Supplement 4 - Statistical analyses

Contents

Confirmatory analysis

Errors (full model)

Results

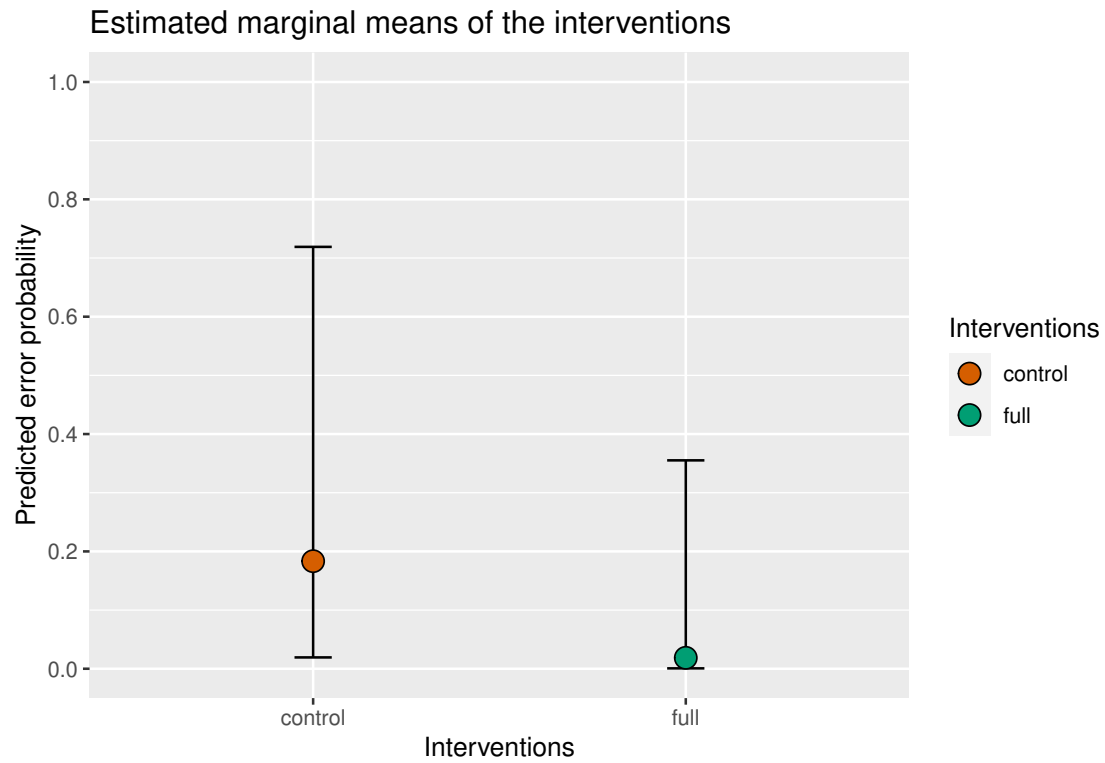| Variable	OR	CI (low)	CI (high)	*p* value
Intervention	0.08	0.02	0.36	<0.001
Institution (Children's hospital)	1.27	0.75	2.15	0.3823
Institution (Hospital)	1.12	0.74	1.70	0.5875
User (partly *vs* no)	0.57	0.26	1.29	0.1779
User (yes *vs* partly)	0.88	0.37	2.11	0.7712

R summary output

```
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula:
## error ~ intervention + institution + user + (intervention | subject) +
##     (intervention | item)
##    Data: data_confirmatory
## Control: glmerControl(optimizer = "bobyqa")
##
##      AIC      BIC   logLik deviance df.resid
##    457.2    510.4   -216.6    433.2      608
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -0.8811 -0.4334 -0.2101 -0.1185  3.7005
##
## Random effects:
##  Groups  Name            Variance Std.Dev. Corr
##  subject (Intercept)     0.2340   0.4838
##          interventionfull 1.4835  1.2180   -0.51
##  item    (Intercept)     0.2954   0.5435
##          interventionfull 0.7559  0.8694   -0.35
## Number of obs: 620, groups:  subject, 52; item, 18
##
## Fixed effects:
##                  Estimate Std. Error z value Pr(>|z|)
## (Intercept)       -1.4938     0.2415  -6.187 6.15e-10 ***
## interventionfull  -2.4694     0.7395  -3.339 0.000839 ***
## institution1       0.2359     0.2700   0.874 0.382263
## institution2       0.1151     0.2121   0.543 0.587464
## userpartly-no     -0.5563     0.4129  -1.347 0.177867
## useryes-partly    -0.1302     0.4478  -0.291 0.771219
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
```

Errors (full model)   *CONFIRMATORY ANALYSIS*

```
##            (Intr) intrvn instt1 instt2 usrpr-
## intrvntnfll -0.252
## institutin1 -0.139 -0.091
## institutin2 -0.137  0.034 -0.404
## userprtly-n  0.238  0.040 -0.297  0.165
## usrys-prtly -0.129  0.144 -0.390  0.164 -0.467
```

Plot - Predicted probability of error

Estimated marginal means of the interventions

Errors (simple model)

Results

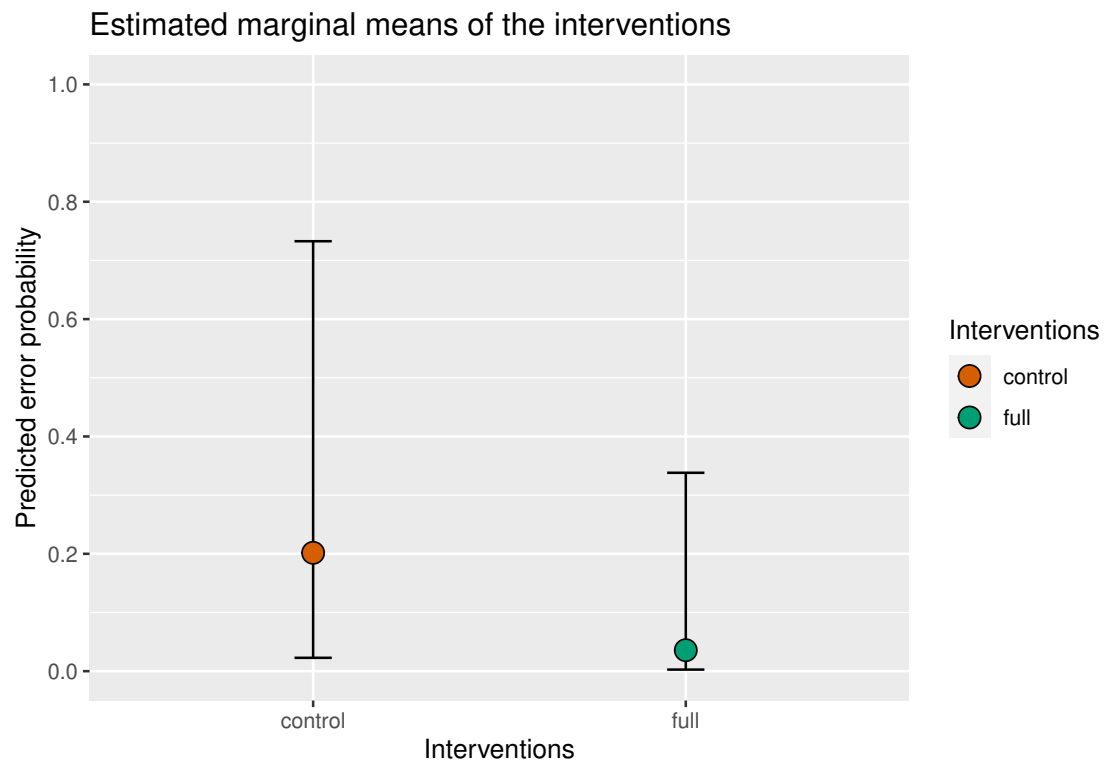| Variable	OR	CI (low)	CI (high)	*p* value
Intervention	0.15	0.08	0.27	<0.001

R summary output

```
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: error ~ intervention + (1 | subject) + (1 | item)
##    Data: data_confirmatory
## Control: glmerControl(optimizer = "bobyqa")
##
##      AIC      BIC   logLik deviance df.resid
##    447.0    464.8   -219.5    439.0      616
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -0.8104 -0.4473 -0.2367 -0.1683  5.8528
##
## Random effects:
##  Groups  Name        Variance Std.Dev.
##  subject (Intercept) 0.2236   0.4728
##  item    (Intercept) 0.2925   0.5408
## Number of obs: 620, groups:  subject, 52; item, 18
##
## Fixed effects:
##                  Estimate Std. Error z value Pr(>|z|)
## (Intercept)       -1.3756     0.2165  -6.355 2.09e-10 ***
## interventionfull  -1.9200     0.3183  -6.032 1.62e-09 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr)
## intrvntnfll -0.242
```

Plot - Predicted probability of error

Estimated marginal means of the interventions

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Time (full model)

Results

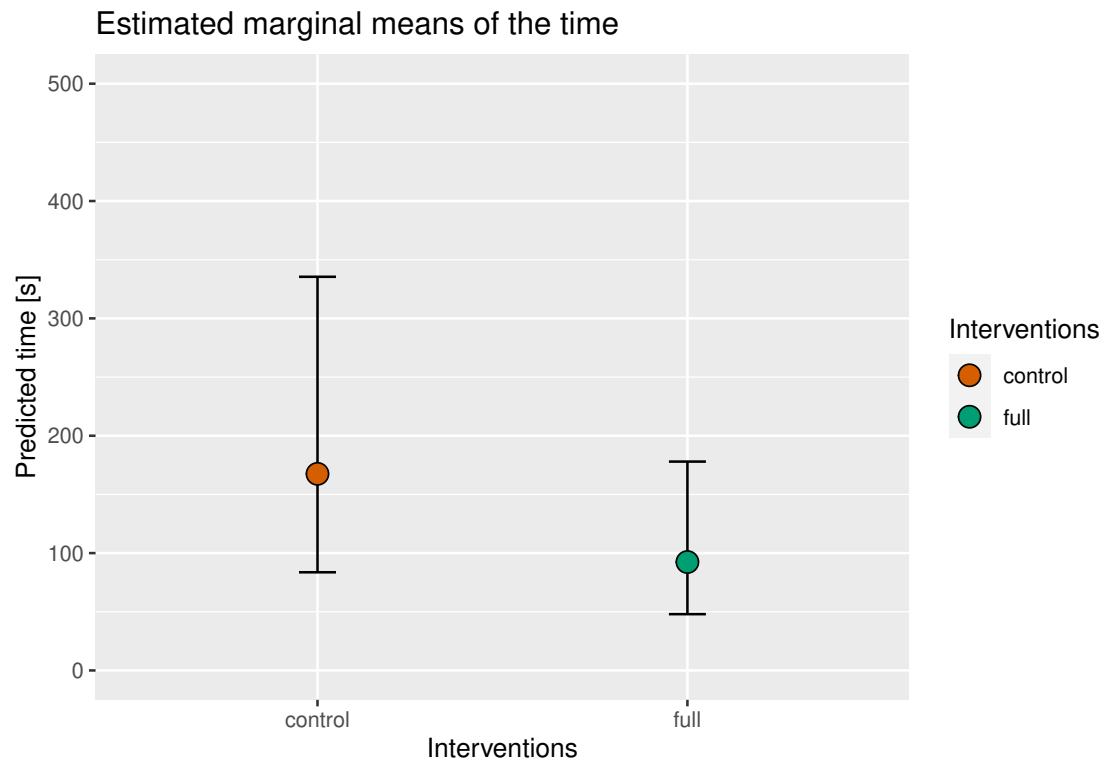| Variable	Deviation (%)	CI (low)	CI (high)	*p* value
Intervention	-44.85	-50.51	-38.54	<0.001
Institution (Children's hospital)	-17.78	-26.16	-8.46	<0.001
Institution (Hospital)	2.60	-6.37	12.42	0.5853
Experience (5-10y *vs* <5y)	2.64	-10.99	18.36	0.7217
Experience (>10y *vs* 5-10y)	-1.39	-15.75	15.40	0.8619
User (partly *vs* no)	6.34	-9.92	25.52	0.4717
User (yes *vs* partly)	-7.73	-22.11	9.30	0.3568

R summary output

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula:
## log_time ~ intervention + institution + experience + user + (intervention |
##     subject) + (intervention | item)
##    Data: data_confirmatory
##
## REML criterion at convergence: 432.7
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -3.4708 -0.6145 -0.0595  0.5344  3.1635
##
## Random effects:
##  Groups   Name            Variance Std.Dev. Corr
##  subject  (Intercept)     0.04406  0.2099
##           interventionfull 0.05292 0.2300   -0.35
##  item     (Intercept)     0.06619  0.2573
##           interventionfull 0.02677 0.1636   -0.91
##  Residual                 0.08039  0.2835
## Number of obs: 618, groups:  subject, 52; item, 18
##
## Fixed effects:
##                    Estimate Std. Error       df t value Pr(>|t|)
## (Intercept)         5.12111    0.07072 26.21325  72.415  < 2e-16 ***
## interventionfull   -0.59507    0.05524 30.37710 -10.773 6.74e-12 ***
## institution1       -0.19580    0.05480 44.96048  -3.573 0.000856 ***
## institution2        0.02564    0.04665 44.84160   0.550 0.585265
## experience5-10y-<5y 0.02606    0.07269 44.77178   0.359 0.721652
## experience>10y-5-10y -0.01404   0.08025 44.96372  -0.175 0.861888
## userpartly-no       0.06144    0.08463 44.84683   0.726 0.471654
## useryes-partly     -0.08049    0.08645 45.06018  -0.931 0.356777
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) intrvn instt1 instt2 e5-10- e>10-5 usrpr-
```

Time (full model)   *CONFIRMATORY ANALYSIS*

```
## intrvntnfll -0.698
## institutin1 -0.071 -0.001
## institutin2 -0.064  0.000 -0.412
## expr5-10-<5  0.039 -0.002 -0.027 -0.311
## exp>10-5-10  0.062  0.000  0.159  0.035 -0.442
## userprtly-n  0.114  0.002 -0.292  0.199 -0.043 -0.047
## usrys-prtly -0.073 -0.001 -0.375  0.134  0.000  0.007 -0.466
```

Plot - Predicted response time

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Time (simple model)

Results

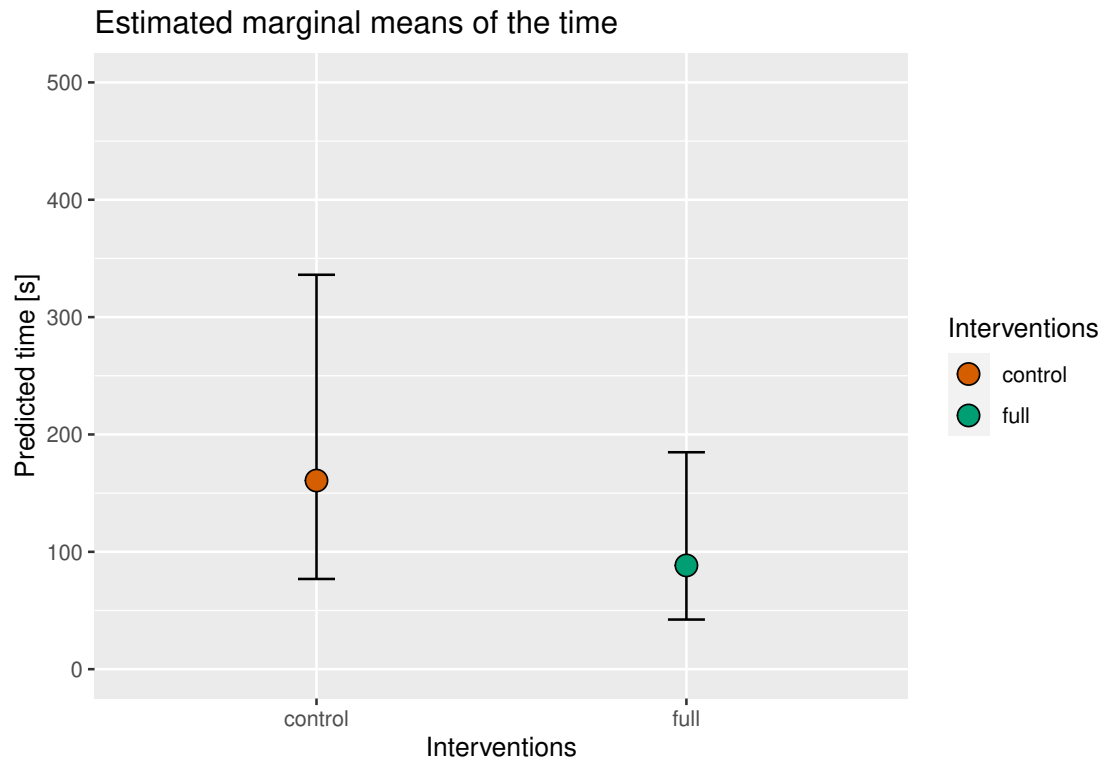| Variable	Deviation (%)	CI (low)	CI (high)	*p* value
Intervention	-45	-47.73	-42.12	<0.001

R summary output

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: log_time ~ intervention + (1 | subject) + (1 | item)
##    Data: data_confirmatory
##
## REML criterion at convergence: 494.8
##
## Scaled residuals:
##     Min     1Q  Median     3Q     Max
## -4.0767 -0.6149 -0.0248  0.5679  3.3763
##
## Random effects:
##  Groups    Name        Variance Std.Dev.
##  subject   (Intercept) 0.05797  0.2408
##  item      (Intercept) 0.03607  0.1899
##  Residual              0.10085  0.3176
## Number of obs: 618, groups:  subject, 52; item, 18
##
## Fixed effects:
##                   Estimate Std. Error        df t value Pr(>|t|)
## (Intercept)        5.07975    0.05877  38.59148   86.44   <2e-16 ***
## interventionfull  -0.59777    0.02604 551.44043  -22.95   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr)
## intrvntnfll -0.222
```

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Plot - Predicted response time

Estimated marginal means of the time

Exploratory analysis

Errors (full model)

Results

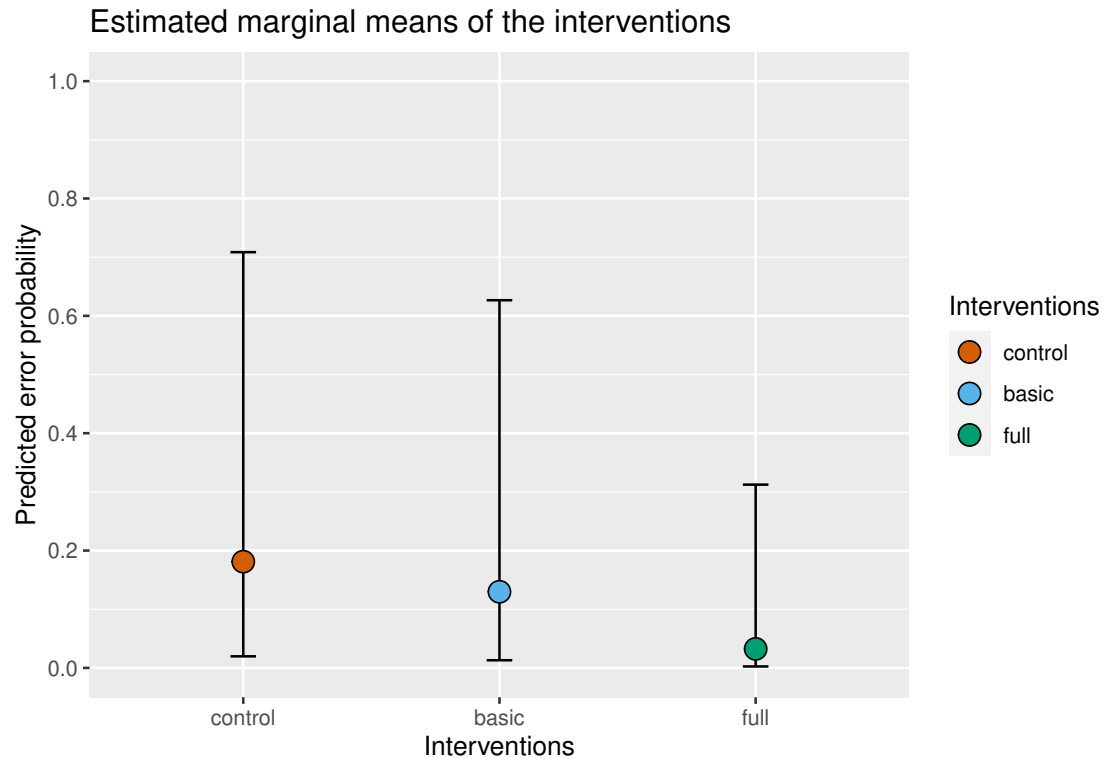| Variable	OR	CI (low)	CI (high)	*p* value
Intervention (basic *vs* control)	0.67	0.44	1.03	0.0677
Intervention (full *vs* basic)	0.22	0.12	0.42	<0.001
Institution (Children's hospital)	1.37	0.90	2.08	0.1428
Institution (Hospital)	0.97	0.68	1.38	0.8601
Experience (5-10y *vs* <5y)	1.36	0.79	2.36	0.2725
Experience (>10y *vs* 5-10y)	1.15	0.64	2.05	0.6443
User (partly *vs* no)	0.51	0.26	1.00	0.0498
User (yes *vs* partly)	1.33	0.68	2.62	0.4019

R summary output

```
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: error ~ intervention + institution + experience + user + (1 |
##     subject) + (1 | item)
##    Data: data_exploratory
## Control: glmerControl(optimizer = "bobyqa")
##
##      AIC      BIC   logLik deviance df.resid
##    711.6    764.9   -344.8    689.6      921
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -1.0078 -0.4323 -0.2991 -0.1736  6.2086
##
## Random effects:
##  Groups  Name        Variance Std.Dev.
##  subject (Intercept) 0.1555   0.3943
##  item    (Intercept) 0.3354   0.5791
## Number of obs: 932, groups:  subject, 52; item, 18
##
## Fixed effects:
##                          Estimate Std. Error z value Pr(>|z|)
## (Intercept)              -2.26943    0.21046 -10.783  < 2e-16 ***
## interventionbasic-control -0.39394   0.21565  -1.827   0.0677 .
## interventionfull-basic   -1.49297    0.31775  -4.699 2.62e-06 ***
## institution1              0.31265    0.21334   1.466   0.1428
## institution2             -0.03148    0.17857  -0.176   0.8601
## experience5-10y-<5y       0.30767    0.28040   1.097   0.2725
## experience>10y-5-10y      0.13731    0.29742   0.462   0.6443
## userpartly-no            -0.67513    0.34415  -1.962   0.0498 *
## useryes-partly            0.28866    0.34439   0.838   0.4019
## ---
```

Errors (full model)   *EXPLORATORY ANALYSIS*

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Correlation of Fixed Effects:
##             (Intr) intrvntnb- intrvntnf- instt1 instt2 e5-10- e>10-5 usrpr-
## intrvntnbs-  0.043
## intrvntnfl-  0.277 -0.374
## institutin1 -0.173 -0.002     -0.010
## institutin2 -0.098 -0.006     -0.005     -0.345
## expr5-10-<5  0.019  0.000     -0.010     -0.042 -0.314
## exp>10-5-10  0.061 -0.004      0.005      0.146  0.070 -0.431
## userprtly-n  0.239  0.007      0.007     -0.312  0.178 -0.039 -0.037
## usrys-prtly -0.137 -0.009      0.002     -0.324  0.113  0.023  0.025 -0.529
```

Plot - Predicted probability of error

Estimated marginal means of the interventions

Errors (simple model)

Results

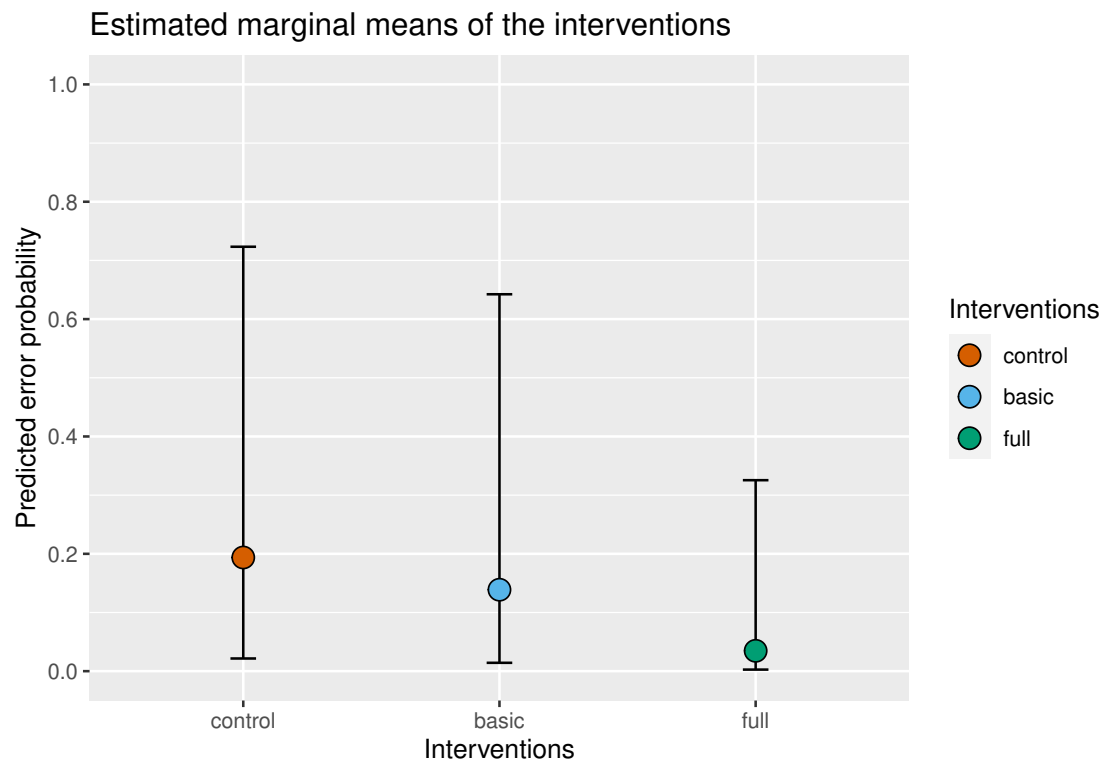| Variable	OR	CI (low)	CI (high)	*p* value
Intervention (basic *vs* control)	0.67	0.44	1.02	0.0629
Intervention (full *vs* basic)	0.22	0.12	0.41	<0.001

R summary output

```
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: error ~ intervention + (1 | subject) + (1 | item)
##    Data: data_exploratory
## Control: glmerControl(optimizer = "bobyqa")
##
##      AIC      BIC   logLik deviance df.resid
##    706.8    731.0   -348.4    696.8      927
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -0.9847 -0.4297 -0.3089 -0.1722  5.7553
##
## Random effects:
##  Groups  Name        Variance Std.Dev.
##  subject (Intercept) 0.2545   0.5044
##  item    (Intercept) 0.3500   0.5916
## Number of obs: 932, groups:  subject, 52; item, 18
##
## Fixed effects:
##                          Estimate Std. Error z value Pr(>|z|)
## (Intercept)               -2.1927     0.2047 -10.710  < 2e-16 ***
## interventionbasic-control -0.3994     0.2148  -1.860   0.0629 .
## interventionfull-basic    -1.5014     0.3169  -4.738 2.16e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##            (Intr) intrvntnb-
## intrvntnbs-  0.044
## intrvntnfl-  0.282 -0.375
```

Errors (simple model)   *EXPLORATORY ANALYSIS*

Plot - Predicted probability of error

Estimated marginal means of the interventions

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Time (full model)

Results

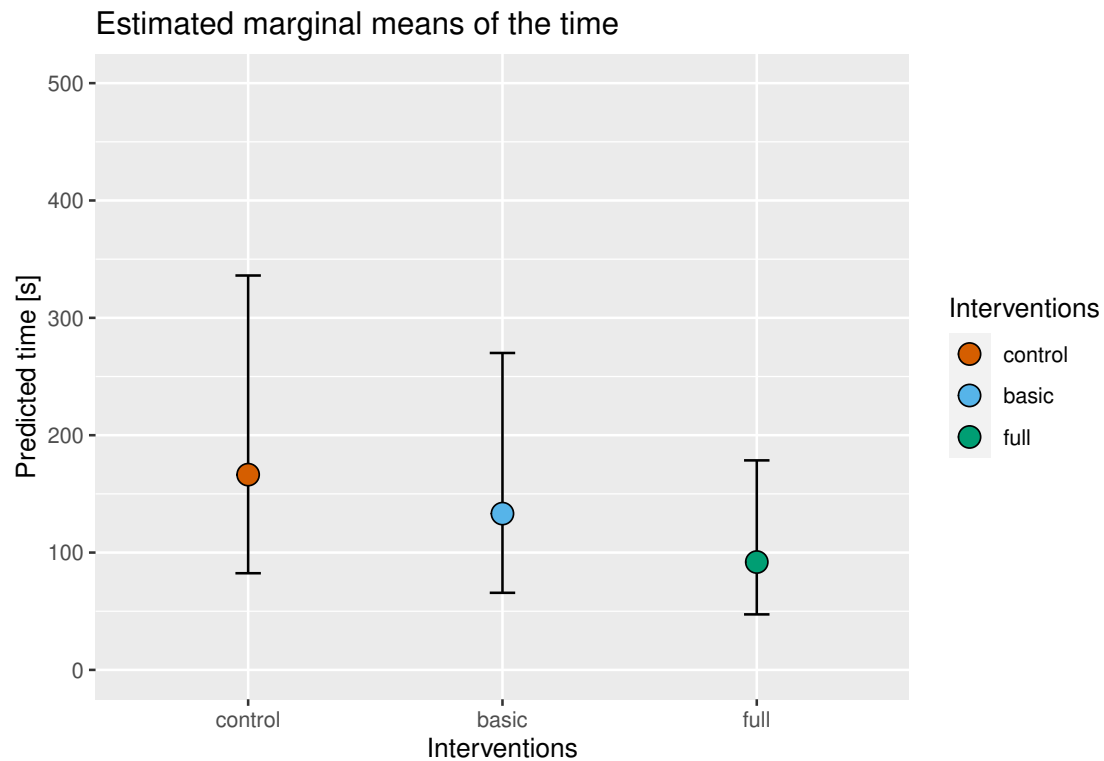| Variable	Deviation (%)	CI (low)	CI (high)	*p* value
Intervention (basic *vs* control)	-19.95	-27.14	-12.06	<0.001
Intervention (full *vs* basic)	-30.99	-38.42	-22.67	<0.001
Institution (Children's hospital)	-18.44	-26.38	-9.64	<0.001
Institution (Hospital)	2.75	-5.83	12.12	0.5453
Experience (5-10y *vs* <5y)	1.85	-11.10	16.69	0.7926
Experience (>10y *vs* 5-10y)	-2.43	-16.02	13.36	0.7493
User (partly *vs* no)	-0.88	-15.39	16.12	0.9133
User (yes *vs* partly)	-5.87	-19.92	10.63	0.4666

R summary output

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula:
## log_time ~ intervention + institution + experience + user + (intervention |
##     subject) + (intervention | item)
##    Data: data_exploratory
##
## REML criterion at convergence: 653.6
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -4.1903 -0.5998 -0.0537  0.5331  3.2470
##
## Random effects:
##  Groups   Name                     Variance Std.Dev. Corr
##  subject  (Intercept)              0.03751  0.1937
##           interventionbasic-control 0.03513 0.1874    0.10
##           interventionfull-basic   0.06151  0.2480    0.02 -0.47
##  item     (Intercept)              0.04184  0.2045
##           interventionbasic-control 0.01928 0.1388    0.01
##           interventionfull-basic   0.02960  0.1721   -0.76 -0.48
##  Residual                          0.08292  0.2880
## Number of obs: 930, groups:  subject, 52; item, 18
##
## Fixed effects:
##                             Estimate Std. Error       df t value Pr(>|t|)
## (Intercept)                 4.842339   0.057639 30.008155  84.011  < 2e-16 ***
## interventionbasic-control  -0.222575   0.048001 28.046824  -4.637 7.46e-05 ***
## interventionfull-basic     -0.370936   0.058103 30.941660  -6.384 4.17e-07 ***
## institution1               -0.203848   0.052280 44.997416  -3.899 0.000319 ***
## institution2                0.027128   0.044511 44.920751   0.609 0.545288
## experience5-10y-<5y         0.018346   0.069372 44.871124   0.264 0.792633
## experience>10y-5-10y       -0.024608   0.076541 44.953549  -0.321 0.749324
## userpartly-no              -0.008842   0.080746 44.900724  -0.110 0.913292
## useryes-partly             -0.060522   0.082432 45.008740  -0.734 0.466626
## ---
```

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Time (full model)   *EXPLORATORY ANALYSIS*

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) intrvntnb- intrvntnf- instt1 instt2 e5-10- e>10-5 usrpr-
## intrvntnbs-  0.030
## intrvntnfl- -0.439 -0.476
## institutin1 -0.083  0.001     -0.001
## institutin2 -0.075  0.000      0.000     -0.412
## expr5-10-<5  0.045 -0.001      0.000     -0.028 -0.312
## exp>10-5-10  0.073  0.000      0.000      0.158  0.035 -0.442
## userprtly-n  0.134  0.001      0.001     -0.292  0.200 -0.043 -0.046
## usrys-prtly -0.086 -0.002      0.001     -0.374  0.134  0.001  0.007 -0.467
```

Plot - Predicted response time

Time (simple model)

Results

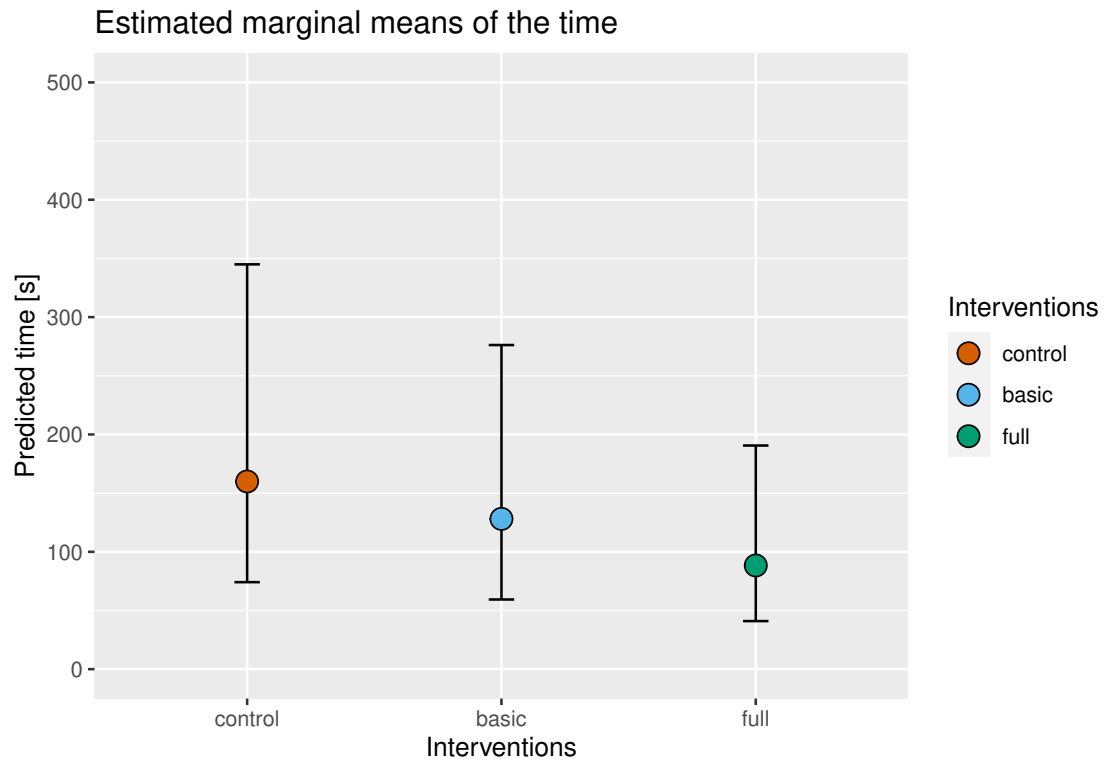| Variable	Deviation (%)	CI (low)	CI (high)	*p* value
Intervention (basic *vs* control)	-19.93	-24.01	-15.62	<0.001
Intervention (full *vs* basic)	-31.01	-34.51	-27.32	<0.001

R summary output

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: log_time ~ intervention + (1 | subject) + (1 | item)
##    Data: data_exploratory
##
## REML criterion at convergence: 762.6
##
## Scaled residuals:
##     Min     1Q  Median     3Q     Max
## -3.7745 -0.6461 -0.0532  0.6139  3.7661
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  subject  (Intercept) 0.06287  0.2507
##  item     (Intercept) 0.04405  0.2099
##  Residual             0.10814  0.3288
## Number of obs: 930, groups:  subject, 52; item, 18
##
## Fixed effects:
##                         Estimate Std. Error        df t value Pr(>|t|)
## (Intercept)              4.80288    0.06142  33.80208  78.194  < 2e-16 ***
## interventionbasic-control -0.22223    0.02671 861.13236  -8.319 3.45e-16 ***
## interventionfull-basic   -0.37118    0.02660 860.23224 -13.953  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##            (Intr) intrvntnb-
## intrvntnbs- 0.000
## intrvntnfl- 0.001 -0.495
```

Time (simple model)   *EXPLORATORY ANALYSIS*

Plot – Predicted response time

Estimated marginal means of the time

Sensitivity analysis

Results

Variable	OR	CI (low)	CI (high)	*p* value
Intervention (basic *vs* control)	0.67	0.44	1.03	0.0664
Intervention (full *vs* basic)	0.22	0.12	0.42	<0.001
Order (block 2 *vs* block 1)	1.14	0.71	1.83	0.5822
Order (block 3 *vs* block 1)	0.80	0.49	1.32	0.3783

R summary output

```
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: error ~ intervention + block_order + (1 | subject) + (1 | item)
##    Data: data_exploratory
## Control: glmerControl(optimizer = "bobyqa")
##
##      AIC      BIC   logLik deviance df.resid
##    708.8    742.7   -347.4    694.8      925
##
## Scaled residuals:
##     Min      1Q  Median      3Q      Max
## -1.0778 -0.4245 -0.3108 -0.1725  6.5485
##
## Random effects:
##  Groups  Name        Variance Std.Dev.
##  subject (Intercept) 0.2403   0.4902
##  item    (Intercept) 0.3724   0.6102
## Number of obs: 932, groups:  subject, 52; item, 18
##
## Fixed effects:
##                          Estimate Std. Error z value Pr(>|z|)
## (Intercept)               -2.1675     0.2493  -8.693  < 2e-16 ***
## interventionbasic-control -0.3950     0.2152  -1.835   0.0664 .
## interventionfull-basic    -1.4935     0.3173  -4.707 2.51e-06 ***
## block_order2               0.1327     0.2412   0.550   0.5822
## block_order3              -0.2238     0.2541  -0.881   0.3783
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) intrvntnb- intrvntnf- blck_2
## intrvntnbs-  0.049
## intrvntnfl-  0.212 -0.376
## block_ordr2 -0.497 -0.022      0.031
## block_ordr3 -0.466 -0.024      0.023      0.494
```

Supplemental material

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CONTRASTS

Contrasts

Contrast matrices for categorical variables

Intervention (exploratory)

```
##         basic-control full-basic
## control    -0.6666667 -0.3333333
## basic        0.3333333 -0.3333333
## full         0.3333333  0.6666667
```

User

```
##         partly-no yes-partly
## no      -0.6666667 -0.3333333
## partly   0.3333333 -0.3333333
## yes      0.3333333  0.6666667
```

Experience

```
##       5-10y-<5y >10y-5-10y
## <5y   -0.6666667 -0.3333333
## 5-10y  0.3333333 -0.3333333
## >10y   0.3333333  0.6666667
```

Institution

```
##                    [,1] [,2]
## Children's hospital   1    0
## Hospital              0    1
## Community            -1   -1
```