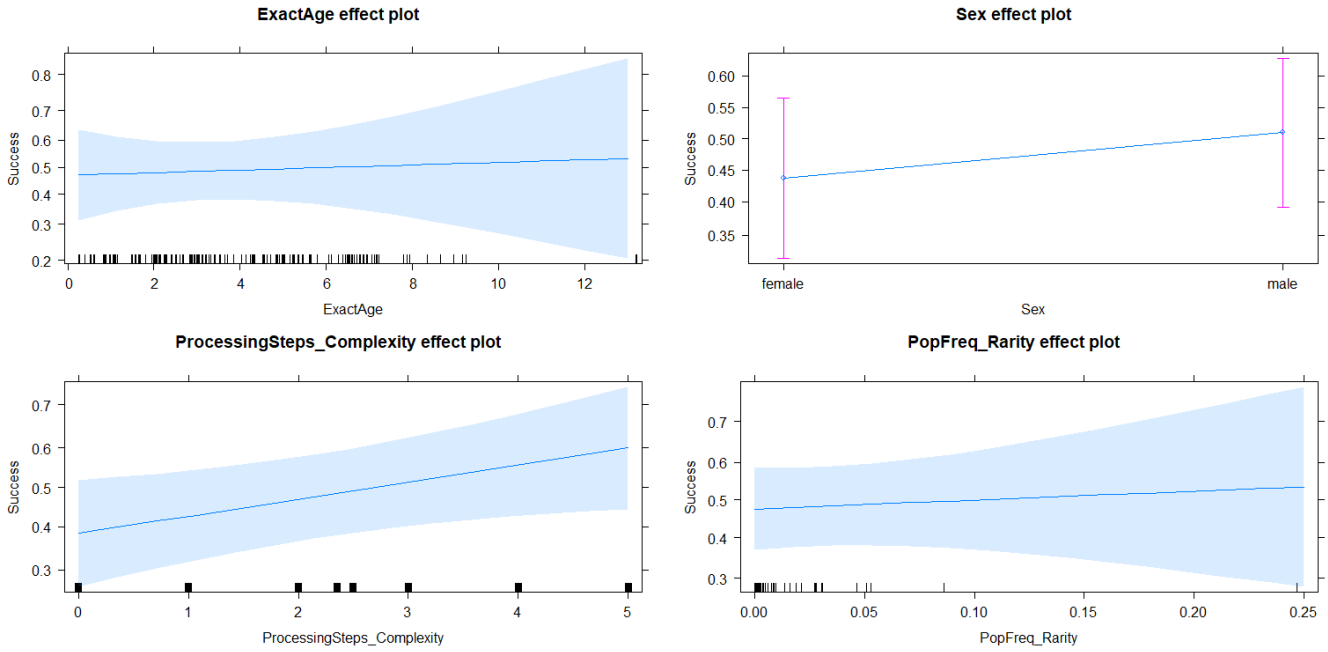
```
> anova(nullModelwild,full_wild_RM,test="Chisq")
Data: wild
Models:
nullModelwild: Success ~ 1 + (1 | Mother/Beggar) + (1 | Species_Item_Simple) +
nullModelwild:     (1 | Month)
full_wild_RM: Success ~ ExactAge + Sex + ProcessingSteps_Complexity + PopFreq_Rarity +
full_wild_RM:     (1 | Mother/Beggar) + (1 | Species_Item_Simple) + (1 | Month)
              Df    AIC    BIC  logLik deviance  Chisq Chi Df Pr(>Chisq)
nullModelwild  5 1080.8 1104.5 -535.41   1070.8
full_wild_RM   9 1083.2 1125.8 -532.63   1065.2 5.5637      4     0.2342

> anova(nullModelwild,full_wild_CS,test="Chisq")
Data: wild
Models:
nullModelwild: Success ~ 1 + (1 | Mother/Beggar) + (1 | Species_Item_Simple) +
nullModelwild:     (1 | AgeClass)
full_wild_CS: Success ~ ExactAge + Sex + ProcessingSteps_Complexity + PopFreq_Rarity +
full_wild_CS:     (1 | Mother/Beggar) + (1 | Species_Item_Simple) + (1 | AgeClass)
              Df    AIC    BIC  logLik deviance  Chisq Chi Df Pr(>Chisq)
nullModelwild  5 1094.6 1118.2 -542.29   1084.6
full_wild_CS   9 1096.6 1139.2 -539.30   1078.6 5.9755      4      0.201
> anova(nullModelwild,full_wild_MM,test="Chisq")
Data: wild
Models:
nullModelwild: Success ~ 1 + (1 | Mother/Beggar) + (1 | Species_Item_Simple) +
nullModelwild:     (1 | Date)
full_wild_MM: Success ~ ExactAge + Sex + ProcessingSteps_Complexity + PopFreq_Rarity +
full_wild_MM:     (1 | Mother/Beggar) + (1 | Species_Item_Simple) + (1 | Date)
              Df    AIC    BIC  logLik deviance Chisq Chi Df Pr(>Chisq)
nullModelwild  5 1084.4 1108.1 -537.22   1074.4
full_wild_MM   9 1083.5 1126.1 -532.77   1065.5 8.903      4    0.06357 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

6. Compare the model plots with fixed effects

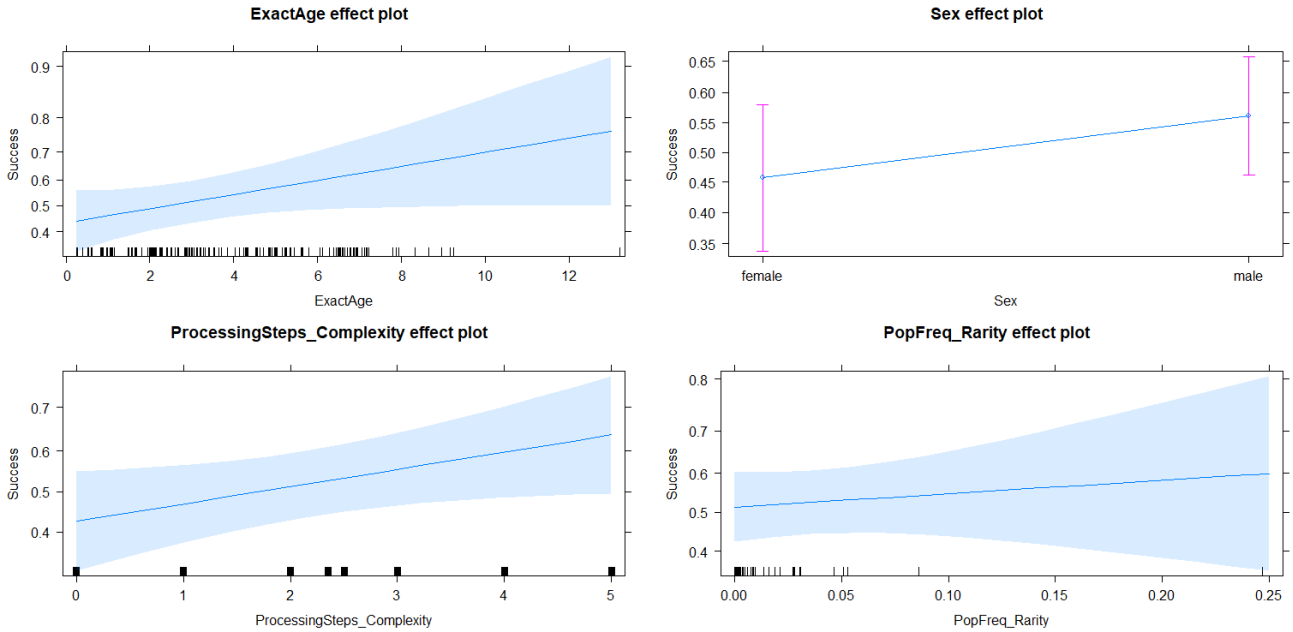
Roger's



Caroline's



Miki's


ExactAge effect plot
Success
ExactAge
Sex effect plot
Success
female
male
Sex
ProcessingSteps_Complexity effect plot
Success
ProcessingSteps_Complexity
PopFreq_Rarity effect plot
Success
PopFreq_Rarity