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LONGITUDINAL DECISION-MAKING IN A TRANSTHEORETICAL MODEL FOR PURSUING LIVING DONOR KIDNEY TRANSPLANT

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LONGITUDINAL DECISION-MAKING IN A TRANSTHEORETICAL MODEL FOR PURSUING LIVING DONOR KIDNEY TRANSPLANT

BY

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Abstract

The transtheoretical model (TTM) is a comprehensive theory of health behavior change that has informed a wide range of health promotion interventions. Despite substantial empirical support for the TTM, our understanding of the mechanisms of behavior change is primarily guided by cross-sectional research. Considerably fewer studies have examined longitudinal relationships between TTM constructs with methods comparable to cross-sectional models. The overarching goal of the present study was to improve our understanding of longitudinal relationships between Stage of Change, Decisional Balance, and Self-Efficacy. Kidney transplant decision-making was used to exemplify longitudinal patterns through secondary data from the trial *Your Path to Transplant*. Across three study objectives, effect size estimates and behavioral predictors were performed to measure magnitudes of change in Decisional Balance (DB) and Self-Efficacy (SE) and detect characteristics that promote readiness for change.

Transtheoretical constructs were measured at the baseline, four-month, and eight-month timepoints among a sample of kidney patients ($N = 815$). Objectives one and two employed repeated measures Hedges' g effect size estimates and 95% confidence intervals to quantify the amount of change in DB (Pros and Cons) and SE from earlier to later timepoints. First, a selection of 534 participants were grouped by Forward, Stable, and Backwards trajectories of Stage movements (e.g., PC-A, A-A, or A-PC). Second, groups were formed among participants who showed substantial change in three construct groups: *Increased Pros*, *Decreased Cons*, and *Increased Confidence* ($N = 571$). In the third objective, a logistic regression analysis tested whether

completion of eight behavioral variables (LDKT Steps) at baseline significantly differentiated individuals who moved to Action versus Pre-Action ($N = 301$).

Effect size findings among groups of Forward Stage transitions provided partial longitudinal support for cross-sectional models within the context of LDKT decision-making. Consistent with cross-sectional models, movement to Action involved increased Pros, decreased Cons, and increased SE. Further, effect sizes for Cons were smallest in adjacent Stage movement and increased proportionately among transitions of two and three Stages. While Pros are commonly understood as the strong principle of change, effect size findings across groups of Stage transitions and construct change suggest that successful behavior change is most strongly driven by Cons. Results are within the context of kidney transplant decision-making and are also in recognition that cross-sectional models are measured with different methods than longitudinal models. Previous findings suggest a difference of -0.50 SD, while a difference of -1.11 SD was demonstrated longitudinally. Lastly, previous engagement in eight common behaviors involved in pursuing transplant significantly predicted movement to Action, with the strongest predictors indicative of greater readiness for pursuing transplant.

Investigating longitudinal pathways of change is important for theory testing and interventions to improve public health. The present study extended preliminary longitudinal support for cross-sectional representations of change and findings emphasized the importance of a kidney patient's perceptions of others in their decision to pursue kidney transplant.

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Introduction

Orientation to the Present Study

The overarching goal of the present study was to test longitudinal predictions for behavior change. The transtheoretical model was used as the guiding theory and was applied to the behavior change of medical decision-making in kidney patients' pursuit of living donor kidney transplant. The primary focus of this study was to improve our understanding of longitudinal change from a transtheoretical perspective, and kidney transplant decision-making was used to exemplify longitudinal processes.

Transtheoretical Model

The transtheoretical model (TTM) is a comprehensive theory of behavior change and a system of measuring change that has informed a wide range of health behavior interventions. The TTM framework characterizes behavior change as temporal progression through a series of five Stages of Change: Precontemplation, Contemplation, Preparation, Action, and Maintenance (Prochaska & Velicer, 1997). Those in Precontemplation do not intend to change a behavior in the six months, while those in Contemplation are considering changing in the next 30 days. Those in Preparation are planning to change a behavior in the next 30 days and have begun to take initial steps involved in the behavior change (DiClemente et al., 1991). Those in Action have actively initiated a behavior change, and those in Maintenance have maintained a behavior change for over six months (DiClemente et al., 1991).

Movement through the Stages of Change is explained by patterns of change in intermediate TTM constructs. Two key intermediate constructs are Decisional Balance

and Self-Efficacy, which measure attitudes and confidence to change. Decisional Balance is the relative weighing of the positive consequences (Pros) and negative consequences (Cons) of a behavior change (Velicer, DiClemente, Prochaska, & Brandenburg, 1985). Decisional Balance was originally developed by Janis and Mann (1977) and was later reduced to a two-component construct, Pros and Cons, for TTM smoking cessation interventions (Velicer et al., 1985). Cross-sectional TTM models have demonstrated a consistent pattern of Pros and Cons in relation to Stage of Change across more than fifty health behavior applications (Hall & Rossi, 2008). In Precontemplation, the Cons of changing a health behavior outweigh the Pros (Prochaska et al., 1994). A defining crossover occurs between Contemplation and Preparation, and by the Action Stage, the Pros of changing outweigh the Cons (Prochaska et al., 1994).

Self-Efficacy is the level of confidence one has in their capacity to achieve a goal (Bandura, 1977). Within the TTM, Self-Efficacy is defined as the confidence to sustain behavior change even when faced with difficult or tempting situations, which influences one's motivation for change (Velicer, DiClemente, Rossi, & Prochaska, 1990). Self-Efficacy has been found to increase across the Stages of Change, with lowest Self-Efficacy reported in Precontemplation and highest reported in Action (DiClemente et al., 1991).

Cross-Sectional Stage Relationships

Cross-sectional models are an important component of TTM theory testing and have been used to validate transtheoretical models across a wide range of health-related behaviors. A widely used and validated cross-sectional TTM method is the analysis of

Stage effects, in which TTM constructs are compared across Stage of Change groups (Johnson et al., 2002; Prochaska, O., Velicer, Prochaska, J., & Johnson, 2004). Stage effects reveal characteristics of each Stage relative to the other Stages and is used to identify significant shifts in decision-making between adjacent Stages.

Stage effects were first examined by DiClemente et al. (1991) in a sample of 691 smokers. Findings for Decisional Balance showed linear differences from Precontemplation to Preparation, in which the Cons of smoking increased across Stages (PC < C < PR) and the Pros of smoking decreased (PR < C < PC). Similar results were found for group differences in Cons of smoking when examined by Fava, Velicer, and Prochaska (1995) among a sample of 4,144 smokers, and by Borland, Segan, and Velicer (2000) within a sample of 304 Australian smokers. However, neither study detected a significant difference in Pros between Stage groups (Borland, Segan, & Velicer, 2000; Fava, Velicer, & Prochaska, 1995).

In cross-sectional evaluations of Self-Efficacy, DiClemente et al. (1991) again found a linear increase in Self-Efficacy across Pre-Action Stage groups (PC < C < PR). Other studies detected a significant increase in Self-Efficacy between Precontemplation and Contemplation, with no differences detected between Contemplation and Preparation (PC < C = PR) (Kraft, Sutton, & Reynolds, 1999; Snow, Prochaska, & Rossi, 1992).

Further support for the generalizability of the TTM and validity of Decisional Balance is found in the strong and weak principles of change, a method that calculates the maximum change in Pros or Cons from Precontemplation to Action, which is often interpreted as an estimate of the change needed to move to Action (Prochaska, 1994).

First published with smoking cessation data, models have been developed for nearly fifty health behaviors to date (Prochaska, 1994; Hall & Rossi, 2008). Relationships are depicted using standardized *z* scores ($M = 0$, $SD = 1$) or *T* scores ($M = 50$, $SD = 10$). Relationships are not usually detected in raw scores due to the tendency for people to endorse the Pros of changing more easily than the Cons (Prochaska, 2008). It is important to note that the transformations are linear and do not affect patterns of group differences or the significance of findings.

Pros are considered the strong principle of change because twice as much change is anticipated for an individual to move from Precontemplation to Action, while Cons are considered the weak principle as half of the anticipated change is expected (Prochaska, 1994; Prochaska et al., 1994). Meta-analytic findings across 48 health behaviors revealed that from Precontemplation to Action, the Pros of changing increased one standard deviation and the Cons decreased 0.56 standard deviations (Hall & Rossi, 2008). These findings are consistent with previous models, which reported an increase of 1.0 SD in Pros and a decrease of 0.5 SD in Cons (Prochaska et al., 1994).

Similar results were found in cross-sectional models within the context of decision-making for pursuing living donor kidney transplant, which adds further support for the generalizability of the TTM to complex medical decision-making. Initially examined for measure development within a sample of 483 kidney patients, findings revealed that from Precontemplation to Action, Pros increased 0.92 SD, Cons decreased 0.29 SD, and Self-Efficacy increased 0.80 SD (Waterman et al., 2015). When examined in the baseline sample of the Your Path to Transplant study, which included a

sample of 815 kidney patients, findings revealed that Pros increased 0.85 SD, Cons decreased 0.45 SD, and Self-Efficacy increased 0.90 SD (Mushkat, 2018).

Measuring Change Longitudinally

Cross-sectional TTM models are an efficient and easily measured means for demonstrating decision-making characteristics across the Stages of Change. However, cross-sectional research cannot be generalized to longitudinal processes, and single-timepoint transtheoretical models may not accurately reflect decision-making as it occurs over time. A core understanding of TTM behavior change models is the conceptualization of behavior change as a series of relationships between decisional constructs that evolve as the individual becomes increasingly ready to enact a behavior change. Longitudinal methods are necessary to accurately depict the process of behavior change and have the potential to reveal key decisional changes that promote readiness to change a health behavior. Yet, compared to cross-sectional research, fewer studies have examined longitudinal relationships between TTM constructs and Stage transitions.

Previous studies suggest that measuring change in TTM relationships across longitudinal trajectories of Stage movement may be considerably more complex than cross-sectional depictions. Individuals that attempt behavior change may experience setbacks or relapses that result in non-linear Stage movements, particularly when attempting to change an addictive behavior such as smoking (Prochaska, Velicer, Guadagnoli, & Rossi, 1991; Velicer, Norman, Fava, & Prochaska, 1999). Evidence from longitudinal TTM smoking cessation research suggests that movement towards

Action may involve non-linear trajectories within intermediate model constructs, and Stage movement itself may be non-sequential (Prochaska et al., 1991; Velicer et al.,1999). Velicer, Martin, and Collins (1996) found that forward movement is more likely than regression among intervention groups, and individuals most commonly move to an adjacent Stage.

Several longitudinal studies have examined the temporal order of change in intermediate TTM constructs in relation to Stage progression. Temporal sequencing of physical activity change constructs showed a cyclical pattern of change, in which change in Decisional Balance and Self-Efficacy promoted Stage progression (Nigg et al., 2019). Schumann et al. (2005a) examined the order of change in intermediate TTM constructs as applied to smoking cessation. In this study, an increase in the Cons of Smoking occurred before a decrease in the Pros of Smoking, which is consistent with cross-sectional findings (Schumann et al., 2005a; Fava, Velicer, & Prochaska, 1995; Prochaska et al., 1994). Schumann et al. (2005a) also detected a path from the Pros of Smoking to Self-Efficacy, in which change in Pros preceded change in Self-Efficacy.

Longitudinal Relationships between TTM Constructs

A variety of methods and statistical approaches have been used in TTM studies of longitudinal decision-making. Across this area of literature, Stage of Change served as the grouping variable and samples were organized by exact or similar Stage transitions across timepoint(s). While studies have varied in the specificity and terminology used to define groups of Stage movements, they tend to represent three directions of movement: Progression (forward movement towards Action), Stable

(remaining in the same Stage over time), or Regression (movement to an earlier Stage). Previous studies have measured change with an array of statistical approaches including latent transition analysis, dynamic typology, group comparisons, and effect size predictions (Martin, Velicer, & Fava, 1996; Prochaska et al., 1991; Velicer et al., 1999).

Group Comparisons. Several studies have measured change in intermediate constructs by comparing groups of Stage transitions. Empirical findings across this area of research show moderate support for cross-sectional models. Cross-sectional Stage models have showed that in Precontemplation, the Cons of changing outweighed the Pros, and in Contemplation, the Pros of changing began to outweigh the Cons (Prochaska et al., 1994). This pattern was replicated longitudinally in two studies, in which significantly greater Pros were detected among those in the Contemplation and Preparation Stages compared to Precontemplation (Velicer et al., 1999; Velicer, Brick, Fava, & Prochaska, 2013).

Expected patterns of change were also detected among two studies of dynamic typologies, a cross-sequential method of grouping based on an individual's pattern of change over multiple timepoints. Similarly, these studies compared dynatype groups. Findings from Norman, Velicer, Fava, and Prochaska (1998) revealed significant differences between groups who progressed to a later Stage compared to groups who vacillated or remained stable, in which movement to a later Stage was associated with increased Cons of Smoking and decreased Pros of Smoking. Expected patterns of change were also detected in a separate analysis of dynamic typology clustering, in which movement towards Action was associated with reduced Pros of Smoking and increased Self-Efficacy (Prochaska et al., 1991).

Effect Size Predictions. Longitudinal group comparison research by Velicer et al. (1999) and Velicer et al. (2013) involved effect size estimates to measure the magnitude of difference between a series of Stage transition groups. Effect sizes were calculated as omega-squared (ω^2), the population estimate of variance accounted for. Effects were interpreted by Cohen's (1988) guidelines of small (.01), medium (.06), and large (.14).

Forty differential a priori effect size predictions were tested based upon previous cross-sectional findings. Tests were conducted among samples of 2,967 smokers (Velicer et al., 1999) and 2,882 smokers (Velicer et al., 2013). Stage transition groups represented movement from baseline to twelve-months, and represented progression towards Action, stable movement, and regression towards Precontemplation.

Velicer et al. (1999) conducted a unique assessment of regression to earlier Stages, in which two Stage regression groups (C to PC and PR to PC, C) were compared to stable Stage movement (C to C, PR to PR). Lower Cons were detected in those who regressed to an earlier Stage (ω^2=.03-.03), while no differences in Pros were detected.

When Stage progression was examined, Velicer et al. (1999) revealed a moderate difference in the Pros of Smoking (ω^2 =.06) among those in Precontemplation who moved to moved Pre-Action (PC, C, or PR) versus Action, with lower Pros among those who quit smoking. No effects were detected for Cons (Velicer et al., 1999).

When stable Contemplation (C to C) was compared to those whose Stage progressed (C to PR, A, M), moderate to large effects were detected for Pros (ω^2=.09-.19) and small to moderate effects for Cons (ω^2 =.03-.06), in which forward Stage

movement exhibited lower Pros and lower Cons of Smoking than stable movement (Velicer et al, 1999; 2013).

Movement from Contemplation to Preparation versus to Action showed large differences in the Pros of Smoking (ω^2=.13-.18) while a small effect was detected for the Cons of Smoking (ω^2=.07), in which smokers (C-PR) exhibited higher Pros while those who quit exhibited lower Cons (Velicer et al., 1999; 2013).

In sum, smoking cessation research by Velicer et al. (1999) and Velicer et al. (2013) showed longitudinal patterns of change in Decisional Balance that were mostly consistent with cross-sectional research, even when effects were in comparison to other groups. Findings suggest that movement to an adjacent Stage may involve smaller changes in Decisional Balance, while transitions that span multiple Stages may show larger effects. This is likely due to the additive nature of change over time, in which movement to Action involves small, cumulative change in intermediate constructs. Further, some observed effects were larger than predicted, which suggests a possibility that cross-sectional models underestimate longitudinal change.

A key difference between the present study and previous longitudinal TTM research is the targeted behavioral change. The behavioral goal of research by Velicer et al. (1999; 2013) was to quit smoking, which involves cessation of a behavior for an addictive substance. The behavioral goal of the present study involved acquisition of behaviors and attitudes that promote health, specifically toward seeking living donor kidney transplant.

Importance of Effect Size Estimates in Theory Testing

Velicer, Cumming, and Fava (2008) presented a strong case for the prioritization of effect size estimates in TTM theory testing. Most statistical tests used in social science research involve null hypothesis significance testing, an ordinal claim that specifies the order and direction of relationships between variables. However, comprehensive theory testing requires an understanding of the strength of relationships. This is accomplished by pairing significance testing with effect size testing, which are statistics that quantify the magnitude of a theoretical relationship thus indicating the degree to which data support the underlying theory. Research by Velicer et al. (1999; 2013) highlighted the utility of pairing effect sizes with null hypothesis statistical tests, as the magnitude of difference between Stage transition groups provided preliminary longitudinal support for foundational cross-sectional models that guide TTM research.

Psychological science benefits from ordinal claims because findings are comparable across studies and allows research to build upon previous findings, while effect size estimates are difficult to generalize across populations (Frick, 1996). However, Cohen (1994), Frick (1996), and others have raised concerns about over-emphasis of null hypothesis testing in psychosocial research. The use of p-values can influence binary decision-making, as the result is either significant ($p < .05$) or non-significant ($p > .05$). This structure is problematic, as it is logical to interpret failure to reject the null hypothesis as confirmation of the null hypothesis is correct.

There are multiple factors that influence whether theory-driven analyses reject or fail to reject the null hypothesis. A common factor is sample size, which determines a study's statistical power to detect effects. Small sample sizes under-power the study's

ability to detect effects and increase the likelihood that a meaningful relationship appears non-significant. Large samples have greater statistical power for detecting significant relationships, however the relationship may not be meaningful.

In sum, effect size estimates and their associated confidence intervals are important for comprehensive theory testing. Effect sizes can increase the depth of ordinal claims by quantifying the strength of theoretical relationships and degree to which data fit the theory.

Kidney Transplant Decision-Making

Chronic kidney disease (CKD) is a significant public health issue affecting nearly 15% of the adult population in the United States (United States Renal Data System, 2020). CKD commonly occurs secondary to hypertension and diabetes, two conditions linked to lifestyle and health behaviors (Lea & Nicholas, 2002). End-stage renal disease (ESRD) is a permanent loss of kidney function that requires long-term dialysis treatment or a transplant from a living or deceased donor to sustain life (Rodger, 2012).

While early stages of CKD show few disparities among those affected, the development of advanced CKD and ESRD is associated with lower socioeconomic status and minority racial and ethnic status (Vart et al., 2015; Volkova et al., 2008). This health disparity is most evident among Black Americans, who are 3.5 times more likely to advance to ESRD than Whites and have an eight percent lifetime prevalence of ESRD (USRDS, 2018; Albertus, Morgenstem, Robinson, & Saran, 2016).

Living donor kidney transplant (LDKT) is widely recognized as the most effective treatment for ESRD compared to dialysis or deceased donor transplant. LDKT

is associated with greater survival and quality of life, reduced risk of transplant failure, shorter waiting times, and lower health care costs (Axelrod et al., 2016; Neipp et al., 2006; Nemati et al., 2014). However, despite benefits to patients' health and wellbeing, only 30% of kidney transplants performed in 2018 were from living donors (OPTN, 2018).

Minorities with ESRD face barriers in access to transplant that have been identified on the individual, provider, health system, and population level (Purnell, Hall & Boulware, 2012). Some individual-level barriers pertain to attitudes and perceptions about transplant, such as limited awareness of the benefits of kidney transplant and hesitation to ask family and friends to donate due to concerns that it may inconvenience or impact the health of a living donor (Gordon et al., 2014; Lunsford et al., 2006; Waterman et al., 2006).

Psychosocial research serves an important role in supporting LDKT utilization among marginalized groups. By examining decision-making and behavior of kidney patients in need of transplant, we can better understand pathways that promote motivation and activation to pursue LDKT. The process of pursuing kidney transplant has recently been examined through the lens of health behavior change, as pursuit of LDKT involves changes in attitudes about transplant and motivation to find a living donor from their social network or broader community. Waterman and colleagues were the first to examine kidney transplant pursuit as a behavioral change process within the theoretical framework of the Transtheoretical Model (Waterman et al., 2014; Waterman et al., 2015). The *Your Path to Transplant* trial applied the transtheoretical model for

pursuing LDKT to better understand factors involved in LDKT decision-making and increase engagement in the transplant process (Waterman et al., 2021).

Present Study

Research within the Transtheoretical Model often relies on cross-sectional models to understand longitudinal behavior change processes. Considerably fewer studies have examined the magnitude of change in decisional variables over time, and no studies to date have examined longitudinal TTM relationships within the context of transplant decision-making. The present study tested a series of longitudinal predictions of decisional change through a secondary data analysis of longitudinal TTM relationships from the *Your Path to Transplant* (YPT) trial, which measured behavior change in decision-making to pursue LDKT. Across three study objectives, effect size estimates and behavioral predictors were used to detect characteristics that promote readiness for behavior change and clarify the magnitudes of change in Decisional Balance and Self-Efficacy as they occurred across a series of Stage movement trajectories.

Study Aims and Hypotheses

Objective 1: Decision-Making in Stage Transition Groups

The first objective of the present study examined magnitudes of change in Decisional Balance and Self-Efficacy across three directions of Stage movement trajectories. Consistent with cross-sectional methods, standardized effect sizes were used to measure longitudinal relationships between Stage movement and changes in

intermediate decisional processes. Specifically, this objective sought to identify decisional processes that promote movement towards Action and to examine the degree to which decision-making continued to change among individuals who had reached Action.

Hypotheses for Forward Stage Movements:

1. Groups of Forward Stage transitions were hypothesized to show a pattern of increased Pros, decreased Cons, and increased Self-Efficacy from the earlier to later timepoints. Consistent with cross-sectional findings from TTM research, larger magnitudes were predicted for change in Pros and Self-Efficacy scores, while Cons were expected to decrease to a smaller magnitude over time (Mushkat, 2018; Hall & Rossi, 2008).
2. Forward groups that involved multiple Stage transitions were expected to show larger effects for change in Pros, Cons, and Self-Efficacy compared to groups that involved adjacent Stage transitions. This hypothesis is in consideration of findings from Velicer et al. (1999), in which largest magnitudes of change were found in multiple Stage transitions, as well as cross-sectional findings that demonstrate greatest change in decisional constructs from Precontemplation to Action.
3. Cross-sectional findings from the baseline YPT data showed the greatest shift in Decisional Balance and Self-Efficacy between the Precontemplation and Contemplation Stages (Mushkat, 2018). In consideration of baseline Stage comparisons, it was hypothesized that movement from Precontemplation to

Contemplation would show the greatest magnitudes of change in Pros, Cons, and Self-Efficacy.

Hypotheses for Stable Stage Movements:

4. Persons who remained in the same Pre-Action Stage across two timepoints were predicted to show modest decisional change oriented towards Stage progression. Because Stage progression did not occur, small magnitudes of change were predicted for Stable Pre-Action groups (Stable Precontemplation and Contemplation) that would reflect potential for future movement to the next adjacent Stage (+Pros, +SE, -Cons).
5. The Stable Action group was predicted to demonstrate change in Decisional Balance and Self-Efficacy reflective of continued engagement in pursuing LDKT (+Pros, +SE, -Cons). Ceiling effects were expected to reduce the magnitude of detectable effects, as some participants in Stable Action reported maximum scores of Pros and Self-Efficacy across each timepoint. However, pursuit of a kidney transplant is an ongoing process even when Action is reached, and decisional processes were expected to continue to change over time.

Hypotheses for Backwards Stage Movements:

6. Groups that involved movement from a later Stage to an earlier Stage were hypothesized to show changes in Decisional Balance that reflected increased value in the Cons of pursuing LDKT and decreased value in Pros over time. Self-Efficacy was predicted to decrease as readiness to pursue living transplant decreased.

7. Groups who regressed multiple Stages were predicted to show greater magnitudes of change in Decisional Balance and Self-Efficacy, while movement to an earlier adjacent Stage was predicted to show smaller effects in decisional processes.

Objective 2: Decision-Making in Construct Groups

In the second objective, longitudinal analyses were conducted amongst groups based on attitudinal changes rather than Stage transitions. When decision-making was examined by change in intermediate TTM constructs, rather than Stage transitions, it was hypothesized that longitudinal patterns would remain consist with cross-sectional models (+Pros, -Cons, +SE). Based on cross-sectional findings from the baseline sample, larger effects are predicted for change in Pros and Self-Efficacy scores, while smaller effects are predicted for change in Cons scores (Mushkat, 2018). Specific predictions per construct group are as follows:

- *Increased Pros* Group: Large effects were predicted for increased Self-Efficacy; moderate effects were predicted for decreased Cons.
- *Decreased Cons* Group: Large effects were predicted for increased Pros and increased Self-Efficacy.
- *Increased Confidence* Group: Large effects were predicted for increased Pros; moderate effects were predicted for decreased Cons.

Objective 3: Behavioral Predictors of Movement to Action

The final aim of this study investigated whether behavior could predict movement to the Action Stage. It was hypothesized that the baseline completion of behaviors involved in LDKT pursuit, such as asking a potential donor to be tested, would significantly differentiate movement to Action versus a Pre-Action Stage at the four-month timepoint. This hypothesis sought to extend cross-sectional findings by Waterman et al. (2015) in which those in Action were more likely to have completed steps such as asking a potential donor to be tested.

Methods

'Your Path to Transplant' Study Design

The present study was a secondary data analysis of longitudinal data from *Your Path to Transplant* (YPT), a randomized control trial that sought to increase patient engagement in pursuit of kidney transplants through a combined intervention of Stage-matched expert system feedback and kidney transplant education (Waterman et al., 2021). The YPT intervention was delivered across four timepoints over an eight-month period. The present study examined data from the baseline, four-month, and eight-month timepoints. Measurements of Stage of Change, Decisional Balance, and Self-Efficacy were conducted at each study timepoint.

The goals of the present study were oriented towards a greater understanding of longitudinal decision-making within the TTM rather than trial efficacy, and all analyses were conducted with pooled data blind to the study condition. During the YPT trial, the intervention group received printed expert-system feedback and telephone coaching tailored to their readiness, confidence, and attitudes towards pursuing kidney transplant. The control group completed TTM measures at each timepoint without additional TTM-tailored print or telephone coaching. Both groups received standard of care activities for kidney patients considering deceased or living donor kidney transplant at the University of California at Los Angeles (UCLA) transplant center. Additional details of the YPT study design and procedures can be found elsewhere (Waterman et al., 2014). All study procedures were approved by the Institutional Review Boards at the University of California, Los Angeles Medical Center and at the University of Rhode Island.

Participant Recruitment

The YPT trial sample was recruited from a database of patients who had scheduled a kidney transplant evaluation at the UCLA Kidney and Pancreas Transplant Program. Patients were eligible to be included if they were over the age of 18, English speaking, self-identified as White, Black, and/or Latino, and had not been previously determined ineligible for transplant.

Your Path to Transplant Trial Sample

The complete YPT trial sample consisted of 815 patients with end-stage renal failure (N = 815). The sample was 60.7% male (n = 495) and reported an average age of 52.46 years (SD = 13.17), with a range of 18 to 85 years. This diverse sample included 39.1% Latino/a patients (n = 319), 34.8% White patients (n = 284), and 24.8% Black/African American patients (n = 202). Among Latino/a patients, the majority were Mexican American (73.5%, n = 234). Most participants had completed a high school education level or beyond (90.8%, n = 715). Seventy percent of the sample were undergoing dialysis (n = 569). Most were diagnosed with a preexisting condition, in which hypertension was reported in 82.6% of the sample (n = 673) and type II diabetes reported in 43.7% (n = 356).

Measures

Demographic and health status variables were collected during the baseline survey. The demographic variables of interest for this study included race/ethnicity, gender, and age. Health variables of interest included dialysis status and previous diagnoses of hypertension and type II diabetes.

Stage of Change. Readiness for pursuing LDKT was measured across four Stages of Change (Waterman et al., 2015). The *Stage of Change* measure is detailed in full in Measure 1 of the Appendix, page 92. Those in Precontemplation (PC) did not intend to take actions for pursuing LDKT in the next six months. Those in Contemplation (C) were considering taking actions for pursuing LDKT in the next six months. Those in Preparation (PR) were preparing to take actions in the next 30 days. Those in Action were currently engaged in pursuit of LDKT. Maintenance was not included in the staging algorithm as it involved transplant receipt. Results of validation testing revealed that Stages were differentiated by the amount of LDKT steps completed, and individuals in Action reported engagement in significantly more LDKT steps compared to Pre-Action Stages (Waterman et al., 2015).

Pros/Cons of Living Donation. A two-factor, twelve item scale was used to measure Decisional Balance. The scale items were oriented towards the health benefits and interpersonal challenges surrounding living donation (Waterman et al., 2015). The *Pros/Cons of Living Donation* measure is detailed in full in Measure 2 of the Appendix, page 93. This scale included six items for the Pros of pursuing LDKT and six for Cons. The importance of a statement towards an individual's decision to pursue LDKT was rated from *not important* (1) to *extremely important* (5). Previous validation testing

revealed a two-factor correlated model when tested across two samples of patients with end-stage renal disease (r = 0.25; Pros: a = 0.78, 0.86; Cons: a = .77, 0.80) (Waterman et al., 2015). For each construct, items were summed and analyzed as scaled variables that ranged from six to 30.

Situational Self-Efficacy. Self-Efficacy was measured as participants' confidence in their ability to pursue LDKT even when faced with difficult situations, such as 'a potential living donor who was evaluated did not match you,' (Waterman et al., 2015). The *Situational Self-Efficacy* measure is detailed in full in Measure 3 of the Appendix, page 94. Six items were rated from *not at all confident* (1) to *completely confident* (5). Previous validation testing revealed strong internal consistency across two samples in this adapted scale (a = 0.88, 0.90) (Waterman et al., 2015). Self-Efficacy items were summed to create a single scaled variable that ranged from six to 30.

Small Steps to Pursue LDKT. This eight-item measure evaluated patient engagement in behaviors that are commonly involved in the process of pursuing LDKT, such as asking potential donors to be tested. The *Small Steps to Pursue LDKT* measure is included in Measure 4 of the Appendix, page 94. Response choices included *already done this*, *are planning to do this*, or *don't plan to do this or don't know*. For the purposes of this study, the eight variables were examined as binary categorical variables organized as *not completed* (0) or *completed* (1). Results from measure development research showed that patients in Action had completed significantly more steps for pursuing LDKT than those in earlier Stages (Waterman et al., 2015). Further, previous cross-sectional findings revealed that engagement in specific LDKT behaviors, such as

sharing a need for LDKT with a larger community, differentiated those in Action for pursuing LDKT versus a Pre-Action Stage (Waterman et al., 2015).

Sample Selection and Grouping Methods for Study Objectives

Objective 1: Decision-Making in Stage Transition Groups

Sample. This combined analysis included participants from both intervention and control groups. Participants included in Stage transition groupings had completed the baseline timepoint and at least one later timepoint (four-months or eight-months). Across the entire sample, a selection of 584 participants met the selection criteria and were included for analysis ($N = 584$). This method allowed for a larger sample size as participation in the YPT trial varied across timepoints. While all 815 YPT trial participants completed the baseline timepoint, 70.1% completed the four-month timepoint ($n = 571$) and 52.6% completed the eight-month timepoint ($n = 429$).

Across the sample of 534 participants, 61% were male ($n = 356$) and the average age was 51.8 years (SD = 13.02), which ranged from 18 to 83 years. The sample was 40.6% Latino/a ($n = 237$), 33.2% White ($n = 194$), and 24.5% Black ($n = 143$). Most participants reported an education level of high school education or beyond (90.7%, $n = 530$). Sixty-seven percent of the sample were undergoing dialysis ($n = 391$). Hypertension was reported in 84.8% of the sample ($n = 495$) and type II diabetes in 43.5% ($n = 254$).

Grouping Procedure. Participants ($N = 534$) were grouped by trajectory of Stage movement from an earlier to later timepoint, such as movement from Precontemplation to Contemplation. Stage transitions were identified across two

timepoint windows: Stage of Change from the baseline to four-month timepoints (BL-4M) and from the four-month to eight-month timepoints (4M-8M). Groups included all instances of the given Stage movement that occurred during *either* timepoint window, which was a method employed to increase sample size. Selected cases of the given Stage transition across the BL-4M and 4M-8M timepoint windows were combined and data were examined as 'earlier' or 'later' measures of Decisional Balance and Self-Efficacy.

Participants who completed all three timepoints (71.2%, n = 416) were included in two Stage movement groups and were examined as two separate instances. To minimize bias and address dependency in the data, no comparison tests were conducted across groups. In addition, instances in which participants were included in a Stable group twice or included in separate groups of the same direction were clearly documented.

Three directions of Stage transitions were examined, organized as Forward, Stable, or Backwards movement. Forward movement involved movement from an earlier to later Stage during either of the two timepoint windows. Stable movement involved instances in which Stage remained the same across two timepoints. Backwards movement involved movement from a later to an earlier Stage during either timepoint window, such as movement from Action to Preparation. While it is less common for TTM research to examine Stable or Backwards directions of Stage movement, it was necessary to include all directions to accurately describe the sample. Across 584 participants, 19.5% remained in Action across all three timepoints (n = 114), and 35.3% regressed to an earlier Stage over the course of the trial (n = 206).

A total of 14 Stage transition groups were included for analysis: five Forward groups, three Stable groups, and six Backwards groups. Groups with less than 15 participants were excluded from analysis, which was chosen as an intermediate sample cutoff between 10 and 20. Ellis (2010) demonstrated the relationship between sample size and statistical power to detect an effect, in which moderate effects can be detected in samples less than 20, while only large effects can be detected in samples less than 10. In consideration of statistical power, two groups were excluded from analysis due to a low likelihood that effects would be detected (PC-PR, PR-PR). Stage movement groups are presented by direction of Stage movement in Table 1.

Table 1. Groups of Forward, Stable, and Backwards Stage Movements

Direction of Movement	**Earlier Stage**	**Later Stage**	**Group Notation**
Forward	PC	C	PC-C
	PC	A	PC-A
	C	PR	C-PR
	C	A	C-A
	PR	A	PR-A
Stable	PC	PC	PC-PC
	C	C	C-C
	A	A	A-A
Backwards	C	PC	C-PC
	PR	PC	PR-PC
	A	PC	A-PC
	PR	C	PR-C
	A	C	A-C
	A	PR	A-PR

Forward Stage Movement. A total of 211 instances of Forward Stage movement were detected across five groups: Precontemplation to Contemplation (PC-C), Precontemplation to Action (PC-A), Contemplation to Preparation (C-PR), Contemplation to Action (C-A), and Preparation to Action (PR-A). The group Precontemplation to Preparation was excluded from analysis due to a low sample size (8 instances). Participants had the potential to be placed in two Forward groups if Stage continued to advance across the three timepoints. Four participants were included in two separate Forward movement groups, for a total of eight instances of dependent data. In Table 2, group sample sizes were reported as instances rather than *n*, and percentages demonstrated the group's size in relation to other Forward movement groups.

Table 2. Sample Sizes of Forward Movement Groups

Group	Instances	% of Total
PC-C	21	10%
PC-A	18	8.5%
C-PR	19	9%
C-A	74	35.1%
PR-A	79	37.4%
Total	211	100%

Note: Four participants were included in two Forward groups: PC-C, PR-A ($n = 1$); C-PR, PR-A ($n = 3$).

Stable Stage Movement. Stable groups included instances in which participants remained in the same Stage for at least two timepoints. A total of 534 instances were detected across three Stable Stage movement groups: Stable Precontemplation (PC-PC), Stable Contemplation (C-C), and Stable Action (A-A). The Stable Preparation group was excluded from analysis due to low sample size (11 instances). Stable groups included the greatest amount of dependency in the data as participants could be included twice within one group if the same Stage was reported across the timepoints. Most instances involved Stable Action, in which Action was reported for all three timepoints (n = 114, 228 instances). This grouping method allowed for consistency across all directional groups and helped to increase sample size.

In Table 3, the sample size for each Stable Stage movement group was reported by timepoint window and in total to clarify incidents of Stable Action. Sample sizes were also reported in relation to the size of other Stable groups, displayed per group as the percentage of total instances.

Table 3. Sample Sizes of Stable Stage Movement Groups

Instances	**Stage Movement Group**			**Total**
	PC-PC	**C-C**	**A-A**	
Instances BL-4M	38	53	193	
Instances 4M-8M	43	30	177	
Total Instances	81	83	370	534
% of Total Instances	15.2%	15.5%	69.3%	100%

Note: Both timepoint windows include participants who remained in the same Stage through all timepoints: PC-PC (n = 22); C-C (n = 17); A-A (n = 114)

Backwards Stage Movement. Regression to an earlier Stage of Change was detected in 223 instances of Stage movement across six groups of Backwards Stage movement: Contemplation to Precontemplation (C-PR), Preparation to Contemplation (PR-C), Preparation to Precontemplation (PR-PC), Action to Preparation (A-PR), Action to Contemplation (A-C), and Action to Precontemplation (A-PC). Participants were counted once within the same group. However, if Stage movement regressed across all three timepoints, participants had potential to be counted in separate Backwards movement groups. Seventeen participants (34 instances) were grouped into two separate Backwards movement groups.

Backwards Movement groups are summarized in Table 4, in which incidents represented the group sample size and percentages demonstrated the size of the group in relation to the other Backwards movement groups.

Table 4. Sample Sizes of Backwards Stage Movement Groups

Group	Instances	% of Total
C-PC	41	18.4%
PR-C	37	16.6%
PR-PC	15	6.7%
A-PR	46	20.6%
A-C	62	27.8%
A-PC	22	9.9%
Total	223	100%

Note: 17 participants were included in two 'Backwards' groups: PR-C, C-PR (n = 4); A-C, C-PC (n = 3); A-PR, PR-C (n = 7); A-PR, PR-PC (n = 3).

Sample Selection and Grouping Methods for Study Objectives

Objective 1: Decision-Making in Stage Transition Groups

The second study objective took an exploratory approach to the study of longitudinal TTM decision-making, in which three groups were organized to represent participants who had shown meaningful change in Pros, Cons, and Self-Efficacy from the baseline to four-month timepoint. Groups were organized among a combined selection of participants in intervention and control groups who had completed both baseline and four-month timepoints ($N = 571$).

Grouping Method. Decisional Balance and Self-Efficacy are intermediate change processes understood to promote movement towards Action, demonstrated cross-sectionally as increased Pros, decreased Cons, and increased Self-Efficacy (Prochaska, 1994). Guided by cross-sectional models, three groups reflective of increased readiness for change were categorized as *Increased Pros*, *Decreased Cons*, and *Increased Confidence*. To quantify meaningful amounts of change, methods consistent with TTM expert systems were used to identify cutoff scores for each variable. Cutoff scores were calculated as 40% of the baseline standard deviation of Pros, Cons, and Self-Efficacy ($N = 815$). Groups consisted of participants who demonstrated change that was equal to or greater than the construct's cutoff score. Baseline descriptives and cutoff scores for each construct are presented in Table 5.

Table 5. Cutoff Scores for the *Increased Pros*, *Decreased Cons*, and *Increased Confidence* Construct Groups

Construct	Baseline Timepoint		Cutoff Score	Grouping Formula
	Mean	SD		
Pros	25.61	4.89	1.96	4M Pros >= (1.96 + BL Pros)
Cons	18.32	6.21	2.48	4M Cons <= (BL Cons - 2.48)
SE	21.12	6.65	2.66	4M Conf >= (2.66 + BL Conf)

*Baseline mean and SD was calculated using the YPT baseline sample (N = 815). Cutoff scores were calculated as 40% of the construct's baseline standard deviation.

To examine whether "levels" of change provide further insight into longitudinal processes, each construct group was further divided into five discrete levels of change, grouped by those who demonstrated change 0.4, 0.8, 1.2, 1.6., and 2.0 standard deviations above or below the baseline mean. For each of the five levels of change, formulas, cutoff scores, frequencies, and average change are reported for the *Increased Pros* group in Table 6, *Decreased Cons* group in Table 7, and *Increased Confidence* group in Table 8.

Table 6. Cutoff Score Calculations and Frequencies of Five Levels of Change in the *Increased Pros* Group (*N* = 224)

Level of Change	Cutoff Score	Grouping Formula	*n*	Increase in Scores	
				Mean	SD
0.4 SD	1.96	4M Pros < (3.92 + BL Pros)	89	2.40 points	0.49
0.8 SD	3.92	4M Pros >= (3.92 + BL Pros) & 4M Pros < (5.88 + BL Pros)	60	4.32 points	0.47
1.2 SD	5.88	4M Pros >= (5.88 + BL Pros) & 4M Pros < (7.84 + BL Pros)	34	6.29 points	0.46
1.6 SD	7.84	4M Pros >= (7.84 + BL Pros) & 4M Pros < (9.80 + BL Pros)	18	8.50 points	0.51
2.0 SD	9.80	4M Pros >= (9.80 + BL Pros)	23	13.65 points	4.21

Table 7. Cutoff Score Calculations and Frequencies of Five Levels of Change in the *Decreased Cons* Group (*N* = 204)

Level of Change	Cutoff Score	Grouping Formula	*n*	Decrease in Scores	
				Mean	SD
0.4 SD	2.48	4M Cons > (Cons – 4.97)	54	-3.56 points	0.49
0.8 SD	4.97	4M Cons <= (BL Cons - 4.97) & 4M Cons > (BL Cons - 7.45)	61	-5.80 points	0.47
1.2 SD	7.45	4M Cons <= (BL Cons – 7.45) & 4M Cons > (BL Cons – 9.94)	35	-8.34 points	0.46
1.6 SD	9.94	4M Cons <= (BL Cons – 9.94) & 4M Cons > (BL Cons – 12.42)	27	-10.96 points	0.51
2.0 SD	12.42	4M Cons <= (BL Cons – 12.42)	27	-16.30 points	4.21

Table 8. Cutoff Score Calculations and Frequencies of Five Levels of Change in the *Increased Confidence* Group (*N* = 216)

Level of Change	Cutoff Score	Grouping Formula	*n*	Increase in Scores	
				Mean	SD
0.4 SD	2.66	4M Conf < (5.32 + BL Conf)	88	3.93 points	0.78
0.8 SD	5.32	4M Conf >= (5.32 + BL Conf) & 4M Conf < (7.98 + BL Conf)	39	6.36 points	0.49
1.2 SD	7.98	4M Conf >= (7.98 + BL Conf) & 4M Conf < (10.64 + BL Conf)	36	8.83 points	0.88
1.6 SD	10.64	4M Conf >= (10.64 + BL Conf) & 4M Conf < (13.30 + BL Conf)	27	12.04 points	0.71
2.0 SD	13.30	4M Conf >= (13.30 + BL Conf)	26	17.39 points	3.02

Sample Characteristics of Construct Groups. Demographic information was examined among the three groups of change in Decisional Balance and Self-Efficacy. The *Increased Pros* group included a sample of 224 kidney patients (*n* = 224). The sample was 62.9% male (*n* = 141), with a racial-ethnic distribution of 41.1% Latino/a individuals (*n* = 92), 33% White (*n* = 74), and 24.6% Black (*n* = 55). Age ranged from 19 to 83 years, with a mean of 52.31 years (*SD* = 13.02). Sixty-four percent of the sample was undergoing dialysis (*n* = 144), and reported pre-existing conditions including type II diabetes (46.4%, *n* = 104) and hypertension (82.1%, *n* = 184).

Two hundred and four individuals were included in the *Decreased Cons* group (*n* = 204). This sample was 61.3% male (*n* = 125), with a distribution of race/ethnicity including 38.2% Latino/a (*n* = 78), 36.3% White (*n* = 74), and 23% Black (*n* = 47). The mean age was 52.40 years (*SD* = 12.43), which ranged from 20 to 83 years. Most of the

sample was undergoing dialysis (62.7%, *n* = 128), 44.6% were diagnosed with type II diabetes (*n* = 91), and 85.3% were diagnosed with hypertension (*n* = 174).

The *Increased Confidence* group included a sample of 216 kidney patients (*n* = 216), 58.3% of whom were male (*n* = 126). The average age of this group was 50.65 years (*SD* = 13.82), with a range of 18 to 83 years. The racial-ethnic distribution of the sample was 43.1% Latino/a (*n* = 93), 31.5% White (*n* = 68), and 24.5% Black (*n* = 53). Most participants were undergoing dialysis (68.5%, *n* = 148). Type II diabetes was reported in 40.7% of the sample (*n* = 88) and hypertension in 88% (*n* = 190).

Objective 3: Behavioral Predictors of Movement to Action

Sample Characteristics. The predictive utility of LDKT steps were examined across among participants who were in a Pre-Action Stage (PC, C, or PR) at baseline and had completed the four-month timepoint. A total of 304 participants in Pre-Action at baseline were included for analysis (*N* = 304). The sample demographics included 62.8% males (*n* = 191), and a distribution of race/ethnicity of 38.2% Latino/a (*n* = 116), 34.2% White (*n* = 34.2%), and 26% Black (*n* = 79). Most individuals were currently receiving dialysis (69.1%, *n* = 210). Preexisting conditions were present in most participants; hypertension was reported in 84.9% of the sample (*n* = 258) and type II diabetes was reported in 48% (*n* = 146).

Statistical Analysis

Objective 1 Analyses

Descriptive statistics, preliminary analyses, and data management were conducted using IBM SPSS Statistics 26. Descriptive statistics were examined for demographic and health variables, which included frequencies for gender, race/ethnicity, hypertension, diabetes, and dialysis status, and the mean and standard deviation for age. Descriptive statistics were then conducted for Stage of Change, Decisional Balance (Pros, Cons), and Self-Efficacy for pursuing LDKT. For each timepoint (BL, 4M, and 8M), Stage distributions were examined, and means and standard deviations were calculated for Pros, Cons, and Self-Efficacy scores of the earlier and later timepoints.

Effect Size Calculations. Magnitudes of change in Pros, Cons, and Self-Efficacy from earlier to later timepoints were calculated using matched groups Hedges' *g* effect size estimates to account for the repeated measures design of this study. Matched groups Hedges' *g* measures the standardized difference between two dependent means, such as matched pairs or pre-post data (Hedges & Olkin, 1985; Borenstein, Cooper, Hedges, & Valentine, 2009). Hedges' *g* is a sample statistic commonly used in studies with small sample sizes ($n < 20$) and meta-analytic research (Hedges & Olkin, 1985). Hedges' *g* is designed to reduce the upward bias found when Cohen's *d*, which estimates the population parameter, is used to describe small sample sizes (Hedges & Olkin, 1985). Hedges' *g* effect sizes were interpreted as small (0.20), medium (0.50), and large (0.80) in accordance with guidelines by Cohen (1988).

Hedges' g effect sizes were calculated using the equations for matched group designs. The matched groups Hedges' g formula divides the difference between two scores by the standard deviation of the difference scores ($S_{Difference}$), rather than within group standard deviation used in independent groups. Hedges' g calculations involved preliminary analyses to calculate the mean and standard deviation of the difference scores and the Pearson's r correlation between earlier and later timepoints. The following formula was used to calculate all effect sizes:

$$\text{Hedges' g}_{matched\ groups} = \left(\frac{\overline{Y_1} - \overline{Y_2}}{S_{difference}}\right)\sqrt{2(1-r)} \times 1 - \left(\frac{3}{4\,df - 1}\right) \quad (1)$$

Where $\overline{Y_1}\ and\ \overline{Y_2}$ are the mean of the earlier and later measure, $S_{difference}$ is the standard deviation of the difference scores, r is the correlation between the earlier and later measure, and df is the number of matched pairs minus one.

The standard error of the effect size was calculated as below.

$$SE_g = \sqrt{S_g^2} \quad (2)$$

To calculate the variance of g, the following equation was used:

$$S_g^2 = J^2 \times S_d^2 \quad (3)$$

Where the variance of *g* is calculated with *J*, the correction term for Hedges' *g*:

$$J\,(df)\;=\;1-\left(\frac{3}{4\,df-1}\right) \tag{4}$$

The variance of Cohen's *d* was calculated was calculated, where *n* is the number of pairs in the group, *d* is the Cohen's *d* effect size, and *r* is the correlation between the two paired measures:

$$S_d^2=\left(\frac{1}{n}+\frac{d^2}{2n}\right)\times 2(1-r) \tag{5}$$

For each effect size, a 95% confidence interval was calculated with the formula reported by Turner and Bernard (2006).

$$95\%\;CI\Delta=\;\mathrm{g}\;\pm\;z_{1-a}(SE_g) \tag{6}$$

The alpha level was set to .05 and the corresponding z critical value, 1.96, was multiplied by the standard error of the effect size. For consistency across equations, standard error was calculated with the equation listed above rather than derived from Cohen's *d* (Turner & Bernard, 2006). Minimal difference was found when standard error was calculated with both formulas. Lastly, the resulting value was added and subtracted to the effect size to identify the upper and lower limits of the confidence interval.

Objective 2 Analyses

Preliminary analyses were conducted to describe the *Increased Pros*, *Decreased Cons*, and *Increased Confidence* groups. Analyses involved Stage distributions, frequencies, and descriptive statistics (means, standard deviations) of Decisional Balance and Self-Efficacy variables. Results were reported by timepoint, and each group contained six sets of analyses: the total group sample and five levels of change in the grouping variable.

Effect sizes were calculated to measure the magnitude of change from the baseline to four-month measurements of Pros, Cons, and Self-Efficacy. A total of 54 repeated-measures effect sizes were calculated, with 18 effect sizes calculated per group (full sample and five levels of change). Each effect size included calculations of the matched-pairs Hedges' *g* statistic, standard error of *g*, and 95% confidence interval, which are detailed above in Equations 1-6.

Objective 3 Analyses

Frequencies and descriptive statistics of demographic variables were computed for gender, race and ethnicity, age, level of education, and preexisting health conditions. Stage distributions and descriptive statistics for intermediate TTM variables (Pros, Cons, and Self-Efficacy) were calculated and reported for both the baseline and four-month timepoints of the sample. Descriptive statistics for the eight LDKT steps were examined for the baseline timepoint and were reported by Stage of Change (Pre-Action or Action) at four months.

Binary logistic regression was implemented to test whether the completion of eight LDKT steps at baseline significantly distinguished movement to Action versus a Pre-Action Stage during the baseline to four-month time window. The eight categorical independent variables were baseline measures of engagement in LDKT steps, detailed in the measure 'Small Steps to Pursue LDKT' (detailed in Measure 4, Appendix). Independent variables were coded as No=0, Yes=1. The dependent variable was binary Stage of Change (Pre-Action=0, Action=1) measured at the four-month timepoint.

Reported results of binary logistic regression included beta weights and the standard error of beta weights, Wald chi-squared statistics (χ^2), and p values for the eight independent variables. The model effect size was reported as average pseudo R^2, calculated as an average of Cox & Snell R^2 and Nagelkerke R^2 indices. The 95% confidence interval for pseudo R^2 was calculated through Daniel Soper's (2021) online R-square Confidence Interval Calculator (2021). The R^2 confidence interval equation was developed by Cohen, Cohen, West, and Aiken (2003) and the equation for the standard error of R^2 was developed by Olkin and Finn (1995). Odds ratios were reported with 95% confidence intervals for each covariate and described the magnitude to which engagement in an LDKT step variable predicted movement from Pre-Action to Action. Lastly, relationships between the eight categorical independent variables were examined across a series of chi-square tests.

Results

Objective 1: Decision-Making in Stage Transition Groups

Stage of Change Distributions

Participants who completed the baseline timepoint and at least one later timepoint were included in Objective 1 analyses (n = 584). Among retained participants, 71.2% completed all three timepoints (n = 416). Stage distributions of the Objective 1 sample are reported by timepoint in Table 9.

The baseline Stage distribution among Pre-Action groups showed 12.5% in Precontemplation, 23.5% in Contemplation, and 17.5% in Preparation. The largest portion of the sample was in Action at baseline (46.6%), which suggests that nearly half of retained participants were actively pursuing living donor kidney transplant at the onset of the study.

At the four-month timepoint, the Precontemplation group grew to 14%, the Contemplation group decreased to 20.4%, Preparation decreased to 9.9%, and Action grew to 53.4%. By the eight-month timepoint, 13.7% of participants were in Precontemplation, 14.9% were in Contemplation, 4.6% were in Preparation, and 40.2% were in Action.

Participants spent the least amount of time in Preparation, which decreased from 17.5% to 4.6% over the course of the study. Notably, fluctuations in Stage distributions over time indicated that some participants who reached Action did not remain in Action, from 53.4% in Action at four-months and 40.2% in Action at eight-months.

Table 9. Stage Distributions by Timepoint among Participants Grouped by Stage Transitions

Timepoint		Stage of Change				*n*
		PC	**C**	**PR**	**A**	
Baseline	%	12.5%	23.5%	17.5%	46.6%	584
	n	73	137	102	272	
Four Months	%	14.0%	20.4%	9.9%	53.4%	571
	n	82	119	58	312	
Eight Months	%	13.7%	14.9%	4.6%	40.2%	429
	n	80	87	27	235	

Frequencies of Forward, Stable, and Backwards Stage Transition Groups

Stage transitions were grouped by trajectories of Stage movement: Forward, Stable, or Backwards. For the remaining analyses, instances were used to describe the sample sizes of Stage transitions groups, as Stage transitions were counted across two timepoint windows (BL-4M and 4M-8M).

A total of 215 participants progressed to a later Stage over the course of the trial. Forward Stage movement included five Stage transition groups, which amounted to a total of 211 instances included for analysis. Frequencies of the five Forward Stage movement groups are presented by timepoint window and total instances in Table 10.

Table 10. Frequencies of Forward Stage Transitions

	PC-C	PC-A	C-PR	C-A	PR-A	Total
%	10%	8.5%	9%	35.1%	37.4%	100%
Instances BL-4M	14	12	13	47	60	
Instances 4M-8M	7	6	6	27	19	
Total Instances	21	18	19	74	79	211

- 4 participants were included in two Forward groups:
  PC-C and PR-A (1); C-PR and PR-A (3)

Stable Stage movement, in which a participant remained in the same Stage during two consecutive timepoints, occurred in 534 instances across 391 participants. Frequencies of the three Stable Stage movement groups are detailed in Table 11.

Across the Stable movement groups, 153 participants remained in the same Stage during both timepoint windows and were counted as two instances. Within the Stable groups, dependent data accounted for a substantial portion of the total instances of the group: 54.3% of Stable Precontemplation, 41% of Stable Contemplation, and 61.6% of Stable Action.

Table 11. Frequencies of Stable Stage Transitions

	PC-PC	C-C	A-A	Total
%	15.2%	15.5%	69.3%	100%
Instances BL-4M	38	53	193	
Instances 4M-8M	43	30	177	
Total Instances	81	83	370	534

Note: Timepoint windows included participants who remained in the same Stage through all timepoints: PC-PC (n = 22); C-C (n = 17); A-A (n = 114). Stable PR (PR-PR) was excluded from analysis due to low frequency (11 instances).

Backwards Stage movement trajectories were examined across six Stage transition groups. Frequencies of the groups by timepoint and total instances are presented in Table 12. The largest trajectory of Backwards movement involved movement out of Action, which encompassed 58.3% of 223 instances.

Table 12. Frequencies of Backwards Stage Transitions

	C-PC	PR-C	PR-PC	A-PR	A-C	A-PC	Total
%	18.4%	16.6%	6.7%	20.6%	27.8%	9.9%	100%
Instances BL-4M	21	21	10	30	31	13	
Instances 4M-8M	20	16	5	16	31	9	
Total	41	37	15	46	62	22	223

- 17 participants were counted in two groups:
  PR-C, C-PC (4); A-C, C-PC (3); A-PR, PR-PC (3); A-PR, PR-C (7)

Effect Size Estimates in Forward Stage Movement Groups

Forward Movement to Action. Movement from a Pre-Action Stage to Action was examined across three Stage transitions: PC-A, C-A, and PR-A, and results are summarized in Table 13. Movement from Precontemplation to Action involved the greatest progression in readiness among the Forward movement groups. PC-A (18 instances) demonstrated an increase of 0.41 SD in Pros, 95% CI [-0.05, 0.88], from earlier (M = 24.22, SD = 6.26) to later timepoints (M = 26.78, SD = 5.47). The Cons of pursuing LDKT decreased -1.11 SD, 95% CI [-1.77, -0.45], from earlier (M = 22.94, SD = 4.80) to later timepoints (M = 16.61, SD = 5.98). Self-Efficacy increased 0.74 SD, 95% CI [0.10, 1.37], from earlier (M = 20.50, SD = 8.18) to later timepoints (M = 25.61, SD = 4.10).

Movement from Contemplation to Action (74 instances) demonstrated increased Pros, decreased Cons, and increased Self-Efficacy. Pros were found to increase 0.22 SD, 95% CI [-0.04, 0.95], from earlier (M = 26.37, SD = 3.60) to later timepoints (M = 27.18, SD = 3.74). Cons decreased -0.46 SD, 95% CI [-0.66, 0.25]), from earlier (M = 19.20, SD = 6.48) to later timepoints (M = 16.32, SD = 6.09). To a lesser magnitude than Pros, Self-Efficacy increased 0.15 SD, 95% CI [-0.10, 0.40], from earlier (M = 21.66, SD = 5.52) to later timepoints (M = 22.55, SD = 6.14).

Movement from Preparation to Action (79 instances) also showed a pattern of increased Pros, decreased Cons, and increased Self-Efficacy. Pros were observed to increase 0.12 SD, 95% CI [-0.12, 0.36], from the earlier (M = 26.48, SD = 4.81) to later timepoints (M = 27.04, SD = 4.52). Cons were found to decrease -0.21 SD, 95% CI [-0.66, -0.25], from earlier (M = 17.13, SD = 5.84) to later timepoints (M = 15.86, SD =

6.10). Self-Efficacy was found to increase 0.89 SD, 95% CI [-0.09, 0.43], from earlier (*M* = 23.59, *SD* = 22.57) to later timepoints (*M* = 23.59, *SD* = 6.1).

Table 13. Descriptive Statistics, Effect Sizes, and Confidence Intervals of Forward Movement to Action

Stage Transition	Construct	Earlier		Later		Hedges' *g*	SE_g	95% CI	
		M	SD	M	SD			Lower	Upper
PC-A	Pros	24.22	6.26	26.78	5.47	0.41	0.24	-0.05	0.88
	Cons	22.94	4.80	16.61	5.98	-1.11	0.34	-1.77	-0.45
	SE	20.50	8.18	25.61	4.10	0.74	0.33	0.10	1.37
C-A	Pros	26.37	3.60	27.18	3.74	0.22	0.14	-0.04	0.49
	Cons	19.20	6.48	16.32	6.09	-0.45	0.10	-0.66	-0.25
	SE	21.66	5.52	22.55	6.14	0.15	0.13	-0.10	0.40
PR-A	Pros	26.48	4.81	27.04	4.52	0.12	0.12	-0.12	0.36
	Cons	17.13	5.84	15.86	6.10	-0.21	0.11	-0.42	-0.001
	SE	22.57	5.74	23.59	6.10	0.17	0.13	-0.08	0.43

Forward Movement to Pre-Action. Two groups, PC-C and C-PR, involved movement within Pre-Action Stages. Effect size findings for both groups are reported in detail in Table 14. Movement from Precontemplation to Contemplation included 21 instances, and Pros, Cons, and Self-Efficacy were found to increase over the four-month windows. Pros were found to increase 0.36 SD, 95% CI [-0.21, 0.94], from earlier (*M* = 22.29, *SD* = 7.12) to later timepoints (*M* = 24.67, *SD* = 5.31). Cons were found to increase 0.10 SD, 95% CI [-0.32, 0.53], from earlier (*M* = 24.22, *SD* = 5.0) to later timepoints (*M* = 19.95, *SD* = 0.10). Self-Efficacy was found to increase 0.11 SD, 95%

CI [-0.44, 0.66], from earlier (*M* = 18.52, *SD* = 7.69) to later timepoints (*M* = 19.33, *SD* = 6.37).

Among those who moved from Contemplation to Preparation (19 instances), attitudes and confidence were found to decrease over the four-month windows. Pros were found to decrease -0.07 SD (*g* = -0.07), 95% CI [-0.38, 0.24], from earlier (*M* = 26.95, *SD* = 3.54) to later timepoints (*M* = 26.68, *SD* = 3.89). Cons decreased -0.14 SD, *g* = -0.14, 95% CI [-0.43, 0.15], from earlier (*M* = 18.95, *SD* = 6.40) to later timepoints (*M* = 18.0, *SD* = 6.62). Self-Efficacy was found to decrease -0.20 SD, 95% CI [-0.76, 0.37], from earlier (*M* = 21.42, *SD* = 6.53) to later timepoints (*M* = 20.05, *SD* = 6.84).

Table 14. Descriptive Statistics, Effect Sizes, and Confidence Intervals of Forward Movement to Pre-Action

Stage Transition	Construct	Earlier		Later		Hedges' g	SE_g	95% CI	
		M	SD	M	SD			Lower	Upper
PC-C	Pros	22.29	7.12	24.67	5.31	0.36	0.29	-0.21	0.94
	Cons	19.43	5.0	19.95	4.67	0.10	0.22	-0.32	0.53
	SE	18.52	7.69	19.33	6.37	0.11	0.28	-0.44	0.66
C-PR	Pros	26.95	3.54	26.68	3.89	-0.07	0.16	-0.38	0.24
	Cons	18.95	6.40	18.0	6.62	-0.14	0.15	-0.43	0.15
	SE	21.42	6.53	20.05	6.84	-0.20	0.29	-0.76	0.37

Forward Movement to an Adjacent Stage. Effect size findings were further examined by movements to adjacent Stages of Change and movements to non-adjacent Stages, which involved movements to a Stage two or more Stages later. Results were presented in two tables, with effect sizes for the three groups of adjacent Stage movement (PC-C, C-PR, and PR-A) summarized in Table 15, and the two groups of non-adjacent Stage movement (PC-A, C-A) summarized in Table 16.

Table 15. Descriptive Statistics, Effect Sizes, and Confidence Intervals of Forward Movement to an Adjacent Stage

Stage Transition	Construct	Earlier		Later		Hedges' g	SE_g	95% CI	
		M	SD	M	SD			Lower	Upper
PC-C	Pros	22.29	7.12	24.67	5.31	0.36	0.29	-0.21	0.94
	Cons	19.43	5.0	19.95	4.67	0.10	0.22	-0.32	0.53
	SE	18.52	7.69	19.33	6.37	0.11	0.28	-0.44	0.66
C-PR	Pros	26.95	3.54	26.68	3.89	-0.07	0.16	-0.38	0.24
	Cons	18.95	6.40	18.0	6.62	-0.14	0.15	-0.43	0.15
	SE	21.42	6.53	20.05	6.84	-0.20	0.29	-0.76	0.37
PR-A	Pros	26.48	4.81	27.04	4.52	0.12	0.12	-0.12	0.36
	Cons	17.13	5.84	15.86	6.10	-0.21	0.11	-0.42	-0.01
	SE	22.57	5.74	23.59	6.10	0.17	0.13	-0.08	0.43

Table 16. Descriptive Statistics, Effect Sizes, and Confidence Intervals of Forward Movement 2+ Stages

Stage Transition	Construct	Earlier		Later		Hedges' g	SE_g	95% CI	
		M	SD	M	SD			Lower	Upper
PC-A	Pros	24.22	6.26	26.78	5.47	0.41	0.24	-0.05	0.88
	Cons	22.94	4.80	16.61	5.98	-1.11	0.34	-1.77	-0.45
	SE	20.50	8.18	25.61	4.10	0.74	0.33	0.10	1.37
C-A	Pros	26.37	3.60	27.18	3.74	0.22	0.14	-0.04	0.49
	Cons	19.20	6.48	16.32	6.09	-0.45	0.10	-0.66	-0.25
	SE	21.66	5.52	22.55	6.14	0.15	0.13	-0.10	0.40

Effect Size Estimates in Stable Stage Movement Groups

Stable movement was examined across three groups, Stable Precontemplation (PC-PC), Stable Contemplation (C-C), and Stable Action (A-A), all of which included participants who remained in the same Stage for two consecutive timepoints. Results are summarized in Table 17 below.

Stable Precontemplation (81 instances) showed a pattern of decreased Pros, decreased Cons, and increased Self-Efficacy. Pros were found to decrease -0.15 SD, 95% CI [-0.40, 0.09], from earlier (M = 22.05, SD = 7.43) to later timepoints (M = 20.78, SD = 8.81). A small decrease in Cons was detected of -0.05 SD, 95% CI [-0.31, 0.20]), from earlier (M = 20.63, SD = 6.68) to later timepoints (M = 20.26, SD = 7.03). Self-Efficacy was found to increase 0.10 SD, 95% CI [-0.12, 0.32], from earlier (M = 15.42, SD = 7.54) to later timepoints (M = 16.25, SD = 8.77).

Stable Contemplation included 83 instances and showed a general pattern of increased Pros and Cons and decreased Self-Efficacy. Pros were found to increase 0.12 SD, 95% CI [-0.12, 0.35], from earlier (M = 26.28, SD = 4.88) to later timepoints (M =

26.82, *SD* = 4.23). A small increase of 0.03 SD was detected in Cons, 95% CI [-0.18, 0.23], from earlier (*M* = 18.71, *SD* = 6.38) to later timepoints (*M* = 18.89, *SD* = 6.09). Self-Efficacy was found to decrease -0.15 SD, 95% CI [-0.41, 0.10], from earlier (*M* = 21.95, *SD* = 6.23) to later timepoints (*M* = 20.98, *SD* = 6.32).

Stable Action was the largest group across all Stage transition groups, with 370 instances detected across the sample. A general pattern reflected increased Pros, decreased Cons, and increased Self-Efficacy. Pros were found to increase 0.25 SD, 95% CI [0.14, 0.36], from earlier (*M* = 26.75, *SD* = 3.77) to later timepoints (*M* = 26.78, *SD* = 5.47). Cons were stable and were found to decrease -0.08 SD (*g* = -0.08), 95% CI [-0.18, 0.02], from earlier (*M* = 16.25, *SD* = 6.03) to later timepoints (*M* = 15.75, *SD* = 6.22). Self-Efficacy increased 0.11 SD, 95% CI [-0.01, 0.23] from earlier (*M* = 23.07, *SD* = 5.87) to later timepoints (*M* = 23.73, *SD* = 5.93).

Table 17. Descriptive Statistics, Effect Sizes, and Confidence Intervals of Stable Stage Movement Groups

Stage Transition	Construct	Earlier		Later		Hedges' g	SE_g	95% CI	
		M	SD	M	SD			Lower	Upper
PC-PC	Pros	22.05	7.43	20.78	8.81	-0.15	0.12	-0.40	0.09
	Cons	20.63	6.68	20.26	7.03	-0.05	0.13	-0.31	0.20
	SE	15.42	7.54	16.25	8.77	0.10	0.11	-0.12	0.32
C-C	Pros	26.28	4.88	26.82	4.23	0.12	0.12	-0.12	0.35
	Cons	18.71	6.38	18.89	6.09	0.03	0.10	-0.18	0.23
	SE	21.95	6.23	20.98	6.32	-0.15	0.13	-0.41	0.10
A-A	Pros	26.75	3.77	27.65	3.45	0.25	0.06	0.14	0.36
	Cons	16.25	6.03	15.75	6.22	-0.08	0.05	-0.18	0.02
	SE	23.07	5.87	23.73	5.93	0.11	0.06	-0.01	0.23

Effect Size Estimates in Backwards Stage Movement Groups

Participants who moved to an earlier Stage over either timepoint window (BL-4M and 4M-8M) were organized into six separate Backwards movement groups. Stage regression is less commonly examined in TTM research but were representative of Stage movements in the sample. Analyses were exploratory and results are interpreted without substantial findings from previous literature to compare with.

Movement from Action to an Earlier Stage of Change. Three Backwards movement groups represented movement out of Action (A-PC, A-C, A-PR). Results are summarized below in Table 18.

Movement from Action to Precontemplation (22 instances) involved the largest Stage movement among the Backwards movement groups. Generally, Pros decreased while Cons and Self-Efficacy increased. Pros decreased -0.12 SD, 95% CI [-0.65, 0.41], from earlier (M = 25.77, SD = 4.01) to later timepoints (M = 25.23, SD = 4.89). Cons were found to increase 0.39 SD, 95% CI [-0.07, 0.85], from earlier (M = 18.55, SD = 6.05) to later timepoints (M = 21.14, SD = 6.77). Self-Efficacy increased 0.21 SD, 95% CI [-0.38, 0.79], from earlier (M = 18.50, SD = 6.95) to later timepoints (M = 20.18, SD = 8.52).

Movement from Action to Contemplation (62 instances) showed a decisional pattern of stable Pros, decreased Cons, and stable Self-Efficacy. Pros were found to increase 0.01 SD, 95% CI [-0.23, 0.26], from earlier (M = 27.66, SD = 3.59) to later timepoints (M = 27.71, SD = 2.79). Cons were observed to decrease -0.24 SD, 95% CI [-0.52, 0.05], from earlier (M = 19.08, SD = 5.99) to later timepoints (M = 17.56, SD =

6.64). Self-Efficacy was stable with a change of 0.01 SD, 95% CI [-0.34, 0.44], from earlier (*M* = 22.32, *SD* = 6.04) to later timepoints (*M* = 22.40, *SD* = 6.99).

Movement from Action to Preparation (46 instances) showed the smallest amount of change in decisional variables across a four-month window, with all constructs showing small increases in scores over time. Pros were stable, with an observed increase of 0.02 SD, 95% CI [-0.32, 0.37], from earlier (*M* = 27.11, *SD* = 4.23) to later timepoints (*M* = 27.22, *SD* = 4.40). Cons increased 0.08 SD, 95% CI [-0.21, 0.38], from earlier (*M* = 17.50, *SD* = 6.26) to later timepoints (*M* = 18.04, *SD* = 6.56). Self-Efficacy increased 0.08 SD, 95% CI [-0.22, 0.37], from earlier (*M* = 23.42, *SD* = 5.78) to later timepoints (*M* = 23.89, *SD* = 6.04).

Table 18. Descriptive Statistics, Effect Sizes, and Confidence Intervals of Movement from Action to Pre-Action

Stage Transition	Construct	Earlier		Later		Hedges' g	SE_g	95% CI	
		M	SD	M	SD			Lower	Upper
A-PC	Pros	25.77	4.01	25.23	4.89	-0.12	0.27	-0.65	0.41
	Cons	18.55	6.05	21.14	6.77	0.39	0.24	-0.07	0.85
	SE	18.50	6.95	20.18	8.52	0.21	0.30	-0.38	0.79
A-C	Pros	27.66	3.59	27.71	2.79	0.01	0.12	-0.23	0.26
	Cons	19.08	5.99	17.56	6.64	-0.24	0.14	-0.52	0.05
	SE	22.32	6.04	22.40	6.99	0.01	0.12	-0.34	0.44
A-PR	Pros	27.11	4.23	27.22	4.40	0.02	0.18	-0.32	0.37
	Cons	17.50	6.26	18.04	6.56	0.08	0.15	-0.21	0.38
	SE	23.43	5.78	23.89	6.04	0.08	0.15	-0.22	0.37

Movement to an Earlier Adjacent Stage of Change. Three Backwards movement groups involved movement to an earlier adjacent Stage of Change (C-PR, PR-C, and A-PR). Results for C-PR and PR-C groups are summarized in the following paragraphs, while results for the A-PR group were previously reported on page 48. Results for the three groups of adjacent-Stage regressions are summarized on Table 19.

Movement from Contemplation to Precontemplation (41 instances) showed a general pattern of decreased Pros, increased Cons, and decreased Self-Efficacy. Pros were found to decrease 0.22 SD, 95% CI [-0.32, 0.23], from earlier (M = 25.24, SD = 4.18) to later timepoints (M = 25.02, SD = 5.07). Cons increased 0.18 SD, 95% CI [-0.10, 0.46], from earlier (M = 17.85, SD = 6.17) to later timepoints (M = 19.00, SD = 1.15). Self-Efficacy was found to decrease 0.42 SD, 95% CI [-0.76, -0.07], from earlier (M = 20.68, SD = 5.91) to later timepoints (M = 17.93, SD = 6.94).

Movement from Preparation to Contemplation (37 instances) revealed a pattern of decreased Pros, increased Cons, and stable Self-efficacy. Pros were observed to decrease 0.07 SD, 95% CI [-0.39, 0.27], from earlier (M = 26.16, SD = 5.09) to later timepoints (M = 25.81, SD = 5.33). Cons increased 0.07 SD, 95% CI [-0.23, 0.37], from earlier (M = 18.57, SD = 5.89) to later timepoints (M = 19.03, SD = 6.81). Self-Efficacy was stable, with an observed change of 0.03 SD, 95% CI [-0.37, 0.42], from earlier (M = 22.68, SD = 5.89) to later timepoints (M = 22.84, SD = 6.34).

Table 19. Descriptive Statistics, Effect Sizes, and Confidence Intervals of Movement to an Earlier Adjacent Stage

Stage Transition	Construct	Earlier		Later		Hedges' g	SE_g	95% CI	
		M	SD	M	SD			Lower	Upper
C-PC	Pros	25.24	4.18	25.02	5.07	-0.05	0.14	-0.32	0.23
	Cons	17.85	6.17	19.0	6.56	0.18	0.14	-0.10	0.46
	SE	20.68	5.91	17.93	6.94	-0.42	0.18	-0.76	-0.07
PR-C	Pros	26.16	5.09	25.81	5.33	-0.07	0.16	-0.39	0.27
	Cons	18.57	5.89	19.03	6.81	0.07	0.15	-0.23	0.37
	SE	22.68	5.89	22.84	6.34	0.03	0.20	-0.37	0.42
A-PR	Pros	27.11	4.23	27.22	4.40	0.02	0.18	-0.32	0.37
	Cons	17.50	6.26	18.04	6.56	0.08	0.15	-0.21	0.38
	SE	23.43	5.78	23.89	6.04	0.08	0.15	-0.22	0.37

Backwards Stage Movements Across Multiple Stages. Three groups involved backwards Stage movement that spanned two or more Stages: PR-PC, A-C, and A-PC. Results are summarized in Table 20. Results for the A-PC and A-C groups are reported above on page 48.

Movement from Preparation to Precontemplation (15 instances) revealed a decisional pattern of decreased Pros, decreased Cons, and stable Self-Efficacy. Pros were found to decrease -0.50 SD, 95% CI [-1.12, 0.12], from earlier (M = 26.2, SD = 4.0) to later timepoints (M = 22.93, SD = 7.5). A smaller decrease was detected in Cons, -0.10 SD, 95% CI [-0.55, 0.35], from earlier (M = 18.00, SD = 6.54) to later timepoints (M = 17.25, SD = 7.26). Self-Efficacy was stable, with a detected increase of 0.02 SD, 95% CI [-0.30, 0.33], from earlier (M = 20.40, SD = 8.75) to later timepoints (M = 20.53, SD = 7.66).

Table 20. Descriptive Statistics, Effect Sizes, and Confidence Intervals of 'Backwards' Movements of Two or More Stages

Stage Transition	Construct	Earlier		Later		Hedges' g	SE_g	95% CI	
		M	SD	M	SD			Lower	Upper
PR-PC	Pros	26.20	4.0	22.93	7.50	-0.50	0.32	-1.12	0.12
	Cons	18.0	6.54	17.27	7.26	-0.10	0.23	-0.55	0.35
	SE	20.4	8.75	20.53	7.66	0.02	0.16	-0.30	0.33
A-PC	Pros	25.77	4.01	25.23	4.89	-0.12	0.27	-0.65	0.41
	Cons	18.55	6.05	21.14	6.77	0.39	0.24	-0.07	0.85
	SE	18.50	6.95	20.18	8.52	0.21	0.30	-0.38	0.79
A-C	Pros	27.66	3.59	27.71	2.79	0.01	0.12	-0.23	0.26
	Cons	19.08	5.99	17.56	6.64	-0.24	0.14	-0.52	0.05
	SE	22.32	6.04	22.40	6.99	0.01	0.12	-0.34	0.44

Lastly, all effects for summarized by construct. Complete results for magnitudes of change in Pros are reported in Table 21, effect sizes for Cons are reported in Table 22, and effect sizes for Self-Efficacy are reported in Table 23.

Table 21. Effect Sizes and Confidence Intervals for Change in Pros across Three Directions of Stage Movement

Direction	**SOC Transition**	**Hedges' *g***	**SE$_g$**	**95% CI**	
				Lower	*Upper*
Forward	PC-C	0.36	0.29	-0.21	0.94
	PC-A	0.41	0.24	-0.05	0.88
	C-PR	-0.07	0.16	-0.38	0.24
	C-A	0.22	0.14	-0.04	0.49
	PR-A	0.12	0.12	-0.12	0.36
Stable	PC-PC	-0.15	0.12	-0.40	0.09
	C-C	0.12	0.12	-0.12	0.35
	A-A	0.25	0.06	0.14	0.36
Backwards	C-PC	-0.05	0.14	-0.32	0.23
	PR-PC	-0.50	0.32	-1.12	0.12
	A-PC	-0.12	0.27	-0.65	0.41
	PR-C	-0.07	0.17	-0.39	0.26
	A-C	0.01	0.12	-0.23	0.26
	A-PR	0.02	0.18	-0.32	0.37

Table 22. Effect Sizes and Confidence Intervals for Change in Cons across Three Directions of Stage Movement

Direction	SOC Transition	Hedges' *g*	SE_g	95% CI	
				Lower	*Upper*
Forward	PC-C	0.10	0.22	-0.32	0.53
	PC-A	-1.11	0.34	-1.77	-0.45
	C-PR	-0.14	0.15	-0.43	0.15
	C-A	-0.45	0.10	-0.66	-0.25
	PR-A	-0.21	0.11	-0.42	-0.001
Stable	PC-PC	-0.05	0.13	-0.31	0.20
	C-C	0.03	0.10	-0.18	0.23
	A-A	-0.08	0.05	-0.18	0.02
Backwards	C-PC	0.18	0.14	-0.10	0.46
	PR-PC	-0.10	0.23	-0.55	0.35
	A-PC	0.39	0.24	-0.07	0.85
	PR-C	0.11	0.15	-0.19	0.41
	A-C	-0.24	0.14	-0.52	0.05
	A-PR	0.08	0.15	-0.21	0.38

Table 23. Effect Sizes and Confidence Intervals for Change in Self-Efficacy across Three Directions of Stage Movement

Direction	SOC Transition	Hedges' *g*	SE_g	95% CI	
				Lower	*Upper*
Forward	PC-C	0.11	0.28	-0.44	0.66
	PC-A	0.74	0.33	0.10	1.37
	C-PR	-0.20	0.29	-0.76	0.37
	C-A	0.15	0.13	-0.10	0.40
	PR-A	0.17	0.13	-0.08	0.43
Stable	PC-PC	0.10	0.11	-0.12	0.32
	C-C	-0.15	0.13	-0.41	0.10
	A-A	0.11	0.06	-0.01	0.23
Backwards	C-PC	-0.42	0.18	-0.76	-0.07
	PR-PC	0.02	0.16	-0.30	0.33
	A-PC	0.21	0.30	-0.38	0.79
	PR-C	0.05	0.20	-0.34	0.44
	A-C	0.01	0.12	-0.34	0.44
	A-PR	0.08	0.15	-0.22	0.37

Objective 2: Decision-Making in Construct Groups

In the second objective of the present study, magnitude of change in Decisional Balance and Self-Efficacy from the baseline to four-month timepoints were examined among groups of change in intermediate TTM constructs: *Increased Pros*, *Decreased Cons*, and *Increased Confidence*. To examine whether decision-making varied by the amount of change in one construct, effects were further examined across five levels of change within each group.

Increased Pros Groups

A total of 224 participants demonstrated a meaningful increase in Pros from the baseline to four-month timepoints ($N = 224$). The *Increased Pros* group reported a mean Pros score of 22.64 ($SD = 4.65$) at baseline and mean of 27.79 ($SD = 3.09$) at four-months.

Stage distributions for the *Increased Pros* group showed the greatest proportions in Action, with 46% in Action at baseline ($n = 103$) and 58.9% in Action at four-months ($n = 132$). Stage distributions for the *Increased Pros* group and five levels of change are reported at baseline in Table 24 and at the four-month timepoint in Table 25.

When Stage transitions were examined, the total *Increased Pros* sample involved 39.4% forward Stage movement, 50.4% stable movement, and 20.1% backwards Stage movement from baseline to four-months. The total sample included 34.8% in Stable Action and was the most frequent Stage transition within each level of change. Across the five levels, Stable Action was represented in 37.1% of Level 1, 30% of Level 2, 38.2% of Level 3, 44.4% of Level 4, and 26.1% of Level 5.

Table 24. Baseline Stage Distributions of the *Increased Pros* Groups

Change Level	SD Increase	Sample Size (*n*)	Stage of Change at Baseline			
			PC	*C*	*PR*	*A*
1	0.4 SD	89	9%	24.7%	18%	48.3%
2	0.8 SD	60	18.3%	25%	15%	41.7%
3	1.2 SD	34	0%	29.4%	23.5%	47.1%
4	1.6 SD	18	22.2%	11.1%	11.1%	55.6%
5	2.0 SD	23	30.4%	21.7%	8.7%	39.1%
	Total	224	13.4%	24.1%	16.5%	46%

Table 25. Four-Month Stage Distributions of the *Increased Pros* Groups

Level of Change	SD Increase	Sample Size (*n*)	Stage of Change at Four Months			
			PC	*C*	*PR*	*A*
1	0.4 SD	89	14.6%	18%	9%	58.4%
2	0.8 SD	60	16.7%	15%	10%	58.3%
3	1.2 SD	34	5.9%	20.6%	2.9%	70.6%
4	1.6 SD	18	22.2%	11.1%	11.1%	55.6%
5	2.0 SD	23	13%	26.1%	13%	47.8%
	Total	224	14.3%	17.9%	8.9%	58.9%

Eighteen effect sizes were calculated to determine the magnitude of change in Pros, Cons, and Self-Efficacy across the *Increased Pros* group and within the five levels of change. A large effect was detected in Pros, which increased 1.23 SD, 95% CI [1.07, 1.38]. Significant effects were also detected for change in Self-Efficacy, which increased 0.27 SD, 95% CI [0.12, 0.43]. Minimal change was detected in Cons, with a decrease of -0.05 SD, 95% CI [-0.19, 0.18].

Across the five levels of change, effect sizes for Pros ranged from +0.70 SD in the Level 1 group to +3.29 SD in the Level 5 group. No effects were detected for change in Cons across levels of *Increased Pros*, as confidence intervals suggested findings were non-significant. Two effects were detected for Self-Efficacy, 0.27 SD and 0.52 SD, which increased to a smaller magnitude than Pros. Descriptive statistics and effect sizes for the *Increased Pros* group are presented in Table 26.

Table 26. Descriptive Statistics, Effect Sizes, and Confidence Intervals of the *Increased Pros* Group and Five Levels of Change

Group	Construct	Baseline		4-Months		Hedges'	SE_g	95% CI	
		M	*SD*	*M*	*SD*	***g***		*Lower*	*Upper*
Full Sample (*n* = 224)									
	Pros	22.64	4.65	27.79	3.09	1.23	0.08	1.07	1.38
	Cons	17.21	6.04	16.88	6.29	-0.05	0.07	-0.19	0.08
	SE	19.92	6.46	21.70	6.56	0.27	0.08	0.12	0.43
Level 1 (*n* = 89)									
	Pros	25.04	3.41	27.45	3.38	0.70	0.02	0.67	0.73
	Cons	17.13	6.09	16.97	5.94	0.14	0.10	-0.29	0.24
	SE	20.24	6.67	20.90	2.27	0.10	0.11	-0.12	0.32
Level 2 (*n* = 60)									
	Pros	23.62	3.0	27.93	2.85	1.37	0.03	1.32	1.43
	Cons	17.60	5.68	16.50	6.73	-0.17	0.14	-0.44	0.10
	SE	19.58	6.33	22.87	6.12	0.52	0.16	0.21	0.83
Level 3 (*n* = 34)									
	Pros	21.91	3.26	28.21	3.12	1.84	0.04	1.76	1.91
	Cons	18.79	6.30	17.53	5.99	-0.20	0.13	-0.46	0.06
	SE	20.82	5.75	21.85	6.92	0.16	0.23	-0.29	0.61
Level 4 (*n* = 18)									
	Pros	19.28	2.74	27.78	2.65	2.97	0.10	2.77	3.17
	Cons	16.61	6.41	16.11	5.47	-0.08	0.24	-0.57	0.41
	SE	18.39	6.62	19.39	8.20	0.13	0.22	-0.30	0.55
Level 5 (*n* = 23)									
	Pros	14.48	4.62	28.13	2.88	3.29	0.55	2.21	4.37
	Cons	14.57	5.69	17.13	7.78	0.36	0.25	-0.12	0.84
	SE	19.39	7.02	23.35	6.45	0.57	0.29	-0.01	1.14

Note: Level 1 = 0.4 SD increase above mean Pros at baseline (*N* = 815), Level 2 = 0.8 SD, Level 3 = 1.2 SD, Level 4 = 1.6 SD, and Level 5 = 2.0 SD.

Decreased Cons Groups

A total of 204 participants demonstrated a substantial decrease in Cons scores from the baseline to four-month timepoints ($N = 204$). Stage distributions for the *Decreased Cons* group showed the greatest percentages in Action at both timepoints, with 49% in Action at baseline and 61.8% in Action at four-months. Across five levels of change, the percentage of the group in Action at baseline ranged from 40.7% to 53.7%, and the percentage in Action at four-months ranged from 48.6% to 72.1%.

From baseline to four-months, the *Decreased Cons* group included 29.4% forward Stage movements, 55.4% stable, and 15.2% backwards stage movements. Across five levels of change in Cons, Stable Action remained the most represented Stage transition, encompassing 40.7% of those in Level 1, 41% in Level 2, 34.3% in Level 3, 37% in Level 4, and 33.3% in Level 5.

Stage distributions for the *Decreased Cons* groups are reported for the baseline timepoint in Table 27 and for the four-month timepoint in Table 28.

Table 27. Baseline Stage Distributions of *Decreased Cons* Groups

Change Level	**SD Increase**	**Sample Size (*n*)**	**Stage of Change at Baseline**			
			PC	*C*	*PR*	*A*
1	0.4 SD	54	20.4%	20.4%	5.6%	53.7%
2	0.8 SD	61	11.5%	23%	16.4%	49.2%
3	1.2 SD	35	8.6%	34.3%	11.4%	45.7%
4	1.6 SD	27	11.1%	25.9%	22.2%	40.7%
5	2.0 SD	27	18.5%	18.5%	11.1%	51.9%
	Total	204	14.2%	24%	12.7%	49%

Table 28. Four-Month Stage Distributions of *Decreased Cons* Groups

Change Level	SD Increase	Sample Size (*n*)	Stage of Change at Four Months			
			PC	*C*	*PR*	*A*
1	0.4 SD	54	13%	18.5%	13%	55.6%
2	0.8 SD	61	3.3%	16.4%	8.2%	72.1%
3	1.2 SD	35	17.1%	28.6%	5.7%	48.6%
4	1.6 SD	27	11.1%	18.5%	7.4%	63%
5	2.0 SD	27	7.4%	22.2%	3.7%	66.7%
	Total	204	9.8%	20.1%	8.3%	61.8%

Results of effect size analyses among total group of *Decreased Cons* revealed a large negative effect for Cons, -1.57 SD, 95% CI [-1.75, -1.39], while minimal effects were detected for change in Pros, 0.06 SD, 95% CI [-0.09, 0.20], or change in Self-Efficacy, 0.13 SD, 95% CI [-0.03, 0.29]. When the group was divided among five levels of change, effects for Cons showed a linear increase from -0.75 SD to -4.96 SD. The Level 1 change group showed that a large decrease in Cons involved a small increase in Pros, 0.21 SD, and a small to moderate increase in Self-Efficacy, 0.40 SD. Effect size findings for the *Decreased Cons* group and the associated levels of change are found in Table 29.

Table 29. Descriptive Statistics, Effect Sizes, and Confidence Intervals of the *Decreased Cons* Group and Five Levels of Change.

Group	Construct	Baseline		4 Months		Hedges' *g*	SE_g	95% CI	
		M	*SD*	*M*	*SD*			*Lower*	*Upper*
Full Sample (*n* = 204)									
	Pros	26.26	4.37	26.53	5.18	0.06	0.08	-0.09	0.20
	Cons	21.38	5.03	13.67	4.77	-1.57	0.09	-1.75	-1.39
	SE	21.53	6.49	22.39	6.87	0.13	0.08	-0.03	0.29
Level 1 (*n* = 54)									
	Pros	26.15	4.43	27.09	4.26	0.21	0.11	0.004	0.42
	Cons	18.57	4.15	14.02	4.61	-0.75	0.02	-0.79	-0.72
	SE	20.98	6.44	23.39	5.56	0.40	0.14	0.12	0.66
Level 2 (*n* = 61)									
	Pros	25.87	4.09	26.90	3.88	0.23	0.13	-0.01	0.52
	Cons	20.62	5.04	14.82	5.15	-1.13	0.03	-1.17	-1.06
	SE	21.28	5.95	23.28	6.36	0.32	0.17	-0.03	0.66
Level 3 (*n* = 35)									
	Pros	26.46	3.97	25.09	6.83	-0.24	0.23	-0.69	0.21
	Cons	21.63	4.31	13.29	4.32	-1.89	0.03	-1.95	-1.83
	SE	21.51	6.19	21.60	6.27	0.01	0.19	-0.35	0.38
Level 4 (*n* = 27)									
	Pros	25.70	3.55	27.56	3.79	0.43	0.18	0.07	0.78
	Cons	23.52	4.03	12.56	3.96	-2.66	0.09	-2.83	-2.48
	SE	21.89	6.87	20.33	7.78	-0.20	0.19	-0.57	0.16
Level 5 (*n* = 27)									
	Pros	27.70	5.11	25.44	7.49	-0.33	0.18	-0.69	0.03
	Cons	26.26	3.10	9.96	3.28	-4.96	0.73	-6.39	-3.53
	SE	22.85	7.91	21.48	9.52	-0.15	0.20	-0.54	0.24

Note: Level 1 = 0.4 SD increase above mean Cons at baseline (*N* = 815), Level 2 = 0.8 SD, Level 3 = 1.2 SD, Level 4 = 1.6 SD, and Level 5 = 2.0 SD.

Increased Confidence Groups

A total of 216 participants were included in the *Increased Confidence* group (*N* = 216). These individuals demonstrated an increase in Self-Efficacy of 0.4+ SDs above the baseline mean, with a mean Self-Efficacy score of 17.44 (*SD* = 5.61) at baseline and a mean of 25.26 (*SD* = 4.59) at four-months. The largest proportions of the sample were in Action at both timepoints, with 49.1% in Action at baseline and 57.9% in Action at four-months. From baseline to four-months, the *Increased Confidence* group included 27.3% forward Stage movements, 52.3% stable, and 20.4% backwards stage movements. Across five levels of change in Self-Efficacy, Stable Action remained the most represented Stage transition, encompassing 39.8% of those in Level 1, 43.6% in Level 2, 36.1% in Level 3, 29.6% in Level 4, and 19.2% in Level 5.

Stage distributions for the *Increased Confidence* group and five levels of change are reported for the baseline timepoint in Table 30 and the four-month timepoint in Table 31.

Table 30. Stage Distributions of *Increased Confidence* Groups at Baseline

Change Level	**SD Increase**	**Sample Size (*n*)**	**Stage of Change at Baseline**			
			PC	*C*	*PR*	*A*
1	0.4 SD	88	8%	22.7%	14.8%	54.5%
2	0.8 SD	39	0%	15.4%	23.1%	61.5%
3	1.2 SD	36	16.7%	27.8%	16.7%	38.9%
4	1.6 SD	27	22.2%	22.2%	14.8%	40.7%
5	2.0 SD	26	30.8%	19.2%	15.4%	34.6%
	Total	216	12.5%	21.8%	16.7%	49.1%

Table 31. Stage Distribution of Increased Confidence Groups at Four-Months

Change Level	SD Increase	Sample Size (*n*)	Stage of Change at Four-Months			
			PC	*C*	*PR*	*A*
1	0.4 SD	88	11.4%	20.5%	10.2%	58%
2	0.8 SD	39	7.7%	23.1%	7.7%	61.5%
3	1.2 SD	36	11.1%	13.9%	5.6%	69.4%
4	1.6 SD	27	18.5%	22.2%	7.4%	51.9%
5	2.0 SD	26	19.2%	19.2%	19.2%	42.3%
	Total	216	12.5%	19.9%	9.7%	57.9%

Overall, effect size findings revealed a decisional profile of increased Pros, deceased Cons, and increased Self-Efficacy amongst those who showed meaningful change in Self-Efficacy scores. Results across the total group revealed that Self-Efficacy scores increased to a large magnitude of effect, 1.50 SD, 95% CI [1.33, 1.67], and Pros increased moderately, 0.37 SD, 95% CI [0.21, 0.53]. No significant effects were detected for Cons. When examined across five levels of change, effects for Self-Efficacy scores showed a linear increase that ranged from 0.77 SD to 6.30 SD. Effects for Pros were variable across the levels of change and were not found to be proportional to the magnitude of increase in Self-Efficacy. Significant effects for Pros were detected at Level 1 (0.29 SD, Level 3 (0.55 SD), and Level 4 (0.64 SD). Across the three levels, no significant effects were detected for change in Cons. Descriptive statistics and effect sizes for the *Increased Confidence* group are presented in Table 32.

Table 32. Descriptive Statistics, Effect Sizes, and Confidence Intervals of the *Increased Confidence* Group and Five Levels of Change.

Group	Construct	Baseline		4 Months		Hedges' *g*	SE_g	95% CI	
		M	*SD*	*M*	*SD*			*Lower*	*Upper*
Full Sample (*n* = 216)									
	Pros	25.38	5.17	27.13	4.22	0.37	0.08	0.21	0.53
	Cons	18.12	5.74	17.48	6.61	-0.10	0.06	-0.23	0.03
	SE	17.44	5.61	25.26	4.59	1.50	0.09	1.33	1.67
Level 1 (*n* = 88)									
	Pros	25.48	5.48	26.93	4.43	0.29	0.12	0.06	0.51
	Cons	18.06	5.69	17.35	6.65	-0.11	0.11	-0.32	0.10
	SE	20.51	5.10	24.44	5.03	0.77	0.02	0.73	0.80
Level 2 (*n* = 39)									
	Pros	26.62	3.18	27.64	3.12	0.33	0.17	-0.02	0.66
	Cons	18.72	5.76	19.21	6.10	0.08	0.14	-0.19	0.35
	SE	18.64	4.65	25.00	4.63	1.37	0.02	1.30	1.39
Level 3 (*n* = 36)									
	Pros	25.39	3.45	27.56	4.16	0.55	0.23	0.10	1.01
	Cons	18.28	5.74	17.58	6.48	-0.11	0.15	-0.40	0.18
	SE	16.19	4.35	25.03	4.20	1.99	0.06	1.88	2.11
Level 4 (*n* = 27)									
	Pros	22.93	7.0	26.81	3.94	0.64	0.23	0.18	1.09
	Cons	17.89	5.93	16.70	6.68	-0.18	0.17	-0.51	0.14
	SE	13.33	3.96	25.37	3.87	2.96	0.08	2.80	3.11
Level 5 (*n* = 26)									
	Pros	25.77	5.79	26.77	3.35	0.18	0.26	-0.33	0.69
	Cons	17.46	6.17	16.0	7.23	-0.21	0.19	-0.58	0.16
	SE	11.27	2.95	28.65	2.33	6.30	1.01	4.32	8.27

Note: Level 1 = 0.4 SD increase above mean Self-Efficacy at baseline (*N* = 815), Level 2 = 0.8 SD, Level 3 = 1.2 SD, Level 4 = 1.6 SD, and Level 5 = 2.0 SD.

Objective 3: Behavioral Predictors of Movement to Action

The final objective of the present study examined whether completion of common steps for pursuing LDKT differentiated movement to Action versus a Pre-Action Stage at four-months. Preliminary analyses included sample descriptives, Stage distributions, frequencies of completed of behavioral predictors at baseline, and relationships between LDKT steps. A logistic regression model was then tested to examine the predictive utility of eight LDKT steps in differentiating movement to Action vs. Pre-Action, and whether certain variables had greater predictive value.

Distributions of Stage of Change

The Stage distribution during the baseline timepoint showed 23.4% of the sample in Precontemplation (n = 71), 44.1% in Contemplation (n = 134), and 32.6% in Preparation stage (n = 99). By the four-month timepoint, the Stage distribution shifted to 22.7% in Precontemplation (n = 69), 28.9% in Contemplation (n = 88), 9% in Preparation (n = 28), and 39.1% in Action (n = 119). Stage distributions across the two timepoints suggest that the sample demonstrated forward Stage movement from baseline to four-months, and 39.1% of the sample moved from a Pre-Action Stage to the Action Stage. A summary of Stage distributions across both timepoints are reported in Table 33.

Table 33. Stage Distributions at Baseline and Four-Month Timepoints

Timepoint	Stage of Change			
	PC % (n)	**C** % (n)	**PR** % (n)	**A** % (n)
Baseline	23.4% (71)	44.1% (134)	32.6% (99)	0% (0)
4 Months	22.7% (69)	28.9% (88)	9.2% (28)	39.1% (119)

Descriptive statistics were calculated for baseline measures of intermediate TTM variables. At baseline, the sample showed a mean Pros of 25.10 (*SD* = 7.04), a mean Cons of 18.83 (*SD* = 6.17), and a mean Self-Efficacy of 20.39 (*SD* = 6.96). By four-months, Pros increased to a mean of 25.60 (*SD* = 6.06), Cons decreased to a mean of 17.88 (*SD* = 6.45), and Self-Efficacy increased to 21.17 (*SD* = 7.17). Descriptive statistics for Decisional Balance and Self-Efficacy at the baseline and four-month timepoints are summarized in Table 34. TTM descriptives are displayed by Stage of Change at baseline and four-month timepoints in Table 35.

Table 34. Descriptive Statistics for Decisional Balance and Self-Efficacy at the Baseline and Four-Month Timepoints

Construct	Timepoint			
	Baseline		**Four-Months**	
	M	*SD*	*M*	*SD*
Pros	25.10	5.37	25.60	6.06
Cons	18.83	6.17	17.88	6.45
SE	20.39	6.96	21.17	7.17

Table 35. Descriptive Statistics by Stage of Change at Baseline and Four-Month Timepoints (n = 304)

Timepoint	Stage of Change	Pros *M (SD)*	Cons *M (SD)*	Self-Efficacy *M (SD)*
Baseline	PC (n = 71)	22.56 (7.04)	20.70 (6.15)	16.27 (7.80)
	C (n = 134)	25.75 (4.20)	18.91 (6.24)	21.13 (6.03)
	PR (n = 99)	26.04 (4.85)	17.37 (5.76)	21.13 (6.03)
4 Months	PC (n = 69)	21.59 (8.18)	19.88 (6.63)	16.61 (7.86)
	C (n = 88)	26.17 (5.23)	18.48 (6.19)	21.27 (6.30)
	PR (n = 28)	27.11 (4.17)	18.61 (7.19)	21.43 (7.24)
	A (n = 119)	27.15 (4.35)	16.10 (5.99)	23.68 (6.04)

Frequencies were calculated for the status of completion at baseline across the eight LDKT steps. Results showed that nearly half of the sample, 49.3%, had completed zero steps for pursuing LDKT at the baseline timepoint (n = 150). At baseline, one LDKT step was completed among 13.8% of the sample (n = 42), two steps were completed in 8.9% of the sample (n = 27), three steps were completed in 12.5% of the sample (n = 38), and four or more steps were completed in 15.5% of the sample (n = 47). The most common LDKT step completed at baseline was ‘Generally talk to people you trust about whether to get a LDKT’, which was completed among 33.6% of the sample (n = 102). ‘Share my need for a living donor with a large community’ was least frequently completed, with 5.6% of the sample engaged in this behavior (n = 18). Frequencies of baseline engagement in eight steps commonly involved in the process of pursuing LDKT are summarized in Table 36.

Table 36. Frequencies of Engagement in LDKT steps at Baseline

LDKT Step	Completed at Baseline	
	Yes	*No*
'Read Information/watch videos about getting a LDKT'	25.3%	74.7%
'Share educational materials about living donation with people in your life'	23.4%	76.6%
'Generally talk to people you trust about whether to get a LDKT'	33.6%	66.4%
'Make a list of people who might be a living donor for you'	27.3%	72.7%
'Ask another person to tell others about your need for a LDKT'	15.8%	84.2%
'Ask potential donors to be tested'	13.8%	86.2%
'Give potential living donors the transplant center phone number'	7.6%	92.4%
'Share my need for a living donor with a large community'	5.9%	94.1%

Among participants who moved to the Action Stage by four-months (n = 119), 37.8% had not completed an LDKT step at baseline (n = 45), while 15.1% (n = 18) had completed one LDKT step, 8.4% (n = 10) had completed two steps, and 13.4% (n = 16) had completed three steps. The most frequently completed behavior among those who moved to the Action Stage was the step, 'Generally talk to people you trust about whether to get a LDKT,' (41.2%, n = 49), while 28.6% (n = 53) of those who completed this behavior transitioned to a Pre-Action Stage. The LDKT step, 'Make a list of people who might be a living donor for you,' was completed at baseline by 40.3% (n = 48) of participants who moved to Action. In Table 37, frequencies of engagement in the eight LDKT steps are reported for participants who moved to a Pre-Action Stage or to Action at four-months.

Table 37. Frequencies of Baseline Engagement in LDKT Steps across Stage Movements to Pre-Action and Action by Four-Months

LDKT Step	**Pre-Action at 4M** (*n* = 185) **Completed at BL**		**Action at 4M** (*n* = 119) **Completed at BL**	
	Yes	*No*	*Yes*	*No*
Read Information/watch videos about getting a (LDKT)	21.6% (*n* = 40)	78.4% (*n* = 145)	31.1% (*n* = 37)	68.9% (*n* = 82)
Share educational materials about living donation with people in your life	18.4% (*n* = 34)	81.6% (*n* = 151)	31.1% (*n* = 37)	68.9% (*n* = 82)
Generally talk to people you trust about whether to get a LDKT	28.6% (*n* = 53)	71.4% (*n* = 132)	41.2% (*n* = 49)	58.8% (*n* = 70)
Make a list of people who might be a living donor for you	18.9% (*n* = 35)	81.1% (*n* = 150)	40.3% (*n* = 48)	59.7% (*n* = 71)
Ask another person to tell others about your need for a LDKT	11.9% (*n* = 22)	88.1% (*n* = 163)	21.8% (*n* = 26)	78.2% (*n* = 93)
Ask potential donors to be tested	9.2% (*n* = 17)	90.8% (*n* = 168)	21% (*n* = 25)	79% (*n* = 94)
Give potential living donors the transplant center phone number	5.9% (*n* = 11)	94.1% (*n* = 174)	10.1% (*n* = 12)	89.9% (*n* = 107)
Share my need for a living donor with a large community	3.2% (*n* = 6)	96.8% (*n* = 179)	10.1% (*n* = 12)	89.9% (*n* = 107)

Relationships among Steps for Pursuing LDKT

A series of chi-square tests were conducted to examine relationships between the eight categorical LDKT steps. Relationships between LDKT steps indicated that all variables are significantly related. Relationships between LDKT steps are presented by chi-square test statistic and *p*-value in Table 38.

Table 38. Results of Chi-Square Tests of Relationships between Eight Steps to Pursue LDKT

	1	2	3	4	5	6	7
1							
2	126.04*						
3	85.80*	107.88*					
4	31.56*	39.35*	63.17*				
5	15.38*	19.21*	24.62*	49.33*			
6	34.47*	51.07*	31.36*	64.54*	49.07*		
7	31.05*	35.53*	26.86*	32.56*	19.21*	98.90*	
8	126.06*	20.05*	16.79*	24.56*	37.25*	15.07*	26.84*

** Indicates the Chi-square test statistic is significant at the p < .001 level.*

Note: Numbers represented the following LDKT steps:

1. Read information/watch videos about getting a living donor transplant.
2. Share education materials about living donation with people in your life.
3. Generally talk to people you trust about whether to get a living donor transplant.
4. Make a list of people who might be a living donor for you.
5. Ask another person to tell others about your need for a living donor transplant.
6. Ask potential donors to be tested.
7. Give potential living donors the transplant center phone number.
8. Share my need for a living donor with a large community.

Logistic Regression Model Testing

An eight-predictor logistic model was fitted to the data to examine whether movement from a Pre-Action Stage to Action four-months could be predicted by engagement in eight LDKT steps at baseline. Results of logistic regression analysis revealed an 8% improvement in predicting movement to Action when predicted by baseline engagement in LDKT steps. The model was statistically significant compared to a constant-only model, χ^2 (8) = 20.99, $p < .01$, which suggests that movement to Action was associated with baseline completion of LDKT steps. The average pseudo R^2 value was .08, 95% CI [0.02, 0.13], which indicated that completion of LDKT steps exhibited a small effect in differentiating movement to Action versus Pre-Action. The correct classification was 66.4%, with correct identification of Pre-Action in 86.5% of cases and Action in 35.3% of cases. Results for the full model are presented in Table 39, correct classifications in Table 40, log likelihood statistics in Table 41, and pseudo R^2 in Table 42.

When individual predictors were examined, one significant Wald statistic was detected, which suggests that 'Make a list of people who might be a living donor for you' was the only LDKT step that significantly contributed to Stage grouping (Wald χ^2 (1) = 6.20, $p < .05$). No significant Wald statistics were detected across the remaining LDKT step variables. Wald statistics for all predictor variables are presented in Table 43.

When odds ratios were examined, findings suggest that multiple behaviors promoted movement to Action. The odds of movement to Action were 2.27 times greater when individuals had made a list of potential donors, 2.03 times greater when a

need for LDKT was shared with a large community, 1.68 times greater when potential donors were asked to be tested, 1.35 times greater when educational materials were shared, and 1.04 times greater when others were informed of the need for a living donor. Odds ratios are summarized for all variables in Table 43.

Table 39. Logistic Regression Analysis of Movement to Action vs. Pre-Action Predicted by LDKT Steps Completed at Baseline – Full Model Results ($N = 304$)

Test	Wald X^2	*df*	*p*
Overall model evaluation Wald Test	20.986	8	.007
Goodness-of-fit test Hosmer & Lemeshow	5.216	4	.266

Table 40. Classification Results of Action versus Pre-Action in a Logistic Regression Model of Engagement in LDKT Steps

	Predicted		
Observed	*Pre-Action*	*Action*	**Percentage Correct**
Pre-Action	160	25	86.5%
Action	77	42	35.3%
Overall Percentage			66.4%

Table 41. Log Likelihood Statistics of the Logistic Regression Model

	-2 Log L	*df*	Significance
Intercept Only (*I*)	386.097		
Intercept + Covariates (*M*)	386.004		
$X^2 = (I - M)$	20.986	8	< .01 (.007)

Table 42. Pseudo R^2 Effect Size Indices

Cox & Snell R^2	Nagelkerke R^2	Average pseudo R^2 ES
.067	.09	.0785

Table 43. Logistic Regression Analysis of Movement to Action vs. Pre-Action Predicted by LDKT Steps Completed at Baseline (N = 304)

Behavioral Predictors	*B*	*SE B*	Wald X^2	*df*	*p*	*OR*	*95% CI OR*
Constant	-.803	.160	25.299	1	.000	.448	
1	-.02	.377	.003	1	.958	.980	[0.47, 2.05]
2	.301	.414	.53	1	.467	1.352	[0.60, 2.04]
3	-.056	.347	.026	1	.871	.945	[0.48, 1.86]
4	.82	.329	6.208	1	.013*	2.27	[1.19, 4.33]
5	.04	.387	.011	1	.917	1.041	[0.49, 2.22]
6	.516	.473	1.192	1	.275	1.675	[0.66, 4.23]
7	-.573	.577	.987	1	.320	.564	[0.18, 1.75]
8	.709	.579	1.501	1	.221	2.032	[0.65, 6.32]

Note: Numbers represented the following LDKT Steps:

1. Read information/watch videos about getting a living donor transplant.
2. Share education materials about living donation with people in your life.
3. Generally talk to people you trust about whether to get a living donor transplant.
4. Make a list of people who might be a living donor for you.
5. Ask another person to tell others about your need for a living donor transplant.
6. Ask potential donors to be tested.
7. Give potential living donors the transplant center phone number.
8. Share my need for a living donor with a large community.

Discussion

The evaluation of longitudinal TTM relationships can provide insight into which constructs are most important for successful health behavior change and the characteristics of individuals at different Stages of readiness for change. The present study primarily focused on effect size testing to better understand longitudinal mechanisms of change using a TTM model of decision-making for pursuing LDKT. Findings of the present study were interpreted within the context of the sample. The present sample of kidney patients had scheduled a transplant evaluation, which indicated that the sample was motivated for pursuing transplant.

A variety of methods were employed to demonstrate longitudinal change processes. Magnitudes of relationships were examined among Decisional Balance and Self-Efficacy across groups of Stage movements and attitudinal changes, and behavioral predictors of movement to Action were fitted to a logistic regression model. Insights from several findings of this study provide empirical support for the TTM and offers considerations for improving treatment adherence in healthcare settings.

Objective 1: Magnitudes of Effects among Stage Transition Groups

The first objective of this study measured change in Pros, Cons, and Self-Efficacy for pursuing LDKT within groups of Forward, Stable, and Backwards trajectories of Stage movement. Effect size estimates quantified the magnitude of change in TTM variables across four-month time periods.

Forward Movement

Forward Stage movement was examined across five Stage transition groups, and three predictions were made based on previous cross-sectional research: 1) The directions and magnitudes of change in Decisional Balance and Self-Efficacy were predicted to reveal larger increases in Pros and Self-Efficacy and smaller decreases in Cons, 2) Multiple Stage transitions were predicted to show larger effects than adjacent Stage movement, and 3) Greatest effects were predicted in movement from PC to C based on a cross-sectional model of baseline data (Mushkat, 2018).

Broadly, magnitudes of change in Pros, Cons, and Self-Efficacy across Forward Stage transition groups were found to vary in both size and direction of estimated effect sizes. Hedges *g* statistics for Pros ranged from -0.07 (C-PR) to 0.41 (PC-A), Cons ranged from -1.11 (PC-A) to 0.10 (PC-C), and Self-Efficacy ranged from -0.20 (C-PR) to 0.74 (PC-A).

Direction of Change in Intermediate Constructs. The fundamental understanding of behavior change within TTM research posits that readiness for change involves an increase in Pros of changing and Self-Efficacy to sustain change, and a decrease in the Cons of changing (DiClemente et al., 1991; Prochaska & Velicer, 1997; Prochaska et al., 1994). The present study predicted that similar patterns would emerge when examined longitudinally among groups of Forward Stage transitions (+Pros, -Cons, +SE). Findings suggest partial support for this hypothesis when the examined behavior change was decision-making for pursuing LDKT. Expected patterns of change were only observed in groups that moved to Action (PC-A, C-A, PR-A). Patterns of change were less consistent among groups who moved to a Pre-Action Stage, in which

all decisional variables increased in movement from PC to C (+Pros, +Cons, +SE) and all variables decreased in movement from PR to A (-Pros, -Cons, -SE).

Magnitudes of change in intermediate constructs. Cross-sectional TTM Stage comparison models across a wide variety of health behaviors have shown that from the earliest to latest Stage of Change, the Pros of changing are expected to increase 1.0 SD, the Cons of changing are expected to decrease -0.56 SD (Hall & Rossi, 2008; Prochaska et al., 1994). Cross-sectional Stage comparisons for LDKT decision-making showed that between Precontemplation to Action, Pros increased 0.92 and 0.85 SDs, Cons decreased -0.29 and -0.45 SDs, and Self-Efficacy increased 0.80 and 0.90 SDs (Waterman et al., 2015; Mushkat, 2018). Additionally, longitudinal change was predicted to show smaller effects in adjacent Stage movement and larger effects in movements across multiple Stages, consistent with findings from Velicer et al. (1999).

The present study hypothesized that similar magnitudes would be demonstrated longitudinally, with larger effects for Pros and Self-Efficacy and smaller effects for Cons. Forward Stage movement groups showed the largest and most consistent effects for the Cons of pursuing LDKT. Four out of the five Forward groups showed a decrease in Cons over time, with greatest magnitudes of change found in forward movements two or more Stages. The largest effect for Cons was detected in movement from PC to A (Hedges' g = -1.11), which is the maximum Stage movement studied. Moderate effects were found in movement from C to A (Hedges' g = -0.45). Smaller effects were shown in adjacent movement from PR to A (Hedges' g = -0.21). Movement from C to PR demonstrated the smallest change in Cons, however this effect may be unreliable as the confidence interval spanned zero (Hedges' g = -0.14).

Effect size findings for Self-Efficacy revealed a large effect in movement from PC to A (Hedges' $g = 0.74$). However, despite evidence that mean scores increased over time, all other effect sizes for change in Self-Efficacy were unreliable due to the presence of zero in the confidence interval. Across the five forward movement groups, no reliable effect sizes were detected for change in Pros, also indicated by confidence intervals that spanned zero.

Ceiling effects for Pros and Self-Efficacy inventories likely accounted for the present study's difficulty in detecting effects. It appears this phenomenon also occurred in the context of decision-making to pursue kidney transplant, particularly in Pros. The frequency in which the highest item value (30) was reported in the earlier and later measurements indicate the presence of ceiling effects among Forward groups that revealed no detectable effects in Pros or Self-Efficacy. This is best demonstrated in movement from PR to A. Maximum scores in Pros were reported in 43% of instances in the earlier timepoint and 46.8% in the later. Maximum scores in Self-Efficacy were reported in 17.7% of instances in the earlier timepoint and 22.8% in the later.

Within TTM research, individuals are known to endorse the Pros of behavior change more readily than the Cons (Prochaska, 2008). It is likely that ceiling effects for Pros, and possibly Self-Efficacy, are not specific to the current study of LDKT decision-making and may prevent the detection of longitudinal effects in other TTM areas of study. Alternately, this is an opportunity for future research to examine thresholds of change, where movement to a certain level of Decisional Balance would indicate readiness to engage in the behavior change.

Forward Movement to Non-Adjacent and Adjacent Stages. The present study predicted that transitions that spanned multiple Stages (2+) would show larger effect sizes for Decisional Balance and Self-Efficacy than movement to an adjacent Stage. Evidence in support of this hypothesis included effect sizes for the PC-A group and effects detected for Cons among groups that moved to Action (PC-A, C-A, and PR-A).

The greatest magnitudes of change in Cons and Self-efficacy from an earlier to later timepoint were detected in movement from PC to A. The PC-A group demonstrated the furthest Stage progression as decision-making shifted from the earliest Stage, with no intentions to pursue LDKT in the next six months, to the latest Stage, active pursuit of a LDKT. Among the 18 instances of movement from PC to A, large effects were detected for decreased Cons (Hedges g = -1.11) and increased Self-Efficacy (Hedges g = 0.74).

Further support for this hypothesis was demonstrated by the linear increase in effects for Cons across three Forward movement groups. A small effect was detected in adjacent Stage movement from PR to A (Hedges g = -0.21). A medium effect was detected in movement of two Stages from C to A (Hedges g = -0.45), and a large effect was detected in movement of three Stages from PC to A (Hedges g = -1.11).

Overall, Forward Stage movements revealed mixed support for the hypothesized effects. The first hypothesis was confirmed in Forward movements to Action, in which cross-sectional patterns of change from PC to A (+Pros, -Cons, +SE) were replicated longitudinally. Hypothesis two was partially confirmed in effect sizes for Cons in groups who moved to Action, in which smaller effects were observed in adjacent Stage

movement and effects increased proportionally in movements across multiples Stages. The third hypothesis was not confirmed; while Stage comparisons of baseline data indicated that largest construct differences occurred between PC and C, effects were not replicated in longitudinal analyses. The present study was likely underpowered to detect small effect sizes for change that occurred in adjacent Stage transitions, except for Cons in the PR-A group. This set of analyses provided preliminary longitudinal validation for cross-sectional models, particularly in movements to Action, and suggest that ceiling effects may present as a barrier in longitudinal effect size in other TTM contexts.

Stable Stage Movement

Stable Stage movement, in which an individual remained in the same Stage for two or more timepoints, was examined due a substantial portion of the YPT sample who remained in Action for the duration of the study. Three Stable Stage transition groups were examined (PC-PC, C-C, A-A), and two hypotheses were tested: 1) Stable Pre-Action groups were predicted to show small changes indicative of Stage progression in the future (+Pros, -Cons, +SE), and 2) Stable Action was predicted to show patterns of change indicative of continued readiness for pursuing LDKT.

Stable Pre-Action. Predictions for Pre-Action groups were unconfirmed in the present study. Stable Pre-Action groups (PC-PC, C-C) showed minimal change in their decision-making over time. Across the groups, no effects were detected for Decisional Balance or Self-Efficacy despite larger sample sizes relative to Forward movement groups (PC-PC = 81 instances; C-C = 83 instances). The direction of changes in Decisional Balance and Self-Efficacy for Stable PC (-Pros, -Cons, +SE) and Stable C

(+Pros, +Cons, -SE) were inconsistent with cross-sectional models. Patterns of change may reflect natural variability within a categorical variable as individuals remained in the same Stage over time. The Stages of Change are broad categories and members of a Stage are not expected to show identical characteristics. Each Stage of Change is expected to contain within-group variability, while continuous variables such as Decisional Balance and Self-Efficacy have greater sensitivity to detect change or variations in the data.

Stable Action. The Stable Action group was predicted to show changes in Decisional Balance and Self-Efficacy reflective of increased engagement in pursuing LDKT (+Pros, -Cons, +SE). Patterns of change in the Stable Action were consistent with the hypothesis, as Pros and Self-Efficacy increased, and Cons decreased. Findings within the Stable Action group revealed a detectable effect for the Pros of pursuing LDKT, which increased to a small magnitude over time (Hedges $g = 0.25$). This finding suggests that the Pros of pursuing LDKT continue to increase as kidney patients pursue transplant. Smaller effects were detected for Cons (Hedges $g = -0.08$) and Self-Efficacy (Hedges $g = 0.11$), however limited conclusions can be made as confidence intervals spanned zero.

Pursuit of kidney transplant is a continuous process as kidney patients seek a match for live donation. Movement to Action does not suggest that a patient found a match or received a transplant. The substantial portion of the sample who remained in Action across the study, yet showed ongoing change in decisional processes, indicates that the LDKT Staging algorithm for the Action Stage may be broader than Pre-Action Stages.

Backwards Stage Movement

Regression to an earlier Stage of Change, referred to as 'Backwards' Stage movement in the present study, is less commonly examined in TTM research. The present study examined backwards Stage movement as the sample frequently demonstrated movements to earlier Stages. Two study hypotheses were tested: 1) Backwards Stage movement was expected to show opposite decisional patterns than Forward movement (-Pros, +Cons, -SE), and 2) Greater effects were predicted in Stage transitions that spanned multiple Stages.

No effects were detected for change within groups of Backwards Stage movements, and both hypotheses were unconfirmed. No clear longitudinal relationships emerged as groups varied in the direction and magnitude of change in Decisional Balance and Self-Efficacy. Results suggest that regression to an earlier Stage may be less influenced by attitudes and confidence for pursuing LDKT.

Trajectories of change in intermediate variables revealed that Self-Efficacy increased for most groups despite movement to an earlier Stage, which suggests that a patient's confidence in their ability to pursue transplant was resilient to changes in attitudes about transplant. However, effect sizes for Decisional Balance were highly variable. No clear patterns emerged when examined by movement from a Pre-Action Stage or Action, or whether the movement was to an earlier adjacent Stage or spanned multiple Stages.

Summary of Objective 1 Findings

In summary, patterns of change in three directions of Stage movement groups demonstrated partial support for cross-sectional TTM models and highlighted important characteristics of transplant decision-making. Consistent with cross-sectional models, groups that moved to Action showed increased Pros, decreased Cons, and increased Self-Efficacy for pursuing LDKT. Further, effects were smallest in adjacent Stage movements and larger in transitions that spanned multiple Stages.

The Cons of pursuing LDKT appeared to be the strongest driver of movement to Action. In this TTM application, the Cons of pursuing LDKT were oriented towards health concerns regarding the living donor, and Pros were oriented towards health benefits of the recipient. Movement from PC to A showed a decrease in Cons more than double the size of cross-sectional models of LDKT decision-making, which suggests that cross-sectional models likely underestimate the amount of change that occurs longitudinally. Findings for Cons suggest that negative perceptions of the potential donor's wellbeing are an important point of intervention for increasing motivation to pursue LDK.

In Backwards Stage movement groups, the observed stability in Decisional Balance and Self-Efficacy suggests that progress in decision-making is not lost during Stage regression. Among Stable Action groups, positive perceptions of the Pros of LDKT continued to progress while patients were actively pursuing a live donation.

Objective 2: Magnitudes of Effect among Construct Change Groups

The second longitudinal approach employed in the present study examined groups formed by attitudinal changes rather than Stage transitions. Magnitudes of change in Decisional Balance and Self-Efficacy were examined among the *Increased Pros*, *Decreased Cons*, and *Increased Confidence* groups, each of which included participants who demonstrated meaningful change from the baseline to four-month timepoint (change greater than 0.4 SD of the baseline sample).

Increased Pros. The *Increased Pros* group was predicted to show larger effects for change in Self-Efficacy and smaller effects for change in Cons. Results showed moderate support for this prediction. Overall, the *Increased Pros* group showed a large effect for change in Pros (Hedges' $g = 1.23$) and a small effect for Self-Efficacy (Hedges' $g = 0.27$). No effects were detected for Cons, which showed minimal change. When five levels of change in Pros were examined, those who showed a large increase in Pros (Hedges' $g = 1.37$) showed a moderate increase in Self-Efficacy (Hedges' $g = 0.52$).

Decreased Cons. The *Decreased Cons* group was predicted to show large effect sizes for increased Pros and Self-Efficacy. Findings suggest modest support for this prediction. The full sample of *Decreased Cons* showed a large effect for Cons over a four-month timespan (Hedges' $g = -1.57$), however no effects in the total group were detected for Pros and Self-Efficacy. When examined across five levels of change,

individuals who showed a large decrease in the Cons of pursuing LDKT (Hedges' g = -0.75) showed a small increase in Pros (Hedges' g = 0.20) and a moderate increase in Self-Efficacy (Hedges' g = 0.40).

Increased Self-Efficacy. The *Increased Confidence* group was predicted to show larger effects for Pros and smaller effects for Cons. Across the *Increased Confidence* group, a large effect was found for Self-Efficacy (Hedges' g = 1.50) and a moderate effect was detected for Pros (Hedges' g = 0.37). No effects were detected for Cons, which showed a small decrease in mean scores between timepoints. While cross-sectional models demonstrate similar increases in Self-Efficacy and Pros across Stage groups, this pattern was not detected longitudinally when the sample was grouped by change in intermediate constructs. Across five levels of change in Self-Efficacy (Hedges' g = 0.77 – 6.30), effects for Pros increased to about half of the magnitude that Self-Efficacy increased.

Summary of Objective 2 Findings

The present study employed an exploratory grouping method that organized the sample by change in Decisional Balance or Self-Efficacy. This reduced reliance on Stage of Change, as many participants remained in Action across all timepoints. Attitudinal groups appeared to provide only modest clarification of longitudinal processes. For these three constructs, the grouping method appeared to isolate those who changed the most in the given variable, which did not necessarily elicit the expected relationships in the other variables. Within the context of kidney transplant

pursuit, grouping participants by increased confidence for pursuing LDKT showed Pros to increase to about half the magnitude of Self-Efficacy.

Objective 3: Behavioral Predictors of Movement to Action

Longitudinal relationships of transplant decision-making were investigated in a logistic regression model that tested behavioral predictors of movement to Action. It was hypothesized that baseline completion of LDKT steps would significantly predict movement to Action.

This hypothesis was confirmed, and the baseline completion of steps to pursue LDKT significantly differentiated those who moved to Action versus a Pre-Action Stage by the four-month timepoint. However, when all eight LDKT steps were fitted to the logistic regression model, the model did not appear to strongly predict movement to Action, evidenced by the percentage of correct classification (35%) and the Pseudo R^2 effect size (0.08). Rather, it appeared that certain behaviors predicted movement to Action while other behaviors were less related. The strongest predictor of movement to Action involved making a list of potential living donors, followed by sharing a need with a larger community, asking potential donors to be tested, sharing educational materials, and informing others of one's need for a living donor. Behaviors that were not found to significantly predict movement to Action included actions such as talking to trusted people about whether to get a LDKT, which was completed by 33.6% of the sample at baseline and by 28.6% of individuals who moved to a Pre-Action Stage.

Based on the present findings, it appears that significant behavioral predictors reflected current engagement in steps for pursuing LDKT, such as making a list of living donors or asking potential donors to get tested. Alternatively, non-significant predictors appeared to reflect earlier steps in decision-making, such as talking to trusted people about whether to pursue LDKT.

From a measure development standpoint, this poses an interesting perspective on the Staging algorithm for pursuing LDKT, where completion of LDKT steps may have served as a marker for Stage. While outside the scope of the present study, engagement in behaviors predictive of Action may have been completed by those in later Pre-Action Stages such as Preparation. Similarly, it would be valuable to assess whether the level of engagement in LDKT steps differed among individuals who were in Action Stage at baseline.

Comparison to Cross-Sectional Models of LDKT Decision-Making

Longitudinal analysis of change in transtheoretical model constructs, examined in the context of kidney transplant decision-making, demonstrated preliminary support for cross-sectional relationships between Decisional Balance, Self-Efficacy, and Stage of Change. Previously, two cross-sectional TTM models of LDKT decision-making revealed differences in Decisional Balance and Self-Efficacy across the Stages that were consistent with TTM models across a variety of behavior change contexts. Decisional Balance and Self-Efficacy for pursuing LDKT showed an increase of 0.85 – 0.92 SD in Pros, a decrease of 0.29 – 0.45 SD in Cons, and an increase of 0.80 – 0.90 SD in Self-Efficacy, while other behavior change models have reported an increase of 1.0 SD in

Pros and a decrease of 0.56 SD in Cons (Hall & Rossi, 2008; Prochaska et al., 1994; Mushkat, 2018; Waterman et al., 2015).

When examined longitudinally, results of the present study suggest that Cons were the strongest principle of change, as movement to Action was driven by a decrease in the Cons of pursuing transplant. Specifically, more than twice the expected change in Cons of pursuing LDKT occurred longitudinally, while only half of the expected change in Pros was detected. Self-Efficacy showed change consistent with cross-sectional models. The difference in methods between cross-sectional group comparisons and longitudinal analyses likely account for the tendency to detect larger effects within longitudinal research.

Additionally, effects for Cons were smaller among adjacent Stage movements and were larger when transitions spanned multiple Stages, which was seen in the three groups that moved to Action where effects increased in proportion to the size of the Stage transition (PC-A, C-A, and PR-A). This showed longitudinal support for cross-sectional comparisons of adjacent Stages (Velicer et al., 1999).

In the present study, longitudinal effects were mostly non-significant, indicated by confidence intervals that spanned zero. This may be because group-based predictions do not reliably predict change on the individual level, which has greater variability. Moreover, the lack of consistent relationships between Pros, Cons, and Self-Efficacy may be impacted by the inventories used to measure LDKT decision-making. TTM Decisional Balance inventories tend to measure the Pros of changing versus the Cons of changing specific to the individual. The process of kidney transplant pursuit is considerably more complex as it involves the behavior and health of potential donors.

The present inventories measured the Pros as health benefits of receiving LDKT and the Cons as negative consequences for the living donor. While previous TTM Decisional Balance scales have included benefits to self and others, this behavior involves potential negative consequences to another person that are more severe than most other behaviors.

Strengths, Limitations and Future Directions

In the present study, multiple methods were employed to evaluate longitudinal qualities of decision-making in LDKT decision-making. One strength of the present study was the inclusion of intervention and control groups, which provided a more naturalistic representation of kidney patients' decision-making to pursue LDKT. While the control group did not receive tailored TTM feedback, both groups received an educational intervention that may have augmented longitudinal patterns of change, as transplant education alone is a key strategy for increasing pursuit of LDKT (Patzer et al., 2012). From a TTM perspective, understanding natural decisional processes for a health behavior can reveal qualities that may improve future interventions. However, for transplant decision-making, it may not be ethical or possible to study this behavior in isolation from an intervention.

While this study was the first of its kind within a TTM application of complex medical decision-making, several methodological limitations should be noted. First, the ability to detect change was limited by sample size and measure reporting. In the first set of analyses, some Stage transition groups were omitted from analyses due to sample size restrictions, which prevented a full depiction of adjacent Stage movements. To

adequately power longitudinal studies, large sample sizes are required to detect small magnitudes of change. Future studies in this focus area would benefit from larger sample sizes to detect small changes in adjacent Stage transitions. Moreover, the ability to measure change over multiple timepoints can be limited by ceiling effects. In the present study, ceiling effects particularly impacted the ability to measure change in Pros and Self-Efficacy in forward Stage movement. It is possible that readiness can continue to progress even when measures have reached their maximum values. Detecting a wider range within a decisional variable would require reconfigurations of TTM measures.

To address limitations in the sample size, the present study utilized methods of Stage transition groupings that limited the depth of the present investigation into longitudinal change. By combining timepoint windows to display 'earlier' or 'later' measures of a construct, analyses were blind to previous Stage movement and included dependent data that limited comparisons across groups. This study did not examine consecutive movements from one window to the next, and groups likely combined participants who had previously progressed, regressed, or had remained Stable in the 'earlier' Stage of the group. In future studies, depictions of longitudinal change would be improved by clarifying previous Stage movements. Further, our understanding of longitudinal change in this focus area would be enhanced by comparisons across Stage transition groups, such as comparing groups who began in Precontemplation and moved to Pre-Action or Action Stages.

Lastly, it is important to note that few studies have been conducted with comparable longitudinal methods. Interpretation of effect size is not an arbitrary process and is contingent on comparisons to previous research. At present, this area of research

has fewer points of comparisons to gauge the size of effects, which will be improved with more research into longitudinal magnitudes of change in TTM decisional models.

Implications

The study of LDKT decision-making has important implications for public health due to the prevalence and societal impact of kidney disease for individuals and health-care systems. The present study was an investigation into the process of decision-making for pursuing living donor kidney transplant and provided preliminary longitudinal support for previous cross-sectional TTM models within this focus area. Longitudinal movement to Action showed expected directions of change in Decisional Balance and Self-Efficacy, however also suggested that cross-sectional models may underestimate the amount of change that occurs in movement from Precontemplation to Action. Further, results of the present study emphasized the importance of Cons in behavior change, which in cross-sectional models show a smaller decrease across the Stages relative to Pros and Self-Efficacy. Findings suggest that motivating readiness for pursuing transplant involves greater decision-making surrounding the Cons of pursuing transplant, regardless of which Pre-Action Stage the patient is in.

In sum, much of our understanding of behavior change within the TTM framework is based on cross-sectional findings. Investigating longitudinal pathways of change is important for theory testing and public health, and the present study adds to the current foundation of research by demonstrating longitudinal characteristics of complex medical decision-making.

Appendix

Measure 1. Stage of Change

Stage of Change	Description
Precontemplation	I am not considering taking actions in the next six months to pursue living donation.
Contemplation	I am considering taking actions in the next six months to pursue living donation.
Preparation	I am preparing to take actions in the next 30 days to pursue living donation.
Action	I am taking actions to pursue living donation.

Developed by Waterman et al. (2015).

Measure 2. Pros/Cons of Living Donation

Scale	Item	Description
Pros	1.	With a living donor transplant, I will be able to contribute to my family and friends sooner.
	2.	I will be healthier because I spent less time on dialysis.
	3.	With a living donor transplant, I can return to my normal activities sooner.
	4.	A living donor kidney generally lasts longer than a deceased donor kidney.
	5.	A living donor transplant could happen more quickly because I don't have to wait for a kidney on the waiting list.
	6.	My living donor will feel good seeing my health improve.
Cons	1.	The surgery will inconvenience the living donor's work or life too much.
	2.	I will feel guilty having someone donate to me.
	3.	I don't want to involve anyone else in my health problems.
	4.	Donation could harm my relationship with a living donor.
	5.	The living donor could not donate again if someone closer to them every need a kidney.
	6.	A living donor could have health problems due to donating.

Developed by Waterman et al. (2015).

Measure 3. Situational Self-Efficacy

Item	Description
1.	You asked someone to donate and they turned you down.
2.	A potential living donor changed their mind and decided not to be evaluated.
3.	A potential living donor who was evaluated did not match you.
4.	You don't know anyone who might be a living donor for you.
5.	You don't know how to discuss living donation with potential donors.
6.	Other people were not supportive of you having a living donor transplant.

Developed by Waterman et al. (2015).

Measure 4. Small Steps to Pursue LDKT

Item	Description
1.	Read information/watch videos about getting a living donor transplant.
2.	Share education materials about living donation with people in your life.
3.	Generally talk to people you trust about whether to get a living donor transplant.
4.	Make a list of people who might be a living donor for you.
5.	Ask another person to tell others about your need for a living donor transplant.
6.	Ask potential donors to be tested.
7.	Give potential donors the transplant center phone number.
8.	Share my need for a living donor with a larger community.

Developed by Waterman et al. (2015).

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