Bayes Task analyses

1 June 2022

# Sleep Restriction (SR) Analyses

## Manipulation Check

* Used StartKSS
  + StartKSS had positive skew, hence applied square-root transformation. Did not alleviate non-normality but alleviated skew
* SR significantly increased sleepiness
* Participants’ sleepiness decreased significantly in the PM session during SR. This decrease wasn’t present in the WR condition. Indicates some recovery in sleepiness from morning to afternoon post-SR.

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| Linear mixed model fit by REML. t-tests use Satterthwaite's method ['lmerModLmerTest']  Formula: sqrtKSS ~ 1 + SessionTime \* Condition + (1 | PtID)  Data: data\_SR\_KSS  REML criterion at convergence: 93  Scaled residuals:  Min 1Q Median 3Q Max  -2.91212 -0.68283 0.09386 0.61345 2.26842  Random effects:  Groups Name Variance Std.Dev.  PtID (Intercept) 0.06103 0.2470  Residual 0.08421 0.2902  Number of obs: 112, groups: PtID, 37  Fixed effects:  Estimate Std. Error df t value Pr(>|t|)  (Intercept) 1.68602 0.06396 79.71586 26.361 < 0.0000000000000002 \*\*\*  SessionTimePM 0.12308 0.06970 72.34397 1.766 0.0816 .  ConditionSR 0.79909 0.08400 80.12179 9.513 0.00000000000000852 \*\*\*  SessionTimePM:ConditionSR -0.26548 0.11387 72.18161 -2.331 0.0225 \*  ---  Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1 |

## Accuracy model:

Logit model with NoBrainers \* SessionTime\*Condition 3-way interaction

* Pts more likely to get accurate response on NoBrainer trials, as expected (6.5x the odds)
* Both SR and SessionTime did not affect trial accuracy, and did not amplify nor reduce ability to make an accurate response on NoBrainer trials.

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| Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) ['glmerMod']  Family: binomial ( logit )  Formula: IsCorrect ~ 1 + NoBrainers + Condition \* SessionTime + (1 | PtID)  Data: data\_SR  AIC BIC logLik deviance df.resid  4594.4 4633.2 -2291.2 4582.4 4719  Scaled residuals:  Min 1Q Median 3Q Max  -6.5256 0.1568 0.4533 0.5977 0.9131  Random effects:  Groups Name Variance Std.Dev.  PtID (Intercept) 0.2205 0.4696  Number of obs: 4725, groups: PtID, 41  Fixed effects:  Estimate Std. Error z value Pr(>|z|)  (Intercept) 1.10265 0.09998 11.029 <0.0000000000000002 \*\*\*  NoBrainers 2.16920 0.16819 12.898 <0.0000000000000002 \*\*\*  ConditionSR -0.10661 0.10890 -0.979 0.328  SessionTimePM 0.03673 0.09558 0.384 0.701  ConditionSR:SessionTimePM -0.01034 0.14926 -0.069 0.945 |

## Pooled model:

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| Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) ['glmerMod']  Family: binomial ( probit )  Formula: PtResp ~ 1 + SessionTime \* Condition \* LogLLA + SessionTime \* Condition \* LogBaserate + (1 | PtID)  Data: data\_SR  AIC BIC logLik deviance df.resid  4743.6 4827.5 -2358.8 4717.6 4676  Scaled residuals:  Min 1Q Median 3Q Max  -123.00 -0.80 0.02 0.74 1617.95  Random effects:  Groups Name Variance Std.Dev.  PtID (Intercept) 0.01198 0.1095  Number of obs: 4689, groups: PtID, 41  Fixed effects:  Estimate Std. Error z value Pr(>|z|)  (Intercept) 0.1181879 0.0422646 2.796 0.00517 \*\*  SessionTimePM 0.0565045 0.0548932 1.029 0.30331  ConditionSR -0.0686080 0.0617739 -1.111 0.26673  LogLLA 0.1804275 0.0158093 11.413 < 0.0000000000000002 \*\*\*  LogBaserate 0.2084346 0.0142148 14.663 < 0.0000000000000002 \*\*\*  SessionTimePM:ConditionSR -0.0280312 0.0870057 -0.322 0.74732  SessionTimePM:LogLLA -0.0206788 0.0219960 -0.940 0.34716  ConditionSR:LogLLA -0.0328646 0.0242782 -1.354 0.17584  SessionTimePM:LogBaserate -0.0043069 0.0200318 -0.215 0.82977  ConditionSR:LogBaserate -0.0186568 0.0215048 -0.868 0.38563  SessionTimePM:ConditionSR:LogLLA 0.0008202 0.0342634 0.024 0.98090  SessionTimePM:ConditionSR:LogBaserate 0.1454087 0.0394771 3.683 0.00023 \*\*\*  ---  Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1 |

## AM only

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| Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) ['glmerMod']  Family: binomial ( probit )  Formula: PtResp ~ 1 + Condition \* LogLLA + Condition \* LogBaserate + (1 | PtID)  Data: data\_SR\_AM  AIC BIC logLik deviance df.resid  2413.7 2454.0 -1199.8 2399.7 2344  Scaled residuals:  Min 1Q Median 3Q Max  -17.8873 -0.8288 0.0248 0.7711 13.8108  Random effects:  Groups Name Variance Std.Dev.  PtID (Intercept) 0.00000005622 0.0002371  Number of obs: 2351, groups: PtID, 41  Fixed effects:  Estimate Std. Error z value Pr(>|z|)  (Intercept) 0.11667 0.03851 3.029 0.00245 \*\*  ConditionSR -0.07193 0.06069 -1.185 0.23592  LogLLA 0.17922 0.01575 11.382 < 0.0000000000000002 \*\*\*  LogBaserate 0.20753 0.01418 14.631 < 0.0000000000000002 \*\*\*  ConditionSR:LogLLA -0.03275 0.02421 -1.353 0.17619  ConditionSR:LogBaserate -0.01891 0.02142 -0.883 0.37736  ---  Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1 |

### Chi-square coefficient tests:

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| For WR:Df Chisq Pr(>Chisq)12 1 3.0769 0.07941 .For SR:Df Chisq Pr(>Chisq)1 2 1 0.3048 0.5809 |

### Relative decision weights:

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| WR\_AM -0.07319974  SR\_AM -0.12578710 |

## PM-only

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| Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) ['glmerMod']  Family: binomial ( probit )  Formula: PtResp ~ 1 + Condition \* LogLLA + Condition \* LogBaserate + (1 | PtID)  Data: data\_SR\_PM  AIC BIC logLik deviance df.resid  2334.7 2375.0 -1160.4 2320.7 2331  Scaled residuals:  Min 1Q Median 3Q Max  -134.02 -0.79 0.00 0.73 1637.65  Random effects:  Groups Name Variance Std.Dev.  PtID (Intercept) 0.01229 0.1108  Number of obs: 2338, groups: PtID, 41  Fixed effects:  Estimate Std. Error z value Pr(>|z|)  (Intercept) 0.17479 0.04273 4.091 0.000043 \*\*\*  ConditionSR -0.09367 0.06344 -1.476 0.139839  LogLLA 0.15994 0.01538 10.400 < 0.0000000000000002 \*\*\*  LogBaserate 0.20440 0.01422 14.378 < 0.0000000000000002 \*\*\*  ConditionSR:LogLLA -0.03201 0.02421 -1.322 0.186053  ConditionSR:LogBaserate 0.12591 0.03320 3.793 0.000149 \*\*\*  ---  Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1 |

### Chi-square coefficient tests:

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| --- |
| For WR:Df Chisq Pr(>Chisq)12 1 7.1902 0.00733 \*\*For SR:Df Chisq Pr(>Chisq)1 2 1 21.175 0.000004192 \*\*\* |

### Relative decision weights:

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| WR\_PM -0.1220289  SR\_PM -0.4416463 |

# Sleep Restriction (SR) Analyses W/O NoBrainer Trials

**Note:**

* According to the data files in the BDS Circadia folder, NoBrainer was coded 1 if odds were 0 or 1.
* **Was unable to run the models with a *NoBrainer* variable (coded 0/1) as an additional covariate** 
  + The pooled model with this variable added failed to converge
  + The AM-only and PM-only models with this added faced singular fit and convergence issues respectively.
* With the following models, I dropped **all NoBrainer trials** (i.e. NoBrainers == 1 ) from the dataset, and ran 3 models here on that:
  + Pooled model without NoBrainer trials (**Convergence issue**, again)
  + AM-only (presented here)
  + PM-only (presented here)

**Takeaway:**

* In AM session, Condition\*LogLLA significant in negative direction. Condition\*LogBaserate near-significant in negative direction
  + Without the NoBrainer trials (driving reliance on Odds), it seems pts are likely to *rely less* on evidence after SR. If we were to take the near-sig Condition\*LogBaserate interaction into account, it’d imply they paid less attention to both information sources in making their decisions SR
* In PM session, Condition\*LogLLA near-significant in negative direction.
  + Decreased reliance on Evidence after SR may still be present nearer to circadian peak, but reliance on Odds unchanged.
* On trials that are more cognitively challenging (require integration of both sources of information), SR affects participants’ ability to take into account Evidence information. Closer to circadian nadir, it seems ability to use both sources of information is blunted.

## Pooled Model without NoBrainer trials

* **Convergence issue**

## AM Model without NoBrainer trials

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| Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) ['glmerMod']  Family: binomial ( probit )  Formula: PtResp ~ 1 + Condition \* LogLLA + Condition \* LogBaserate + (1 | PtID)  Data: data\_SR\_AM2  AIC BIC logLik deviance df.resid  1903.8 1942.6 -944.9 1889.8 1869  Scaled residuals:  Min 1Q Median 3Q Max  -4.3359 -0.6550 0.1941 0.6003 3.8445  Random effects:  Groups Name Variance Std.Dev.  PtID (Intercept) 0.007274 0.08529  Number of obs: 1876, groups: PtID, 41  Fixed effects:  Estimate Std. Error z value Pr(>|z|)  (Intercept) 0.13398 0.04555 2.942 0.00327 \*\*  ConditionSR -0.09146 0.06826 -1.340 0.18028  LogLLA 0.30879 0.02118 14.580 < 0.0000000000000002 \*\*\*  LogBaserate 0.77677 0.04496 17.276 < 0.0000000000000002 \*\*\*  ConditionSR:LogLLA -0.06359 0.03113 -2.043 0.04104 \*  ConditionSR:LogBaserate -0.12544 0.06728 -1.864 0.06226 .  ---  Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1 |

### Chi-square coefficient tests:

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| --- |
| For WR: Df Chisq Pr(>Chisq)  1  2 1 172.66 < 0.00000000000000022 \*\*\*  **For SR:**  Df Chisq Pr(>Chisq)  1  2 1 1.2752 0.2588 |

### Relative decision weights:

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| --- |
| WR\_AM -0.4310955  SR\_AM -0.4530021 |

## PM Model without NoBrainer trials

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| --- |
| Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) ['glmerMod']  Family: binomial ( probit )  Formula: PtResp ~ 1 + Condition \* LogLLA + Condition \* LogBaserate + (1 | PtID)  Data: data\_SR\_PM2  AIC BIC logLik deviance df.resid  1872.5 1911.2 -929.2 1858.5 1862  Scaled residuals:  Min 1Q Median 3Q Max  -6.5488 -0.6537 0.2152 0.5742 10.7682  Random effects:  Groups Name Variance Std.Dev.  PtID (Intercept) 0.02641 0.1625  Number of obs: 1869, groups: PtID, 41  Fixed effects:  Estimate Std. Error z value Pr(>|z|)  (Intercept) 0.20078 0.05070 3.960 0.000075 \*\*\*  ConditionSR -0.13695 0.07085 -1.933 0.0532 .  LogLLA 0.29171 0.02058 14.175 < 0.0000000000000002 \*\*\*  LogBaserate 0.72799 0.04369 16.661 < 0.0000000000000002 \*\*\*  ConditionSR:LogLLA -0.05820 0.03087 -1.885 0.0594 .  ConditionSR:LogBaserate 0.04367 0.06808 0.641 0.5212  ---  Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1 |

### Chi-square coefficient tests:

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| --- |
| For WR:Df Chisq Pr(>Chisq)12 1 154.78 < 0.00000000000000022 \*\*\*---For SR:Df Chisq Pr(>Chisq)1 2 1 3.271 0.07052 . |

### Relative decision weights:

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| --- |
| WR\_PM -0.4278513  SR\_PM -0.5353821 |