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Title
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Permalink
https://escholarship.org/uc/item/8k72d542

Journal
Journal of Experimental Psychology General, 149(4)

ISSN
0096-3445

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Publication Date
2020-04-01

DOI
10.1037/xge0000668

Peer reviewed

Experimental Manipulation of Extraverted and Introverted Behavior

and Its Effects on Well-Being

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in press, *Journal of Experimental Psychology: General*

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Abstract

Research in personality psychology has remained predominantly correlational. For example, three decades of research demonstrate a robust cross-sectional relationship between extraversion and positive affect. A handful of studies, however, have examined this link experimentally, showing that extraversion boosts positive affect over short durations. If this is true, behaving in an extraverted manner should be a reliable method for increasing positive affect and, thus, suitable as a well-being-increasing practice. The current study instructed participants to engage in both extraverted and introverted behavior, each for 1 week. Participants increased in well-being when they were assigned to act extraverted and decreased in well-being when they were assigned to act introverted. These findings suggest that changing behavior associated with personality is possible and can impact well-being. More broadly, this study adds to a growing body of research on the potential of experimental methods in personality psychology.

Keyword: Extraversion, Well-Being, Happiness, Personality Change, Personality

Experimental Manipulation of Extraverted and Introverted Behavior

and Its Effects on Well-Being

As a relatively new and growing field, the science of well-being—that is, the extent to which one's life is going well—still needs effective experimental interventions that boost happiness and other favorable outcomes to be discovered. Researchers have developed and tested multiple well-being interventions based on established correlates of well-being—for example, gratitude, optimism, savoring, and forgiveness (see Bolier et al., 2013; Lyubomirsky & Layous, 2013; Sin & Lyubomirsky, 2009, for reviews). However, one of the strongest correlates of well-being, extraversion, has been relatively neglected. Previous research points to the effectiveness of both social role interventions (Heaven et al., 2013) and acts of kindness interventions (e.g., Aknin, Hamlin, & Dunn, 2012; Chancellor, Margolis, Jacobs Bao, & Lyubomirsky, 2018; Dunn, Aknin, & Norton, 2008; Nelson, Layous, Cole, & Lyubomirsky, 2014) and suggests that social connection is the key ingredient of prosocial interventions (Aknin, Dunn, Sandstrom, & Norton, 2013; Fritz et al., 2019). However, only one study, to our knowledge, has used an extraversion intervention lasting more than an hour (Jacques-Hamilton, Sun, & Smillie, in press). Like Jacques-Hamilton and his colleagues, we believe it is possible to manipulate trait-relevant behavior for long enough to observe meaningful changes in well-being. The current study tests whether people can alter the extent to which they behave in an extraverted and introverted way over 2 weeks, and, if so, whether these behavioral changes impact well-being.

Well-Being Research

In psychological science, well-being is typically referred to as subjective well-being or, more colloquially, as happiness. Subjective well-being is defined by three components: presence

of positive affect, absence of negative affect, and high level of life satisfaction (Diener, 1984; Diener, Suh, Lucas, & Smith, 1999).

Although well-being can be viewed as an end, it is also a means to other positive outcomes (Lyubomirsky, King, & Diener, 2005; Walsh, Boehm, & Lyubomirsky, 2018). For example, flow—defined as an energized state of focus, involvement, and enjoyment (Csikszentmihalyi, 1990)—is experienced more frequently by people high in well-being (Csikszentmihalyi & Hunter, 2003). Self-determination theory argues for three core psychological needs—connectedness, competence, and autonomy (Deci & Ryan, 2000)—and satisfaction of each of these needs is associated with well-being (Milyavskaya & Koestner, 2011). Furthermore, research suggests that personality states impact well-being via satisfaction of these needs (Howell, Ksendzova, Nestingen, Yerahian, & Iyer, 2017).

Extraversion and Well-Being

Almost 4 decades ago, Costa and McCrae (1980) found that extraversion is positively correlated with well-being, and with positive affect in particular. More recently, a meta-analysis of over 50 studies using the NEO measure of personality (Costa & McCrae, 1992) found that the association between extraversion and positive affect is substantial, with a meta-analytic effect size of $r = .44$ (Steel, Schmidt, & Shultz, 2008). Research also points to a within-person correlation between extraversion and well-being. For example, within-person changes in extraversion are positively associated with within-person changes in well-being, and this association is stronger among people who desire to increase in extraversion (Hudson & Fraley, 2017). Despite the robust correlation between extraversion and well-being, however, relatively few experiments have examined this association.

Several studies have directly examined the relationship between extraversion and well-being with experimental methods in laboratory settings (Fleeson, Malanos, & Achille, 2002; McNiel & Fleeson, 2006; McNiel, Lowman, & Fleeson, 2010). In these experiments, participants were instructed to act extraverted or introverted during a 10-minute dyadic discussion. All three studies found that greater levels of extraverted behavior during the discussion led to higher levels of positive affect but did not impact negative affect. In addition, trait levels of extraversion did not moderate these effects. Jacques-Hamilton and colleagues (in press) have extended this work by manipulating extraverted behavior over a week. They also observed effects on positive affect, but, unlike the previous studies, these effects were moderated by trait extraversion, with extraverts benefitting more than introverts from the intervention. (See below for further discussion of the similarities and differences between our methods and results and those of Jacques-Hamilton et al., in press.) We believe it is important to develop long-term extraverted behavior interventions like those of Jacques-Hamilton et al., because they provide further support for the causal link between extraversion and well-being. Furthermore, long-term well-being interventions have important practical outcomes. Many laypeople likely value increasing well-being for days or weeks more than increasing it over minutes or hours. In addition, long-term well-being interventions may be more likely to create new behavioral habits and to generate other positive outcomes, such as in the domains of physical health, interpersonal relationships, and career success (Lyubomirsky, King, & Diener, 2005; Walsh, Boehm, & Lyubomirsky, 2018).

Other relevant research has not found an interaction with baseline trait extraversion levels. Epley and Schroeder (2014) recruited participants who commuted to work on a train or bus. Participants were instructed to either converse with a stranger or remain silent on their

commutes. Those who conversed with a stranger experienced more positive affect than those who did not, and this effect was not moderated by trait extraversion. In a study that followed a similar procedure to that of McNiel and colleagues (2010), participants acted extraverted and introverted separately during short discussions. Again, extraverted behavior positively predicted levels of positive affect, but trait extraversion did not moderate this effect (Zelenski, Santoro, & Whelan, 2012). This study also assessed the emotional costs of behaving extraverted (i.e., negative affect during the manipulation), as well as the cognitive costs (measured with a Stroop performance task following the manipulation). Introverts suffered from neither emotional nor cognitive costs when acting extraverted, at least for the short duration examined in this study. Taken together, these results suggest that extraverted behavior promotes positive affect, and, with the exception of Jacques-Hamilton et al.'s (in press) findings, this is just as true for introverts as extraverts.

From Behavior Change to Trait Change

Although several investigators have manipulated extraverted behavior and examined changes in well-being, some research suggests that changes in extraverted behavior may lead to changes in trait extraversion. For example, people appear to be able to change their personality volitionally (see Hudson & Fraley, 2017, for a review). Specifically, individuals who desire to increase their extraversion can do so by creating plans to increase the frequency of extraverted behavior (Hudson & Fraley, 2015). Clinical research—by examining shifts in behavior stemming from psychotherapies—also posits a link between behavioral and trait change (Allemand & Flückiger, 2017). Indeed, participation in psychotherapy tends to increase extraversion (Roberts et al., 2017). Lastly, recent theorizing suggests that behavior changes can become habitual, leading to personality change (Magidson, Roberts, Collado-Rodriguez, & Lejuez, 2014).

Moderators of Positive Activity Interventions

The positive activity model (Lyubomirsky & Layous, 2013) posits several potential moderators that impact the well-being benefits of any particular positive activity. Relevant to the current study, such potential moderators include effort, person-activity fit, personality, and demographics. As with any other intervention, the extent to which participants adhere to the instructions and put in effort should impact the intervention's efficacy. Another potential moderator is person-activity fit, which describes how well suited a well-being increasing intervention is for a particular individual and, thus, should positively predict its success. For example, if an individual seeks to become more sociable, energetic, and assertive, then he or she may especially benefit from an extraversion-increasing intervention. Importantly person-activity fit can be assessed both before and after engaging in the positive activity (i.e., "expected" vs. "actual" fit).

In addition, despite prior null results, an intervention targeting extraverted behavior seems particularly likely to be moderated by baseline trait levels of extraversion. Those high in extraversion may benefit less than those low in extraversion due to a ceiling effect. Alternatively, those high in extraversion might benefit relatively more because an extraversion-boosting exercise is a better fit for them. Both (or neither) effects could occur, which may explain why most previous studies have not found that extraversion moderates the effects of behaving in an extraverted way. Lastly, demographic factors such as sex and ethnicity might moderate the efficacy of an extraversion intervention due to cultural differences in behavioral norms (e.g., the extent to which extraverted behavior in particular situations is considered desirable for cultural members).

Current Study

The current study was designed to answer four primary questions: 1) Can extraverted behavior be manipulated over days (rather than minutes)? 2) Do instructions to change extraverted behavior lead to changes in well-being? 3) Do the same instructions lead to changes on personality measures? 4) Do effort, person-activity fit, personality, or demographics moderate these effects?

Method

Participants

Participants were undergraduates at a medium-sized public university who were given research credit for their participation. No incentives were offered for completing all assessments. This study was approved by the university's Institutional Review Board and all participants consented to the study online. Our desired sample size of 150 participants was determined by a general estimate, based on previous research in our laboratory, of the number of participants needed to detect effects of our interventions. To avoid post-hoc analytic decisions, we retained as many participants as possible. However, we had to remove cases in two situations. First, we removed participants who were not assigned a condition (i.e., did not complete the Day 1 assessment). Second, for participants with multiple assessments at a timepoint, we could only use one assessment, and so we used their last assessment. Our final sample consisted of 131 participants. Of our final sample, 91 participants (69%) were female and the mean age was 19.2 years. The sample was primarily comprised of Asian (46%) and Latino(a) (34%) students but also included students who identified as White (8%), Black (5%), or other (7%) ethnicities.

Procedure

Study design. All instructions and measures were administered online. Participants were instructed to behave like an extravert for 1 week and like an introvert for 1 week. Order was randomly assigned via a feature of the online survey software. Thus, some participants acted extraverted then introverted, while others acted introverted then extraverted. Participants completed three online weekly assessments: 1) at the beginning of the study (Day 1), 2) after the first week of behavior change (Day 8), and 3) after the second week of behavior change (Day 15). Because we focus on within-person changes and had little attrition, we were not concerned by the slight variations in sample size by timepoint.

In addition to the weekly assessments, participants were asked to complete much briefer surveys thrice weekly (on Days 3, 5, 7, 10, 12, and 14). See Table 1 for the sample size in each condition at each timepoint.

Experimental manipulation. Unlike previous research aimed at experimentally shifting levels of extraversion, we sought to describe extraversion and introversion to participants in a way that minimized differences in social desirability. Trait adjectives related to extraversion (e.g., outgoing, enthusiastic) tend to be more socially desirable in Western cultures than trait adjectives related to introversion (e.g., shy, reserved). To mitigate social desirability as a confound, we selected three trait adjectives describing extraversion that were as low as possible in social desirability and three trait adjectives describing introversion that were as high as possible in social desirability. Trait adjectives and social desirability ratings were obtained from Hampson, Goldberg, and John (1987). The final set of extraversion adjectives ("talkative," "assertive," and "spontaneous") were slightly more socially desirable than our introversion adjectives ("deliberate," "quiet," and "reserved").

After receiving instructions on how to change their behavior, participants were informed that previous research has found that the listed behaviors are beneficial for college students. This statement was included in both the extraversion and introversion prompts to increase adherence to the instructions and to reduce potential demand characteristics. In addition, participants were asked to list five specific ways in which they planned to change their behavior, as previous research has demonstrated that this additional instruction can foster larger shifts in behavior (Hudson & Fraley, 2015; cf. Sheeran & Webb, 2016). This is the prompt we administered for participants immediately before the extraversion [introversion] week:

> During the next week, we would like you to try to change your behavior.
> Specifically, for the next 7 days, try to act as talkative, assertive, and spontaneous [deliberate, quiet, and reserved] as you can. Previous research has shown that performing these behaviors is beneficial for college students. Please list 5 specific ideas below for how and when you will incorporate these types of behaviors into your daily life. For example, "When my friends are discussing something important to me, I will [will not] express my opinion."

> Participants were reminded of their assignment to change their behavior three times per week via email.

Analytic Approach

Analyses of our weekly measures were conducted using an R function we wrote which incorporates statistical functions from base R (version 3.6.0; R Core Team, 2019) as well as the psych (Revelle, 2018) and lavaan (Rosseel, 2012) packages. After reverse coding necessary items and creating parcels for multidimensional (i.e., faceted) constructs, we examined longitudinal measurement invariance using SEM. In these

models, residuals of the same item at different time points were correlated. These

correlations were constrained, such that correlations of the same item over the same

duration were equal. We used second-order latent growth models to estimate growth in

our weekly outcomes over time (see Figure 1). In each model, strong measurement

invariance constraints (i.e., equal loadings and equal intercepts) were imposed. In all

second-order latent growth models, residuals were correlated in the same way as in the

measurement invariance testing, and estimation was done with full information maximum

likelihood to account for attrition. To measure piece-wise growth over the study, we

included one intercept and two slope latent variables. The loadings of the slope latent

variables were set so that one estimated growth over the first week of the study and the

other estimated growth over the second week of the study. The variances of the intercept

latent variables were set to 1, so that the model was identified and slope latent variables

represent growth in units of Week 1 standard deviations. Fit statistics of these models are

presented in Table 2.

We extracted latent intercepts and slopes from the second-order latent growth

models and tested for effects of condition by predicting latent slopes from latent

intercepts (to control for regression to the mean) and condition (dummy coded with the

extraversion-then-introversion group set to 1 and the introversion-then-extraversion

group set to 0).

To ensure that our results were not limited to a specific analytic approach, we also

analyzed each weekly measure with a type III repeated-measures ANOVA. Notably, this

technique is quite different from our second-order latent growth models. Using the afex

(Singman, Bolker, Westfall, & Aust, 2019) and sjstats (Lüdecke, 2019) R packages, we

predicted each measure from condition (between-subjects), time (within-subjects), and the condition × time interaction.

We analyzed measures administered multiple times per week with multilevel models. Multilevel models were used because some responses were received 1 day late. For example, a questionnaire that was received on Day 4 could not reasonably be assigned to Day 3 rather than Day 5. Thus, we coded this response as having occurred on Day 4. As a result, the data were unbalanced with regard to time and, thus, could not be analyzed with latent growth models or repeated-measures ANOVAs. Therefore, we employed multilevel models with responses nested within participants. We included Day 1, 8, and 15 data in these models, if the same measure was used on those days. We included two time predictors, coded to represent growth over the first week and the second week, respectively. We also included random effects of these predictors. Each construct was predicted from these time variables, and we extracted an intercept and two slopes for each participant. We then divided these numbers by the standard deviation of the intercept scores so that slopes were interpretable as change per week in units of intercept Z-scores (matching the interpretation of our latent slopes from latent growth models). As we did with latent slopes, we predicted our multilevel model slopes from the multilevel model intercepts and condition.

We tested for moderation effects by first computing difference scores between slopes from extraversion weeks and slopes from introversion weeks. These difference scores were then correlated with our moderator latent variables. For behavioral moderators (i.e., intervention adherence, extraverted behavior, and expected and actual fit), we calculated the difference of factor scores from the extraversion and introversion

weeks. For other moderators (e.g., personality, demographics), the Week 1 factor scores were used.

All data, measures, and R code for this study can be found at: https://osf.io/jvnqr/?view_only=31a14c43786d471a863d21f8cc3ec052. We report all administered measures, conditions, data exclusions, and determination of our sample sizes in accordance with the Center for Open Science recommendations (Nosek et al., 2017).

Measures

All measures used a Likert format. See Table 3 for information on when each measure was administered, reliability coefficients, and longitudinal measurement invariance fit statistics. One measure, a health behavior and symptoms checklist, was not analyzed because it did not fit with the aims of the current project. Measures that were administered on our thrice-weekly questionnaire asked participants about their previous 2 days.

Positive and negative affect. The Brief Emotion Report (Diener & Emmons, 1984) assesses positive and negative affect by asking participants to rate the extent to which they have felt certain emotions over the last week. Three items ("peaceful/serene," "dull/bored," and "relaxed/calm") were added to the original nine-item scale to ensure that both high and low arousal emotions were represented. However, we removed two of the positive affect items ("pleased" and "relaxed/calm") to achieve strong measurement invariance. On the thrice-weekly questionnaire, we measured overall affect with one item ("How have you been feeling in the past week?"), which was rated on a slider with a frowning face and a smiling face as anchors.

Happiness. We used the Subjective Happiness Scale (Lyubomirsky & Lepper, 1999) to measure happiness. This four-item measure asks participants to rate their happiness without

explicitly defining it. For example, one item asks participants to rate themselves on a 7-point

Likert scale from "not a very happy person" to "a very happy person."

Life satisfaction. We measured life satisfaction with the Satisfaction With Life Scale

(Diener, Emmons, Larsen, & Griffin, 1985). This 5-item measure asks participants to rate their

agreement with such statements as, "The conditions of my life are excellent." On the thrice-

weekly questionnaire, life satisfaction was measured with one item ("How satisfied with your

life have you been in the past week?"), which was rated on a slider with a frowning face and a

smiling face as anchors.

Self-Determination Theory needs. We measured feelings of connectedness,

competence, and autonomy over the last week with the Balanced Measure of Psychological

Needs (Sheldon & Hipert, 2012). Each need is assessed with six items, three of which are

reverse-coded. Example items include "I felt close and connected with other people who are

important to me" (connectedness), "I took on and mastered hard challenges" (competence), and

"I was free to do things my own way" (autonomy). The first connectedness item ("I felt a sense

of contact with people who care for me, and whom I care for") was removed to achieve at least

strong measurement invariance.

Flow. Participants were given the six-item Flow Short Scale (Csikszentmihalyi, 1990),

which asked participants to rate their agreement with statements over the last week. Items

includes "I felt very interested in what I was doing" and "I felt a strong sense of enjoyment."

One item ("I felt there was no separation between me and my behavior") was removed to achieve

at least strong measurement invariance.

Extraverted behavior. We assessed extraverted behavior with an 8-item measure used

by McNiel et al. (2010). This measure asked participants to rate the extent to which they behaved

in a way that was "talkative," "reserved," "full of energy," "enthusiastic," "quiet," "assertive," "shy, inhibited," and "outgoing, sociable" over the last week. Whereas trait measures require participants to rate general behavioral tendencies, this scale asked participants to rate behavioral tendencies over the past week. We analyzed this measure both with all items and with four of the items omitted. We omitted the four items that overlap with our instructions (i.e., to be more "talkative," "assertive," "reserved," "quiet") to ensure that our results using this measure were not impacted by demand effects. Results with the shortened measure were similar to results with the whole measure, which we report below.

Big Five personality traits. Participants were given the full 60-item Big Five Inventory-2 (BFI-2; Soto & John, 2017), as well as the 48 extraversion items from the Revised NEO Personality Inventory (Costa & McCrae, 1992). However, we removed the eight activity facet items from the latter measure to achieve at least strong measurement invariance. Unfortunately, due to a clerical error, only 11 of the 12 conscientiousness items of the BFI-2 were administered. Both measures ask participants to rate their agreement with statements that could describe their personality.

Extraversion desire. Participants were administered the eight extraversion items from the Change Goals Big Five Inventory (Hudson & Roberts, 2014), which asks respondents the extent to which they want to increase or decrease on items from the original Big Five Inventory. For example, one item is "I want to be talkative" and participants rate this item on a 5-point Likert scale from "Much less than I currently am" to "Much more than I currently am"

Adherence. To assess the extent to which participants were adhering to the intervention instructions, we asked participants a single question: "Over the past 7 days, to what extent did you act in the instructed ways?"

Fit. Participants completed three-item measures of both expected fit and actual fit (adapted from Lyubomirsky, 2008). The former asks participants how natural, enjoyable, and meaningful they expect the intervention over the next week to be, while the latter asks participants how natural, enjoyable, and meaningful they actually found the intervention to be over the last week.

Results

First, we examined whether participants complied with the intervention instructions and were able to change the extent of their extraverted behavior. Indeed, participants' self-reports of their extraverted behavior increased substantially during the extraversion week and decreased substantially during the introversion week (see Table 4 and Figure 2, top left).

Did changes in extraverted behavior coincide with changes in well-being? Participants reported marked growth in positive affect during the extraversion week and marked decline in positive affect during the introversion week (see Table 4 and Figure 3). They increased in well-being significantly more during the extraversion week than the introversion week according to all but one of our other well-being outcomes (happiness). However, some simple slopes contained confidence intervals that contained zero. Our experimental manipulations had larger effects on positive affect, connectedness, competence, autonomy and flow but weaker, less consistent effects on negative affect, happiness, and life satisfaction.

Were personality measures impacted by the interventions? According to both the BFI-2 and the NEO, self-ratings of trait extraversion increased during the extraversion week and decreased during the introversion week, and these changes were significantly different (see Table 4). Although we found a similar pattern of results with trait conscientiousness, changes in conscientiousness depended on the order of the interventions (see Table 4). Furthermore, as

illustrated in Figure 2 (bottom left), changes in conscientiousness may have been impacted more by time than by our interventions. None of the other Big Five factors showed significant shifts as a result of our interventions.

Our repeated-measures ANOVAs closely match each of the results described above (see Table 5). We performed Mauchly's test for violations of sphericity. For most measures, this test was not significant, indicating that the assumption of sphericity was, for the most part, not violated. Indeed, Greenhouse-Geisser *p*-values, which correct for non-sphericity, closely matched the uncorrected p-values. We observed large effect sizes with extraverted behavior and moderate effect sizes with positive affect, negative affect, connectedness, competence, autonomy, and flow. For more details on our repeated-measures ANOVAs (e.g., main effects of condition and time, other types of effect sizes), please see our OSF page.

Which factors moderated the impact of our interventions? Participants who reported changing their extraverted behavior greatly between the extraversion and introversion weeks experienced larger impacts in several well-being and well-being related constructs (see Table 6). In addition, Latino(a)s and those with a high desire for extraversion also experienced more psychological change between the extraversion and introversion weeks than did others. Participants with large differences in how natural, enjoyable, and meaningful they found the interventions (i.e., actual fit) also experienced larger changes in our outcomes throughout the study. However, the strength of the interventions was not substantially impacted by expected fit, baseline trait extraversion, or gender.

Discussion

We showed that a manipulation to increase extraverted behavior substantially improved well-being—especially positive affect, connectedness, and flow—and a manipulation to increase

introverted behaviors substantially decreased well-being. Given that introversion is generally not regarded as desirable or advantageous in U.S. culture (Cain, 2013), we believe our most compelling results are those showing that well-being *decreases* can be substantial when people act more introverted than usual.

The effects of extraverted behavior on positive affect, connectedness, and flow were considerable and did not depend on order (i.e., condition). However, findings with other well-being outcomes were less consistent across weeks and conditions. Indeed, the effect of acting introverted on negative affect was in different directions across the two orders. This was not entirely unexpected, as previous research has demonstrated that the association between extraversion and positive affect is more robust than the association between extraversion and negative affect (Steel et al., 2008). In addition, our instructions to participants, which described each intervention as beneficial for college students, may explain the drop in negative affect over Days 1-8 observed in both conditions. Other well-being measures (e.g., happiness, life satisfaction, and competence) were also inconsistently or weakly impacted by our interventions. We believe an extraversion intervention specifically targets positive affect and feelings of connectedness. This would explain why we witnessed strong effects on positive affect, connectedness, and flow, with weaker effects on more evaluative (and perhaps more stable) measures such as happiness, life satisfaction, and competence.

Interestingly, trait assessments of extraversion also appeared to be impacted by our interventions. Although we think it is possible that behavior can impact traits (e.g., see Magidson, et al., 2014), an alternative interpretation is that our interventions impacted the state components of the BFI-2 and NEO measures (see the STARTS model; Kenny & Zautra, 2001). Indeed, participants' responses to the personality questionnaires may have been biased by their

previous week's behaviors. That is, when responding to trait extraversion items at the end of each week, the participants may have been primarily recalling their behavior over that week rather than their perceptions of their personality, even though they knew that their behavior was affected by their participation in the study and that the measures called for trait-relevant statements (e.g., "I am someone who…"). In addition, experimenter demand could have led participants to respond to personality questionnaires (and behavioral measures) consistent with the instructed behavioral changes (e.g., "I was asked to be more talkative, so I should indicate that I am now rather talkative"). For these two reasons, we caution readers in interpreting the self-reported personality findings.

Instructions to increase extraverted behavior had larger effects on well-being for some individuals relative to others. As one might expect, larger changes in extraverted behavior predicted larger changes in well-being. Although these moderation analyses are correlational, they are consistent with the notion that extraverted behavior has a causal impact on well-being. Another intuitive moderator was actual fit. Unsurprisingly, people who found acting extraverted to feel relatively more natural, enjoyable, and meaningful than acting introverted experienced larger boosts in well-being after acting extraverted (vs. acting introverted).

Two less obvious moderators also emerged—the desire for extraversion and Latino(a) status. People who had a stronger desire to become more extraverted may have been impacted more by the interventions because they value extraversion more and likely mustered more effort into acting extraverted. Similarly, Latino(a)s might have been more affected by the interventions because extraversion may be relatively more socially desirable in their culture.

We also find the lack of evidence for some potential moderators to be interesting. First, our effects were not moderated by baseline levels of trait extraversion. Although one might

expect our interventions to have quite different impacts on extraverts and introverts (cf. Jacques-Hamilton et al., in press), our failure to observe this moderation effect parallels prior findings (Epley & Schroeder, 2014; Fleeson et al., 2002; McNiel & Fleeson, 2006; McNiel et al., 2010; Zelenski et al., 2012). Again, it could be that both ceiling effects (i.e., extraverts have less room to improve) and fit effects (e.g., extraverts find the intervention more enjoyable or take it more seriously) are present and cancel each other out. Alternatively, trait extraversion may simply reflect tendencies to engage in particular behaviors and not relate to hedonic benefits of those behaviors (Zelenski et al., 2013).

Second, some may be surprised that expected fit did not moderate our results. However, previous research suggests that introverts make an affective forecasting error when they consider extraverted behaviors—namely, they underestimate the positive affect and overestimate the negative affect they will experience while performing extraverted acts (Zelenski et al., 2013). Thus, the predictions captured by our expected fit measure may be affective forecasting errors, which would explain why they did not predict changes in well-being. Lastly, why was extraverted behavior a consistent moderator but not adherence? We believe this may be due to the low reliability of our 1-item adherence measure.

The magnitude of some of our observed effect sizes depended on whether we examined weekly data with latent growth modeling or more frequent data with multilevel modeling. In particular, the effects of our intervention on self-reported extraverted behavior seemed to be impacted by the types of data and analyses used. However, we find it plausible that participants' own aggregation of changes they observed in their own behavior over a week—a judgment likely influenced by their self-schemas and recall biases—would differ from statistical models aggregating the same participants' changes in behavior assessed with much more frequent

questionnaires. In addition, results from the latent growth models may differ from those of multilevel models not only because of differences in the models specified, but because the latent growth models were conducted with a subset of the data used for the multilevel models.

Both our experiment and that of Jacques-Hamilton and his colleagues (in press) found that extraverted behavior can be manipulated over the course of multiple days. Further, in both projects, an intervention to change extraverted behavior led to increases in well-being, particularly positive affect. However, Jacques-Hamilton et al. found that the effects of their intervention were stronger for trait extraverts, whereas we did not observe moderation effects of trait extraversion. This discrepancy may be due to methodological differences between the studies, including different measures and comparison conditions. In addition our study employed a within-subjects (rather than between-subjects) design, used different intervention prompts designed to minimize social desirability differences across conditions, and included participants from a university in the Western United States (rather than Australia). Furthermore, differences in results between the studies could arise from simple sampling variability. Thus, we hope investigators will replicate and extend our findings in future extraverted behavior interventions and continue to explore possible moderation effects.

Limitations and Future Directions

To avoid potential confounds, our extraversion and introversion prompts were designed to evoke equal demand characteristics. Accordingly, both prompts included language that may have led participants to expect increases in well-being. Thus, growth rates during both the extraversion and introversion weeks may be biased upwards. Future research could include extraversion and introversion prompts without any expectations or demand characteristics.

Other factors might have impacted growth rates. First, growth rates on Days 8-15 may have been biased by contrast effects from complying with an "opposite" intervention on Days 1-8. Furthermore, growth rates on Days 8-15 may have been biased by regression to the mean. Thus, future researchers may want to include a neutral control group, as Jacques-Hamilton et al. (in press) did, to obtain more practical estimates of the impact of an extraversion (and introversion) manipulation. In addition, growth estimates from a neutral control group would likely not be impacted by demand characteristics. We also estimated growth rates from only two time points. The use of more time points in future work would lead to more accurate growth estimates and the opportunity to model non-linear growth.

Would the effects observed in our study persist over an intervention period with a longer duration? Although baseline trait extraversion was not a significant moderator, it is possible that introverts (as well as extraverts) may experience cognitive and hedonic costs after behaving more extraverted (or more introverted) than usual for multiple weeks. These possibilities can be tested in future studies.

Which specific behaviors led to changes in well-being? Unfortunately, we do not know the particular behaviors that participants enacted and their unique effects. For example, was it acting deliberate, quiet, or reserved that caused participants to decline in positive affect during the introversion week? Future studies can test the effects of manipulating changes in a narrower set of behaviors than those generally related to extraversion. It is likely that shifting behaviors representing different facets of extraversion (e.g., sociability vs. assertiveness, see Saucier & Ostendorf, 1999) will have different outcomes.

Relatedly, we need better measures of participants' adherence. Although our participants' self-reports of extraverted behavior followed the pattern we would expect if they did adhere to

our instructions, future investigators may wish to consider using more objective behavioral measures. Another possibility is to measure well-being with momentary, rather than retrospective, reports (e.g., ESM; see Jacques-Hamilton et al., in press), in order to avoid the potential memory biases associated with retrospective reports.

Our sample was comprised of college students who were primarily female and Asian or Latina. Our results suggest that intervention effectiveness was not impacted by sex but was affected by Latino(a) status. Thus, effect sizes may be smaller in a sample with a smaller proportion of Latino(a)s. In addition, our interventions may be less powerful in older age groups, as changing habitual behavior is likely to be more difficult for older adults. Indeed, personality becomes more stable in older adulthood (Roberts & DelVecchio, 2000). Future investigators may also wish to examine the efficacy of an extraversion intervention in different cultures. Research suggests that collectivist (e.g., Asian) cultures value introverted emotions and attributes (e.g., being calm and reserved) relatively more (Tsai, Knutson, & Fung, 2006); hence, an extraversion intervention may be less effective or desired in non-individualist cultures. Indeed, some positive interventions, like expressing gratitude, have been found to be less effective in such cultures (Shin & Lyubomirsky, 2017). However, some research suggests trait-state relationships are not substantially impacted by culture (Ching et al., 2014).

Conclusions

Our results suggest that personality-relevant behavior can be successfully manipulated for several days by simply instructing participants to behave differently. Our participants were prompted to create specific intentions for how they would change their behavior and were reminded of those instructions three times per week, which might have been crucial to elicit high

levels of participant compliance. Perhaps similar methods could be used to induce behavioral changes related to other traits.

Furthermore, our study extends previous research showing that behavioral changes may lead to trait changes. Future research can test this idea by measuring the magnitude of habit formation in participants—for example, by using both observational (i.e., peer reports, videos) and self-report follow-up assessments that track the extent to which instructed behavioral changes are maintained after the intervention period.

In sum, even if extraversion is a fairly stable trait, our experiment adds to a growing body of literature suggesting, first, that extraverted behavior can be manipulated and, second, that such manipulations can produce considerable positive outcomes.

Context of the Research

This project was motivated by a desire to develop effective well-being interventions. We observed that many existing well-being interventions are based on known correlates of well-being (e.g., happier people are more grateful). However, no interventions to our knowledge were based on one of the strongest predictors of well-being—namely, extraversion. We hope that research from our and others' laboratories encourages future investigators to test the potential of behavioral interventions to spur both personality change and well-being gains.

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Table 1

Sample Size by Condition and Day

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Extraversion then introversion	69	44	12	52	10	52	6	70	52	12	50	12	49	12	68
Introversion then extraversion	67	38	9	39	13	39	7	68	38	10	41	14	40	4	66

Table 2

Fit Statistics of Second-Order Latent Growth Models

Construct	χ^2	df	CFI	TLI	RMSEA [90% CI]	SRMR
Positive Affect	283.8	142	.922	.916	.087 [.072, .102]	.069
Negative Affect	313.9	142	.869	.859	.096 [.081, .110]	.105
Happiness	82.1	57	.980	.977	.058 [.026, .084]	.049
Life Satisfaction	141.2	95	.966	.962	.061 [.038, .081]	.056
Connectedness	281.5	142	.854	.843	.086 [.071, .101]	.107
Competence	392.2	142	.661	.634	.116 [.102, .129]	.151
Autonomy	262.9	142	.809	.794	.080 [.065, .095]	.120
Flow	253.1	142	.877	.868	.077 [.061, .092]	.085
Extraverted Behavior	527.4	110	.767	.746	.170 [.156, .185]	.092
Extraverted Behavior 2	72.8	22	.929	.909	.133 [.100, .167]	.104
BFI-2 Extraversion	46.8	28	.978	.972	.071 [.032, .106]	.054
BFI-2 Agreeableness	61.8	28	.958	.945	.096 [.063, .128]	.058
BFI-2 Conscientiousness	3.3	28	.997	.996	.025 [.000, .073]	.043
BFI-2 Negative Emotionality	45.0	28	.984	.979	.068 [.026, .103]	.056
BFI-2 Open Mindedness	33.8	28	.993	.991	.040 [.000, .082]	.046
NEO Extraversion	267.7	142	.940	.936	.082 [.067, .097]	.117

Note. Extraverted Behavior 2 = Extraverted behavior with items that overlap with intervention instructions omitted. BFI-2 = Big Five Inventory-2. NEO = Revised NEO Personality Inventory. CFI = Comparative Fit Index. TLI = Tucker-Lewis Index. RMSEA = Root Mean Square Error of Approximation. SRMR = Standardized Root Mean Square Residual.

Table 3

Measures

Construct	Days Administered					ω_t range	ΔCFI		
	1	3, 5, 7	8	10, 12, 14	15		Weak	Strong	Strict
Positive Affect	X	X	X	X	X	.89 - .94	.003	.012	.012
Negative Affect	X	X	X	X	X	.81 - .90	.003	.030	.046
Happiness	X		X		X	.87 - .89	.002	-.003	.004
Life Satisfaction	X		X		X	.86 - .87	.001	.008	.004
1-Item Life Satisfaction		X		X					
1-Item Affect		X		X					
Connectedness	X		X		X	.72 - .83	.004	.000	.003
Competence	X		X		X	.52 - .73	.005	.012	.011
Autonomy	X		X		X	.66 - .67	.016	.001	-.006
Flow	X		X		X	.74 - .78	.010	-.008	.000
Extraverted Behavior		X	X	X	X	.90 - .94	-.001	.005	.005
Extraverted Behavior 2		X	X	X	X	.85 - .91	.005	.002	.009
BFI-2 Extraversion	X		X		X	.71 - .77	.011	.012	-.003
BFI-2 Agreeableness	X		X		X	.81 - .82	.006	.031	-.003
BFI-2 Conscientiousness	X		X		X	.72 - .76	.002	-.005	.000
BFI-2 Negative Emotionality	X		X		X	.83 - .85	.007	-.001	-.001
BFI-2 Open Mindedness	X		X		X	.77 - .80	.005	-.006	.004
NEO Extraversion	X		X		X	.80 - .84	.000	.014	.003
Extraversion Desire	X					.79			
Adherence		X	X	X	X				
Expected Fit	X		X			.73-.89			
Actual Fit		X	X	X	X	.84-.85			

Note. Extraverted Behavior 2 = Extraverted behavior with items that overlap with intervention instructions omitted. BFI-2 = Big Five Inventory-2. NEO = Revised NEO Personality Inventory. ΔCFI = Change in Comparative Fit Index after adding constraints of that model. ω_t range = range of McDonald's ω_ts over Days 1, 8, and 15.

Table 4

Growth Rates by Condition and Week

Construct	Days 1-8 Extraversion Growth Rate [95% CI]	Days 8-15 Extraversion Growth Rate [95% CI]	Days 1-8 Introversion Growth Rate [95% CI]	Days 8-15 Introversion Growth Rate [95% CI]	Overall p
Positive Affect	0.30 [0.00, 0.60]	0.67 [0.37, 0.97]	-0.56 [-0.81, -0.31]	-0.54 [-0.85, -0.23]	2.22×10^{-7}
Positive Affect (MLM)	0.15 [-0.06, 0.35]	0.36 [0.20, 0.52]	-0.49 [-0.66, -0.32]	-0.25 [-0.41, -0.09]	2.54×10^{-7}
Negative Affect	-0.67 [-0.89, -0.44]	-0.32 [-0.59, -0.05]	-0.21 [-0.43, 0.01]	0.33 [0.10, 0.55]	4.02×10^{-4}
Negative Affect (MLM)	-0.83 [-1.01, -0.65]	-0.16 [-0.32, -0.01]	-0.4 [-0.59, -0.21]	0.21 [0.08, 0.34]	.001
Happiness	0.08 [-0.03, 0.18]	0.03 [-0.05, 0.11]	-0.01 [-0.10, 0.09]	-0.07 [-0.15, 0.00]	.076
Life Satisfaction	0.23 [0.11, 0.34]	0.10 [-0.01, 0.21]	-0.03 [-0.14, 0.07]	-0.12 [-0.24, -0.01]	4.93×10^{-4}
1-Item Life Satisfaction (MLM)	0.16 [0.08, 0.24]	0.08 [0.00, 0.15]	0.15 [0.07, 0.24]	-0.07 [-0.14, 0.00]	.004
1-Item Affect (MLM)	0.24 [0.15, 0.33]	0.12 [-0.03, 0.26]	0.23 [0.14, 0.33]	-0.21 [-0.33, -0.09]	.018
Connectedness	0.25 [0.02, 0.48]	0.57 [0.29, 0.85]	-0.51 [-0.82, -0.21]	-0.34 [-0.55, -0.14]	4.40×10^{-6}
Competence	0.30 [0.04, 0.55]	0.22 [-0.03, 0.47]	-0.16 [-0.38, 0.07]	-0.20 [-0.46, 0.05]	.011
Autonomy	0.23 [0.05, 0.42]	0.31 [0.11, 0.50]	-0.24 [-0.46, -0.02]	-0.26 [-0.42, -0.10]	7.00×10^{-5}
Flow	0.20 [-0.02, 0.43]	0.46 [0.21, 0.71]	-0.35 [-0.60, -0.10]	-0.26 [-0.47, -0.06]	7.81×10^{-5}
Extraverted Behavior		1.53 [1.25, 1.81]		-1.24 [-1.49, -0.99]	1.38×10^{-28}
Extraverted Behavior (MLM)		0.35 [0.22, 0.49]		-0.48 [-0.59, -0.37]	1.04×10^{-16}
Extraverted Behavior 2		1.21 [0.95, 1.48]		-1.11 [-1.38, -0.85]	4.26×10^{-23}
Extraverted Behavior 2 (MLM)		0.51 [0.38, 0.64]		-0.48 [-0.60, -0.36]	9.28×10^{-21}
BFI-2 Extraversion	0.12 [0.02, 0.22]	0.11 [-0.01, 0.23]	-0.07 [-0.16, 0.01]	-0.14 [-0.27, 0.00]	.003
BFI-2 Agreeableness	0.10 [-0.01, 0.21]	-0.01 [-0.12, 0.10]	-0.02 [-0.11, 0.07]	-0.07 [-0.18, 0.05]	.212
BFI-2 Conscientiousness	0.14 [0.06, 0.23]	0.03 [-0.06, 0.11]	-0.02 [-0.09, 0.05]	-0.12 [-0.20, -0.04]	.006
BFI-2 Negative Emotionality	-0.16 [-0.26, -0.05]	-0.05 [-0.11, 0.02]	-0.07 [-0.16, 0.02]	0.05 [-0.01, 0.12]	.052
BFI-2 Open Mindedness	-0.05 [-0.16, 0.05]	-0.08 [-0.18, 0.02]	0.03 [-0.07, 0.13]	-0.01 [-0.09, 0.07]	.195
NEO Extraversion	0.11 [-0.01, 0.23]	0.08 [-0.01, 0.16]	-0.07 [-0.16, 0.01]	-0.09 [-0.19, 0.00]	.007

Note. Overall p = p-value associated with comparison of growth rates of extraversion weeks to introversion weeks. Extraverted Behavior 2 = Extraverted behavior with items that overlap with intervention instructions omitted. BFI-2 = Big Five Inventory-2. NEO = Revised NEO Personality Inventory. MLM = multilevel modeling. (Other estimates are from latent growth models.) Growth rates are in units of Week 1 standard deviations for each construct.

Table 5

Condition × Time Effects in Repeated-Measures ANOVAs

Outcome	F	p	Mauchly's p	Greenhouse-Geisser Corrected p	Eta
Positive Affect	18.21	4.03×10^{-8}	.18	5.72×10^{-8}	.24
Negative Affect	7.69	.001	.72	.001	.15
Happiness	1.37	.26	.09	.26	.04
Life Satisfaction	6.97	.001	.25	.001	.09
Connectedness	14.39	1.23×10^{-6}	.03	2.09×10^{-6}	.20
Competence	5.51	.005	.09	.005	.13
Autonomy	6.50	.002	.15	.002	.13
Flow	8.28	3.28×10^{-4}	.27	3.66×10^{-4}	.16
Extraverted Behavior	206.73	7.22×10^{-28}			.67
Extraverted Behavior 2	166.13	2.16×10^{-24}			.62
BFI-2 Extraversion	6.89	.001	.68	.001	.08
BFI-2 Agreeableness	1.41	.25	.57	.25	.04
BFI-2 Conscientiousness	5.39	.005	.99	.005	.07
BFI-2 Negative Emotionality	1.68	.19	.03	.19	.04
BFI-2 Open Mindedness	0.67	.51	.67	.51	.03
NEO Extraversion	4.15	.02	.74	.02	.05

Note. Extraverted Behavior 2 = Extraverted behavior with items that overlap with intervention instructions omitted. BFI-2 = Big Five Inventory-2. NEO = Revised NEO Personality Inventory.

Table 6

Correlations Between Moderators and Outcomes

	Extrv. Beh.	Extrv. Beh. 2	Adhr.	Exp. Fit	Act. Fit	Extrv. Des.	BFI-2 Extrv.	BFI-2 Socbl.	BFI-2 Assrt.	BFI-2 Energ.	NEO Extrv.	Fem. Status	Asian	Latino (a)
Positive Affect	.47*	.48*	-.08	.12	.44*	.16	.11	.05	.08	.11	.21*	.06	-.22*	.26*
Positive Affect (MLM)	.41*	.42*	-.14	.07	.42*	.13	.08	.01	.07	.09	.18*	.03	-.25*	.27*
Negative Affect	-.39*	-.40*	-.21*	-.14	-.40*	-.17	-.04	-.01	.07	-.01	-.11	-.08	.08	-.15
Negative Affect (MLM)	-.30*	-.32*	-.42*	-.08	-.36*	-.14	.00	.03	.09	.07	-.03	-.13	.08	-.10
Happiness	.12	.21*	.13	.07	.13	.25*	.02	.02	.04	-.09	-.01	.08	.03	.06
Life Satisfaction	.16	.22*	.13	.08	.17*	.14	.00	.00	.17	-.07	-.04	.07	-.16	.11
1-Item Life Satisfaction (MLM)	-.09	-.06	.53*	-.15	-.04	.02	-.06	-.03	-.10	-.02	-.12	.03	.07	.04
1-Item Affect (MLM)	.37*	.47*	.40*	.24*	.42*	.03	.07	.03	.10	.06	.12	.01	-.04	.09
Connectedness	.42*	.41*	-.07	.14	.41*	.09	.13	.06	.18*	.15	.22*	-.01	-.25*	.23*
Competence	.23*	.24*	.05	.07	.19*	.07	.06	.05	-.01	.01	.11	-.08	-.12	.11
Autonomy	.31*	.29*	-.01	.10	.32*	.11	.10	0	.17	.14	.15	-.12	-.18*	.12
Flow	.36*	.35*	-.08	.01	.42*	.00	.06	-.03	.12	.06	.12	-.01	-.12	.11
BFI-2 Extraversion	.12	.08	.03	.08	.08	.13	-.14	-.14	-.04	-.23*	-.26*	.13	-.01	.11
BFI-2 Agreeableness	.22*	.21*	.18	-.04	.11	.19*	.00	-.01	-.03	.05	.05	.04	-.04	.17*
BFI-2 Conscientiousness	.10	.13	.24*	.11	.22*	.13	.01	.05	-.02	-.06	-.08	-.08	-.04	.02
BFI-2 Negative Emotionality	-.11	-.14	-.25*	-.06	-.19*	.03	-.06	-.08	-.06	.05	.07	-.10	.03	-.08
BFI-2 Open Mindedness	.14	.16	.02	.01	.06	.18*	.03	.04	-.03	.03	.05	.02	.09	.01
NEO Extraversion	.22*	.23*	.02	-.07	.15	.19*	.00	-.04	-.06	.00	.06	.01	-.09	.16

Note. Extrv. Beh. = Extraverted Behavior. Extrv. Beh. 2 = Extraverted behavior with items that overlap with intervention instructions omitted. Adhr. = Adherence. Exp. = Expected. Act. = Actual. Des. = Desire. BFI-2 = Big Five Inventory-2. Socbl. = Sociability. Assrt. = Assertiveness. Energ. = Energy Level. NEO = Revised NEO Personality Inventory. Fem. = Female. MLM = multilevel modeling (other estimates are from latent growth models). $* = p < .05$. Column names are moderators and row names are outcomes.
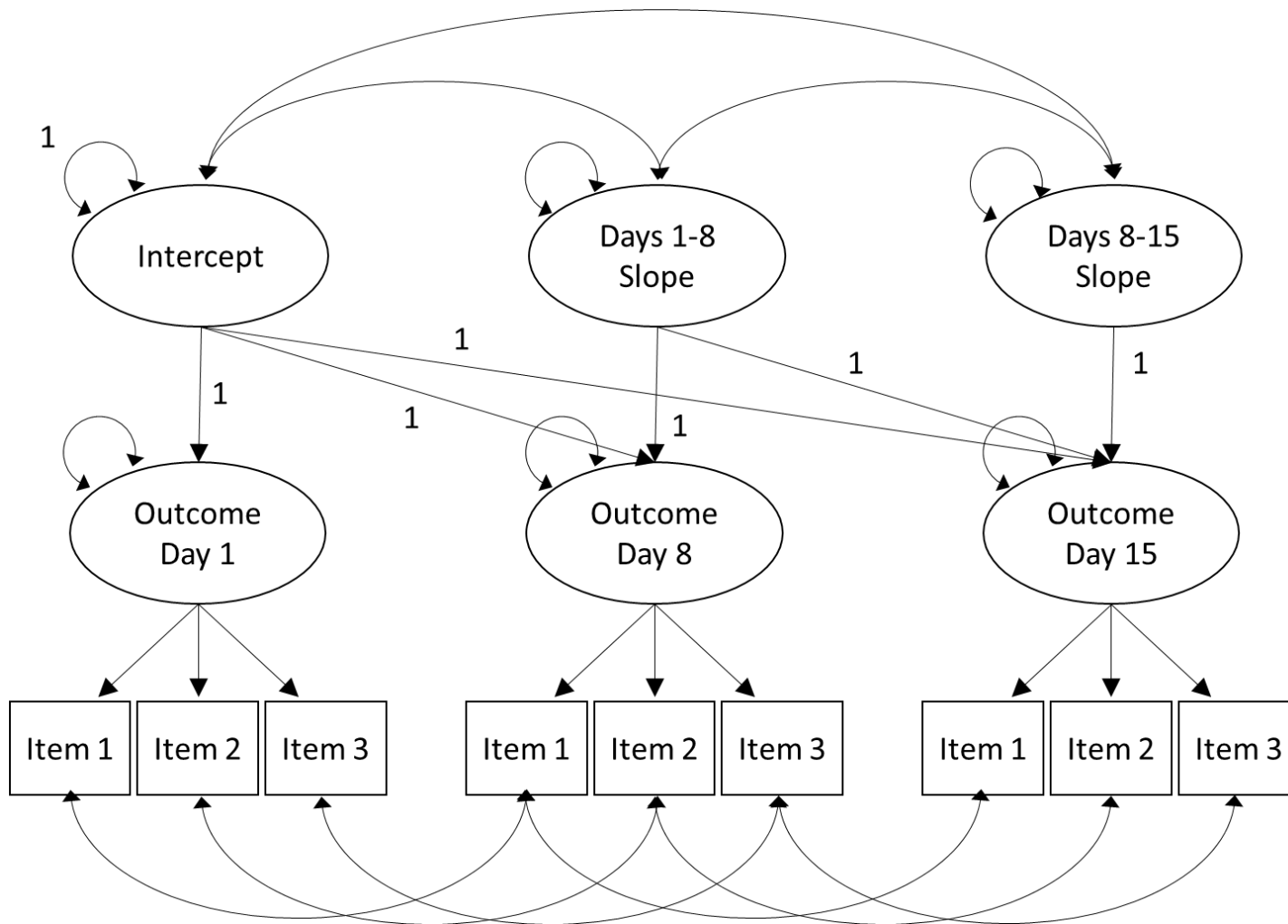
Figure 1. Latent growth model used to model growth in our outcomes. Factor loadings and item intercepts were constrained to be equal across time. In addition, correlations between the same items over the same duration were constrained to be equal and first-order latent variables had residual variances set to zero.
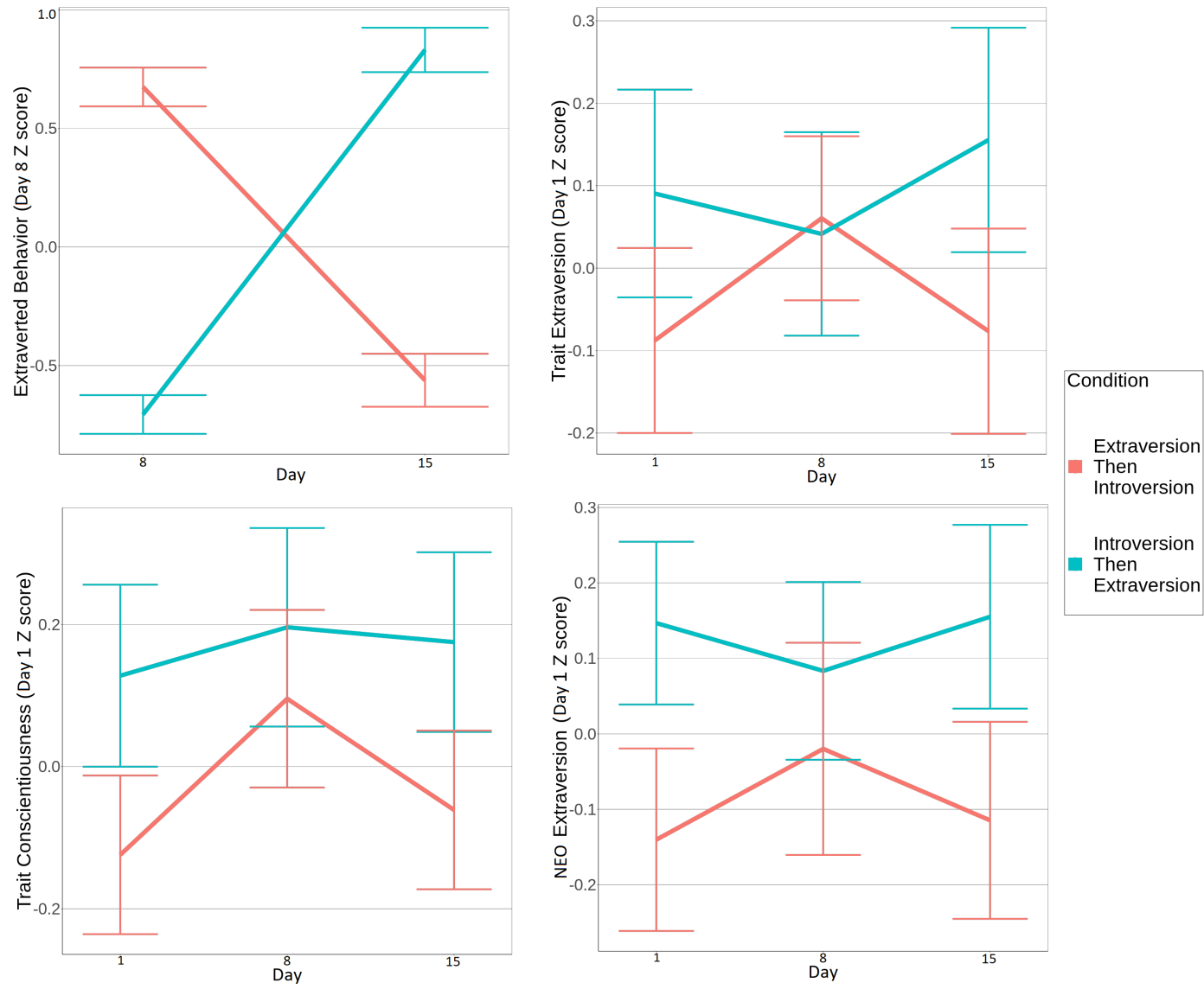
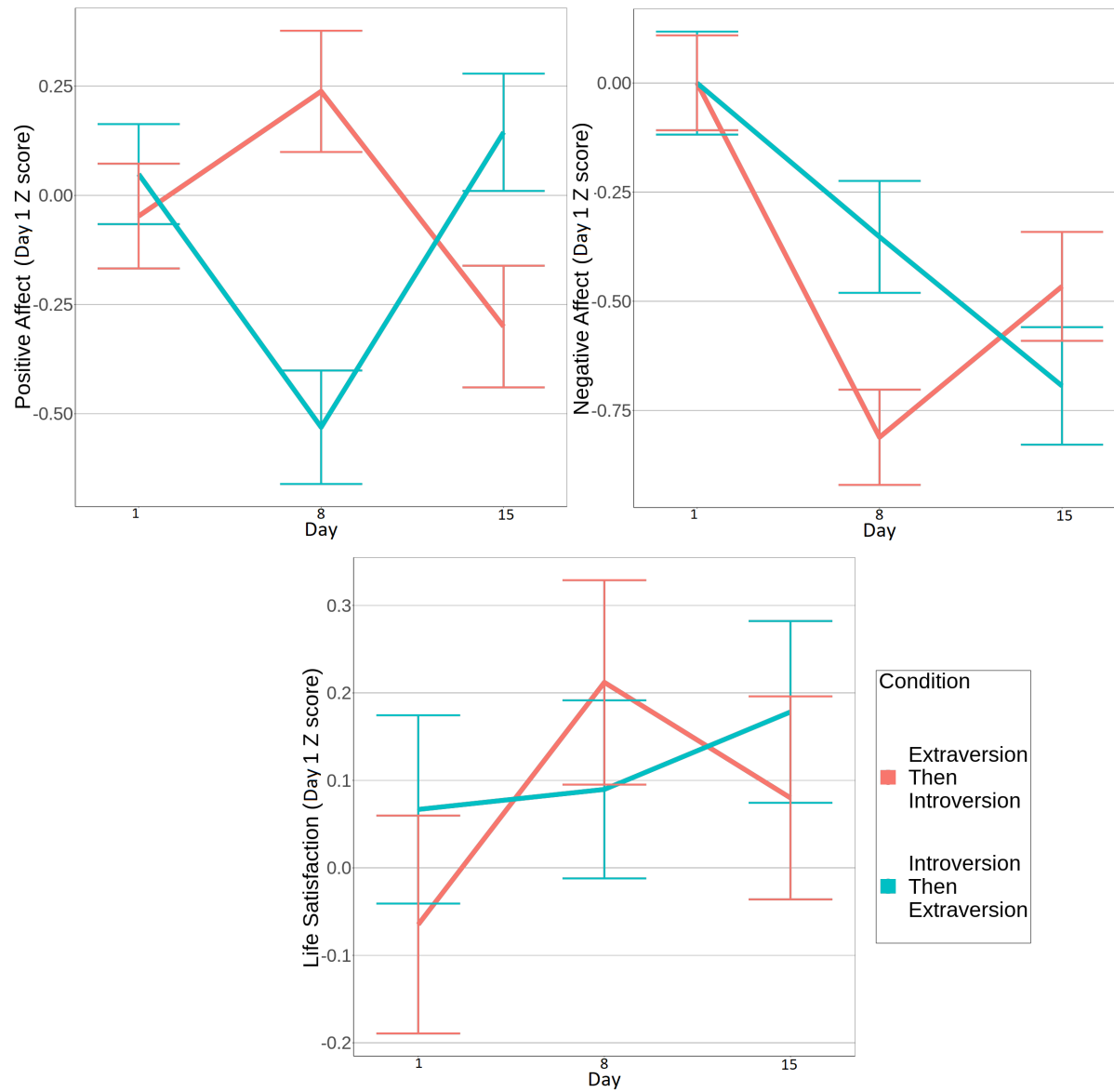*Figure 2.* Growth in behavior and personality over time by condition

Figure 3. Growth in well-being over time by condition.