

Effects of Gratitude Journaling on Well-being

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Introduction

Gratitude journaling has been associated with improved emotional well-being and reduced stress. This study simulates a 2-week longitudinal intervention comparing gratitude journaling and neutral journaling on subjective happiness and stress levels.

Data Overview

```
setwd("C:/Users/0&1/OneDrive/Documents/Student-Projects-Portfolio/gratitude_wellbeing")
data <- read.csv("gratitude_wellbeing_data.csv")
head(data)
```

```
##   SubjectID      Group Happiness_Pre Happiness_Post Stress_Pre Stress_Post
## 1      S001 Gratitude          3.09           4.91       7.42       6.50
## 2      S002  Neutral          3.72           4.85       5.43       6.54
## 3      S003 Gratitude          3.39           4.74       5.17       3.68
## 4      S004 Gratitude          6.25           8.04       6.47       5.32
## 5      S005 Gratitude          5.44           7.63       5.45       4.80
## 6      S006  Neutral          5.77           6.29       6.63       5.62
## Compliance_14Day
## 1              11
## 2              10
## 3              13
## 4              14
## 5              14
## 6              12
```

```
summary(data)
```

```
##   SubjectID      Group      Happiness_Pre      Happiness_Post
## Length:60      Length:60      Min.   :2.420      Min.   :2.670
## Class :character Class :character 1st Qu.:3.720      1st Qu.:4.790
## Mode  :character Mode  :character Median :4.450      Median :5.290
##                                     Mean  :4.401      Mean  :5.376
##                                     3rd Qu.:5.095      3rd Qu.:6.082
##                                     Max.   :6.250      Max.   :8.480
##   Stress_Pre      Stress_Post      Compliance_14Day
## Min.   :4.480      Min.   :3.430      Min.   : 8.0
## 1st Qu.:5.633      1st Qu.:4.957      1st Qu.:11.0
## Median :6.310      Median :5.585      Median :12.0
## Mean   :6.381      Mean   :5.633      Mean   :12.2
## 3rd Qu.:7.080      3rd Qu.:6.440      3rd Qu.:13.0
```

```
## Max.      :8.530   Max.      :8.580   Max.      :14.0
```

- Groups: Gratitude vs. Neutral
- Measures:
 - Happiness: Pre and Post
 - Stress: Pre and Post
 - Compliance over 14 days

Mixed-Effects Model: Happiness Over Time

We fit a mixed-effects model with random intercepts per subject.

```
data_long <- data %>%
  pivot_longer(cols = c(Happiness_Pre, Happiness_Post),
               names_to = "Time", values_to = "Happiness") %>%
  mutate(Time = factor(Time, levels = c("Happiness_Pre", "Happiness_Post")),
         SubjectID = factor(SubjectID))

model <- lmer(Happiness ~ Time * Group + (1 | SubjectID), data = data_long)
summary(model)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: Happiness ~ Time * Group + (1 | SubjectID)
## Data: data_long
##
## REML criterion at convergence: 291.1
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -1.55368 -0.46832  0.02847  0.49149  1.81154
##
## Random effects:
## Groups Name Variance Std.Dev.
## SubjectID (Intercept) 0.9124 0.9552
## Residual 0.2024 0.4498
## Number of obs: 120, groups: SubjectID, 60
##
## Fixed effects:
## Estimate Std. Error t value
## (Intercept) 4.36586 0.19606 22.268
## TimeHappiness_Post 1.26621 0.11813 10.719
## GroupNeutral 0.06865 0.27277 0.252
## TimeHappiness_Post:GroupNeutral -0.56459 0.16435 -3.435
##
## Correlation of Fixed Effects:
## (Intr) TmHp_P GrpNtr
## TmHppnss_Ps -0.301
## GroupNeutr1 -0.719 0.217
## TmHppn_P:GN 0.217 -0.719 -0.301
```

```
library(lmerTest)
```

```
## Warning: package 'lmerTest' was built under R version 4.4.3
```

```
##
## Attaching package: 'lmerTest'
## The following object is masked from 'package:lme4':
##
##     lmer
## The following object is masked from 'package:stats':
##
##     step
summary(lmer(Happiness ~ Group * Time + (1 | SubjectID), data = data_long))

## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: Happiness ~ Group * Time + (1 | SubjectID)
## Data: data_long
##
## REML criterion at convergence: 291.1
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -1.55368 -0.46832  0.02847  0.49149  1.81154
##
## Random effects:
## Groups      Name                Variance Std.Dev.
## SubjectID (Intercept) 0.9124     0.9552
## Residual              0.2024     0.4498
## Number of obs: 120, groups: SubjectID, 60
##
## Fixed effects:
##
##              Estimate Std. Error      df t value Pr(>|t|)
## (Intercept)      4.36586    0.19606  69.46450   22.268 < 2e-16
## GroupNeutral      0.06865    0.27277  69.46450    0.252  0.8020
## TimeHappiness_Post 1.26621    0.11813  58.00000   10.719 2.23e-15
## GroupNeutral:TimeHappiness_Post -0.56459    0.16435  58.00000   -3.435  0.0011
##
## (Intercept)          ***
## GroupNeutral
## TimeHappiness_Post          ***
## GroupNeutral:TimeHappiness_Post **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##              (Intr) GrpNtr TmHp_P
## GroupNeutrl -0.719
## TmHppnss_Ps -0.301  0.217
## GrpNtr:TH_P  0.217 -0.301 -0.719
```

Result

A significant Time \times Group interaction was found ($p = 0.0011$), indicating steeper gains in happiness for the gratitude group.

Independent t-Test: Stress Reduction

```
data <- data %>%
  mutate(Stress_Reduction = Stress_Pre - Stress_Post)

t_test <- t.test(Stress_Reduction ~ Group, data = data)
t_test

##
## Welch Two Sample t-test
##
## data: Stress_Reduction by Group
## t = 2.4223, df = 57.742, p-value = 0.01858
## alternative hypothesis: true difference in means between group Gratitude and group Neutral is not equal to 0
## 95 percent confidence interval:
##  0.08325919 0.87616239
## sample estimates:
## mean in group Gratitude mean in group Neutral
##           0.9955172           0.5158065
```

Result

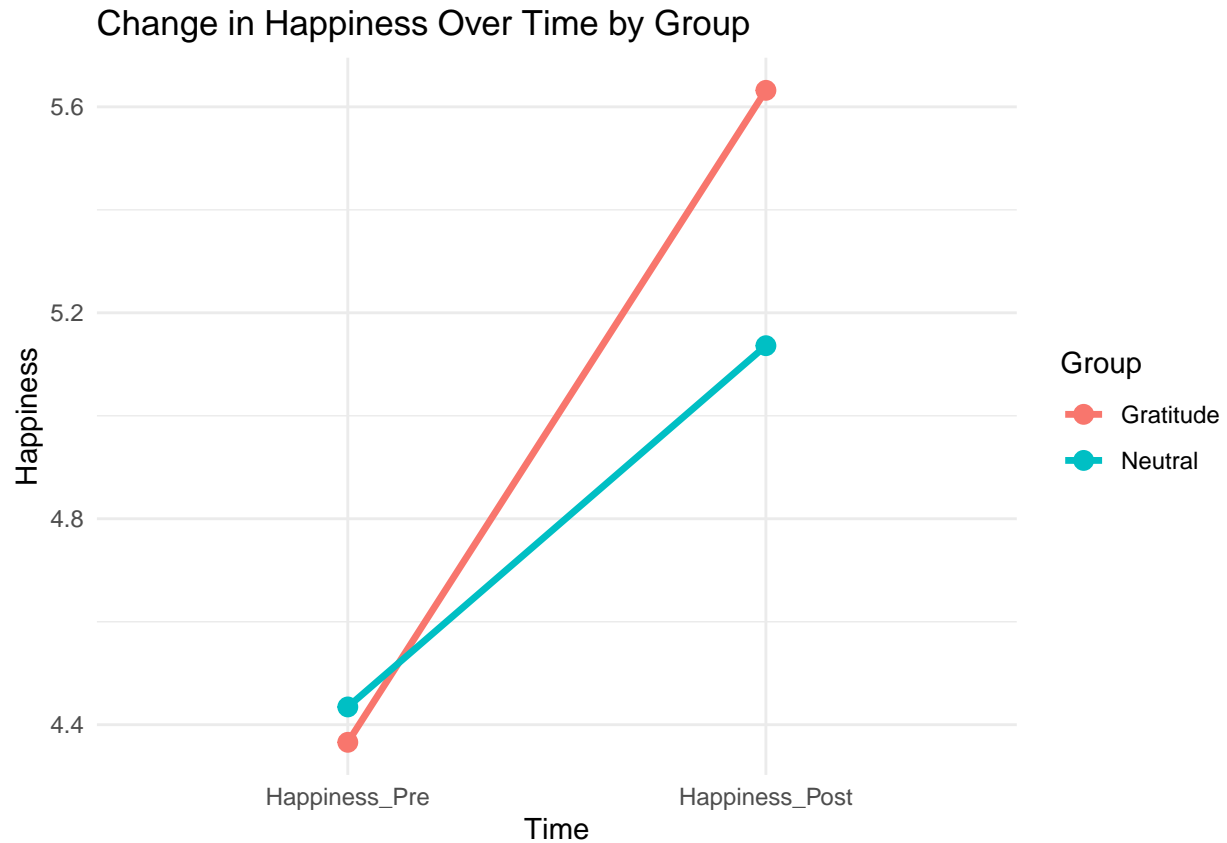
Stress levels decreased more in the Gratitude group than the Neutral group ($p = 0.019$).

Before the intervention, both groups had similar happiness scores — but by the end, the Gratitude group jumped from an average of 4.4 to 5.7, while the Neutral group only rose to 5.0.

```
library(ggplot2)

ggplot(data_long, aes(x = Time, y = Happiness, color = Group, group = Group)) +
  stat_summary(fun = mean, geom = "line", size = 1.2) +
  stat_summary(fun = mean, geom = "point", size = 3) +
  labs(title = "Change in Happiness Over Time by Group") +
  theme_minimal()

## Warning: Using `size` aesthetic for lines was deprecated in ggplot2 3.4.0.
## i Please use `linewidth` instead.
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
## generated.
```



Handling Missing Data (Example)

Let's assume some missing happiness scores and use multiple imputation.

```
set.seed(123)
data_miss <- data
data_miss$Happiness_Post[sample(1:nrow(data), 5)] <- NA
imp <- mice(data_miss, m = 5, method = "pmm", seed = 500)
```

```
##
## iter imp variable
## 1 1 Happiness_Post
## 1 2 Happiness_Post
## 1 3 Happiness_Post
## 1 4 Happiness_Post
## 1 5 Happiness_Post
## 2 1 Happiness_Post
## 2 2 Happiness_Post
## 2 3 Happiness_Post
## 2 4 Happiness_Post
## 2 5 Happiness_Post
## 3 1 Happiness_Post
## 3 2 Happiness_Post
## 3 3 Happiness_Post
## 3 4 Happiness_Post
```

```
## 3 5 Happiness_Post
## 4 1 Happiness_Post
## 4 2 Happiness_Post
## 4 3 Happiness_Post
## 4 4 Happiness_Post
## 4 5 Happiness_Post
## 5 1 Happiness_Post
## 5 2 Happiness_Post
## 5 3 Happiness_Post
## 5 4 Happiness_Post
## 5 5 Happiness_Post
```

```
## Warning: Number of logged events: 27
```

```
summary(imp)
```

```
## Class: mids
## Number of multiple imputations: 5
## Imputation methods:
##      SubjectID      Group  Happiness_Pre  Happiness_Post
##      ""           ""      ""            ""            "pmm"
##      Stress_Pre    Stress_Post Compliance_14Day Stress_Reduction
##      ""           ""      ""            ""            ""
## PredictorMatrix:
##      SubjectID Group Happiness_Pre Happiness_Post Stress_Pre
## SubjectID      0    0            1            1            1
## Group          0    0            1            1            1
## Happiness_Pre  0    0            0            1            1
## Happiness_Post 0    0            1            0            1
## Stress_Pre     0    0            1            1            0
## Stress_Post    0    0            1            1            1
##      Stress_Post Compliance_14Day Stress_Reduction
## SubjectID      1            1            1
## Group          1            1            1
## Happiness_Pre  1            1            1
## Happiness_Post 1            1            1
## Stress_Pre     1            1            1
## Stress_Post    0            1            1
## Number of logged events: 27
##  it im      dep      meth      out
## 1  0  0      constant SubjectID
## 2  0  0      constant      Group
## 3  1  1 Happiness_Post      pmm Stress_Post
## 4  1  2 Happiness_Post      pmm Stress_Post
## 5  1  3 Happiness_Post      pmm Stress_Post
## 6  1  4 Happiness_Post      pmm Stress_Post
```

```
# Pool model
```

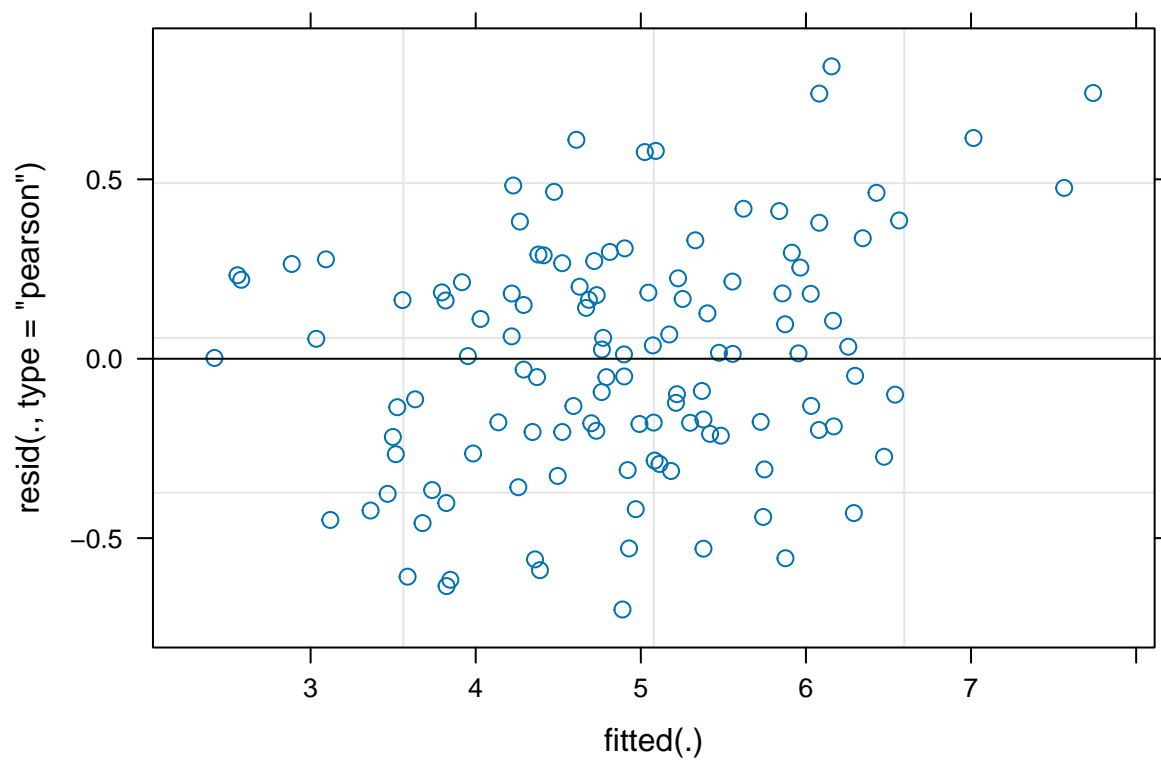
```
completed_data <- complete(imp, 1)
head(completed_data)
```

```
##      SubjectID      Group Happiness_Pre Happiness_Post Stress_Pre Stress_Post
## 1      S001 Gratitude      3.09      4.91      7.42      6.50
## 2      S002 Neutral      3.72      4.85      5.43      6.54
## 3      S003 Gratitude      3.39      4.79      5.17      3.68
## 4      S004 Gratitude      6.25      8.04      6.47      5.32
```

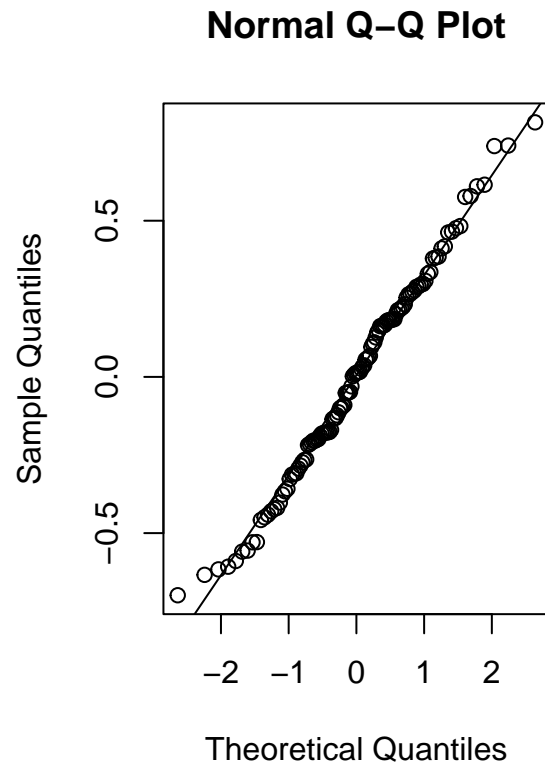
```
## 5      S005 Gratitude      5.44      7.63      5.45      4.80
## 6      S006   Neutral      5.77      6.29      6.63      5.62
## Compliance_14Day Stress_Reduction
## 1          11          0.92
## 2          10         -1.11
## 3          13          1.49
## 4          14          1.15
## 5          14          0.65
## 6          12          1.01
```

#Assumption Checks

```
par(mfrow=c(1,2))
plot(model)
```



```
qqnorm(resid(model)); qqline(resid(model))
```



References

- Emmons, R. A., & McCullough, M. E. (2003). Counting blessings versus burdens.
- Lyubomirsky, S., Sheldon, K. M., & Schkade, D. (2005). Pursuing happiness.
- Field, A. (2013). Discovering Statistics Using R.

Conclusion

The gratitude journaling group experienced significantly greater increases in happiness and reduced stress levels over the 2-week period. These results support the use of gratitude interventions to enhance psychological well-being.