

## ORIGINAL ARTICLE

# Longitudinal mediation by perceived burden of the pathway from thwarted belonging to suicidal ideation

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Email: [linscott@psy.otago.ac.nz](mailto:linscott@psy.otago.ac.nz)**Abstract****Introduction:** Whereas the interpersonal theory of suicide entails the assumption that thwarted belongingness and perceived burdensomeness are equally important, mutually moderating, proximal causes of active ideation, evidence suggests these may not be co-moderating processes. We tested an alternative perspective, hypothesizing that burden mediates the longitudinal relationship of thwarted belonging with active ideation.**Methods:** A 6-week, four-wave prospective online survey was completed by 298 undergraduates. We tested cross-sectional and cross-lagged panel models (CLPM, with and without random effects) with belonging, burden, and ideation at 2-week lags, and post hoc models with burden as a concurrent mediator of ideation.**Results:** Approximately 28% of undergraduates reported active ideation at baseline. Cross-sectionally, thwarted belonging had no direct influence on ideation but indirectly affected ideation via burden. This result was not confirmed in the 2-week CLPM analyses. In post hoc analyses, we found belonging operated indirectly via later burden to influence contemporaneous ideation.**Conclusions:** Findings suggest thwarted belonging influences active ideation indirectly via perceived burden. The effect of burden as a mediator appears to depend on its temporal proximity to ideation. Future research should delimit the period during which perceived burden is an active mediator, accommodate dual-process approaches, and explore other mediation alternatives to co-moderation.**KEYWORDS**

cross-lagged panel analysis, interpersonal theory of suicide, perceived burdensomeness, prospective analysis, suicidal ideation, thwarted belongingness

**INTRODUCTION**

Suicidal ideation is a key risk factor for completed suicide (Franklin et al., 2017). Therefore, one strategy to reduce death by suicide involves reducing or preventing suicidal ideation at an early stage of its development. One of the

most studied assumptions about suicidal ideation—from the interpersonal theory of suicide (Joiner, 2005; Van Orden et al., 2010)—is that perceptions of thwarted belongingness and burdensomeness are the most proximal mental states preceding suicidal ideation (Cero et al., 2015; Joiner, 2005; Van Orden et al., 2012), and that individually

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these give rise to passive ideation but when they occur together they give rise to active suicidal ideation. That is, belonging and burden are additive causes of passive ideation and mutually moderating causes of active ideation.

Although popular, many studies have yielded findings that are inconsistent with the co-moderation argument of the interpersonal theory. Few longitudinal studies yield evidence of co-moderation (Crosby et al., 2020). Instead, evidence more consistently shows that although perceived burden is positively associated with suicidal ideation, thwarted belonging is not a direct predictor of ideation in analyses that include perceived burden (Cero et al., 2015; Hill et al., 2015; Zhang et al., 2013). The pattern of inconsistency may suggest that perceived belonging and burden are not co-moderating predictors of active ideation but that thwarted belonging causes active ideation indirectly through perceived burden. That is, psychologically speaking, people who feel lonely or perceive that they fail to belong may go on to perceive a sense of burdensomeness or blameworthiness that, in turn, increases the likelihood of suicidal ideation.

Other observations point to this mediation hypothesis. First of all, most studies provide evidence of a strong direct relationship between perceived burden and suicidal ideation (Chu et al., 2017). Therefore, perceived burden behaves as a reliable proximal cause or precursor of active ideation. Second, the association between thwarted belonging and perceived burden is consistently demonstrated to be strong. Third, thwarted belonging is more commonly associated with active ideation in analyses that exclude burden as a concurrent predictor than in analyses where burden is included—a pattern typical of mediation.

Alternatively, inconsistency in evidence of co-moderation may be attributable to less interesting possibilities. For example, methodological limitations in prior research include the failure to consider the temporal dynamics of ideation and its risk factors (Kleiman et al., 2017), reliance on cross-sectional or retrospective designs (Chu et al., 2017), small or biased samples, and single-item measures of key constructs. Critically, construct contamination in the assessment of belonging and burden may also contribute to the observed inconsistencies. The Interpersonal Needs Questionnaire (INQ) is by far the most commonly used measure for the assessment of belonging and burden in studies of the interpersonal theory. Several items within the INQ Perceived Burden subscale are contaminated by explicit references to passive ideation experiences. For example, the INQ item, “These days, I think my death would be a relief to the people in my life” strongly resembles items used in standardized measures of suicidal ideation (e.g., “I thought that others would be better off if I was dead” in two versions of the Suicide Ideation Questionnaire; Reynolds, 1987, 1991).

Following Rogers and Joiner's (2019) call for prospective research elucidating the role of thwarted belonging in suicidal ideation, we sought to test the hypothesis that thwarted belonging influences active ideation through mediation by perceived burden. We tested this hypothesis prospectively, assessing interpersonal processes and ideation four times over 6 weeks. We also tested whether observed effects survived adjustment for individual differences in depressed affect. As best we can tell, the belonging–burden–ideation mediation hypothesis has not been tested previously. Clarification of the proximal pathway to suicidal ideation is critical to the understanding and prevention of completed suicide.

## METHOD

### Participants

Undergraduates enrolled in introductory courses in psychology were recruited over a 3-week period from July to August 2020. Participants who did not fully complete the baseline survey or who completed only one of the four assessments were excluded from the analysis.

Volunteers provided informed consent prior to participating. The University of Otago Human Ethics Committee (Health) reviewed and approved the research and related risk management procedures (H20/010). All participants received general debriefing about the nature and purpose of the study as well as about sources of help for mental health and well-being issues. At the end of the study, a clinical psychologist provided individualized debriefing and referral to support services to those reporting elevated suicidal ideation or behavior. Participants could earn a small amount of course credit for completing the baseline and first two follow-up assessments, and \$20 for completing the third follow-up assessment.

### Measures

The 25-item version of the Interpersonal Needs Questionnaire (INQ-25; Van Orden et al., 2012; Van Orden et al., 2008) was used to assess thwarted belonging and perceived burden. Participants rate items using 7-point Likert scales (1 = *not at all true for me*, 7 = *very true for me*). The INQ-25 has two sub-scales: Thwarted Belongingness (10 items) and Perceived Burdensomeness (15 items). Higher scores indicate greater severity. The INQ-25 has good internal consistency and subscale correlations (Hill et al., 2015; Nademin et al., 2008). We amended the scoring of the Perceived Burdensomeness subscale. Four items in the burden subscale conflate

burden with passive suicidal ideation (Reynolds, 1987, 1991) and were therefore not included in the scoring. The 4 items are “These days the people in my life would be better off if I were gone,” “These days the people in my life would be happier without me,” “These days, I think my death would be a relief to the people in my life,” and “These days, I think the people in my life wish they could be rid of me.”

Depressive Symptoms Inventory—Suicidality Subscale (DSI-SS; Joiner et al., 2002), a four-item self-report measure, was used to assess the frequency, planning, controllability, and impulsive nature of active ideation within the past 2 weeks. Each item comprises four ordinal statements, of which the respondent selects one as most like them. Higher sum scores indicate greater severity of suicidality. The DSI-SS has excellent internal consistency and construct validity in undergraduate samples (Cukrowicz et al., 2011).

The two depression screening items from the *DSM-5* Self-Rated Level 1 Cross-Cutting Symptom Measure—Adult were used to measure depressed affect during the past 2 weeks. Each item is rated on a 5-point scale (0 = none or not at all, 4 = severe or nearly every day). A rating of mild (i.e., 2) or greater on either item is regarded as indicative of depression. The internal consistency and validity statistics from undergraduate samples are good (Bravo et al., 2018).

A demographics questionnaire was used to obtain details on age, sex, birthplace, languages, ethnicity, the year of undergraduate study, Māori descent, history of mental illness, family history of mental illness, history of psychological treatment for mental illness, history of receiving medications for mental illness, and history of hospitalization for mental illness. Inattentive responding was assessed using 6 direct instruction items (e.g., “Rate this item as frequent”) embedded among the INQ-25, DSI-SS, and other study measures.

## Procedure

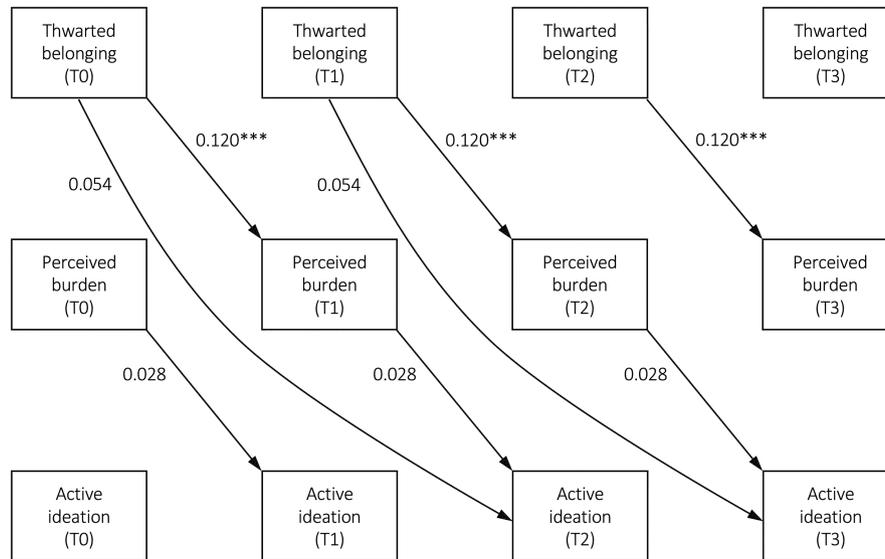
In the study, which was conducted in the context of a larger investigation into suicidal ideation, all procedures were undertaken online using the Qualtrics platform. The baseline assessment (Time 0; T0) was administered as a non-personalized Qualtrics survey that included the full information for participants, an informed consent process, and survey questionnaires (demographics, INQ-25, DSI-SS, *DSM-5* Level 1 Measure). Three follow-up assessments (T1 to T3) were administered, each at 2-week intervals. Follow-up assessments, which were personalized Qualtrics surveys, included reminders about study

information and right of withdrawal from the survey, and the INQ-25, DSI-SS, and *DSM-5* Level 1 Measure.

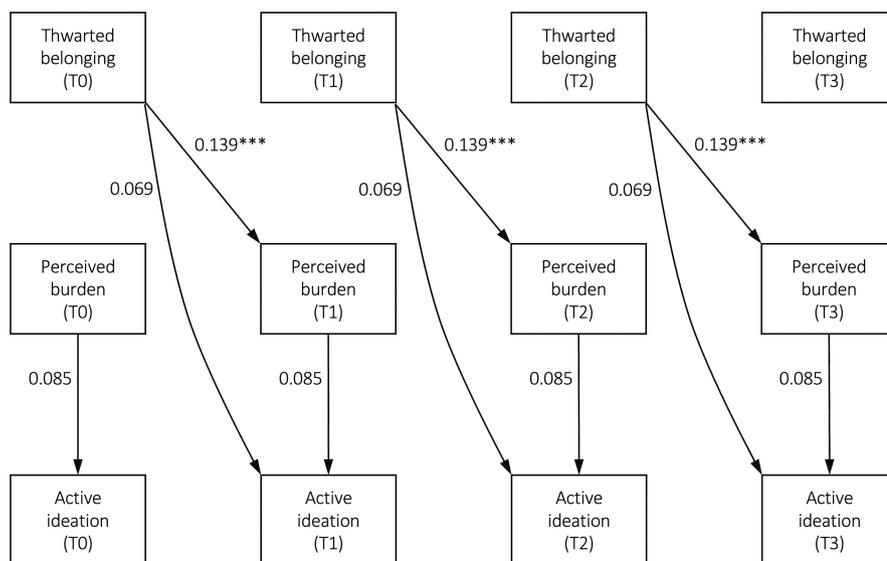
## Data analyses

Data from the four assessment waves (T0, T1, T2, and T3) were examined and collated. Participants who responded incorrectly to more than 3 inattention items were regarded as unreliable and excluded. Missing data at T1, T2, and T3 were imputed using predictive mean matching (5 times) using the R package MICE, which implements the assumption that data are missing at random (Van Buuren & Groothuis-Oudshoorn, 2011). Six participants had missing data (2.0%) in thwarted belonging, perceived burden, and active ideation at T1, 15 (5.0%) at T2, and 62 (20.8%) at T3. Scores of thwarted belonging, perceived burden, and active ideation at all time points were standardized to reduce multicollinearity (Aiken et al., 1991; Frazier et al., 2004) and enhance interpretability. The means, standard deviations, and correlation coefficients were calculated for all three variables at all time points; Cronbach's alpha was calculated from T0 data.

Hypotheses were tested using a series of mediation analyses. Firstly, a rudimentary cross-sectional analysis (T0 only) was conducted using Baron and Kenny's (1986) method to estimate the direct effects of thwarted belonging on perceived burden (the *a* path), perceived burden on active ideation (the *b* path), thwarted belonging on active ideation (the *c* path), and thwarted belonging on active ideation adjusting for perceived burden (the *c'* path) (see also Muthén et al., 2016, and Preacher, 2015). The indirect effect was estimated by the product of the *a* and *b* path coefficients. Secondly, a cross-lagged panel model (CLPM) was used to test lagged mediation using four waves of data, as illustrated in Figure 1. As the temporal relationships among variables were assumed to be the same across different time points of the study, estimation of parameters for autoregressive and cross-lagged relationships were constrained to be the same. Concurrent variables were allowed to covary at all time points (Santini et al., 2020). The maximum likelihood estimator and bootstrapping (1000 replications) were used to obtain 95% CIs of all effects. The estimates were considered significant if the bootstrapped 95% CIs did not contain zero (Preacher & Hayes, 2008). Thirdly, we used a single-level random-effects CLPM (RE-CLPM) to incorporate random effects (Wu et al., 2018). In the RE-CLPM models, autoregressive and cross-lagged effects were freed to be random across participants. Analyses used the expectation-maximization algorithm and the robust maximum likelihood estimator. Fourthly, in post hoc CLPM and RE-CLPM analyses, we tested whether the burden mediator affected



**FIGURE 1** General a priori cross-lagged modeling framework, with results from the single-level random-effects cross-lagged panel model (RE-CLPM;  $n = 298$ ). In the general model, perceived burden is regressed onto thwarted belonging (path *a*); ideation is regressed onto perceived burden (path *b*) and thwarted belonging (path *c*); mediation is not explicitly represented (see [Tables 2](#) and [3](#)); corresponding paths are constrained to be equal and so have the same coefficients; and autoregressive paths are omitted for clarity. In the RE-CLPM, all autoregressive estimates were significant. T0 = Time 0; T1 = Time 1; T2 = Time 2; T3 = Time 3. \*\*\*  $p < 0.001$



**FIGURE 2** Po hoc cross-lagged model, with results from the single-level random-effects cross-lagged panel model (RE-CLPM;  $n = 298$ ). All autoregressive estimates were significant (not shown). Indirect effects are reported in [Tables 4](#) and [5](#). T0 = Time 0; T1 = Time 1; T2 = Time 2; T3 = Time 3. \*\*\*  $p < 0.001$

contemporaneous ideation—whether perceived burden had an immediate effect on active ideation ([Figure 2](#)). Finally, depressed affect was added as a covariate (concurrent with active ideation) to test whether mediation occurred above and beyond the effects of depression.

CLPM models were evaluated using global fit indices (Morimoto & Takebayashi, 2021). Values of the comparative fit index (CFI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR) were considered acceptable at  $\geq 0.90$ ,  $< 0.10$ , and  $< 0.10$ , respectively (Kline, 2015). As RMSEA and CFI cannot be computed in the RE-CLPM, the Akaike information criterion (AIC; Akaike, 1974), the Bayesian information

criterion (BIC; Raftery, 1995), and the sample-size-adjusted BIC (ABIC) were used as relative fit indices for the comparison between the CLPM and RE-CLPM models (Wu et al., 2018). CLPM and RE-CLPM analyses were conducted using *Mplus* Version 8.6 (Muthén & Muthén, 2017).

## RESULTS

### Sample description

Of 320 eligible participants who were recruited, 309 completed the T0 survey. There were 294, 287, and 238

participants who completed T1, T2, and T3 assessments, respectively. Excluding those who did not complete at least 2 assessments and those who met the inattention criterion, the final sample size for analysis was 298.

The participants had a mean age of 20.1 years ( $SD = 2.0$ , range = 18–37 years), were mostly female ( $n = 262$ , 87.92%), in their second year of study ( $n = 190$ , 63.86%), were mainly NZ-born ( $n = 222$ , 74.50%), spoke English as their first language ( $n = 270$ , 90.60%), and identified as NZ European ( $n = 235$ , 78.86%). There were 33 (11.07%) Māori students and 38 (12.75%) were of Māori descent. Nearly one-third of the participants ( $n = 91$ , 30.54%) had a history of mental illness, with 85 (28.52%) reporting having received psychological treatment, 65 (21.81%) medications, and 15 (5.03%) hospitalization for mental illness. There were 108 (36.24%) with a history of mental illness in their first-degree relatives. Defined by DSI-SS score above 0, the percentage of active ideation at T0, T1, T2, and T3 was 28.2%, 22.4%, 18.5%, and 18.1%, respectively. The correlations and descriptive statistics for thwarted belonging, perceived burden, and active ideation at all time points are shown in [Table 1](#). Cronbach's alpha for thwarted belonging, perceived burden, and active ideation at T0 was high at 0.924, 0.908, and 0.891, respectively.

## Cross-sectional analysis

In cross-section analyses, thwarted belonging predicted active ideation ( $\beta = 0.49$ ,  $SE = 0.06$ , 95% CI: 0.37, 0.62) and perceived burden ( $\beta = 0.79$ ,  $SE = 0.04$ , 95% CI: 0.72, 0.86). When active ideation was regressed onto thwarted belonging and perceived burden, the direct effect of belonging on ideation reduced from 0.49 to 0.02 ( $SE = 0.08$ , 95% CI: -0.15, 0.16); perceived burden had a strong effect on ideation ( $\beta = 0.60$ ,  $SE = 0.09$ , 95% CI: 0.43, 0.79). Belonging had a strong indirect effect on ideation ( $\beta = 0.46$ ,  $SE = 0.078$ , 95% CI: 0.34, 0.65). The total effect on ideation was 0.49 ( $SE = 0.06$ , 95% CI: 0.37, 0.62). Therefore, these results fulfilled Baron and Kenny's (1986) criteria for mediation. The maximum variance inflation factor was 2.69, suggesting that multicollinearity was not a concern.

## CLPM mediation analysis

Cross-lagged panel models analyses were structured as illustrated in [Figure 1](#). [Table 2](#) shows the main CLPM results. The relationships between thwarted belonging and next time-point perceived burden (e.g., from T0 belonging to T1 burden) and between thwarted belonging and next time-point active ideation (e.g., from T0 belonging to T2 ideation) were significant. The relationship between

perceived burden and active ideation (e.g., from T1 burden to T2 ideation) was not significant, unlike in the cross-sectional model. The indirect relationship between thwarted belonging and 2-lag active ideation was not significant despite a significant total effect. Autoregressive estimates for all three variables were high and statistically significant.

The model fit data showed that the CFI and SRMR values were acceptable at 0.920 and 0.085, respectively, but the RMSEA value suggested poor fit (0.150). The AIC, BIC, and ABIC values were 6079.1, 6234.4, and 6101.2, respectively.

## RE-CLPM mediation analysis

[Table 3](#) and [Figure 1](#) show the main results of the RE-CLPM model. As in the CLPM model, thwarted belonging predicted perceived burden but perceived burden did not predict active ideation. In contrast to the results from the CLPM model, the direct relationship between thwarted belonging and active ideation, the indirect relationship between thwarted belonging and active ideation, and the total effect were not significant. Autoregressive estimates for all three variables were high and statistically significant. Although absolute fit indices were not available, the relative model fit data (AIC, BIC, and ABIC values were 6000.9, 6182.0, and 6026.7, respectively) indicated the RE-CLPM was better fitting than the CLPM.

## Post hoc analyses

One of the major changes between the result of the cross-sectional analysis and that of the CLPM and RE-CLPM analysis was the dramatic decrease in the effect of perceived burden on active ideation (from 0.60 to -0.01 and 0.03). We speculated this decrease might be due to the lengthy 2-week lag between perceived burden and active ideation and hypothesized that the relationship between these two variables would be stronger if their lag time was greatly decreased—given the design, practically contemporaneous. Thus, the post hoc CLPM and RE-CLPM analyses were completed using a model with a path from perceived burdensome to contemporaneous active ideation.

As can be seen in [Table 4](#), in the post hoc CLPM analysis, the relationship between thwarted belonging and perceived burden (e.g., from T0 belonging to T1 burden) remained significant. However, the direct relationships between perceived burden and active ideation (e.g., from T1 burden to T1 ideation) and between thwarted belonging and active ideation (e.g., from T0 belonging to T1

TABLE 1 Bivariate correlations and descriptive statistics for variables at all time points

	TB0	TB1	TB2	TB3	PB0	PB1	PB2	PB3	AI0	AI1	AI2	AI3
TB1	0.81											
TB2	0.76	0.82										
TB3	0.79	0.85	0.82									
PB0	0.79	0.69	0.67	0.66								
PB1	0.71	0.76	0.70	0.70	0.86							
PB2	0.64	0.66	0.81	0.65	0.78	0.84						
PB3	0.70	0.73	0.74	0.78	0.81	0.89	0.87					
AI0	0.49	0.46	0.39	0.40	0.61	0.61	0.52	0.54				
AI1	0.38	0.41	0.38	0.36	0.48	0.54	0.53	0.51	0.83			
AI2	0.41	0.42	0.44	0.37	0.48	0.52	0.57	0.51	0.77	0.86		
AI3	0.44	0.45	0.45	0.43	0.49	0.51	0.51	0.53	0.76	0.84	0.83	
M	28.1	27.4	27.7	28.3	32.7	31.5	32.1	31.4	1.1	0.9	0.9	0.9
SD	12.7	13.0	12.9	13.3	12.9	13.0	14.1	13.4	1.9	2.0	1.9	2.0

Note: Total  $n = 298$ . All correlation coefficients are significant at  $p$  value = 0.001.

Abbreviations: AI, active suicidal ideation; PB, perceived burden; TB, thwarted belonging.

ideation) were not significant. The indirect relationship from thwarted belonging through perceived burden to active ideation was also not significant. The autoregressive estimates for all three variables were high and statistically significant. The model fit data showed that the RMSEA and SRMR values were acceptable at 0.085 and 0.093, respectively, but the CFI value was low at 0.880. The AIC, BIC, and ABIC values were 6255.6, 6403.5, and 6276.7, respectively.

Table 5 and Figure 2 show the results of post hoc analysis of the RE-CLPM. The relationship between thwarted belonging and perceived burden was still significant. The strength of relationship between perceived burden and active ideation was higher than in the corresponding CLPM model (0.085 vs 0.011), albeit not significant. The direct relationship between thwarted belonging and active ideation was also not significant. However, the indirect relationship and the total effect between thwarted belonging and active ideation were both significant. Autoregressive estimates for all three variables were all high and significant. The model fit data showed that the AIC, BIC, and ABIC values were 6009.0, 6182.7, and 6033.7, respectively, which were much lower than those of the corresponding CLPM suggesting the RE-CLPM is more acceptable.

### Adjusting for depression

After depressed affect was added to all the above models as a covariate for concurrent active ideation, including the cross-sectional model and the longitudinal models, the significance of the indirect  $ab$  effects did not change. There

were still significant indirect effects in the cross-sectional model and the post hoc RE-CLPM models. Depressed affect predicted active ideation in the cross-sectional model ( $\beta = 0.259$ ,  $SE = 0.098$ , 95% CI: 0.073, 0.459), RE-CLPM model ( $\beta = 0.176$ ,  $SE = 0.063$ , 95% CI: 0.053, 0.300), and post hoc RE-CLPM model ( $\beta = 0.233$ ,  $SE = 0.068$ , 95% CI: 0.099, 0.432).

## DISCUSSION

We examined the hypothesis that perceived burden mediates the relationship between thwarted belonging and active ideation using cross-sectional and longitudinal analyses of data obtained at fortnightly intervals from non-help-seeking young adults. Whereas results of cross-sectional analysis were as expected, the results of planned longitudinal analyses were not. Despite this inconsistency, a post hoc analysis using a different temporal structure of the same longitudinal data—with a lag from thwarted belonging to burden, but no lag from burden to ideation—showed evidence that burden mediated the association of belonging with subsequent suicidal ideation. This mediation effect remained significant while adjusting for the influence of depression. This new finding has significant implications in light of the interpersonal theory of suicide.

According to the interpersonal theory (Van Orden et al., 2010), thwarted belonging and perceived burden are of equal importance and the most proximal antecedents of active ideation. Existing research casts doubt on the veracity of this assumption. Despite some studies showing that thwarted belonging is associated with active ideation when adjusting for perceived burden (Chu et al., 2016;

**TABLE 2** Results from the cross-lagged panel mediation analysis

Effect	Estimate	SE	95% CI		p
			LL	UL	
TB → PB ( <i>a</i> )	0.110	0.027	0.054	0.163	<0.001
PB → AI ( <i>b</i> )	−0.012	0.026	−0.061	0.041	0.628
TB → AI ( <i>c'</i> )	0.094	0.028	0.041	0.150	0.001
Indirect ( <i>ab</i> )	−0.001	0.003	−0.008	0.004	0.652
Total effect	0.092	0.027	0.042	0.146	0.001

Note: Total  $n = 298$ .

Abbreviations: *a*, the effect of TB on PB; *ab*, the indirect effect of TB on AI via PB; AI, active suicidal ideation; *b*, the effect of PB on AI; *c'*, the direct effect of TB on AI; CI, confidence interval; LL, lower limit; PB, perceived burden; TB, thwarted belonging; *total*, the total effect of TB on AI; UL, upper limit.

Kyron et al., 2019), most studies show that perceived burden has a stronger effect than thwarted belonging on active ideation (Bodell et al., 2021; Cero et al., 2015; Chu et al., 2016; Mitchell et al., 2020; Rogers & Joiner, 2019; Silva et al., 2015; Zhang et al., 2013). In fact, some investigators have reported that thwarted belonging is not associated with suicidal ideation at all (Cero et al., 2015; Hollingsworth et al., 2018; O'Keefe et al., 2014; Van Orden et al., 2008; Wong et al., 2011). Mediation could account for observed non-effects of thwarted belonging on suicidal ideation in studies where thwarted belonging and perceived burden were concurrent predictors. Moreover, evidence for the co-moderation assumption (also called the synergy hypothesis) mostly derives from cross-sectional and not longitudinal studies (Crosby et al., 2020). Therefore, there is sufficient cause for questioning the assumption of co-moderation of ideation by belonging and burden.

The inconsistency in the results of previous studies led to our hypothesizing that thwarted belonging is associated with active ideation through mediation by perceived burden. This hypothesis is supported by evidence from the cross-sectional and post hoc RE-CLPM analyses, but not by evidence from the fully lagged RE-CLPM analysis. The mediation hypothesis, our results, and results from other similar recent work (e.g., Chu et al., 2017) do not relegate thwarted belonging to a non-causal role in the pathway to suicidal thinking. Instead, thwarted belonging remains an important causal interpersonal process, albeit one that operates indirectly. However, the mediation hypothesis does imply that thwarted belonging and burden are not equal in significance or proximity to active ideation (Rogers & Joiner, 2019). Whereas we consider the state of existing evidence is sufficient grounds for amending aspects of the interpersonal theory concerning ideation (Meehl, 1978), it is also clear that additional research is required.

The discrepancy in findings from the planned vs. post hoc longitudinal models likely reflects the temporal proximity of perceptions of burden to active ideation. As a

mediator, the effects of perceived burden on active ideation may be maximal for a comparatively short period of time. We found that with a 2-week lag, over a 4-week interval, there was no evidence burden mediated the belonging–ideation relationship in our nonclinical sample. Whereas our study design did not permit testing of a brief lag (i.e., of hours or days) from burden to ideation, burden mediated concurrent ideation. The planned and post hoc models also differed with respect to the latency between thwarted belonging and ideation (4 vs. 2 weeks, respectively), but this reduction in time in the post hoc model did not appear to affect evidence on direct effects from belonging to ideation. Just as Crosby et al. (2020) have suggested testing of shorter follow-up intervals (daily or hourly) to determine whether perceived burden is a proximal, distal, or general risk factor of suicidal ideation, designs such as these would also assist in understanding the temporal dynamics of interpersonal processes on suicidal thinking. Careful examination of temporality should occur in both clinical and nonclinical samples.

We speculate that in nonclinical populations, the effect of perceived burden on active ideation is volatile, lasting only a short period of time, whereas perceived belonging is typically slow-changing. The interpersonal theory does not explicitly address the temporality of the interpersonal belonging and burden processes or the psychological mechanism that may underpin these, although a recent dual-process re-framing of the interpersonal theory offers promise (Olson et al., 2021). In our view, perceptions of burden entail strong negative emotions arising from a sense of worthlessness, self-blame, and guilt feelings. It is predominantly emotion that is reactive to inner experience. Consequently, in nonclinical samples, burden operates on active ideation over short time-frames, perhaps involving hours and days, but not over periods spanning weeks. Whereas in the interpersonal theory, burden and belonging are both subjective perceptions, in contrast to burden, we think thwarted belonging has a greater dependence on social and interpersonal experience, involving

Effect	Estimate	SE	95% CI		<i>p</i>
			LL	UL	
TB → PB ( <i>a</i> )	0.120	0.029	0.062	0.177	<0.001
PB → AI ( <i>b</i> )	0.028	0.047	−0.065	0.121	0.554
TB → AI ( <i>c'</i> )	0.054	0.034	−0.012	0.121	0.109
Indirect ( <i>ab</i> )	0.004	0.013	−0.022	0.030	0.767
Total effect	0.058	0.031	0.002	0.118	0.058

Note: Total *n* = 298.

Abbreviations: *a*, the effect of TB on PB; *ab*, the indirect effect of TB on AI via PB; AI, active suicidal ideation; *b*, the effect of PB on AI; *c'*, the direct effect of TB on AI; CI, confidence interval; LL, lower limit; PB, perceived burden; TB, thwarted belonging; *total*, the total effect of TB on AI; UL, upper limit.

slow-changing attributions about acceptance and rejection. That is, belonging is predominantly cognitive; a belief structure that is more resistant to change. Consequently, perceptions of an enduring sense of failure or inability to belong may, in the moment of burden emotion, lead to thoughts of suicide.

Traditional dual-process models distinguish the influence of automatic, non-conscious processes from controlled, deliberative processes in attention (Posner & Snyder, 1975), memory (e.g., Linscott & Knight, 2001), and other domains of functioning. Olson et al. (2021) have suggested that perceived belonging and burden, as well as other components within the interpersonal model, have automatic and controlled counterparts. Critically, these operate over distinct time-frames and contribute independently to the emergence of suicidal thinking and behavior. At a conceptual level, Olson et al.'s model may be better aligned with our post hoc findings than the original interpersonal theory, but testing the dual-process model in practice would require prospective tracking of subjective appraisals of belonging and burden as well as tests of automatic belonging and burden processing.

Clarification of the pathway to suicidality in clinical and nonclinical groups may have important implications for prevention and intervention (Turecki et al., 2019). If perceived burden is a short-acting volatile process, it could hold promise as an immediate target for intervention. Similarly, suicide prevention programs based on the interpersonal model would be designed and applied differently if we had a better understanding of the temporal characteristics of belonging and burden.

## Strengths and limitations

Our findings should be evaluated in light of several strengths and weaknesses. With respect to analytic methods, the CLPM is one of the most popular methods used to analyze the relationships among variables over time

TABLE 3 Results from the random-effects cross-lagged panel mediation analysis

(Mund & Nestler, 2019). As CLPM usually includes autoregressive and cross-lagged effects (Zyphur et al., 2020), these reduce bias in the estimation of mediation effects in cross-sectional studies (Cole & Maxwell, 2003). Despite this benefit, CLPM involves the presumption that effects in the model are fixed across individuals. Consequently, effect estimates can be biased if there is individual variability in the sample. Moreover, because much of the variability in suicidal ideation appears to be within-persons (Wolford-Clevenger et al., 2020), if random effects are treated as fixed effects, it is impossible to estimate the covariance between the *a* and *b* effects, resulting in biased estimates for indirect effects. In addition, the heteroscedasticity in the residuals resulting from random effects can bring about misleading statistical inferences in fixed-effect models (Wu et al., 2018). In fact, our adoption of the RE-CLPM did increase the model fit, which was evident in the results that all the AIC, BIC, and ABIC values were smaller in all RE-CLPMs than in the corresponding CLPMs.

Our sample comprised 298 non-help-seeking undergraduates, representing young adults with little, low, or mild risk of suicide. Our sample size is larger than most of the longitudinal studies and also much larger than required to achieve power of 0.80 using bias-corrected bootstrapped mediation (Fritz & Mackinnon, 2007). By comparison, other investigators have studied participants with more severe levels of suicidality. For example, Kleiman et al. (2017) recruited two samples, one of 54 adults with a history of suicide attempts in the past year and another of 36 adult psychiatric inpatients admitted for suicide risk. Bodell et al. (2021) recruited a sample of people with eating disorders, and Cero et al. (2015) recruited a sample of psychiatric inpatients. Rogers and Joiner (2019) conducted a prospective study in a sample of 91 adults with significant suicidal ideation. As we acknowledge above, our findings speak to the operation of the interpersonal theory within nonclinical groups. We are mindful that the operation of interpersonal processes in clinical

**TABLE 4** Results from post hoc cross-lagged panel mediation analysis

Effect	Estimate	SE	95% CI		<i>p</i>
			LL	UL	
TB → PB ( <i>a</i> )	0.123	0.028	0.067	0.179	<0.001
PB → AI ( <i>b</i> )	0.011	0.043	−0.067	0.103	0.801
TB → AI ( <i>c'</i> )	0.053	0.036	−0.015	0.126	0.143
Indirect ( <i>ab</i> )	0.001	0.006	−0.009	0.0014	0.801
Total effect	0.054	0.032	−0.009	0.118	0.092

Note: Total *n* = 298.

Abbreviations: *a*, the effect of TB on PB; *ab*, the indirect effect of TB on AI via PB; AI, active suicidal ideation; *b*, the effect of PB on AI; *c'*, the direct effect of TB on AI; CI, confidence interval; LL, lower limit; PB, perceived burden; TB, thwarted belonging; *total*, the total effect of TB on AI; UL, upper limit.

**TABLE 5** Results from post hoc single-level random-effects cross-lagged panel mediation analysis

Effect	Estimate	SE	95% CI		<i>p</i>
			LL	UL	
TB → PB ( <i>a</i> )	0.139	0.030	0.080	0.198	<0.001
PB → AI ( <i>b</i> )	0.085	0.054	−0.021	0.190	0.115
TB → AI ( <i>c'</i> )	0.069	0.042	−0.012	0.151	0.096
Indirect ( <i>ab</i> )	0.039	0.011	0.017	0.061	<0.001
Total effect	0.109	0.037	0.037	0.181	0.003

Note: Total *n* = 298.

Abbreviations: *a*, the effect of TB on PB; *ab*, the indirect effect of TB on AI via PB; AI, active suicidal ideation; *b*, the effect of PB on AI; *c'*, the direct effect of TB on AI; CI, confidence interval; LL, lower limit; PB, perceived burden; TB, thwarted belonging; *total*, the total effect of TB on AI; UL, upper limit.

groups is likely to be quite different to how these function in nonclinical samples. For example, in the former, extreme belonging and burden states may be more integrally entwined in suicidality end-state processes (Joiner et al., 2016).

Our findings are critically dependent on the INQ. The INQ (Van Orden et al., 2008; Van Orden et al., 2012) is the most commonly used self-report measure of thwarted belonging and perceived burden in research on the interpersonal theory. However, there are multiple versions of the INQ and, according to Hill et al. (2015), different versions of the INQ may influence outcomes of tests of the interpersonal theory. We also note that the INQ burden subscale is affected by construct contamination that, without amendment, make it unsuitable in frequentist null-hypothesis testing of pathways to suicidal ideation. Here, we scored the burden subscale without four items that describe passive ideation experiences. Nevertheless, contamination may have affected the observed relationship between burden and ideation.

We note greater sample attrition at T3 (20.8%) than at the two earlier follow-up assessment waves. However, imputation of missing data using predictive mean matching meant we could make better use of the longitudinal data

and take heteroscedastic data into account more appropriately (Little, 1988). We also note that the RE-CLPM could be limited by the fact that the estimated variance of the random effect was assumed to be normally distributed, although the estimated mean indirect effect would not be influenced by this assumption (Wu et al., 2018).

## CONCLUSION

Whereas a key assumption in the interpersonal theory of suicide places perceptions of thwarted belonging and burden as equally important, co-moderating proximal causes of suicidal ideation, empirical tests of this assumption have yielded a body of literature with effect patterns more consistent with a mediation hypothesis. In a non-clinical sample, we found cross-sectional and longitudinal evidence that suggests that burden perceptions mediate the association of thwarted belonging with active suicidal ideation. The role of burden in mediation may be critically time-dependent, having a maximal effect over short (hours or days) intervals and little or no effect over long intervals (weeks). In the future research, there is a pressing need to test the temporal parameters of active mediation

in the prediction of ideation from belonging and burden in clinical and nonclinical samples. The new dual-process adaptation of the interpersonal theory (Olson et al., 2021) offers an important conceptual framework for exploring temporal parameters. Investigators should also explore mediation and other alternatives to the co-moderation assumption in the interpersonal theory.

## ACKNOWLEDGMENTS

We are grateful to the volunteers who contributed to this research and to Rachel Knight and Sarah Jutel who assisted with data collection. Open access publishing facilitated by University of Otago, as part of the Wiley - University of Otago agreement via the Council of Australian University Librarians.

## FUNDING INFORMATION

This research was funded by the University of Otago.

## CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

## ETHICAL APPROVAL

The research was reviewed and approved by the University of Otago Human Ethics Committee (Health, H20/010).

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**How to cite this article:** Lin, C.-C., & Linscott, R. J. (2022). Longitudinal mediation by perceived burden of the pathway from thwarted belonging to suicidal ideation. *Suicide and Life-Threatening Behavior, 00*, 1–12. <https://doi.org/10.1111/sltb.12914>