Effects of Gratitude Journaling on Well-being

Ronak Fathi

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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
## GroupNeutrl -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 × 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 eq
## 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.
```

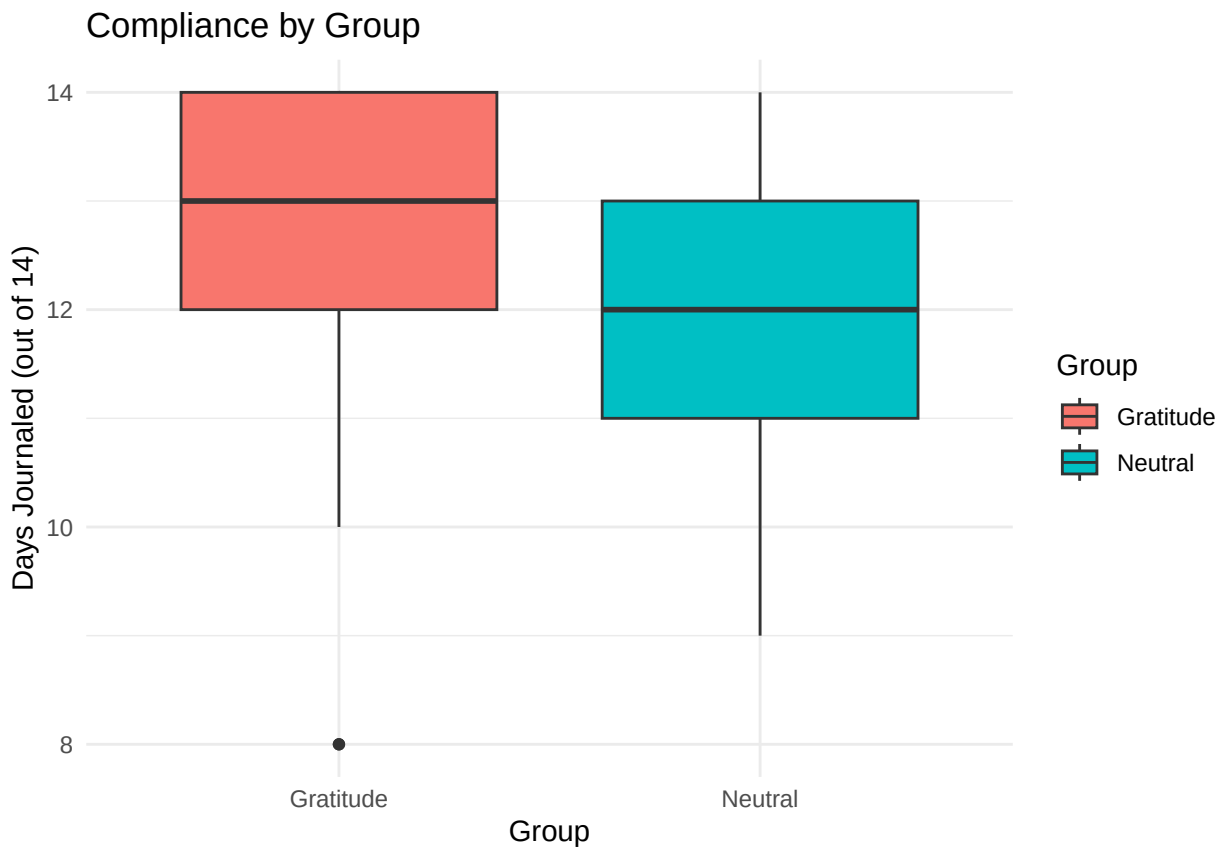
Comparison of Compliance

```
# Compare compliance between groups
t.test(Compliance_14Day ~ Group, data = data_long)
```

```
##
##  Welch Two Sample t-test
##
## data:  Compliance_14Day by Group
## t = 3.2266, df = 113.9, p-value = 0.001636
## alternative hypothesis: true difference in means between group Gratitude and group Neutral is not eq
## 95 percent confidence interval:
##  0.3143208 1.3141552
## sample estimates:
## mean in group Gratitude   mean in group Neutral
##                12.62069                11.80645
```

```
library(ggplot2)

ggplot(data_long, aes(x = Group, y = Compliance_14Day, fill = Group)) +
  geom_boxplot() +
  labs(title = "Compliance by Group", y = "Days Journaled (out of 14)") +
  theme_minimal()
```



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
```

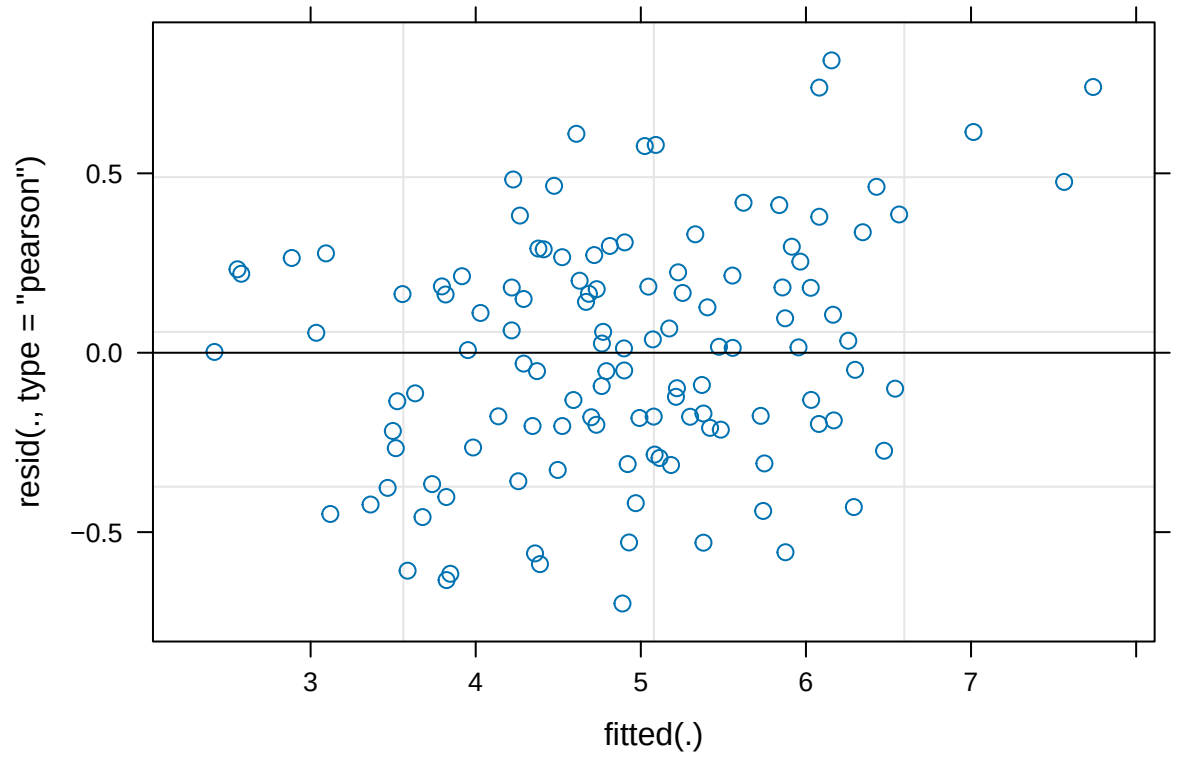
```
# Pool model
completed_data <- complete(imp, 1)
head(completed_data)
```

```
##   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
```

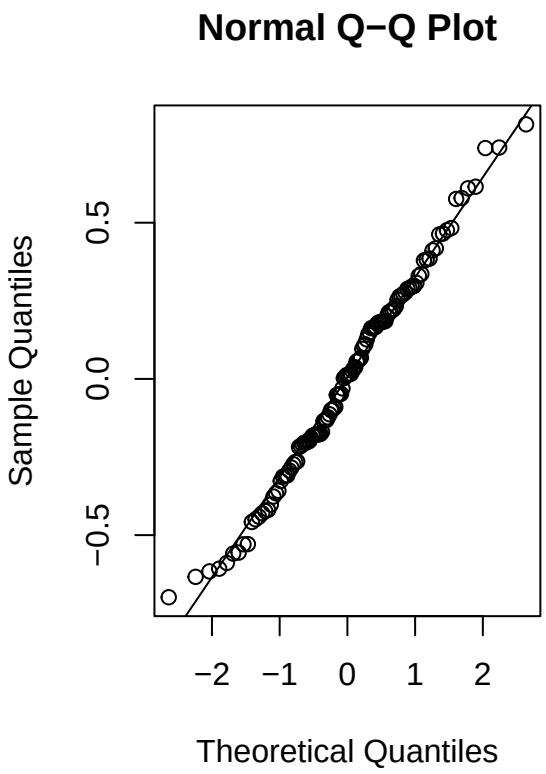
```
## 5      S005 Gratitude          5.44           7.63       5.45        4.80
## 6      S006   Neutral          5.77           6.29       6.63        5.62
##   Compliance_14Day Stress_Reduction
## 1               11             0.92
## 2               10            -1.11
## 3               13             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.