Hierarchical Linear Modeling of the Effects of Self-Reflection Strategies on Mood

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Introduction and Hypotheses

- The positive Psychology movement has fostered self-regulation research as a means to examine strategies for improving subjects’ moods in their daily settings.

- Two self-regulation strategies in particular have been shown to be effective in 4-week and 6-month studies: imagining one’s best possible self (BPS) and expressing gratitude (EG).

- The current study is designed to track change induced by BPS and EG on mood of participants over 3 days to better understand immediate and long-term effects of positive self-reflection.

- We hypothesized that BPS and EG will lead to significant improvement compared to the control; trajectory of change will have the greatest slope between the baseline and the first posttest measurements will show a slow, cumulative increase thereafter; improvement obtained over three days will be comparable to improvement obtained in longer studies.
A 3x4 repeated measures design was used for this study.

78 undergraduate participants were randomly assigned to one of the three treatment groups (between subjects factor).

The Authentic Happiness Index (AHI) was used as the dependent measure.

There were three assessment times (repeated measures factor):
- A pretreatment AHI score was calculated to determine baseline affect levels.
- Following completion of interventions on days 1, 2, and 3 an AHI was completed to determine the amount of change.

The dependent variable was the level of positive affect as measured by the AHI.
Treatment Groups

- **Best possible self.**
  - Participants assigned to this condition were instructed to write a brief story which described a moment at which they had performed at their best and reflect upon this story.

- **Expressing gratitude.**
  - Participants assigned to this condition were instructed to write about three things from the previous week for which they were grateful and reflect upon the positive effects of these three things.

- **Early morning routine.**
  - Participants assigned to this condition were asked to outline the details of their normal morning activities. This condition served as the control.
The first stage of the analysis will assess the impact of allowing participants’ intercepts and slopes to vary randomly versus being set to fixed coefficients.

Second, a series of growth curve models, representing different possible forms of growth will be tested to determine the overall shape of the individual change trajectories.
  - Maximum likelihood estimation will be used to model change in AHI scores.
  - Time will be coded so that the intercept is equal to zero at the pretreatment assessment and thus represent the participants’ baseline value on the dependent measures.

Finally, treatment condition will be added to the models to test the impact of treatment on initial status and change over time. Treatment effects will be estimated for a main effects only model and then a main effects and interaction mode.
Data Screening and Assumption Checks

- Histograms, boxplots, stem and leaf plots, and Normal Q-Q plots indicated normal distribution. Shapiro-Wilk tests of normality confirmed this. (Baseline (p = .10), Post Assessment 1 (p = .83), Post Assessment 2 (p = .73), and Post Assessment 3 (p = .47)).

- Levine’s test showed assumption of homogeneity of variance was met, pretreatment (F (2, 75) = 1.4, p = .25, Day 1 post F (2, 75) = 1.3, p = .27, Day 2 post F (2, 75) = .54, p = .58, Day 3 post F (2, 75) = .61, p = .54).
Data Screening and Assumption Checks

Table 2. Correlations between AHI Scores Across Assessment Times

<table>
<thead>
<tr>
<th></th>
<th>AHI Baseline</th>
<th>AHI Time 1</th>
<th>AHI Time 2</th>
<th>AHI Time 3</th>
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<tbody>
<tr>
<td>AHI Baseline</td>
<td></td>
<td>.75**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AHI Time 1</td>
<td>.65**</td>
<td>.89**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AHI Time 2</td>
<td>.66**</td>
<td>.88**</td>
<td>.94**</td>
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</table>

**. Correlation is significant at the 0.01 level (2-tailed).

- AHI scores were strongly correlated across assessment points as shown.
- Correlation matrix argues for ruling out variance components and diagonal models for the covariance structure.
- Pattern of correlations approaches a first order autoregressive (AR1) pattern, but does not completely fulfill the AR1 requirements.
- The best assumption is that the covariance matrix is unstructured and does not conform to a systematic pattern.
Results showed no difference among the treatment groups on baseline values of the AHI, indicating successful randomization ($F(2, 75) = .794, p = .612$).

There were no significant differences among the groups with regard to gender composition ($\chi^2 (2) = .03, p = .98$) or age of participants ($F(2, 75) = .60, p = .55$).

Two participants dropped out of the Control condition, three dropped out of the EG condition, and one dropped out the BPS condition; this was not a statistically significant differential drop out rate ($\chi^2 (2) = .07, p = .96$).
BPS and EG have a positive impact on increasing positive mood at session one, which slows down, but remains positive at sessions two and three.

A quadratic function might best describe the growth. The trajectory for the control appears linear and flat.
Random Intercepts and Slopes

- The likelihood ratio difference tests showed that allowing participants’ intercepts to vary randomly significantly improved the fit of the model vs. the fixed intercept and slope model ($\Delta \chi^2 (1) = 267, p \leq .0001$).

- Permitting the slopes of individual subject trajectories to randomly vary also improved the fit of the model ($\Delta \chi^2 (1) = 42, p \leq .0001$).

- Subsequent models were fit allowing for random intercepts and slopes.

- Covariance structure was set to unstructured based on the evaluation of the correlation matrix.
A likelihood ratio difference test established a quadratic model fitted the AHI change trajectories better than the linear model ($\Delta \chi^2 (1) = 14.3, p \leq .001$).

A likelihood difference test comparing the cubic model to the quadratic model was significant ($\Delta \chi^2 (1) = 4, p \leq .05$). Similar results were obtained when the control group was left out of the model fitting procedure and the focus was only on the active treatment groups.

A likelihood ratio difference test found that the quadratic model fitted better than the linear model ($\Delta \chi^2 (1) = 21.32, p \leq .001$) and the cubic model provided adequate fit ($\Delta \chi^2 (1) = 6.1, p \leq .05$).

Based upon the group mean trajectories exhibited in Figure 1 and our desire to not over fit the growth curve, we opted for the quadratic model.
Treatment Effects

The slope for EG did not differ significantly from BPS during this same time period, so we assumed that EG also produced significantly greater improvement than the control condition.

The EG and BPS groups did not differ on their quadratic slopes, but the control group did show a positive quadratic slope that was significantly more positive than the two active treatments.

The mean intercept, linear slope, and quadratic parameter estimates were 3.11, .25, and -.06, respectively, and all were significant.

The control group showed significantly less improvement than BPS between pretreatment assessment and post intervention assessment on Day 1.

Table 3. Test of Fixed Effects and Parameters for the Complete Model

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimate</th>
<th>Std. Error</th>
<th>df</th>
<th>t</th>
<th>Sig.</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
<th>95% Confidence Interval</th>
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<tbody>
<tr>
<td>Intercept</td>
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<td>83.72</td>
<td>37.41</td>
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<td>Time</td>
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<td>4.77</td>
<td>.00</td>
<td>.15</td>
<td>.35</td>
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<td>.02</td>
<td>156.00</td>
<td>-3.69</td>
<td>.00</td>
<td>-.09</td>
<td>-.03</td>
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<tr>
<td>Control</td>
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<td>-.37</td>
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<tr>
<td>EG</td>
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<td>.12</td>
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<td>-.93</td>
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<td>-.34</td>
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<td>.00</td>
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<td>.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control * Time</td>
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<td>.07</td>
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<td>-3.73</td>
<td>.00</td>
<td>-.42</td>
<td>-.13</td>
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<td>.07</td>
<td>217.69</td>
<td>1.00</td>
<td>.32</td>
<td>-.07</td>
<td>.22</td>
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<tr>
<td>BPS * Time</td>
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<td>.00</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control * Time * Time</td>
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<td>.02</td>
<td>156.00</td>
<td>3.01</td>
<td>.00</td>
<td>.02</td>
<td>.11</td>
<td></td>
</tr>
<tr>
<td>EG* Time * Time</td>
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<td>.02</td>
<td>156.00</td>
<td>-.10</td>
<td>.92</td>
<td>-.05</td>
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<tr>
<td>BPS* Time * Time</td>
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<td>.00</td>
<td></td>
<td>.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. This parameter is set to zero because it is redundant.
The variance of the random intercepts was .15, which was significant. This suggests that we were correct to assume that scores on the AHI varied significantly across people at the pretreatment assessment.

The variance of the random slopes was .009 and was also significant. This suggests that the improvements in positive mood varied significantly across people over time.
Discussion

- We obtained support for all three hypotheses we set out to test.
  - The BPS and EG exercises did lead to significant improvement in mood compared to the control treatment.
  - The trajectory of this change has the greatest slope between the baseline and the first posttest measurements, and the trajectory of change does show a leveling off with a slow, cumulative increase over 3 days.
  - Finally, the amount of improvement obtained in the current study, which lasted only three days, is comparable to the improvement found in the longer studies.
Sources


Sources


