

Inhibition, processing speed and late talker outcomes

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29/10/2020

Import data

Anonymized data has RTs longer/shorter than ± 2 SD and all RTs shorter than 100 ms filtered for each participant. Only correct responses included. Scripts used for filtering available on request.

```
data.rt <- read.csv2("data.csv")

data.rt$RTlog <- log(data.rt$Target.RT)

summary(data.rt)
```

```
##          id          PRI          risk
## Min.   : 1.00   Min.   : 60.0   Late talker      :3434
## 1st Qu.:19.00   1st Qu.: 91.0   Typical early development:3034
## Median :38.00   Median :104.0
## Mean   :37.81   Mean   :103.7
## 3rd Qu.:56.00   3rd Qu.:118.0
## Max.   :75.00   Max.   :140.0
##      Lindex      Lindex.C      FlankerType      Trial
## Min.   : 3.667   Min.   :-1.91671   congruent :3294   Min.   : 1.00
## 1st Qu.: 7.333   1st Qu.: -0.62797   incongruent:3174  1st Qu.:24.00
## Median : 8.667   Median : -0.15934
## Mean   : 9.139   Mean   : 0.00653
## 3rd Qu.:12.000   3rd Qu.: 1.01225
## Max.   :14.667   Max.   : 1.94952
## Max.   :96.00
##      Target.RT      RTlog
## Min.   : 123.0   Min.   :4.812
## 1st Qu.: 584.0   1st Qu.:6.370
## Median : 688.0   Median :6.534
## Mean   : 733.4   Mean   :6.556
## 3rd Qu.: 832.0   3rd Qu.:6.724
## Max.   :1692.0   Max.   :7.434
```

```
#releveling risk variable, using TED as reference level
data.rt$risk <- relevel(data.rt$risk, ref = "Typical early development")

data.e70 <- subset(data.rt, data.rt$PRI>=70)
data.e85 <- subset(data.rt, data.rt$PRI>=85)
```

Models

Model for data with exclusion criteria PRI < 70

```
mdl70 <- lmer(RTlog ~ FlankerType*risk*Lindex.C + (1+FlankerType|id), data=data.e70)
summary(mdl70)
```

```

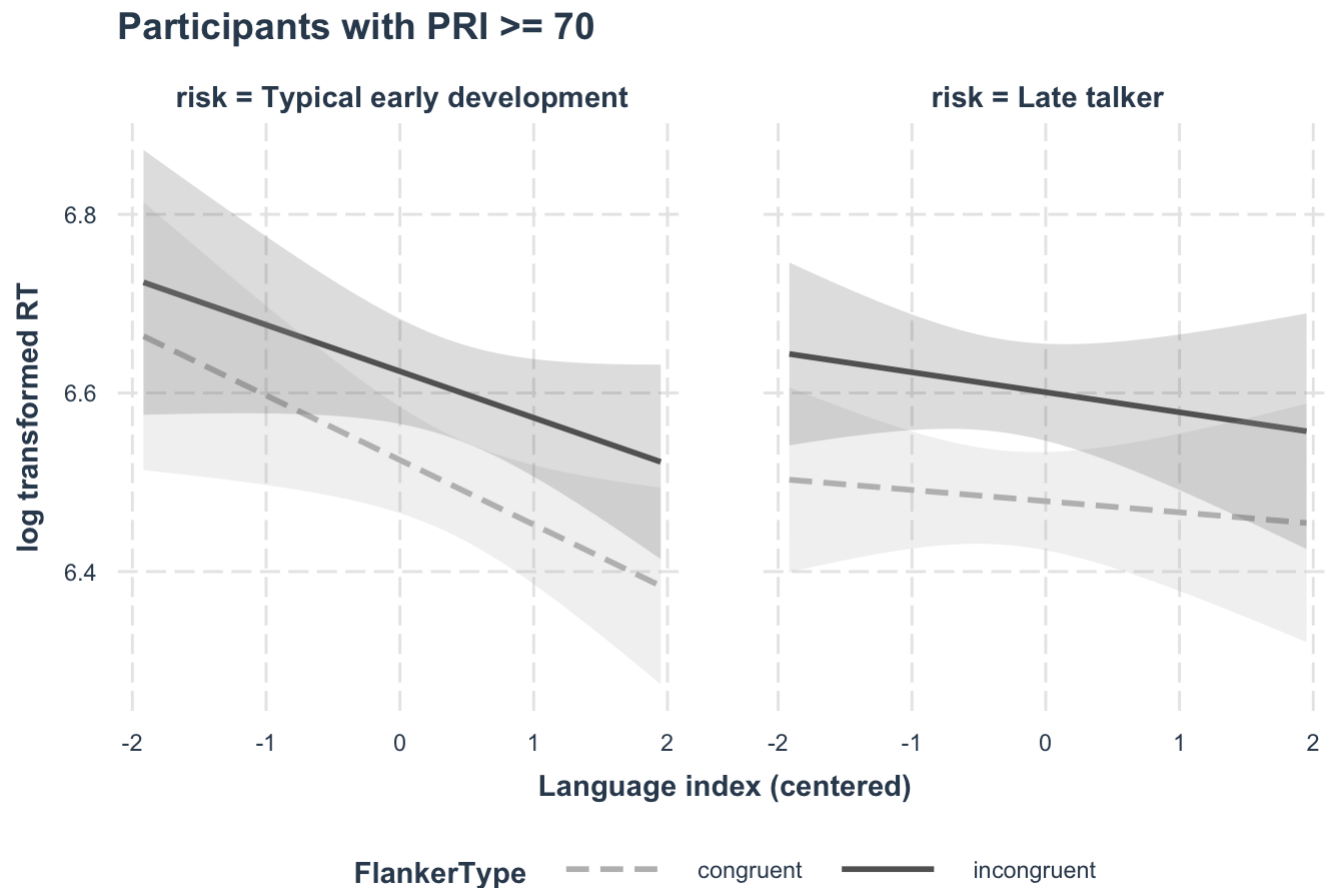
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: RTlog ~ FlankerType * risk * Lindex.C + (1 + FlankerType | id)
## Data: data.e70
##
## REML criterion at convergence: -958.7
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -7.9150 -0.6372 -0.0420  0.5900  3.7414
##
## Random effects:
## Groups   Name                Variance Std.Dev. Corr
## id      (Intercept)            0.026271 0.16208
##          FlankerTypeincongruent 0.002059 0.04538 -0.18
## Residual                    0.047420 0.21776
## Number of obs: 6310, groups: id, 73
##
## Fixed effects:
##
##              Estimate Std. Error    df
## (Intercept)      6.52492    0.03033 68.86515
## FlankerTypeincongruent    0.09929    0.01196 68.48232
## riskLate talker    -0.04607    0.04129 68.85885
## Lindex.C          -0.07233    0.03099 68.84432
## FlankerTypeincongruent:riskLate talker    0.02265    0.01629 68.53893
## FlankerTypeincongruent:Lindex.C          0.02033    0.01224 68.78751
## riskLate talker:Lindex.C          0.05981    0.04172 68.85795
## FlankerTypeincongruent:riskLate talker:Lindex.C -0.03020    0.01647 68.84091
##
##              t value Pr(>|t|)
## (Intercept)    215.134 < 2e-16 ***
## FlankerTypeincongruent    8.301 5.92e-12 ***
## riskLate talker    -1.116  0.2684
## Lindex.C         -2.334  0.0225 *
## FlankerTypeincongruent:riskLate talker    1.391  0.1687
## FlankerTypeincongruent:Lindex.C          1.661  0.1012
## riskLate talker:Lindex.C          1.434  0.1562
## FlankerTypeincongruent:riskLate talker:Lindex.C -1.833  0.0711 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##      (Intr) FlnkrT rskLtt Lndx.C FLT:Lt FT:L.C rLt:L.
## FlnkrTypncn -0.225
## rskLattlkr -0.735  0.165
## Lindex.C   -0.388  0.088  0.285
## FlnkrTyp:Lt  0.165 -0.734 -0.225 -0.065
## FlnkrTy:L.C  0.088 -0.388 -0.065 -0.224  0.285
## rskLtlk:L.C  0.288 -0.065 -0.081 -0.743  0.019  0.167
## FlnT:Lt:L.C -0.065  0.288  0.019  0.167 -0.082 -0.743 -0.225

```

```

interact_plot mdl170, pred = Lindex.C, modx = FlankerType, mod2 = risk, interval = T,
               colors = "Greys",
x.label = "Language index (centered)",
y.label = "log transformed RT",
main.title = "Participants with PRI >= 70")

```



```

tab_model(mdl170, show.stat = T)

```

<i>Predictors</i>	RTlog			
	<i>Estimates</i>	<i>CI</i>	<i>Statistic</i>	<i>p</i>
(Intercept)	6.52	6.47 – 6.58	215.13	<0.001
FlankerType [incongruent]	0.10	0.08 – 0.12	8.30	<0.001
risk [Late talker]	-0.05	-0.13 – 0.03	-1.12	0.264
Lindex.C	-0.07	-0.13 – -0.01	-2.33	0.020
FlankerType [incongruent] * risk [Late talker]	0.02	-0.01 – 0.05	1.39	0.164
FlankerType [incongruent] * Lindex.C	0.02	-0.00 – 0.04	1.66	0.097

risk [Late talker] * Lindex.C	0.06	-0.02 – 0.14	1.43	0.152
(FlankerType [incongruent] * risk [Late talker]) * Lindex.C	-0.03	-0.06 – 0.00	-1.83	0.067

Random Effects

σ^2	0.05
$\tau_{00 \text{ id}}$	0.03
$\tau_{11 \text{ id.FlankerTypeincongruent}}$	0.00
$\rho_{01 \text{ id}}$	-0.18
ICC	0.35
N_{id}	73
Observations	6310
Marginal R^2 / Conditional R^2	0.066 / 0.396

Model for data with exclusion criteria PRI < 85

```
mdl85 <- lmer(RTlog ~ FlankerType*risk*Lindex.C + (1+FlankerType|id), data=data.e85)
summary(mdl85)
```

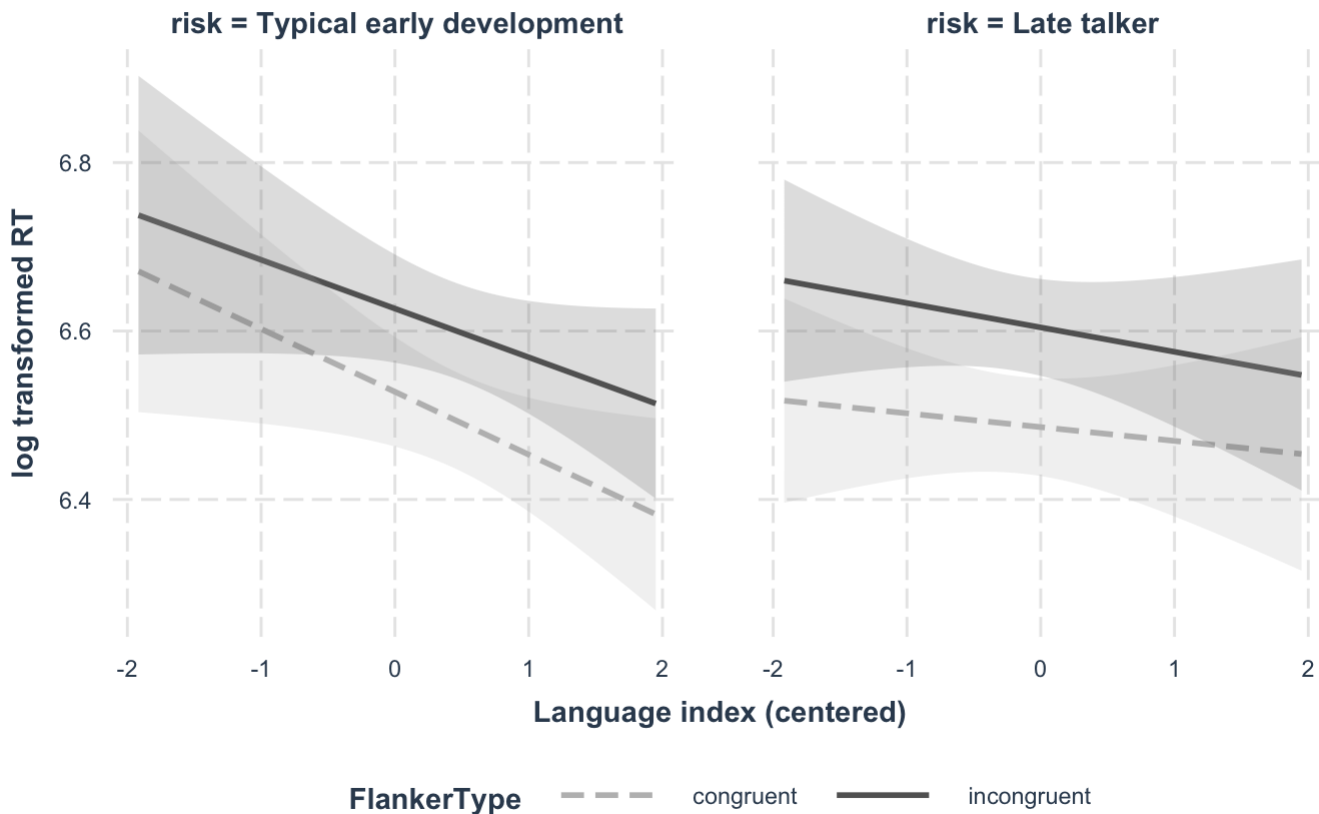
```

## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: RTlog ~ FlankerType * risk * Lindex.C + (1 + FlankerType | id)
## Data: data.e85
##
## REML criterion at convergence: -988.4
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -8.0223 -0.6475 -0.0513  0.5977  3.7925
##
## Random effects:
## Groups   Name                Variance Std.Dev. Corr
## id      (Intercept)          0.026368 0.1624
##          FlankerTypeincongruent 0.001972 0.0444  -0.18
## Residual                    0.046158 0.2148
## Number of obs: 5551, groups: id, 64
##
## Fixed effects:
##
##              Estimate Std. Error      df
## (Intercept)      6.52786    0.03311 59.88243
## FlankerTypeincongruent    0.09880    0.01280 59.62408
## riskLate talker    -0.04193    0.04442 59.87733
## Lindex.C          -0.07460    0.03368 59.86443
## FlankerTypeincongruent:riskLate talker    0.01955    0.01718 59.70812
## FlankerTypeincongruent:Lindex.C          0.01676    0.01304 59.92767
## riskLate talker:Lindex.C          0.05823    0.04557 59.87714
## FlankerTypeincongruent:riskLate talker:Lindex.C -0.02936    0.01766 60.11018
##
##              t value Pr(>|t|)
## (Intercept)    197.157 < 2e-16 ***
## FlankerTypeincongruent    7.720 1.53e-10 ***
## riskLate talker    -0.944  0.3490
## Lindex.C         -2.215  0.0306 *
## FlankerTypeincongruent:riskLate talker    1.138  0.2596
## FlankerTypeincongruent:Lindex.C          1.285  0.2037
## riskLate talker:Lindex.C          1.278  0.2062
## FlankerTypeincongruent:riskLate talker:Lindex.C -1.663  0.1015
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##      (Intr) FlnkrT rskLtt Lndx.C FlT:Lt FT:L.C rLt:L.
## FlnkrTypncn -0.220
## rskLattlkr -0.745  0.164
## Lindex.C   -0.468  0.103  0.349
## FlnkrTyp:Lt  0.164 -0.745 -0.220 -0.077
## FlnkrTy:L.C  0.103 -0.466 -0.077 -0.219  0.347
## rskLtlk:L.C  0.346 -0.076 -0.191 -0.739  0.043  0.162
## FlnT:Lt:L.C -0.076  0.344  0.043  0.162 -0.191 -0.739 -0.219

```

```
interact_plot mdl85, pred = Lindex.C, modx = FlankerType, mod2 = risk, interval = T,
               colors = "Greys",
x.label = "Language index (centered)",
y.label = 'log transformed RT',
main.title = "Participants with PRI >= 85")
```

Participants with PRI >= 85



```
tab_model(mdl85, show.stat = T)
```

Predictors	RTlog			
	Estimates	CI	Statistic	p
(Intercept)	6.53	6.46 – 6.59	197.16	<0.001
FlankerType [incongruent]	0.10	0.07 – 0.12	7.72	<0.001
risk [Late talker]	-0.04	-0.13 – 0.05	-0.94	0.345
Lindex.C	-0.07	-0.14 – -0.01	-2.21	0.027
FlankerType [incongruent] * risk [Late talker]	0.02	-0.01 – 0.05	1.14	0.255
FlankerType [incongruent] * Lindex.C	0.02	-0.01 – 0.04	1.29	0.199

risk [Late talker] * Lindex.C	0.06	-0.03 – 0.15	1.28	0.201
(FlankerType [incongruent] * risk [Late talker]) * Lindex.C	-0.03	-0.06 – 0.01	-1.66	0.096

Random Effects

σ^2	0.05
$\tau_{00 \text{ id}}$	0.03
$\tau_{11 \text{ id.FlankerTypeincongruent}}$	0.00
$\rho_{01 \text{ id}}$	-0.18
ICC	0.36
N_{id}	64
Observations	5551
Marginal R^2 / Conditional R^2	0.067 / 0.404

Post hoc analysis

```
# incongruent trials only
data.e70inc <- subset(data.e70, data.e70$FlankerType=="incongruent")
data.e85inc <- subset(data.e85, data.e85$FlankerType=="incongruent")

#exclusion criteria PRI > 70

mdl70inc <- lmer(RTlog ~ Lindex.C + (1|id), data=data.e70inc)
summary(mdl70inc)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: RTlog ~ Lindex.C + (1 | id)
## Data: data.e70inc
##
## REML criterion at convergence: -400.9
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -4.7367 -0.6320 -0.0361  0.6036  3.5238
##
## Random effects:
## Groups   Name                Variance Std.Dev.
## id      (Intercept) 0.02516   0.1586
## Residual                0.04761   0.2182
## Number of obs: 3101, groups: id, 73
##
## Fixed effects:
##              Estimate Std. Error      df t value Pr(>|t|)
## (Intercept)  6.60695    0.01899 70.94052 347.983  <2e-16 ***
## Lindex.C    -0.03203    0.01915 70.99387  -1.672  0.0989 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##              (Intr)
## Lindex.C -0.032
```

```
#exclusion criteria PRI > 85
```

```
mdl85inc <- lmer(RTlog ~ Lindex.C + (1|id), data=data.e85inc)
summary(mdl85inc)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: RTlog ~ Lindex.C + (1 | id)
## Data: data.e85inc
##
## REML criterion at convergence: -468.7
##
## Scaled residuals:
## Min      1Q  Median      3Q      Max
## -4.2291 -0.6388 -0.0451  0.6126  3.6032
##
## Random effects:
## Groups Name Variance Std.Dev.
## id      (Intercept) 0.02518 0.1587
## Residual 0.04556 0.2135
## Number of obs: 2724, groups: id, 64
##
## Fixed effects:
## Estimate Std. Error df t value Pr(>|t|)
## (Intercept) 6.61045 0.02052 61.94856 322.128 <2e-16 ***
## Lindex.C -0.03926 0.02108 62.02363 -1.862 0.0673 .
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
## (Intr)
## Lindex.C -0.161
```

```
tab_model mdl70inc, mdl85inc, show.stat = T, title = "Incongruent trials only")
```

Incongruent trials only

Predictors	RTlog					RTlog			
	Estimates	CI	Statistic	p		Estimates	CI	Statistic	p
(Intercept)	6.61	6.57 – 6.64	347.98	<0.001		6.61	6.57 – 6.65	322.13	<0.001
Lindex.C	-0.03	-0.07 – 0.01	-1.67	0.095		-0.04	-0.08 – 0.00	-1.86	0.063
Random Effects									
σ^2	0.05					0.05			
τ_{00}	0.03	id				0.03	id		
ICC	0.35					0.36			
N	73	id				64	id		
Observations	3101					2724			
Marginal R^2 / Conditional R^2	0.014 / 0.355					0.020 / 0.368			

```
# congruent trials only
data.e70cong <- subset(data.e70, data.e70$FlankerType=="congruent")
data.e85cong <- subset(data.e85, data.e85$FlankerType=="congruent")

#exclusion criteria PRI > 70

mdl70cong <- lmer(RTlog ~ Lindex.C + (1|id), data=data.e70cong)
summary(mdl70cong)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: RTlog ~ Lindex.C + (1 | id)
## Data: data.e70cong
##
## REML criterion at convergence: -442
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -7.7531 -0.6501 -0.0479  0.5877  3.9265
##
## Random effects:
## Groups Name Variance Std.Dev.
## id      (Intercept) 0.02667 0.1633
## Residual          0.04723 0.2173
## Number of obs: 3209, groups: id, 73
##
## Fixed effects:
##              Estimate Std. Error      df t value Pr(>|t|)
## (Intercept)  6.49060    0.01951 70.87674 332.726 <2e-16 ***
## Lindex.C     -0.03232    0.01967 70.88107  -1.643  0.105
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##              (Intr)
## Lindex.C -0.033
```

```
#exclusion criteria PRI > 85

mdl85cong <- lmer(RTlog ~ Lindex.C + (1|id), data=data.e85cong)
summary(mdl85cong)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: RTlog ~ Lindex.C + (1 | id)
## Data: data.e85cong
##
## REML criterion at convergence: -419.4
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -7.7966 -0.6550 -0.0538  0.5941  3.9456
##
## Random effects:
## Groups   Name                Variance Std.Dev.
## id      (Intercept) 0.02639  0.1625
## Residual                0.04673  0.2162
## Number of obs: 2827, groups: id, 64
##
## Fixed effects:
##              Estimate Std. Error      df t value Pr(>|t|)
## (Intercept)  6.49680    0.02099 61.91176 309.531  <2e-16 ***
## Lindex.C    -0.03767    0.02156 61.91379  -1.748   0.0855 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##              (Intr)
## Lindex.C -0.162
```

```
tab_model mdl70cong, mdl85cong, show.stat = T, title = "Congruent trials only")
```

Congruent trials only

Predictors	RTlog					RTlog			
	Estimates	CI	Statistic	p		Estimates	CI	Statistic	p
(Intercept)	6.49	6.45 – 6.53	332.73	<0.001		6.50	6.46 – 6.54	309.53	<0.001
Lindex.C	-0.03	-0.07 – 0.01	-1.64	0.100		-0.04	-0.08 – 0.00	-1.75	0.081
Random Effects									
σ^2	0.05					0.05			
τ_{00}	0.03					0.03			
ICC	0.36					0.36			
N	73					64			
Observations	3209					2827			
Marginal R^2 / Conditional R^2	0.014 / 0.370					0.018 / 0.372			