

English Nominal Recursion Study, Part 2:

Condition (ABCE) by Group (Adult-Child): Response is AllTargets

```
> rm(list=ls()); options(scipen=999) # To avoid scientific notation
> # Install packages if necessary. Only need to do this once.
> # install.packages("lme4")
> # install.packages("car")
> # Load packages -- do this every time
> library(lme4) # For lmer function
Loading required package: Matrix
> library(car) # For F-tests with p-values, Wald chi-squared tests
>
> # Read data into a data frame
> rdata =
read.table("http://www.utstat.toronto.edu/~brunner/workshops/mixed/Recursion.data.txt",
header=T)
> head(rdata); attach(rdata)
```

	Participant	AgeinMonths	Group	Agegroup	Condition	Item	StrictTarget	AllTargets	Years	Months	Days	KABC_Hand
1	1	48.5	Child	4yos	A	a1a	1	1	4	0	14	4
2	1	48.5	Child	4yos	A	a1b	0	0	4	0	14	4
3	1	48.5	Child	4yos	A	a2	0	0	4	0	14	4
4	1	48.5	Child	4yos	A	a3	0	0	4	0	14	4
5	1	48.5	Child	4yos	A	a4	0	0	4	0	14	4
6	1	48.5	Child	4yos	A	a5	NA	NA	4	0	14	4

```

      CELF_SS CELF_WS CELF_EV CELF_Sent PPVT KBIT
1      16      13      22      21      92    NA
2      16      13      22      21      92    NA
3      16      13      22      21      92    NA
4      16      13      22      21      92    NA
5      16      13      22      21      92    NA
6      16      13      22      21      92    NA
> # Effect coding
> contrasts(Group) = contr.sum; contrasts(Condition) = contr.sum
>
> # Adult versus Child
> table1 = table(Group,AllTargets); table1
      AllTargets
Group      0      1
Adult    152    171
Child   1433    336
> prop.table(table1,1) # Row proportions
      AllTargets
Group      0      1
Adult 0.4705882 0.5294118
Child 0.8100622 0.1899378
> table2 = table(Group,StrictTarget); table2
      StrictTarget
Group      0      1
Adult    212    111
Child   1573    196
> prop.table(table2,1) # Row proportions
      StrictTarget
Group      0      1
Adult 0.6563467 0.3436533
Child 0.8892029 0.1107971

> # The difference between adults and children is huge. There is no need to
> # test it by itself.
>
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> # Condition (ABCE) by Group (Adult-Child)
> # Response is AllTargets
> table3 = table(AllTargets,Condition,Group); table3
, , Group = Adult

      Condition
AllTargets  A    B    C    E
      0  25  22  47  58
      1  65  56  31  19

, , Group = Child

      Condition
AllTargets  A    B    C    E
      0 362 299 376 396
      1 130 127  50  29

> prop3A = prop.table(table3[,1],2); prop3A # Adults
      Condition
AllTargets  A          B          C          E
      0 0.2777778 0.2820513 0.6025641 0.7532468
      1 0.7222222 0.7179487 0.3974359 0.2467532
> prop3C = prop.table(table3[,2],2); prop3C # Children
      Condition
AllTargets  A          B          C          E
      0 0.73577236 0.70187793 0.88262911 0.93176471
      1 0.26422764 0.29812207 0.11737089 0.06823529
> # Percent3 will have percent AllTargets response
> Percent3 = 100*rbind(prop3A[2,],prop3C[2,])
> rownames(Percent3) = c("Adult","Child")
> oddsA = Percent3[1,]/(100-Percent3[1,]); oddsC = Percent3[2,]/(100-Percent3[2,])
> OddsRatio = oddsA/oddsC
> Percent3 = round(rbind(Percent3,OddsRatio),2); Percent3
      A    B    C    E
Adult 72.22 71.79 39.74 24.68
Child 26.42 29.81 11.74  6.82
OddsRatio 7.24  5.99  4.96  4.47
>
> # Fit and test
> model3 = glmer(AllTargets ~ Group*Condition + (1 | Participant), family=binomial)
Warning message:
In checkConv(attr(opt, "derivs"), opt$par, ctrl = control$checkConv, :
  Model failed to converge with max|grad| = 0.00197264 (tol = 0.001, component 1)
> # Failed to converge, but just barely. Test anyway.
> Anova(model3, type="III") # Each effect controlled for all others
Analysis of Deviance Table (Type III Wald chisquare tests)

Response: AllTargets
      Chisq Df          Pr(>Chisq)
(Intercept)  26.9935  1 0.000000204145 ***
Group        33.0605  1 0.000000008933 ***
Condition    133.7476  3 < 0.00000000000000022 ***
Group:Condition  1.2555  3 0.7397
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
> # P-value for interaction = 0.7397

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>
> model3 = glmer(AllTargets ~ Group*Condition + (1 | Participant), family=binomial,
nAGQ=0)
> # nAGQ=0 requests a faster, even less exact approximation of maximum likelihood
> Anova(model3, type="III") # Each effect controlled for all others
Analysis of Deviance Table (Type III Wald chisquare tests)

Response: AllTargets
              Chisq Df              Pr(>Chisq)
(Intercept)    24.8942  1          0.00000060565 ***
Group           30.5422  1          0.00000003267 ***
Condition      130.1869  3 < 0.000000000000000022 ***
Group:Condition   1.0962  3              0.778
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
> # P-value for interaction = 0.778
>
> model3 = glmer(AllTargets ~ Group*Condition + (1 | Participant), family=binomial,
nAGQ=2)
> # It worked with MORE precision!
> Anova(model3, type="III")
Analysis of Deviance Table (Type III Wald chisquare tests)

Response: AllTargets
              Chisq Df              Pr(>Chisq)
(Intercept)    26.9101  1          0.000000213142 ***
Group           32.9325  1          0.000000009542 ***
Condition      132.5334  3 < 0.000000000000000022 ***
Group:Condition   1.2293  3              0.746
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
> # P-value for interaction = 0.746
> # Same conclusion: No evidence of interaction. Now we believe it.
> # Playing with the nAGQ parameter seems to be a good way to deal with
> # convergence problems. It's available when there's only a single random
> # effect, ouch. Otherwise glmer uses a LaPlace approximation, which is nAGQ=1.
>

```