# Longitudinal Trajectories of Readiness to Change: Alcohol Use and Help-Seeking Behavior

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**ABSTRACT. Objective:** Pre–post changes in readiness for change (RC) are commonly assessed in treatment outcome studies, often with contradictory results. Little is known about 12-month RC trajectories among those initiating change or about the association between RC and either within- or between-person alcohol use or time-lagged help-seeking behavior. **Method:** This observational longitudinal study measured RC as ambivalence, problem recognition, and taking steps. Participants ($N$ = 253; 66.4% male) diagnosed with alcohol use disorders were recruited from treatment sites, Alcoholics Anonymous (AA) groups, and other community sources when first initiating change and assessed at baseline and 3, 6, 9, and 12 months. **Results:** Support for significant participant heterogeneity as well as linear and quadratic change in RC trajectories was found, although results differed across the three aspects of RC. Independent associations of both within- and between-person percentage of days abstinent were found for ambivalence and taking steps. Lagged, time-specific fluctuations in prior help-seeking behaviors within an individual predicting subsequent RC showed that both AA ($B$ = -1.650, $p < .05$) and treatment attendance ($B$ = 2.914, $p < .01$) were associated with subsequent ambivalence. Prior increases in taking steps within individuals were predictive of subsequent AA but not treatment attendance. **Conclusions:** Results inform treatment providers about how RC trajectories vary depending on alcohol use, both within and between individuals, and how individuals may mobilize change attitudes and behaviors, especially in relation to AA attendance. Future research should investigate additional predictors of RC trajectories and the causal direction between RC and help seeking. (*J. Stud. Alcohol Drugs, 75,* 486–495, 2014)

READINESS FOR CHANGE (RC) has been identified as a factor influencing treatment engagement and outcome (e.g., Collins et al., 2012; Zhang et al., 2004), and motivational interviewing posits that client motivation is a central mechanism accounting for substance-related behavior change (Miller and Rollnick, 1991, 2002, 2012; Miller et al., 1992). Motivational interviewing seeks to resolve client ambivalence about change, enhance substance use problem recognition, encourage clients to take responsibility for resolving the problem, and ultimately lead clients to take steps to reduce use. It is theoretically grounded in Prochaska and DiClemente's (1982) and Prochaska et al.'s (1992) transtheoretical model (TTM). The TTM proposed five stages to describe the process of changing problematic health behavior: precontemplation, contemplation, preparation, action, and maintenance.

Several measures assess RC in accordance with the TTM, including the University of Rhode Island Change Assessment Scale (McConnaughy et al., 1989), the Readiness to Change Questionnaire (Rollnick et al., 1992), and the Stages of Change Readiness and Treatment Eagerness Scale (SOCRATES; Miller and Tonigan, 1996). The SOCRATES contains three scales—ambivalence, problem recognition, and taking steps—that correspond to three processes that may underlie the TTM (Miller and Tonigan, 1996). Ambivalence corresponds to the precontemplation stage. Heavy drinkers in this stage are considering whether their drinking is becoming a problem but are not necessarily committed to endorsing an awareness of their problem or to changing their behavior. Problem recognition, or an individual's awareness of the negative consequences of continuing to drink, is a combination of items originally developed to measure the precontemplation (reverse coded) and preparation stages. Taking steps—small, incremental movements toward change—corresponds to the action and maintenance stages (Miller and Tonigan, 1996). The SOCRATES scale structure has been replicated cross-culturally (Chun et al., 2010; Demmel et al., 2004; Zullino et al., 2007) and has predicted treatment compliance and posttreatment outcome in a variety of settings (Miller and Tonigan, 2001; Mitchell and Angelone, 2006).

The TTM predicts that decreased levels of ambivalence and increased levels of problem recognition and taking steps would lead to behavior change (Miller and Rollnick, 2002; Miller and Tonigan, 2001). However, examination of this proposed relationship has produced inconsistent results (Bertholet et al., 2009; Gossop et al., 2006; Maisto et al., 1999; Miller and Tonigan, 2001; Nochajski and Stasiewicz, 2005; Zhang et al., 2004). Conflicting findings, for example, are

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highlighted among the results of Project MATCH (Matching Alcoholism Treatments to Client Heterogeneity; Project MATCH Research Group, 1997).

In the outpatient arm of Project MATCH, problem recognition and taking steps were positively related to percentage of days abstinent (PDA) and negatively related to a measure of drinking intensity (drinks per drinking day; DPDD) at both proximal and distal follow-up assessments. Ambivalence scores had no relationship to subsequent PDA or DPDD. However, in the aftercare arm, taking steps was significantly predictive of PDA and DPDD, whereas problem recognition had no relationship to outcome. Ambivalence was not related to outcome except for predicting a reduction in DPDD at proximal follow-up (Miller and Tonigan, 2001).

Despite mixed findings, RC is theoretically appealing as a potential reason for attending substance use treatment and Alcoholics Anonymous (AA). Treatment and AA attendance should be expected to affect levels of client RC. However, the hypothesized relationship between RC and help-seeking behaviors is fraught with inconsistent empirical findings.

For example, it was hypothesized in Project MATCH that clients in the motivational enhancement therapy condition would experience greater increases in problem recognition and taking steps and decreases in ambivalence (Miller and Tonigan, 2001). A motivational enhancement therapy treatment effect was found for increased levels of problem recognition, but ambivalence and taking steps did not function differently between Project MATCH treatment conditions. Contrary to predictions, ambivalence levels slightly increased and taking steps slightly decreased throughout the course of all three treatments (Miller and Tonigan, 2001). Additionally, Kelly and Moos (2003) found that individuals higher in RC were less likely to drop out from AA following treatment, and McKellar et al. (2003) found that less ambivalence was associated with more AA involvement. However, SOCRATES scale scores did not explain the relationship between AA attendance and alcohol outcomes (McKellar et al., 2003).

Because of contradictory findings, this study examined trajectories of RC in treatment-naive participants with alcohol use disorders, unconfounded with investigator-delivered treatment or previously successful attempts to change drinking. Aim 1 builds on the existing literature, which has usually investigated only pre–post changes in RC or estimated a single linear trajectory of RC based on the average trajectory of all participants in the study (i.e., linear or fixed effect) by empirically evaluating quadratic effects in RC and participant heterogeneity in RC trajectories across time.

The TTM also theorizes about change processes occurring within an individual but is usually only tested with quantitative methods that evaluate the association of RC with alcohol use between individuals. Aim 1 also assessed both the within- and between-person associations of alcohol use on RC. This allowed for an examination of whether time-specific fluctuations from an individual's average PDA were associated with corresponding fluctuations in ambivalence, problem recognition, or taking steps for any given individual (within-person effect) as well as whether participants with high average levels of PDA also exhibited high levels of RC (between-person effect; Curran and Bauer, 2011; Enders and Tofighi, 2007).

According to the TTM, we hypothesized a decrease in ambivalence and an increase in problem recognition and taking steps across time. Theoretically, ambivalence levels should be higher when first initiating change and decline as a resolution of problematic drinking is achieved. The TTM also predicts that problem recognition of alcohol misuse and taking steps to reduce alcohol consumption would increase throughout the year. Higher levels of ambivalence were hypothesized to be associated with lower levels of PDA, whereas higher levels of problem recognition and taking steps were expected to be associated with higher levels of PDA, both within and between participants.

Aim 2 investigated the time-ordered association of AA and psychosocial treatment attendance for alcohol, other drug, or emotional problems with RC. Theoretically, help-seeking behaviors may influence subsequent RC, RC may influence subsequent help seeking, or both may exhibit a simultaneous dynamic influence on each other. Aim 2 investigated the first two possibilities. We hypothesized that more days attending AA or treatment would predict lower subsequent ambivalence and higher subsequent problem recognition and taking steps. Conversely, we predicted that higher ambivalence levels would be associated with lower levels of AA or treatment attendance but that higher levels of problem recognition and taking steps would predict subsequent AA and treatment attendance.

## Method

### *Participants*

This study is a secondary data analysis from a prospective observational study of 253 adults with alcohol use disorders during early efforts to reduce their alcohol use. To control for prior learning effects when investigating change processes, the parent study excluded adults who had prior success at achieving abstinence (Tonigan and Beatty, 2011; Tonigan and Rice, 2010). Thus, participants were excluded from the study if they had already achieved alcohol abstinence for 12 months or longer or had attended AA for more than 4 months.

Inclusion criteria were meeting *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*, criteria for current alcohol abuse or dependence (American Psychiatric Association, 1994), consuming alcohol in the prior 90 days, and attending at least one AA meeting in the prior 3 months. Participants were recruited from outpatient substance use

TABLE 1. Participant baseline characteristics ($N = 253$)

| Variable | % or *M* (*SD*) |
|---|---|
| Demographic variables | |
| % male | 66.4% |
| Age, in years | 38.47 (9.81) |
| Education, years of | 12.76 (2.71) |
| % married/cohabitating | 16.6% |
| % White | 34.4% |
| % unemployed | 64.0% |
| Baseline substance use | |
| Proportion days abstinent[a] | .54 (.31) |
| Drinks per drinking day[a] | 17.79 (12.70) |
| Proportion days cocaine[a] | .07 (.18) |
| Proportion days marijuana[a] | .14 (.29) |
| Alcohol dependence score[b] | 48.73 (9.29) |
| Alcohol-related consequences[c] | 13.32 (3.14) |
| Drug-related consequences[d] | 41.44 (7.19) |
| Motivation–ambivalence[e] | 14.92 (4.09) |
| Motivation–problem recognition[e] | 30.76 (5.08) |
| Motivation–taking steps[e] | 34.40 (5.81) |
| Efficacy–temptation[f] | 57.41 (19.03) |
| Efficacy–confidence[f] | 61.16 (19.20) |
| Proportion of treatment days[a] | .08 (.15) |
| Proportion AA attendance[a] | .17 (.18) |

*Notes:* AA = Alcoholics Anonymous. [a]Form 90; [b]Alcohol Dependence Scale (range: 25 [*low dependence*] – 72 [*high dependence*]; Skinner and Allen, 1982); [c]Short Inventory of Problems (range: 0 [*no problems*] – 45 [*many and frequent problems*]; Miller et al., 1995); [d]Inventory of Drug Use Consequences (range: 0 [*no consequences*] – 50 [*many consequences*]; Tonigan and Miller, 2002); [e]Stages of Change Readiness and Treatment Eagerness Scale (SOCRATES); [f]Alcohol Abstinence Self-Efficacy (range: 20 [*no self-efficacy*] – 100 [*high self-efficacy*]; DiClemente et al., 1994).

treatment ($n = 87$), community-based AA groups ($n = 68$), and other community-based sources ($n = 98$). Sample characteristics are reported in Table 1. Additional information regarding this sample has been published elsewhere (Jenkins and Tonigan, 2010; Tonigan and Beatty, 2011; Tonigan and Rice, 2010).

### *Procedure*

Participants were assessed in 3-month intervals at baseline and at 3, 6, 9, and 12 months. Before each interview, participants' breath was analyzed to ensure that their blood alcohol concentration was below .05%. Completion rates for each follow-up period were 93.7% at 3 months, 94.1% at 6 months, 93.7% at 9 months, and 91.7% at 1 year. Institutional review board approval was granted for all study procedures.

### *Measures*

*Readiness to change.* The SOCRATES (Miller and Tonigan, 1996) is a widely used 19-item self-report instrument comprising three scales: ambivalence (four items), problem recognition (seven items), and taking steps (eight items). Examples of items in each scale are the following: "There are times when I wonder if I drink too much" (ambivalence), "I know that I have a drinking problem" (problem recognition), and "I am actively doing things now to cut down or stop drinking" (taking steps). Participants responded to each item on a 5-point Likert scale ranging from 1 (*NO! strongly disagree*) to 5 (*YES! strongly agree*). Scale scores were the sum of their items and have demonstrated acceptable test–retest reliability ($r = .83$, .99, and .93 for ambivalence, problem recognition, and taking steps, respectively) and internal consistency (Cronbach's $\alpha = .88$, .95, and .95, respectively; Miller and Tonigan, 1996). Baseline SOCRATES data in this sample indicated similarly acceptable levels of internal consistency (Cronbach's $\alpha = .72$, .89, and .89, respectively).

*Substance use.* The calendar-based Form 90 (Miller, 1996) was used to measure alcohol consumption over the past 90 days. This instrument has shown satisfactory reliability on PDA ($r = .79$ for outpatients and $r = .97$ for aftercare patients) and DPDD ($r = .94$, and .95, respectively; Tonigan et al., 1997).

*Help-seeking behavior.* Help-seeking behavior was assessed with the Form 90 and was defined as the proportion of days attending AA or any psychosocial treatment. AA attendance was computed by summing the number of days AA was attended in an assessment period and dividing by the total number of days in the assessment period. Psychosocial treatment was defined as the sum of non-overlapping days participants attended inpatient or outpatient treatment for alcohol, other drug, or emotional problems, divided by the total number of days in the assessment period.

### *Statistical analysis*

*Aim 1: Empirically derived trajectories of readiness to change.* An exploratory model-building approach was used to develop the model that best described trajectories for the three outcome variables—ambivalence, problem recognition, and taking steps. Parameters were systematically added to the model one at a time, and deviance statistics were compared. Model building ended when all parameters were tested and the resulting model did not lead to better fit. Given that these analyses were primarily concerned with describing linear and quadratic change, assessing if model parameters were best modeled as random or fixed, and testing for within- and between-participant associations of PDA with RC, variables were specified in the following order: fixed intercept–only model, fixed linear time, fixed quadratic time, random intercept, random linear slope, and then a random quadratic slope, producing an unconditional growth model.

Next, the within- and between-participant associations of PDA with RC were tested, beginning with fixed PDA collected at each assessment (Level 1) and then its random component. The average PDA during the year for each participant (Level 2) predicting the intercept of RC at baseline was added next, and then its association with the linear slope

Table 2. Means and standard deviations of change readiness, help-seeking behavior, and alcohol use

| Variable | Baseline | *N* | 0–3 mos. | 4–6 mos. | 7–9 mos. | 10–12 mos. |
|---|---|---|---|---|---|---|
| Ambivalence[a] | 14.92 (4.09) | 253 | 13.17 (4.73) | 12.95 (4.73) | 12.82 (5.12) | 12.61 (4.95) |
| Problem recognition[a] | 30.76 (5.08) | 253 | 28.86 (6.14) | 27.81 (6.85) | 27.67 (6.60) | 26.96 (6.84) |
| Taking steps[a] | 34.40 (5.81) | 253 | 33.91 (6.05) | 32.72 (6.98) | 32.63 (7.06) | 32.14 (7.01) |
| Percentage of days abstinent | 0.538 (.019) | 253 | 0.770 (.022) | 0.793 (.020) | 0.778 (.022) | 0.782 (.022) |
| Proportion days AA[b] | .17 (.18) | 253 | .28 (.32) | .19 (.25) | .15 (.23) | .15 (.23) |
| Proportion days Treatment[b] | .08 (.15) | 253 | .11 (.20) | .09 (.20) | .06 (.11) | .05 (.14) |

*Notes:* AA = Alcoholics Anonymous; mos. = months. [a]Stages of Change Readiness and Treatment Eagerness Scale (SOCRATES); [b]Form 90.

was tested. Finally, its association with the quadratic curvature parameter was tested.

Multilevel modeling was conducted with the Hierarchical Linear Modeling software (HLM Version 7, Raudenbush et al., 2011). Full maximum likelihood was used to estimate model parameters. Linear and quadratic time parameters were coded such that the intercepts evaluated the average level of the outcome at baseline, as inclusion criteria required that participants were just initiating a change in their alcohol use. The PDA variable at Level 1 was centered at the group mean to assess for time-specific change within an individual, and the variable representing the average annual PDA for each participant (Level 2) was centered at the grand mean. Significant independent associations of these parameters with RC were tested according to methods described in Enders and Tofighi (2007). All model parameters were interpreted with robust standard errors.

*Aim 2: Lagged effects of help-seeking efforts on readiness to change.* The second aim of this study investigated the time-ordered association of AA and psychosocial treatment attendance with ambivalence, problem recognition, or taking steps. For the first subset of analyses, help-seeking efforts were lagged such that self-reported AA and treatment attendance at baseline were lagged to test for an association with RC at 3 months, help seeking at 3 months was potentially associated with RC at 6 months, etc. Models were again built by adding parameters individually and retaining parameters on the basis of model fit. After the unconditional growth models were built, group-centered predictors were added in the following order: fixed AA attendance, its random component, fixed treatment attendance, and its random component.

The second part of Aim 2 lagged RC and help-seeking behavior in the opposite direction, such that RC at baseline predicted AA or treatment attendance at 3 months, RC at 3 months predicted AA or treatment attendance at 6 months, etc. Two multilevel models evaluated either AA or treatment attendance as the outcome. The unconditional growth models were built first, and group-centered ambivalence, problem recognition, and taking steps were added separately in that order. Random components of RC were each tested next.

## Results

RC outcome measures were first inspected for normality and outliers. Problem recognition and taking steps were negatively skewed because of ceiling effects for these scales. Nineteen percent of scores were the highest possible score: 35 for problem recognition or 40 for taking steps. Thus, transformations did not significantly improve normality because the modal response was at the extreme of these scales. The decision was made to analyze outcomes in their original metric to aid in the interpretation of results and their comparison with previous studies.

### *Aim 1: Empirical examination of readiness for change trajectories and their association with alcohol use*

Unconditional growth models were built first, and trajectories of RC were examined. Next, within- and between-participant associations of alcohol use on RC were interpreted. The means and standard deviations of RC are listed in Table 2. Fixed effects, variance components, and variance–covariance parameters are shown for all six models in Table 3.

Commonalities in results for each outcome were that the covariances between the intercept and linear or quadratic slopes were nonsignificant; the initial level of ambivalence, problem recognition, or taking steps was unrelated to its decrease or curvature. Additionally, unexplained variability at Level 1 did not decrease substantially between the unconditional growth and final models, suggesting that the final models could be improved by the inclusion of other relevant factors influencing RC trajectories. Divergent results for each outcome are reported below.

*Ambivalence.* Model building proceeded in a straightforward manner, and the unconditional growth model indicated that ambivalence exhibited curvilinear change over time and substantial variability in this change among participants. The instantaneous rate of change of ambivalence at baseline was -1.360 ($SE = 0.265$, $p < .001$). A decrease in ambivalence at baseline was evident, but there was also nontrivial variance in this decrease ($r = 3.633$, $SD = 1.906$, $p < .01$). However,

TABLE 3. Aim 1 multilevel models

| | | Ambivalence | | Problem recognition | | Taking steps | |
|---|---|---|---|---|---|---|---|
| Variable | Parameter | Unconditional growth model | Final model | Unconditional growth model | Final model | Unconditional growth model | Final model |
| Fixed effects | | | | | | | |
| Intercept | $\beta_{00}$ | 14.799*** | 14.386*** | 30.639*** | 30.048*** | 34.316*** | 34.721*** |
| Linear time | $\beta_{10}$ | -1.360*** | 0.825** | -1.790*** | -1.016** | -0.592*** | -0.844*** |
| Quadratic time | $\beta_{20}$ | 0.207*** | 0.105 | 0.218** | 0.067 | | |
| PDA-within | $\beta_{30}$ | | -2.262*** | | -3.466*** | | 4.280*** |
| [a]PDA-between | $\beta_{01}$ | | -1.643* | | | | 8.424*** |
| Variance components | | | | | | | |
| Level 1: Within | $e_{ij}$ | 9.575 | 9.165 | 13.577 | 13.210 | 24.927 | 24.240 |
| Level 2: Initial status | $r_0$ | 7.731*** | 9.052*** | 14.278*** | 15.812*** | 13.230*** | 7.806*** |
| Linear time | | | | | | | |
| Variance | $r_1$ | 3.633** | 2.344* | 8.150*** | 3.813 | 1.351*** | 1.334*** |
| Covariance with initial status | $\tau_{10}$ | 0.357 | -0.185 | 1.801 | 2.028 | -0.698 | -0.648 |
| Quadratic time | | | | | | | |
| Variance | $r_2$ | 0.163* | 0.143* | 0.351*** | 0.203 | | |
| Covariance with initial status | $\tau_{20}$ | -0.047 | 0.127 | -0.695 | -0.550 | | |
| Covariance with linear time | $\tau_{21}$ | -0.735 | -0.555 | -1.514 | -0.745 | | |
| PDA-within | $r_3$ | | 6.954* | | 20.079 | | |

*Notes:* PDA = percentage of days abstinent. [a]PDA-between ($\beta_{01}$) association with initial status.
*$p < .05$; **$p < .01$; ***$p < .001$.

the quadratic curvature parameter ($B = 0.207$, $SE = 0.063$, $p < .001$) indicated that although ambivalence decreased initially, the model-predicted trajectory increased at approximately the end of Month 9, although there was also significant participant heterogeneity in this curvature ($r = 0.163$, $SD = 0.404$, $p < .05$).

The test of the contrast between PDA at Level 1 and Level 2 in the final model indicated that there were separate, independent associations of both within- and between-person alcohol consumption with ambivalence, $\chi^2(1) = 20.230$, $p < .001$. The Level 1 PDA measure showed that time-specific increases in PDA within an individual relative to that individual's average PDA were associated with simultaneous decreases in ambivalence, and vice versa. The Level 2 PDA measure indicated that individuals with lower average levels of PDA during the first year of attempted behavior change exhibited higher levels of ambivalence than did individuals with higher average annual PDA. Model fit was not substantially improved by specifying that the average between-participant PDA predicted the linear or quadratic parameters.

*Problem recognition.* During the model-building procedure, the deviance test indicated that the addition of the fixed PDA term measured at Level 1 resulted in significantly improved fit, $\chi^2(1) = 22.133$, $p < .001$. However, when it was added to the model, the quadratic term became nonsignificant. Next, the random component associated with PDA at Level 1 also resulted in improved model fit, $\chi^2(4) = 26.978$, $p < .001$. However, this random component was not significantly different from zero, and its inclusion in the model rendered all other random slope components nonsignificant. Given that single parameter tests of random components can be misleading (Singer and Willet, 2003), the decision was made to retain these parameters in the model on the basis of improved model fit.

The unconditional growth model exhibited curvilinear change in problem recognition over time and substantial variability among participants in this change. Problem recognition initially decreased ($B = -1.790$, $SE = 0.336$, $p < .001$) but then increased ($B = 0.218$, $SE = 0.078$, $p < .01$) toward the end of the first year of initiating a change in alcohol use.

Fluctuations from an individual's average PDA indicated that the association of PDA with problem recognition was context dependent. Within an individual, time-specific decreases in PDA relative to his or her individual mean were associated with increases in problem recognition, and vice versa. After statistically adjusting for the association of PDA with problem recognition at Level 1, the addition of between-person average PDA at Level 2 did not contribute any additional explanatory power to the model.

*Taking steps.* During the model-building process, the first attempt at the addition of a fixed quadratic curvature parameter did not result in better fit, $\chi^2(1) = 0.566$, $p > .05$. However, Hox (2002) recommends that fixed effects that were previously not included in the model be tested again for inclusion after random components have been assessed. Thus, the fixed quadratic parameter was tested again after the random intercept and linear slope components were evaluated. This model did not result in better fit, $\chi^2(1) = 0.693$, $p > .05$, nor was the curvature parameter significantly different from zero ($B = 0.076$, $SE = 0.093$, $p > .05$). Thus, there

Table 4. Aim 2 multilevel models: Prior help seeking predicting subsequent readiness for change

| | | Ambivalence | | Problem recognition | | Taking steps | |
|---|---|---|---|---|---|---|---|
| Variable | Parameter | Unconditional growth model | Final model | Unconditional growth model | Final model | Unconditional growth model | Final model |
| Fixed effects | | | | | | | |
| Intercept | $\beta_{00}$ | 13.209*** | 13.186*** | 28.798*** | 28.810*** | 33.693*** | 33.652*** |
| Linear time | $\beta_{10}$ | -0.212* | -0.200 | -0.660*** | -0.667*** | -0.571*** | -0.552*** |
| AA attendance | $\beta_{20}$ | | -1.650* | | -2.623* | | -0.932 |
| Treatment | $\beta_{30}$ | | 2.914** | | 2.134 | | 0.338 |
| Variance components | | | | | | | |
| Level 1: Within | $e_{ij}$ | 10.661 | 10.516 | 14.776 | 13.489 | 25.970 | 26.203 |
| Level 2: Initial status | $r_0$ | 12.905*** | 12.977*** | 25.829*** | 25.574*** | 14.845*** | 14.422*** |
| Linear time | | | | | | | |
| Variance | $r_1$ | | | 1.707*** | 1.720*** | 0.952* | 0.902* |
| Covariance with initial status | $\tau_{10}$ | | | -1.091 | -0.896 | 0.502 | 0.666 |
| AA attendance | | | | | | | |
| Variance | $r_2$ | | | | 33.481 | | |
| Covariance with initial status | $\tau_{20}$ | | | | 13.483 | | |
| Covariance with linear time | $\tau_{21}$ | | | | 2.749 | | |

*Note:* AA = Alcoholics Anonymous.
*$p < .05$; **$p < .01$; ***$p < .001$.

was no evidence of curvilinear change in taking steps in this sample.

The unconditional growth model demonstrated empirically that taking steps decreased a half point every 3 months ($B$ = -0.592, $SE$ = 0.132, $p < .001$). There was also significant heterogeneity among participants in this decrease ($r$ = 1.351, $SE$ = 1.162, $p < .001$). In the final model, the parameters measuring PDA at Level 1 and Level 2 were significantly different from each other, $\chi^2(1) = 82.915$, $p < .001$. Both within- and between-person PDAs were independently associated with taking steps. Individual time-specific increases in PDA were associated with simultaneous increases in taking steps, and decreases from average individual PDA were associated with decreases in taking steps. Additionally, a between-person association of PDA with taking steps was also observed. Participants with high average levels of PDA also have high average levels of taking steps, and vice versa.

### *Aim 2: Lagged effects of help-seeking efforts on readiness for change*

Results for both the unconditional growth models and final models for the first subset of analyses of Aim 2 are shown in Table 4. In the first part of Aim 2, help seeking at baseline was lagged to test for an association with RC at 3 months, etc. Model building for this subset of analyses proceeded in a straightforward manner, and for all three RC scales the addition of quadratic curvature parameters to the model did not result in better model fit and thus were removed. In addition, the residual variance at Level 1 did not decrease between the unconditional growth and final models, suggesting that these models could be improved by specifying additional predictors.

*Ambivalence.* Beginning at Month 3 of the study, there was a small decrease in ambivalence at each assessment point ($B$ = -0.212, $SE$ = 0.105, $p < .05$), but the lagged analysis demonstrated that there was not significant participant variation in this decrease. The final model indicated that both AA attendance and treatment attendance were associated with subsequent ambivalence levels beyond what would be expected by the average linear decrease in ambivalence across time. The slope of AA attendance was -1.650 ($SE$ = 0.767, $p < .05$), indicating that for any given individual, reporting more than his or her average AA attendance at a particular assessment predicted less ambivalence at the next assessment. Alternatively, the parameter for treatment attendance was the opposite sign ($B$ = 2.914, $SE$ = 0.946, $p < .01$). Within an individual, attending more days of treatment for alcohol, other drugs, or emotional problems at a specific assessment was associated with more ambivalence at the subsequent assessment period.

*Problem recognition.* The unconditional growth model indicated that problem recognition decreased approximately half a point at each assessment period after Month 3 of the study ($B$ = -0.660, $SE$ = 0.149, $p < .001$) and that there was significant participant heterogeneity in the decrease ($r$ = 1.707, $SE$ = 1.306, $p < .001$). There was no relationship between levels of problem recognition at 3 months and its rate of decrease across time ($\tau_{10}$ = -1.091, $SE$ = 1.033, $p > .05$).

The final model showed that for an individual participant, attending less AA than his or her average level of

Table 5. Aim 2 multilevel models: Prior readiness for change predicting subsequent help seeking

| | | AA attendance | | Treatment attendance | |
|---|---|---|---|---|---|
| Variable | Parameter | Unconditional growth model | Final model | Unconditional growth model | Final model |
| Fixed effects | | | | | |
| Intercept | $\beta_{00}$ | 0.280*** | 0.277*** | 0.112*** | 0.114*** |
| Linear time | $\beta_{10}$ | -0.115*** | -0.105*** | -0.022*** | -0.023*** |
| Quadratic time | $\beta_{20}$ | 0.024*** | 0.022*** | | |
| Ambivalence | $\beta_{30}$ | | 0.002 | | 0.001 |
| Problem recognition | $\beta_{40}$ | | | | 0.000 |
| Taking steps | $\beta_{50}$ | | 0.004* | | |
| Variance components | | | | | |
| Level 1: Within | $e_{ij}$ | 0.020 | 0.021 | 0.015 | 0.015 |
| Level 2: Initial status | $r_0$ | 0.076*** | 0.076*** | 0.026*** | 0.026*** |
| Linear time | | | | | |
| Variance | $r_1$ | 0.021*** | 0.024*** | 0.003*** | 0.003*** |
| Covariance with initial status | $\tau_{10}$ | -0.030* | -0.031* | -0.008** | -0.008** |
| Quadratic time | | | | | |
| Variance | $r_2$ | 0.001 | 0.001* | | |
| Covariance with initial status | $\tau_{20}$ | 0.005 | 0.006 | | |
| Covariance with linear time | $\tau_{21}$ | -0.004 | -0.005 | | |

*Note:* AA = Alcoholics Anonymous
*$p < .05$; **$p < .01$; ***$p < .001$.

AA attendance across the year was associated with higher levels of subsequent problem recognition, and vice versa, beyond what would be expected by the average decline in problem recognition across time ($B$ = -2.623, $SE$ = 1.069, $p < .05$).

*Taking steps.* A decrease in taking steps was evident ($B$ = -0.571, $SE$ = 0.171, $p < .001$). Participants significantly differed in this decrease ($r$ = 0.952, $SE$ = 0.976, $p < .05$), and the amount of taking steps at 3 months did not inform the rate of decrease ($\tau_{10}$ = 0.502, $SE$ = 1.252, $p > .05$). Neither AA nor treatment attendance was associated with subsequent taking steps ($\alpha = .05$).

The second part of Aim 2 lagged RC and help-seeking behavior in the opposite direction such that RC at baseline predicted AA or treatment attendance at 3 months, etc. Results are shown in Table 5.

*AA attendance.* During the model-building process, the addition of the random component associated with the quadratic parameter resulted in better model fit, $\chi^2(3) = 13.990$, $p < .01$, although it was not statistically different from zero. The same was true for ambivalence, $\chi^2(1) = 88.826$, $p < .001$. Problem recognition neither was significantly different from zero nor resulted in better model fit and thus was removed from the model, $\chi^2(1) = 0.196$, $p > .05$.

The polynomial growth model indicated curvilinear change in AA attendance; first, AA attendance at 3 months decreased, and then it increased at the beginning of Month 11. There was also significant participant variability in the rate of decrease at 3 months. The intercept and linear slope covariance was significant ($\tau_{10}$ = -0.030, $SE$ = 0.007, $p < .05$), indicating that participants who attended AA more at 3 months had a faster rate of decrease in AA attendance than did participants who attended AA less at 3 months.

All parameters in the final model were significantly different from zero, except for ambivalence, which had no relationship to the proportion of days AA was attended in the subsequent assessment period. In addition to the average linear decrease in AA attendance across time, prior increases in taking steps within an individual at specific time points were related to subsequent increases in AA attendance ($B$ = 0.004, $SE$ = 0.001, $p < .01$).

*Treatment attendance.* Although the fixed ambivalence parameter was not significantly different from zero, its addition during the model-building process resulted in better model fit and was thus retained in the model, $\chi^2(1) = 94.307$, $p < .001$. The same was true for the addition of the fixed problem recognition parameter, $\chi^2(1) = 7.703$, $p < .01$; however, neither the inclusion of taking steps nor the random components associated with RC contributed to better model fit and were thus removed from the final model.

The unconditional growth model indicated that treatment attendance decreased almost 2 days every 3 months; however, there was significant participant heterogeneity in the decrease. The intercept-slope covariance indicated that participants who attended more treatment at 3 months exhibited more of a decrease in attendance over time ($\tau_{10}$ = -0.008, $SE$ = 0.001, $p < .01$). Prior ambivalence and problem recognition were not related to subsequent treatment attendance. All other parameters in the model were significantly different from zero.

## Discussion

Findings indicated that RC across the first year of attempted change in alcohol use is a complex and dynamic process and one that significantly varies among people. Both ambivalence and problem recognition exhibited curvilinear change; on average, initial decreases were followed by increases toward the end of the year, whereas taking steps only decreased. Although support for both within- and between-participant associations of alcohol use on RC was found, results, particularly the residual error variance at Level 1 in the final models, suggest that there are other factors besides alcohol use that are important for understanding RC trajectories. Participants also differed substantially in RC and how RC changed across time. Thus, postulating only one method of change, such as that proposed by the TTM, may be premature.

The independent within- and between-participant associations of alcohol use with ambivalence and taking steps were predicted by the TTM. However, the TTM predicts that the cessation of problem drinking occurs with increased—as opposed to decreased—problem recognition. In addition, fluctuations from an individual's annual average alcohol use at a given assessment period better explained variance in problem recognition than did comparisons between participants who drank more or less. This scale appears to measure problem recognition as a state rather than a more unchanging traitlike variable.

Findings also suggested that problem recognition did not remain high when problematic drinking was lessened or resolved, as predicted by the TTM, but rather decreased. Reasons for this are unknown, but it may have varied depending on the personal views of participants. For example, if participants endorsed the disease model, items in this scale such as "I am an alcoholic" may be highly endorsed even after the cessation of problem drinking. Alternatively, some abstinent participants may have felt that they were no longer "alcoholics," thus endorsing low agreement with this item. Item response theory has been used to evaluate the most appropriate number of response categories for SOCRATES items (Lopes et al., 2010) but not for the effect of item wording. Because the SOCRATES is used extensively to evaluate RC, future research would benefit from an item-level analysis of its measurement properties.

The second aim investigated the lagged associations between prior help-seeking behavior and subsequent RC. Both AA attendance and treatment attendance were associated with subsequent ambivalence, but with opposite signs. Within an individual, more AA attendance than average predicted less subsequent ambivalence, but more treatment attendance than average predicted more ambivalence. These associations were in addition to expected ambivalence levels based on individual participant ambivalence trajectories.

Factors accounting for this differential influence are unclear. It may be that participants who chose to attend AA were already less ambivalent about their need to change or that attending AA helped participants become more certain about the need for change. Alternatively, participants who chose to attend treatment may have done so because of greater problem severity or difficulty with their change efforts. Disentangling the association between AA or treatment attendance and subsequent ambivalence levels presents an interesting goal for future research. Surprisingly, prior help seeking did not predict subsequent taking steps, and prior increases in taking steps relative to an individual's average predicted subsequent AA but not treatment attendance, beyond what would have been expected based on participant AA attendance trajectories.

Several study limitations should be noted. First, specifying parameters in a different order during the model-building process may have produced models that fit the data equally well, but with slightly different results. Second, although five is a sufficient number of assessments to estimate quadratic change, the precision and reliability of these estimates may have been influenced by sample-specific variability (Singer and Willet, 2003). Third, this study investigated associations between temporally ordered variables; the direction of causality cannot be inferred. Future research should attempt to manipulate both RC and help seeking to clarify the direction of causality. Longitudinal designs that include random assignment and many frequent assessments would aid in this goal. Additionally, this study evaluated individual RC trajectories instead of averaging over this variability to produce one fixed estimate for the entire sample. Given this heterogeneity, quantitative methods that address person-level change and model potential random variation should be used when evaluating RC.

In sum, trajectories of RC are complex, are changing, and vary considerably among people trying to change their drinking. Ambivalence and taking steps were related to alcohol use in ways predicted by the TTM. When individuals drank less than their usual amount in a particular assessment period, they reported less ambivalence, and across the sample, more abstinent participants were less ambivalent than were those who drank more. Similarly, more abstinent participants were also higher in taking steps, and when participants drank less than their usual amount, they also reported taking steps more.

However, the association of alcohol use with problem recognition was not as expected; when participants were more abstinent in a particular assessment period, they reported less problem recognition, not more. Individual fluctuations in drinking explained more variability in problem recognition than did comparisons between participants who drank more or less throughout the year. Also, problem recognition and taking steps did not increase throughout the first year of attempted behavior change, as predicted by the TTM. On

average, problem recognition decreased initially but gradually increased throughout the year, and taking steps only decreased, although this was not true for every participant.

The TTM predicts that, excluding relapse, people linearly progress through the stages, and that processes of change are relatively the same for everyone. Our study findings support neither a straightforward nor homogenous longitudinal pattern of change. A comprehensive, dynamic model of behavior change is needed to inform mechanisms of change research.

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